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WELCOME NOTE

Prof. Ljiljana Trajkovic Pavlovic

Prof. Slađana Sobajic

The Serbian Nutrition Society (SNS) was established in 1956y as an independent non-profit organization. It has a tradition of gathering established experts and young ones from the fields of human and veterinary medicine, pharmacy, biology, chemistry, biochemistry, agriculture, food technology, food microbiology, dietitians-nutritionists and others with similar interests.

In 2023 SNS hosted the 14th European Nutrition Conference (ENC) with 1500 participants, mainly from Europe, but also from other continents.

The program of the 15th national congress on nutrition will cover wide areas across nutritional science plenary and parallel sessions, as well as oral and poster presentations. The programme will also include panel discussions/round tables and young experts' presentations, exhibitions and satellite symposia by food production and food trade stakeholder.

Belgrade is the capital of Serbia situated at the confluence of the Sava and Danube rivers. It is an important educational center. The University of Belgrade is on the Shanghai *ranking* list, one of the 500 most valuable universities in the world. It is also a cultural centre with interesting museums, theatres, art festivals, but also with lot of gastronomical events at local restaurants with traditional cuisine and music.

We are looking forward to hearing from you and welcoming you in Belgrade, from 20 to 22 November 2024.

Prof. Ljiljana Trajkovic Pavlovic
& Prof. Slađana Sobajic
Co-chairs of the 15th Congress on Nutrition

REČ DOBRODOŠLICE

Društvo za ishranu Srbije (DIS), osnovano je 1956. g kao nevladina neprofitna organizacija. DIS tradicionalno okuplja stručnjake iz oblasti agronomije, biohemije, biologije, dijetetike, farmacije, hemije, humane i veterinarske medicine, mikrobiologije prehrambene tehnologije, i drugih obrazovnih profila koji se bave hranom i ishranom.

Društvo za ishranu Srbije sarađuje sa brojnim domaćim i stranim obrazovnim i naučnim ustanovama i udruženjima. U 2023. godini u saradnji sa Federacijom evropskih društava za ishranu, DIS je organizovao 14. evropski kongres ishrane u Beogradu sa oko 1500 učesnika pretežno sa evropskog ali i drugih kontinenata.

Glavne teme 15. kongresa ishrane obuhvataju veliki broj naučnih disciplina koje se bave hranom, ishranom i zdravljem u okviru održivog razvoja. Program kongresa osmišljen je tako da, kroz plenarna predavanja, paralelne sesije, posebne satelitske programe, panel diskusije, usmene i poster prezentacije, omogući da domaći i straini stručnjaci razmene mišljenja o opšte prihvaćenim naučnim dostignućima i rezultatima sopstvenih istraživanja.

Beograd, kao veliki univerzitetski i kulturni centar, ima tradiciju organizacije brojnih domaćih i međunarodnih stručnih skupova ali pruža i mogućnost korišćenja raznovrsnih turističkih ponuda povezanih sa bogatom istorijom i kulturološkim nasleđem.

Radujemo se još jednom lepom i uspešnom susretu sa eminentnim ali i mladim stručnjacima koji se bave hranom i ishranom u Beogradu od 20-22. novembra 2024. godine.

Prof. Ljiljana Trajkovic Pavlovic
& Prof. Slađana Sobajic
Kopredsedavajući 15. Kongresa Ishrane

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Improving standards in the science of nutrition

Philip C. Calder[1]

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Improvements in nutrition across the 20th century, supported by important scientific discoveries, were one of several contributors to improved public health and increased longevity of the population. Nevertheless, there are still many who are undernourished and/or deficient in micronutrients, while a double-burden of malnutrition (the combination of excess caloric intake resulting in obesity with inadequate intake of essential nutrients) has emerged as a new global epidemic in the last few decades. Thus, there is clearly more work to be done by nutrition scientists to find solutions to these public health problems. But nutrition science can no longer work in silos; different parts of the discipline need to work together more cohesively and nutrition scientists need to work with other disciplines in order to solve major challenges like how to transform the food system so that we can cope with the multiple threats of malnutrition, population growth, an aging demographic and climate change. In order for nutrition science to play its expected part in meeting these challenges, it needs to be able to provide reliable answers to the (scientific) questions being asked. Where surveys have been done it is identified that, even in the most well-developed countries, there are severe constraints in the quality of nutrition science and the contribution it can make due to organisation, funding and rigor. Basic nutrition science often uses unphysiological conditions; nutritional epidemiology can sometimes be flawed in not acknowledging confounders and by its nature cannot prove cause-and-effect, while intervention trials in nutrition are often too small, too short and poorly conducted. However, there is also an issue with the adoption of the medical/drug model of research to nutrition science which may not be fully compatible with the reality of diet, food and health. Also messages about food and nutrition provided to the public can often be inaccurate (even false) which creates issues of confusion and mistrust with the public and within the discipline. Since 2019 the Federation of European Nutrition Societies has supported an activity to develop ways to improve the quality of (standards) and trust in the science of nutrition. Working groups have been working on concepts and methods; organisation, education and funding; and communication. An update on the outputs from the working groups will be provided and next steps outlined.

Keywords: Immunity, Infection, Ageing, Nutrition, Microbiota

Overweight and obesity in children. How much does physical activity contribute to prevention and therapy?

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Overweight and obesity is major health problem in children and adolescents. According to World Health Organization, in the year 2022, 37 million children under the age of 5 were overweight. In the same year, in age group 5–19 years, over 390 million children and adolescents were overweight, including 160 million who were living with obesity. The prevalence of overweight (including obesity) among children and adolescents aged 5–19 raised dramatically from just 8% in 1990 to 20% in 2022. Being overweight in childhood and adolescence affects immediate health and is associated with greater risk and earlier onset of various noncomunicable diseases, such as type 2 diabetes and cardiovascular disease. Etiology of obesity, in most cases, is a multifactorial,

but there is always imbalance of energy intake (diet) and energy expenditure (physical activity). Evidence suggests that physical activity plays a crucial role in both the prevention and treatment of childhood overweight and obesity. It helps regulate energy balance - calories consumed versus calories burned, promotes lean body mass, bone density, healthy growth and development, improve metabolic health - insulin sensitivity, lipid profiles, lower blood pressure, promote cardiovascular health contributing to a lower overall health risk, reduce symptoms of anxiety and depression, improve academic achievements, promotes social interaction and supports overall well-being. When designing program of physical activity and exercise for overweight and obese children, it's essential to prioritize activities that are enjoyable, sustainable, and safe, while gradually increasing intensity. General recommendations are at least 60 minutes of moderate to vigorous physical activity per day that combine aerobic exercises, muscle and bone strengthening and flexibility work to target all aspects of fitness and development. Aerobic activities, such as walking, swimming, cycling, dancing or team sports, are recommended for at least 20-30 minutes per session, starting with moderate-intensity activities and progressively increase as fitness improves. Muscle-strengthening activities, like climbing, gymnastics, resistance band or bodyweight exercises such as squats, lunges, push-ups or yoga are recommended at least 3 days per week. Bone-strengthening activities, like jumping rope, running, and playing basketball are recommended at least 3 days per week. Flexibility and mobility exercise, incorporating stretching, like yoga or simple mobility drills helps with flexibility, which is crucial for overweight children who may have limited mobility. While physical activity is critical, it works best in combination with a healthy diet. Reducing calorie intake and making healthier food choices should accompany increased physical activity to maximize health benefits and manage weight.

Mediterranean diet adherence indexes: comparison and towards a single one

Jacques Delarue
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Traditional MedDiet was the predominant dietary pattern among populations in the Mediterranean basin before the mid-1960s. The first investigation of dietary intake in the Mediterranean region was undertaken at the initiative of the government of Greece in 1948. Plant foods (cereals, pulses, nuts, potatoes, vegetables and fruits) accounted for 61% of total energy intake (TEI), animal foods (meat, eggs, fish, and dairy products) for 7% of TEI, and olive oil was the main oil used. Between 1958 and 1964, Keys and co-workers carried out the Seven Countries Study, which enrolled men aged 40-59 years in one of 16 cohorts from seven countries (Finland, Greece, Italy, Yugoslavia, Japan, USA and Italy), After 15-y, 25-y and 50-y follow up, a strong positive relation was observed between saturated fat intake and CHD mortality, and a negative one with Mediterranean Dietary Index. In 1975, Keys and his wife published a book intitled: "How to eat well and stay well. The Mediterranean way", which popularized Mediterranean Diet (MedDiet). Protecting effect of MedDiet towards CHD incidence and risk is now confirmed by PREDIMED and CARDIPOR-EV studies. Several meta-analysis have concluded to its protective effect towards coronary heart disease, type 2 diabetes, some cancers, cognitive decline as well a decrease in global mortality. MedDiet is sustainable and recognized by UNESCO as an Intangible Cultural Heritage, which is the most beautiful homage that can be paid to Ancel Keys and all his co-workers. Despite the health benefits associated with MedDiet, the Western diet has gradually replaced MedDiet in Mediterranean countries, particularly among the youngest and the poorest. Rubba et al., in their review of MedDiet in Italy, report several studies showing that between 1960 and 1996 Italians consumed more milk, cheese, meat, sweetened beverages, cakes/pies/cookies, and less cereals and legumes, especially in the 1980s. However, some positive trends were observed in the 1990s. Vilarnau et al. compared MedDiet adherence between 1960 and 2011 in 41 countries divided into Mediterrane-

an (Mediterranean Europe and Southern Mediterranean) and non-Mediterranean (Central Europe, Northern Europe, Other countries) country groups. MAI decreased in both Mediterranean Europe and the Southern Mediterranean. The movement away from MedDiet was more pronounced in the Mediterranean Europe, Southern Mediterranean, and Central Europe subcategories.

Adherence to MedDiet is traditionally measured by adherence indexes. The main utility of these indexes is their ability to assess MedDiet adherence in various study populations, and to relate it to disease or mortality risk in many countries, including non-Mediterranean countries. Several scoring systems have been defined to operationally assess the (mainly health) effects of MedDiet. Historically, the first was the MedDiet Score (MDS) defined by Trichopoulou et al. to assess the association between MedDiet adherence and mortality in a population of elderly people in Greece. The MDS (0-9 points) consisted of eight components: six beneficial components (monounsaturated/saturated fat ratio, vegetables, fruits and nuts, legumes, fish, cereals), two harmful components (meat/meat products, dairy products), and moderate alcohol consumption (5-25 g/d for women, 10-50 g/d for men). One point was assigned to positively weighted items if consumption was superior or equal to the sex-specific median, and one assigned to negatively weighted items if consumption was inferior to the sex-specific median. Several other indexes of adherence have emerged over the years until recently to study the association of MedDiet adherence with health outcomes. Searching PubMed through October 2014, Hernandez-Ruiz et al., in their review, found 22 indexes with differences regarding the number of components (7-28), scoring (0, 1, 2, 3, 4, 5, 8, or 10, if adherent), range (0-100), and type of components (foods, food groups, nutrients, and/or lifestyle factors). Fruits and vegetables were the most common beneficial components, and meats were the most common detrimental components. Moderate alcohol consumption was common to all indexes and was considered positive, but its definition differed among indexes: 10-20 g/day, or 5-25 g/day in women and 10-50 g/day in men, or 0 g/day in women and up to 10 g/day in men. Another difference between indexes was the scoring system and the cut-off points (in medians, terciles or established portions). Milà-Villarroel et al. evaluated the reliability of 10 MedDiet adherence indexes, including the MDS, MAI, and PREDIMED scores. They found that all 10 indexes satisfactorily assessed MedDiet adherence, but that there was a lack of internal consistency among the indexes, arguing for standardization. Sofi et al.(46) in their meta-analysis of 27 cohorts, addressing the association of MedDiet with health status, reported all selected cut-offs for different MedDiet adherence indexes. From mathematic determination they created a literature-based index. Currently more than 30 indexes have been reported.

The main challenges of such a number of different indexes are they are not consistent about the choice of food items, they do not use the same algorithms, they do not incorporate the cultural and lifestyle characteristics of the Mediterranean way of life as it is included in the definition by Unesco, and at last but not at least they do not take into account the sustainability of MedDiet. For all these reasons developing a unified global index associating all these components is one of the objectives of the development of a voluntary code of conduct for measuring and promoting adherence and sustainability of MedDiet. These objectives have led to the creation of a Joint Task Force of CIHEAM, FENS and IUNS. Two papers are under submission on behalf of the Joint Task Force: one by Nahla Hwalla about the unified global index, the other by Jacques Delarue about the voluntary of conduct in more general terms.

Gut microbiota - the key mediator between nutrition and health

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Humans live in symbiosis with a complex microbial ecosystem that inhabits the entire digestive tract. The densest microbial community is present in the colon, which can be perceived as a specialized bioreactor. These microbes, collectively termed gut microbiota, utilize indigested food components and host-derived substrates to produce metabolites that complement human physiology. It is well established that nutrition is essential for human health, but in order to fully comprehend the health impact of food, the interaction between (indigested) food components and microbiota should also be taken into account. Microbiota can produce beneficial and hazardous chemicals depending on the available substrates. The availability of different substrates for fermentation largely depends on nutritional intake. Various plant-derived compounds, such as indigestible carbohydrates and polyphenols are transformed by gut microbiota into beneficial bioactive compounds. Therefore, several carbohydrates and polyphenols are considered to be prebiotics. In addition, food can contain probiotic microorganisms which can improve human health through direct interaction with humans or indirectly by modifying gut microbiota. On the contrary, some gut microbiota metabolites generated in the fermentation of proteins impair metabolic and cardiovascular health. Furthermore, some food additives also interact with gut microbiota. Conserving agents, but also artificial sweeteners and emulsifiers can impact the composition and function of microbiota, mostly in a negative manner. Epidemiological studies have shown that consumption of some presumably safe processed foods can compromise health. This surprising finding could be, at least to some extent, explained by the negative interaction between food additives and microbiota. This interaction is recognized as a missing link in the risk assessment of food additives by regulatory agencies. Given the importance of gut microbiota for systemic health, it is clear that food should nourish both humans and their microbiota to preserve and improve health.

Scientific approach in using by-products for formulation food with added value: a focus on wine by-products

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One of the primary challenges currently faced by food scientists and technologists is the advancement of functional food and sustainable production methods. With consumers increasingly recognizing the role of a healthy diet in preventing conditions such as hypertension, diabetes, heart disease, and cancer, there is growing demand for health-focused food products. To address these demands and promote environmental sustainability, researchers are exploring bioactive compounds derived from food waste, aiming to incorporate them into functional foods as part of a valorization strategy. The winemaking process produces a significant amount of by-products, such as grape pomace, which consists of skins, seeds, and stems and represents about 10-30% of the total grape mass. These by-products are rich in valuable nutrients, including dietary fiber, proteins, lipids, and phenolic compounds. Researchers have shown particular interest in the phenolic compounds found in pomace due to their wide range of health-promoting properties, such as antioxidant, antimicrobial, anticancer, anti-inflammatory, and anti-diabetic activities, as well as their protective effects on the liver, heart, and nervous system. The highest concentration of phenolic compounds is found in the seeds (60-70%), followed by the skins (28-35%) and pulp

(10%). Anthocyanins like malvidin-3-O-glucoside, peonidin, cyanidin, petunidin, and delphinidin dominate in the skins, while the seeds are rich in flavan-3-ols and proanthocyanidins. Pomace extracts have been used as natural substitutes for synthetic additives in functional foods and in the production of active packaging films or coatings. Polyphenol extracts, whether in water-based or lyophilized forms, are commonly incorporated into fermented dairy products like yogurt, kefir, and fermented milk. Additionally, whole pomace, seeds, skins, or their finely ground powders are increasingly used. This method is not only more cost-effective and environmentally sustainable but also enables fuller utilization of pomace's valuable compounds. Various food products, such as cereals, dairy, and meats, have been successfully enriched with finely ground pomace, seed, or skin flour. However, the application of phenolic compounds from pomace in food products faces challenges due to their poor solubility, stability, and bioavailability. Recent studies have focused on the interactions between phenolic compounds and food matrices, revealing that the structure and composition of food—such as the presence of proteins, carbohydrates, and lipids—significantly affect the bioavailability, digestibility, and antioxidant activity of phenolic compounds. Consequently, research has increasingly focused on protecting phenolic compounds in nano- and microcapsule forms to enhance their bioavailability and effectiveness.

Keywords: grape pomace, bioactive compounds, functional food, phenolic compounds

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Dietary nucleic acids: The overlooked food component with unrecognized nutritional role

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Currently, the nutritional value of food is associated mainly with the presence of lipids and macromolecules such as proteins being a source of amino acids and carbohydrates degraded to simple sugars to provide energy and precursors for anabolic reactions. Another abundant group of macromolecules present in majority of food products are nucleic acids (NA) which are hardly mentioned in nutrition textbooks, not even as a source of building blocks for the synthesis of new NA. In the context of food and nutrition, currently NA are mostly perceived as molecular tools to monitor food microbiological contamination or to track food adulteration. Even this role concerns only DNA and its coding role. However, non-refined whole foods may be expected to contain quantitatively ample share not only of plant or animal DNA, depending on the source, but also all kinds of RNA, both coding and non-coding, occurring in a free form or encapsulated in exosomes.

It seems obvious that dietary NA are food components that would be readily utilized by organisms as a source of reagents to built new cellular structures (e.g. chromatin, ribosomes) and to serve multiple metabolic purposes as alimentary tract is equipped with all necessary enzymes and transporters to hydrolyze and absorb products of dietary NA digestion. Unfortunately, NA are very conducive to chemical modifications when exposed to oxygen and elevated temperatures as during culinary processing of food. The absorption and subsequent incorporation of modified nucleobases derived from processed foods may pose a genotoxic risk to consumers.

The presentation will summarize current knowledge on dietary NA abundance in food, their digestion and absorption from alimentary tract, multitude of nutritional roles and the potential genotoxic risk associated with the consumption of modified NA present in processed foodstuffs.

Human milk nutrition

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Human milk occurs in the form of colostrum, transitional milk and mature milk. All research data confirm that children fed human milk have fewer: nosocomial infections, sepsis, meningitis, necrotizing enterocolitis, chronic lung disease, retinopathy of prematurity, developmental and neurocognitive disorders, rehospitalization after discharge from intensive care, otitis media, respiratory tract infections and asthma, diarrhea, urinary tract infection, sudden infant death syndrome, diabetes mellitus type 1 and 2, lymphoma, leukemia, hypercholesterolemia, obesity. Oro-facial development is better, hospital stay is shortened, neurodevelopmental processes and emotional connection with the mother are better. Also, the total cost of treatment is reduced. In addition to all the well-known ingredients of human milk (macro and micronutrient composition, the presence of numerous immune components, etc), special attention is drawn to recent studies related to the presence of oligosaccharides, HAMLET proteins and stem cells in human milk. Studies confirm that oligosaccharides affect not only the child's microbiome, but also immunomodulatory effects. The influence of the HAMLET protein is particularly important because it has proven anticancer effects on a large number of cancers. Stem cells in human milk have an impact on tissue regeneration, which is especially important for premature babies who may have serious brain damage. Human milk is of special importance for premature babies, and in order to apply this nutrition, it is necessary to have an adequate health status of the mother, as well as adequate handling of this milk for newborns who are in the hospital. When there is no milk from one's own mother, milk from milk banks is used, where donor milk is prepared according to specific protocols.

Keywords: human milk nutrition, neonates

Nutrition of premature infants after hospital discharge

Vesna Marinkovic

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Ideally, nutritional support should enable rate of growth and development of preterm infants that resembles intrauterine rate. Yet, it is very challenging in clinical practise, since most of these infants cannot tolerate enteral feeds needed for adequate protein and energy intake. Almost 97% of very low birthweight (VLBW) infants and 99% of extremely low birthweight (ELBW) infants have body weight under 10 th percentile at 36 weeks of postmenstrual age. Hospital and postdischarge feeding of premature infants is inseverable. Prenatal growth restriction, along with the characteristics of food during their stay in the hospital determines the degree of "catch-up growth" after discharge.

Inadequate nutrition in the early period has important effects on the immune status of the child, as well as the development of the central nervous system and long-term effects in later life. An increasing number of preterm infants is fed with fortified human milk. Acording to most authors fortification is implemented up to 40 weeks of postconceptional age, and sometimes even longer. In Serbia, fortification of human milk is so far implemented only in the hospital environment. Children with adequate body mass for the corrected gestational age at discharge should be breastfed or fed with standard formulas enriched with long chain polyunsaturated fatty acids (LC PUFA).

In case where lactation is interrupted, and in children whose body mass is under expected for the corrected gestational age, feeding with specialized postdischarge milk formulas is the official recommendation from the European Association for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN). Nutritional charachteristics of postdischarge milk formulas for preterm infants imply higher protein and mineral content, and higher caloric value. Nutritional content of such milk formula is specific, and represents transition between preterm and term milk formula. Introduction of complementary feeding in premature infants involves an individual approach in accordance with corrected gestational age and associated diseases. research is needed to determine the precise recommendations for feeding of preterm infants after discharge from hospital, as well as for the timely introduction of complementary feeding in this group of children.

Keywords: premature infant; diet after discharge from hospital; complementary feeding

Nutritional and antioxidant aspects of human milk in infant nutrition

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Human milk is the most natural and optimal food for infants. The World Health Organization supports and recommends using breast milk within the first hour of life and exclusively breastfeeding for up to 6 months of age, as the source of nutrients for both term and preterm infants. Various biological, ecological, hormonal, immunological, and social factors impact the synthesis and secretion of breast milk, influencing its composition and lactation. During the lactation period, these factors contribute to changes in composition in colostrum, transitional, and mature milk. Human milk contains major components such as proteins, lipids, carbohydrates, minerals, vitamins, and water. Additionally, it contains bioactive components like hormones, growth factors, enzymes, and immune factors. Human milk is considered the "gold standard" in infant nutrition due to its unique nutritional composition and biological activity. The aim was to compare the nutritional and antioxidant potential of human milk for infant feeding throughout the lactation period. The composition and energy content of milk change as lactation progresses. Major components such as proteins, lipids, and carbohydrates differ between colostrum and mature milk. Human milk oligosaccharides are critical to shaping the developing neonatal gut microbiome. The antioxidants in human milk provide nutritional benefits and protection from oxidative damage. Colostrum and mature milk contain different antioxidant systems. Various lipophilic, hydrophilic, and enzymatic antioxidants in human milk limit the consequences of excessive oxidative damage, which is important for premature infants. The energy and antioxidant requirements for the growth of preterm babies are higher than those of full-term babies. Therefore, it is crucial to supplement human milk adequately with fortifiers to support their development. Human milk has both short-term and long-term effects on infant development.

Behavioral approach in childhood obesity – experiences from North Macedonia

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Introduction: According to the 6th round of Childhood Obesity Surveillance Initiative study (2022), around 34% of boys and 28.3% of girls in North Macedonia are living with overweight (including obesity), and these prevalences are still on rise. This puts those children in higher risk of developing physical health conditions, including type 2 diabetes, cardiovascular and respiratory problems, liver disease and orthopaedic health issues. The aim of this work was to explore the possibilities of application of behavioral approach when addressing childhood obesity in North Macedonia.

Methods: Two tracks approach was implemented for gaining insights. The Exploration track included observations of the environment of primary schools and the wider context, as well as interviews with stakeholders in order to detect barriers for maintaining healthy weight. The Solution track generated policy options to tackle childhood obesity in North Macedonia by collating insights from the scientific literature and summarizing the most robust findings from behavioural approach that drives actions.

Results: Three types of barriers were detected, namely capability, opportunity and motivational ones. Five groups of solutions were also detected emerging from long list of possible actions and those included actions on: taxation, regulation, changing food environment, service provision and communication.

Conclusion: Findings indicate the need of its more comprehensive communication with local stakeholders, including policymakers. Assessment should be made about likelihood and feasibility for implementation of proposed solutions after the identification the most promising ones. Implementation of rigorous monitoring and evaluation of an intervention or a combination of different interventions that will be implemented is essential for the purpose of assessment and fine-tuning towards success.

The Impact of Public Health Interventions on Children's nutritional status in Montenegro from 3 COSI rounds

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The childhood obesity epidemic is particularly concerning for children and adolescents. Over the past few decades, the prevalence of childhood obesity has increased significantly, with the current rate being ten times higher than in the 1970s. Addressing childhood obesity is crucial for the health of future generations, yet it remains an underestimated and poorly addressed public health challenge with substantial economic implications. Method: Montenegro joined the European Childhood Obesity Surveillance Initiative during the fourth round of research in 2016. Since then, 3 rounds have been conducted in Montenegro. The sample was stratified by regions (northern, central and southern) and type of area (urban, suburban and rural). The target age group were 7-year-old children. Anthropometric characteristics were measured, and data on eat-

ing habits, physical activity and socioeconomic characteristics of the family were obtained from the parents. The school administration filled out a school questionnaire that included data on the status of the school's urbanization, the way the school eats and the organization of physical activity. The Montenegrian study protocol and data collection procedures were in accordance with WHO – COSI methodological procedures. Sample size from each round was about 1630 seven years old children. Results: After the first conducted round, Montenegro was ranked as sixth in terms of overweight and obesity prevalence among the 36 countries that conducted the COSI survey with about 37% prevalence in boys and girls. After the published results of the first round, the problem of childhood obesity became the focus of interest of health authorities, international UN organizations, and numerous activities related to reducing childhood obesity were initiated. By the time the second round was conducted, 3 publications had been started and published after the second round. In the second round, we had reduced overweight and obesity with prevalence of overweight and obesity 34% overall. The third round of COSI research was conducted in 2022. after COVID 19 pandemic and showed increase in percentages from a total of around 39% for boys and girls. Conclusion: The decrease in prevalence between the first and second COSI round can be explained by raising awareness of this public health problem both among the general population and among decision makers, but achieving the goal of preventing and combating the obesity epidemic in children requires multifaceted programs and policies across the community as well as wider multisectoral cooperation and involvement.

Keywords: Childhood obesity, public health interventions, cooperation

Young Adults Nutrition Trajectories and Middle-Aged Liver Steatosis

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Liver steatosis, a hallmark of non-alcoholic fatty liver disease (NAFLD), is increasingly prevalent and poses significant health risks, including cirrhosis and liver cancer. This summary explores the link between dietary patterns in young adulthood and the development of liver steatosis in middle age, emphasizing the importance of early nutritional choices. Studies indicate that a Western diet, characterized by a high intake of processed foods, red and processed meats, sugary beverages, and refined grains, significantly increases the risk of liver steatosis. These foods contribute to obesity, insulin resistance, and inflammation, which are key drivers of NAFLD. In contrast, adherence to a Mediterranean diet, rich in fruits, vegetables, whole grains, nuts, and olive oil, is associated with a reduced risk of liver steatosis due to its anti-inflammatory and antioxidant properties. Macronutrient composition plays a crucial role in liver health. Diets high in saturated fats and simple sugars during young adulthood correlate with higher liver fat content and steatosis development, while diets high in polyunsaturated fats and fiber are protective. Adequate intake of micronutrients, such as vitamins E and C, and minerals like zinc and selenium, which possess antioxidative properties, also help mitigate liver fat accumulation. Behavioral and socioeconomic factors further influence liver health. Regular physical activity during young adulthood can reduce the risk of liver steatosis, even among individuals with suboptimal diets. Lower socioeconomic status, often linked to poorer dietary choices, underscores the need for public health interventions focusing on nutritional education and improved access to healthy foods. In conclusion, the trajectory of nutrition from young adulthood significantly impacts liver health in middle age. Early dietary interventions and public health policies promoting healthy eating patterns are crucial for preventing liver steatosis and its complications. Emphasizing the importance of nutrient-rich diets

and addressing socioeconomic barriers to healthy eating are essential strategies in combating the rising prevalence of NAFLD.

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Nutrition and Aging - Development of osteosarcopenic obesity

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Elderly individuals represent the fastest-growing population globally. Aging is inevitably linked to changes in body composition, including muscle loss, bone loss, and fat accumulation. The coexistence of osteoporosis, sarcopenia, and adiposity has recently been termed osteosarcopenic obesity (OSO) or osteosarcopenic adiposity (OSA). Adiposity can be presented as visible overweight/obesity or as fat redistributed around organs (visceral fat) and/or infiltrating bone, muscle, and other tissues (ectopic fat). This syndrome is often exacerbated by chronic conditions, including endocrine disorders, neurodegenerative diseases, inflammation, and lifestyle factors such as physical inactivity and poor nutrition. However, aging remains the primary risk factor for OSA. To prevent or slow the progression of OSA, appropriate nutrition and exercise are considered the most effective interventions. Increased intake of protein, calcium, potassium, and vitamins D and C has been shown to positively impact OSA, alongside a diet rich in fruits and low-fat dairy. Resistance training is a particularly safe and beneficial intervention for managing OSA, especially in older women. Although less robust, associations have also been found between OSA and omega-3 fatty acids, fiber, magnesium, phosphorus, and vitamin K. Research on serum nutritional biomarkers and their relationship with OSA is limited, but studies suggest that higher serum 25(OH) D levels are beneficial, while elevated serum ferritin has been linked to worse OSA outcomes. In conclusion, maintaining a balanced diet and regular physical activity throughout life is crucial for preventing body deterioration, including the development of OSO.

Omega-3 fatty acids intake: Health benefits throughout life

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Omega-3 fatty acids, particularly eicosapentaenoic and docosahexaenoic acid are essential throughout life. These molecules are integral components of cell membranes and serve as precursors to various bioactive metabolites, that can contribute to the prevention and management of numerous diseases. Since our bodies cannot produce omega-3 fatty acids efficiently, these nutrients must primarily be obtained through the diet, with seafood being a major source. Omega-3 fatty acids play an important role in fetal development, including neuronal, immune, and retinal functions. Adequate maternal intake of omega-3 fatty acids and placental transport

of maternal plasma omega-3 fatty acids during the third trimester of pregnancy is critical for optimal fetal brain development. Insufficient maternal intake of these nutrients can be linked to an increased risk of preterm delivery and health complications for preterm infants. After birth, newborns receive omega-3 fatty acids through breast milk. Suitable omega-3 fatty acids intake during pregnancy and breastfeeding, often through fish oil supplementation, ensures normal growth and development and reduces the incidence of allergies in infants. Inadequate omega-3 fatty acids intake in children and adolescents is connected to diabetes and asthma as well as various neurological and psychiatric conditions. Conversely, higher omega-3 fatty acids consumption is linked to better impulse control, reduced depressive symptoms, and improved emotional and behavioral management in these populations. For adults, omega-3 fatty acids support cardiovascular health by modulating lipid metabolism, inflammation, oxidative stress, and gene expression. They may also assist in weight management and cognitive function in certain neurological disorders. Given their extensive health benefits, ensuring adequate omega-3 fatty acids intake through diet or supplementation is crucial across all stages of life.

From Diet to Hormones: Endocrine Disruptors in our Daily Lives

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Endocrine disrupting chemicals (EDCs) are natural or synthetic chemicals that interfere with the body's endocrine system, leading to adverse health effects. Common EDCs include bisphenol A (BPA), phthalates, dioxins, toxic metals and many more, and they can be found in everyday items like food, packaging materials, and personal care products. These substances mimic or block the action of hormones, leading to disruptions in metabolic, reproductive, and immune functions. Exposure through diet is one of the most significant routes for these chemicals to enter the human body.

Research has shown that long-term exposure to EDCs is associated with various health problems, including hormonal cancers, infertility, metabolic disorders, and developmental issues in children. The "cocktail effect," where multiple low-dose exposures combine to amplify endocrine disruption, poses an additional concern. Children, pregnant women, and individuals with high consumption of processed foods or frequent use of plastic packaging are especially vulnerable.

Strategies to minimize exposure include opting for fresh, minimally processed foods, reducing the use of plastic packaging, and following proper handling and preparation techniques to prevent chemical leaching. Further research and stricter regulations are necessary to better understand the long-term impacts of these chemicals and to protect public health.

Challenges in Hazard Assessment of Endocrine Disrupters

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Endocrine disruptors (EDs) are chemicals which under certain conditions can impact on the hormonal system of humans and animals. However, not all endocrine active substances are EDs. This depends on whether there is reasonable evidence that the substance can cause an adverse effect as a result of its interaction or interference with the endocrine system. Endocrine disruption is a fairly recent way of looking at the toxicity of chemicals. Humans and animals may be exposed to a wide range of endocrine active substances through the diet as well as other sources. EDs can be naturally-occurring (such as phytoestrogens in soya) or man-made. Examples of EDs sometimes found in food include several pesticides, environmental pollutants like dioxins and PCBs, and the food contact material, bisphenol A. OECD revised Conceptual Framework addresses the complexity and comprehensive relevance of information available in five ascending Levels: from Level 1 (existing information and non-test data, which should guide the initial needs for testing and assessment), to Level 2 (selected in vitro endocrine mechanistic/mode of action test methods), to in vivo selective endocrine mechanistic screening methods in Level 3, in vivo apical tests (for adverse effects) which include endocrine relevant endpoints in Level 4, and more comprehensive data over more extensive parts of the lifecycle in Level 5. In recent years, the scientific community and authorities worldwide have been discussing this topic and how to regulate it. Significant progress has been achieved, both in the EU (EFSA, ECHA) and international organisations. Scientific knowledge in this area is still growing and, therefore, understanding of what is an ED continues to be the subject of scientific debate.

Endocrine disrupting pesticides in food

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As the world's population grew, it became necessary to increase the production of food. This was partly achieved through the large-scale use of various pesticides. Despite their benefits, these chemicals have polluted almost all parts of our environment (i.e. soil, air and water). Therefore, assessing their toxicity to humans and their environmental persistence has become a crucial factor in the development of global pesticide legislation that protects both humans and the environment. Among the various biological effects that can be induced by pesticides, the ability of pesticides to alter the function of the endocrine system has recently received much attention. Due to their effects on the endocrine system, some pesticides are classified as endocrine disruptors, i.e. substances that interfere with the biosynthesis, metabolism or action of hormones, thereby altering the normal homeostatic balance of an organism. Literature data indicate that endocrine disrupting pesticides interfere with estrogen biosynthesis and estrogen signaling. In humans, endocrine disrupting pesticides have also been shown to affect reproductive and sexual development, and these effects appear to be dependent on various factors such as gender, age and diet. Due to their harmful effects on human health, the European Union (EU) has banned endocrine disrupting pesticides. In addition, consumers are advised to avoid exposure to endocrine disrupting pesticides found as pesticide residues in conventionally grown fruit and vegetables. Individual measures can be taken to limit exposure to endocrine disrupting pesticides, e.g. washing, peeling and eating organic fruit and vegetables that absorb high levels of pesticides (strawberries, cherries, apples, grapes, potatoes, peppers, spinach). It has been shown that imported food contains a higher proportion of pesticide residues than food grown in the EU. Therefore, agricultural products imported from non-EU countries must meet the same standards as products produced in the EU in order to ensure a level playing field. Allowing higher maximum residue levels for imports would also endanger the health of citizens in Europe and in the producing countries.

Key words: food, endocrine disrupting chemicals, pesticides, human health

Youth, WASH and climate changes

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Introduction: Climate change is putting already stretched water, sanitation, and hygiene services, which are an essential component of sustainable development and play a crucial role in human well-being, under growing threat. Climate change undermines the rights and advances made for children and youth, so we need to work towards protecting them against its impact. Method: In February 2024, UNICEF Serbia, in collaboration with the U-REPORT platform, conducted a comprehensive survey. This survey, a part of the UNICEF Serbia Project "Youth, water, and climate changes," was dedicated to the youth in five cities of the Autonomous Province of Vojvodina. The active participation of 1705 young people (37% males, 61% females, 2% others), mostly (95%) aged 15-19, was instrumental in the success of this survey. Results: Half interweaved youth think their daily drinking water requirement is 2 l, but only ¼ drinks. Around 60% of youth have access to drinking water in schools, but most do not know whether it is safe. Half of interweaved youth use drinking water from public fountains and find that they need more public fountains, especially at the public places around the schools, parks, and courts. For taking away, almost everyone uses plastic bottles. Around 2/3 have additional drinking water sources during the hot days in their cities. Nearly all use water and soap for hand washing, if available, but not alcohol for disinfection. ½ of the youth have basic sanitation services in schools, but public toilets are available only for 1/3. Most (44%) do not believe that recreational water in their cities is safe. Around half of the youth do not know how climate change impacts water, sanitation, and hygiene and how they can be resilient, but most are willing to learn and act. Conclusion: This research's findings underscore the urgent need for our national, provincial, and local governments to adapt their water, sanitation, and hygiene services to climate change. It's our collective responsibility to ensure the health and well-being of our youth. This requires immediate action, focusing on the availability of safe drinking water, basic sanitation, youth involvement, improved information, and continuous education.

Drinking water safety and sanitary conditions in schools in the Republic of Serbia

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Background: Access to proper water, sanitation, and hygiene (WASH) in schools is one of the basic children's rights. A key prerequisite for ensuring a safe environment in schools that provides equal opportunities for quality education and healthy development of children is based on the consistent application of WASH principles in schools. Recent experience COVID 19 pandemic has actualized the necessity of ensuring the consistent application of WASH in schools. Evaluation of the national programmes on the risk factors from the school environment and on the protection of the population against communicable diseases pointed to outdated surveillance methodology and poor data quality inconsistent with the WASH in schools international indicators. A dedicated study was conducted in 2016 to assess the situation of WASH conditions in rural schools in Pomoravlje and Sumadija regions and to improve assessment methodology in this WASH area. Methods: In total, 238 rurals schools were inspected for hygienic-sanitary conditions, including drinking water quality, sanitary inspection of drinking water source solid waste disposal and pupils' perception of WASH in their schools. Assessment of WASH conditions was based on core and

expended Sustainable Development Goals (SDG) WASH in school indicators, sanitary inspection forms for different types of drinking water sources and a questionnaire for pupils' perception. Results: This survey revealed that 92.8%, 84.9%, and 92.4% of the investigated schools met the criteria for basic drinking water, sanitation, and hygiene services, respectively. The dominant reason for not meeting advanced service criteria for each dimension is the lack of accessibility of WASH service to children with physical disabilities. Two-thirds of water samples complied with standards regarding the presence of bacteria Escherichia coli in water. Only 73% of water samples complied with standards regarding concentrations of nitrates in water. Conclusions: The results of this survey provide important insights into the drinking water quality within rural schools in two investigated districts in Serbia. It pointed to the need for improving the management of drinking water sources and on-site sanitation management based on a risk assessment approach and improving infrastructure to meet the needs of children with physical disabilities.

Searching for the most realistic and sustainable advanced WASH indicators (water, sanitation, hygiene)

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Water, sanitation, and hygiene (WASH) are essential for providing safe environments in households, schools, and health care facilities. WASH services are critical for preventing infectious diseases, promoting health, and providing quality health care and child care. WASH in all settings, particularly in health care facilities, presents a national priority in line with the targets for quality of health care and universal access to WASH established by the 2030 Agenda for Sustainable Development.

WASH services in households, schools, and healthcare facilities are assessed using the so-called service ladders proposed by the World Health Organization (WHO). These ladders consist of three service levels for each WASH dimension: 1) the basic service – the minimum acceptable set of requirements; 2) the limited service – not all requirements are met; and 3) no service – the absence of any requirements. The fourth level of the service ladder is the advanced service. It includes indicators beyond the basic service provision, currently not pre-defined by the WHO, but proposed at the country level according to the actual situation, perceived needs, and future goals. The service ladder system can portray the actual WASH situation in line with human rights, show progress in reaching sustainable development goals, and identify priorities and interventions to achieve targets. This paper discusses potential advanced indicators typically considered for different WASH services.

Potential advanced indicators for drinking water would include water safety and quality, water quality controls, water hygienic plans, water accessibility, maintenance of water supplies, etc. Sanitation aspects beyond basic standards could be related to toilet cleanliness, accessibility for persons with disability, provision of toilet supplies, operation and maintenance, wastewater treatment, etc. Some of the advanced hygiene indicators would include hand hygiene promotion posters in public institutions and the provision of personal protective equipment supplies in emergencies.

The proposed indicators would realistically support universal and equitable access to safe and affordable drinking water for all, the use of safely managed sanitation services, gender equality and empowerment of girls and women, elimination of discrimination, reduction of social inequalities, insurance of equal opportunities, and other sustainable goals and targets. Finally, these indicators are applicable in public institutions to help reduce the burden of water-borne infectious diseases, control other communicable diseases, improve well-being, and promote good health practices for the whole population.

Human health risk assessment of drinking water in Autonomous Province of Vojvodina

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Introduction: The local governments in the Autonomous Province of Vojvodina (APV) provides safe drinking water to 55% of the population. The remaining 45% are forced to use non-purified but disinfected drinking water (NPDW), which is safe in only about 15% of drinking water samples per year. This work aims to assess the human health risk of drinking water in APV, especially in municipalities without appropriate treatment.

Method: The analyses are based on the results from 2022 for 12.281 NPDW samples from the APV originating from seven authorized and accredited public health institutions. Drinking water safety was assessed according to national laws. The microbiological risk was evaluated using the semi-quantitative World Health Organization methodology. Total cancer risk (TCR) and chronic hazard index (HHI) were characterized for the 713 NPDW samples from South Bačka District (SBD) in 2022 using the United States Environment Protection Agency methodology.

Results: Microbiological safety was not compliant in 10% of NPDW samples. Thermotolerant organisms, especially Escherichia coli, were found in 0.68% and 0.21%, respectively. The number of E. coli was recognized as the intermediate (n=13) and high (n=14) risk for the SBD, West Bačka, North Banat, and, respectively, for South Banat District populations. Regarding chemical safety, 83% of NPDW samples were not in compliance. There were recognized human health hazards like arsenic (in 74% of 908 NPDW), nitrate (0,62%), and nitrite (14%). TCR for adults, concerning ingestion and dermal absorption of average (0.027 mg/l) and maximum (0.122 mg/l) arsenic concentration in NPDW from SBD is not acceptable (1.05E-03; 4.73E-03, respectively), especially for children under five (5.40E-03; 2.44E-02, respectively). In the SBD, HHI for average nitrate concentration (6.2 mg/l) after ingestion and dermal absorption among adults and children under five is acceptable (1.00E-01; 5.17E-01, respectively), while the maximum nitrate concentration (91 mg/l) with HHI 1.47E+00 for adults and 7.58E+00 for children under five represent a nonacceptable hazard. Nitrite concentration, regarding average (0.041 mg/l) or maximum (0.447 mg/l) concentration in SBD, does not represent a human health hazard (<1).

Conclusion: The NPDW in APV poses significant human health risks, especially for children under five, due to E.coli, arsenic, and nitrate. The severity of these risks underscores the urgent need for action to provide safe drinking water to every citizen of APV. The local governments must be encouraged to take immediate and effective action to address this pressing issue.

Keywords: drinking water, risk assessment, South Backa, Serbia

Availability and drinking water safety from alternative water supply sources in the territory of AP Vojvodina

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Objective: This study aims to determine, based on data from public health institutes, whether the population of AP Vojvodina has access to drinking water from alternative sources and to identify microbiological (MH) and physicochemical (PCH) hazards associated with such water,

especially considering climate change impacts. Alternative sources include public wells, springs, capture facilities, and "eco-fountains." MH hazards are the presence of thermotolerant microorganisms of fecal origin (e.g., Escherichia coli), Streptococcus faecalis, Proteus species, and Pseudomonas aeruginosa, along with secondary contamination indicators. PCH hazards include elevated arsenic, nitrites, and nitrates. Method: Data from public health institutes in AP Vojvodina cover 1828 drinking water samples, analyzed using standard methods. Approximately 56% of Vojvodina's population, residing in the districts of South Banat, North Banat, West Bačka, Central Banat, and Srem, does not have access to drinking water from alternative sources. Results: In 2022, drinking water from public wells, springs, and capture facilities (974 samples) was safe in 50% of samples; thermotolerant microorganisms were found in 11% (Escherichia coli (44°C) in 3.5%), fecal streptococci in 7%, Pseudomonas aeruginosa in 2%; arsenic in 20%, and nitrates in 3.5%. Drinking water from "eco-fountains" (834 samples) was safe in 57% of samples; thermotolerant microorganisms were present in 1% (Escherichia coli (44°C) in 0.36%), fecal streptococci in 1.5%, Pseudomonas aeruginosa in 4%; arsenic in 11.5%, and nitrates in 4%. Public wells, springs, and capture facilities are operational and monitored by local public health institutes in South Bačka, Srem, and North Bačka districts. However, these sources are not available or not monitored in South Banat, North Banat, West Bačka, and Central Banat districts. "Eco-fountains" are available in all districts except Srem, typically installed in areas facing arsenic issues in their local water supplies. Conclusion: Drinking water from alternative sources in AP Vojvodina is safe in about 50% of samples. Due to microbiological and physicochemical hazards, it is essential to ensure drinking water safety for the population. About 56% of Vojvodina's population does not have access to alternative water sources. Considering climate change and potential emergencies, there is a clear need for more alternative water sources.

Keywords: Public health, drinking water safety, alternative water supply sources

Hydration among youth in North Bačka region

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Aim: Providing an overview of research on hydration among adolescents and its significance for health. This includes considering future perspectives on creating a water-friendly environment in schools, ensuring the availability of drinking water during classes, and delivering adequate education on fluid intake.

Methods: A total of 113 individuals (77.9% female), aged 15-19 years (mean age 15.8 years) participated in healthy hydration workshops. Data on fluid intake volume and type were collected using a 7-day beverage-specific intake questionnaire designed for the workshop. Height (m), weight (kg) and physical activity levels were self-reported by participants.

Results: In our sample, total fluid intake ranged from 0.78 to 7.02 L (mean 2.96 L) for females and 0.81 to 6.89 L (mean 3.401 L) for males. Total water intake ranged from 0.25 to 3.64 L (mean 1.78 L) for females and 0.5 to 4 L (mean 2.15 L) for males. Non-adherence to EFSA AIs for fluids was observed in 24 adolescents (21.2%). The intake of sugar-sweetened beverages (SSBs) ranged from 0 to 5.99 L (mean 1.08 L) for females and 0.70 to 5.15 L (mean 1.21 L) for males. There was a statistically significant correlation between total fluid intake and SSB intake, $r(111)=0.76$, $p<0.001$. The mean values for excess liquid calories were, similar between sexes, with 192 kcal for females and 195 kcal for males ($p=0.969$). Likewise, there were no significant sex differences in energy drink consumption ($p=0.925$). Among the participants, 31 (27.4%) were classified as heavy SSB drinkers (>500 kcal/day). A one-way analysis of variance indicated a significant difference between BMI and SSB intake, with higher SSB intake associated with higher BMI ($p=0.024$).

Conclusion: Our findings indicate that healthy hydration education should prioritize adequate water intake, the reduction of sugar-sweetened beverage (SSB) consumption, and the availability of water both at school and at home. Additionally, it should address the influence of peers and media on hydration choices. Understanding these preferences and influences can aid in designing effective nutrition education programs tailored to children and adolescents. Routine screening for SSB consumption is essential, as reducing the intake of these beverages among adolescents is crucial for improving their overall health.

Legionella in water systems

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Legionella infections represent a significant problem for public health at the global and regional level. The risk assessment and risk management approach is promoted by the Drinking Water Quality Guidelines (WHO) as well as the revised European Union Drinking Water Directive, which explicitly addresses the effective control and management of Legionella. The Protocol on Water and Health is also an important platform to promote and advance the implementation of global and regional commitments on WASH and health and an opportunity to plan health-related goals. Although many countries have established national regulations and procedures for the prevention and control of Legionella in water systems, there are still a significant number of countries where such capacities are lacking. Method: The paper presents the results of control of drinking water from water supply systems for the presence of legionella in the period from 2019-2023. The water was tested by standard microbiological procedures (MEST EN ISO 11731 and Legiolert), in accordance with the Rulebook on parameters, compliance verification, methods, method, scope of analysis and monitoring of the healthiness of water for human use Sl.list CG no. 101/21. The analysis includes samples from the city's water supply networks, according to the program for monitoring the healthiness of water for human use, according to individual requirements, requirements of the health and sanitary inspection and from individual water supply facilities. Results: Results: Out of the total number (1244) of water samples analyzed for the presence of Legionella, in 306 (24.60%) Legionella bacteria were identified. Out of the total number of analyzed samples, Legionellae pneumophilae (1052) was identified in 36.80%. Legionellae spp, excluding Legionellae pneumophilae, was identified in 11.98% of samples. With the introduction of the obligation to test legionellae through regulation, an increase in the number of analyzed samples was recorded in the observed period. Conclusion: International standards and recommendations represent the basis for the development of state policy in order to promote risk management, including the prevention and control of legionellosis. The results of the analysis in Montenegro speak in favor of the commitment to harmonize the national legislation with international standards, but also for the need to strengthen capacities in the control of the implementation of the current regulations. In order to reduce the number of samples in which legionellae is identified, it is necessary to work on strengthening awareness of the importance of applying preventive measures to prevent legionellosis.

Non-carcinogenic risk assessment of exposure to iron and manganese in the drinking water of South Bačka district

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Introduction: Iron and manganese are naturally occurring elements in soils, rocks, and minerals and can thus be found in groundwater from deeper wells. Ingesting iron from drinking water is not directly associated with adverse health effects, but exposure to too much manganese may be associated with toxicity to the nervous system, especially among infants. Aim: This research, which is of significant importance, was conducted to assess the non-carcinogenic risks of adults, teenagers, and children from exposure to iron (Fe) and manganese (Mn) by ingestion of drinking water in South Bačka District (SBD), Vojvodina, Serbia. Method: In 2023, the concentrations of Fe and Mn were measured in 8272 drinking water samples (7377 purified and 895 non-purified but disinfected) using flame atomic absorption spectrometry. We used the U.S. EPA risk assessment method to calculate non-carcinogenic risks of exposure to the average and maximum concentrations of Fe and Mn by defining hazard index (HI) levels of exposure in 12 cities in SBD. HI was assessed for adults, adolescents, and children. Results: The HIs to the average and maximum concentration of Fe and Mn from the purified drinking water were for adults 5.36x10-03– 8.49x10-02, i.e., 1.33x10-02 – 2.18x10-01, for adolescents 6.00x10-03– 9.51x10-02, i.e., 1.49x10-02– 2.44x10-01, and for children 1.60x10-02 – 2.54x10-01, i.e., 3.96x10-02 – 6.51x10-02. The lowest HIs are in the Bačka Palanka City for all age groups. The highest HIs are in Titel City for all age groups. The HIs to the average and maximum iron and manganese concentration in non-purified but disinfected drinking water were for adults 2.90x10-02– 1.01x10-01, i.e., 6.94x10-02– 2.54, for adolescents 3.24x10-02– 1.14x10-01, i.e., 7.77x10-02 – 2.84 and for children 8.65x10-02 – 3.03x10-01, i.e., 2.07x10-01 – 7.58. The lowest HIs are in the Bač municipality for all age groups. The highest HIs are in Vrbas City for all age groups. Conclusion: The risk assessment analysis indicates no non-carcinogenic risks related to iron and manganese for all purified and non-purified but disinfected drinking water at average and maximum measured concentrations and all age groups (HI<1). Only non-purified but disinfected drinking water from Vrbas city with the maximum measured concentration of iron (15,96 mg/l) and manganese (1,159 mg/l) has HI> 1. It could negatively affect health because of poor drinking water quality ingestion. This finding underscores the importance of water supply with purified drinking water of Vrbas city in reducing non-carcinogenic risk for inhabitants of this area.

Keywords: Health Risk Assessment, Drinking Water, Metals, Heavy, Public Health

Benefit of essential elements calcium and magnesium: drinking water vs. natural mineral water

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Water is a vital element of our lives as well as a source of numerous essential elements whose deficiency may pose a health risk. Although the main dietary source of calcium and magnesium is food, hard water also significantly contributes to calcium and magnesium intake. As bottled waters have a long tradition of use in combination with, or instead of tap drinking water, it is of interest to compare the benefit of drinking water consumption from water supply systems of

Juznobacka and Srem District against natural mineral waters, in terms of calcium and magnesium content. The data were retrieved from water monitoring programs, conducted by the Institute of Public Health of Vojvodina on nine water supply networks (Novi Sad, Bačka Palanka, Vrbas, Nadalj, Bečej, Čurug, Beočin, Titel, Sremska Mitrovica) during 2023. All of the tested samples (total number 7.354) can be classified as very hard water (harness range 219-633mg/l as calcium carbonate). Average annual concentration of calcium ranged from 43.4mg/l in Čurug to 131.2mg/l in Beočin, and in case of magnesium from 16.5mg/l in Novi Sad to 101.5mg/l in Srbobran. Taking into account daily recommended values of water of 2 litters for male and female, consumers of tap water from the Juznobacka and Srem districts ingest 87mg-262mg of calcium and 33mg-203mg of magnesium, thus contributing with 9-26% and 9-58% of their respective daily recommended intakes (DRIs): 1000mg for calcium, 350mg for magnesium. Based on the declared calcium and magnesium content of 15 natural mineral waters and 3 spring waters from Serbia, calculated daily intake of calcium ranges from <1% to 23% of DRI and in case of magnesium from <1% to 196% of DRI, assuming that adult consumers drink two litters of bottled water instead of tap water. These figures indicate that, on the one hand, the consumption of only bottled water with a small amount of calcium and magnesium could significantly reduce the intake of essential elements, and on the other hand, that the consumption of water with an increased content of these elements should be carefully managed. Considering that daily intake of bottled water varies (on average 200-250ml), the input amounts of essential elements could also be very variable. These findings indicate that drinking of tap water from nine analyzed water supply networks supports optimal intake of calcium and magnesium through water. With regard to bottled water, consumers should be well informed about its calcium and magnesium content.

Keywords: dietary intake, minerals, water monitoring, water quality

Microbial Threats to Food Security

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Food safety is the basis of the food systems with its impact on public health. Safety of the product relates to food-borne diseases and it is achieved throughout the whole food chain from the primary production, preparation, storage, distribution and consumption. Food Security means that all people always have access to sufficient, safe and nutritious food for an active and healthy life. There is only secure food with the established food safety objectives. Nowadays we are more aware that food systems need to transform in such a way as to achieve sustainable goals and to provide enough safe and nutritious food for the growing population. One of the important issues in the food sector is food loss and waste which occur at all stages of the food sector and account for the largest share attributed to consumption, followed by production, distribution, and the primary sector which includes farms and feed. The reasons for food loss and waste are numerous and include lack of transport infrastructure, inadequate handling, inadequate operational practices, variety of products available in the retail network, and microorganisms. Food, especially animal-source food, is highly susceptible to contamination by biological hazards. Food animals are carriers of various pathogens (e.g. poultry: Campylobacter, Salmonella; pigs: Salmonella, Yersinia etc.), which can be easily transmitted throughout the food chain and consumers. Mitigation of these pathogens includes measures (good hygiene practice) with various activities applied along the food production – distribution – consumption chain.

Keywords: pathogens, safety, sustainability, system

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Foodborne viruses: their significance and the need for further study

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Foodborne viruses, major pathogens that cause food poisoning, pose significant threats to food safety and human health. The main viruses responsible for outbreaks of foodborne illness are norovirus, hepatitis A and E viruses, rotavirus, astrovirus, adenovirus, Aichi virus, and sapovirus, and the rate at which novel viral varieties arise is always increasing. Raw foods such as bivalve shellfish, fruits, salads of raw vegetables and raw fish, and ready-to-eat (RTE) foods are frequently linked to foodborne viral outbreaks. Viruses cannot grow in food because they are obligate intracellular pathogens that can only reproduce in live cells. They survive in the environment, on different surfaces for food preparation and food packing, as well as on human hands, where they can persist for days and even weeks in the food chain. Frequent symptoms of viral gastroenteritis include vomiting and diarrhea, but they can cause life-threatening infections, especially in chil-

dren, the elderly, immunocompromised people, and pregnant women. The contamination of food with viruses may be controlled by preventing viral occurrence, the adoption of strict hygienic food processing measures from farm to fork, or by inactivation. Inactivation of foodborne viruses in the food industry is a difficult task because they can survive in the food during food processing and storage. The development of technologies and the rapid and accurate detection of foodborne viruses are essential for food safety control. Reverse transcription-polymerase chain reaction (RT-PCR) is considered the method of choice for virus detection due to the small number of viruses usually present in food. The aim of this review is to present the available information on viral foodborne outbreaks, their characteristics, control strategies, and the need for further study.

Importance of Trichinella spp. in food safety

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Trichinellosis is a foodborne parasitic zoonosis that poses a global threat to public health. The causative agents are nematodes of the genus Trichinella which includes 10 species T. spiralis, T. nativa, T. britovi, T. murrelli, T. nelsoni, T. patagoniensis and T. chanchalensis, T. pseudospiralis, T. papuae and T. zimbabwensis and 3 genotypes (T6, T8 and T9). Two species, T. spiralis and T. britovi, have been identified in Serbia. The characteristic of this parasite that both adult and larval forms develop in the same host, because it does not have a developmental cycle in the wild. It was found that species of Trichinella differ from each other in terms of infectivity and pathogenicity in humans and animals, as well as resistance to freezing. There is also a difference in capsule creation, based on which the division into two groups was made, encapsulating and non-encapsulated species. Except for the existence of a capsule, the species and genotypes belonging to the genus Trichinella cannot be distinguished morphologically, so only biochemical or molecular methods have to be used to identify the species/genotype of the parasite. Many methods have been developed for this purpose, but the most used are those based on the polymerase chain reaction (PCR). Trichinellosis in humans occurs through the consumption of infected meat, which is directly related to the culture of food preparation, as well as inadequate or missing examination of meat for the presence of larvae. Pigs and other domestic and wild animals, including horses (Equus caballus), dogs (Canis familiaris), wild boars (Sus scrofa), walruses (Odobenus rosmarus), red foxes (Vulpes vulpes), and bears (Ursus spp.), are sources of Trichinella spp. infections for humans. Inspection of meat for Trichinella spp. is mandatory in Serbia. Testing of the meat of domestic pigs is carried out using the artificial digestion method (in slaughterhouses) and compression technique (slaughtering in the household for meat intended for private consumption). For testing game meat only the artificial digestion method is allowed. Studies of Trichinella spp. have lasted since 1835 when James Paget noticed "tiny white grains" incorporated in the musculature of human corpses, until today, considering that the last species named Trichinella chanchalensis (T13) was described in 2020. In the future, Trichinella will certainly remain a topic of research considering the zoonotic potential and economic damage caused by the occurrence of trichinosis.

Microbiological analysis of various food products on the Serbian market and potential solutions

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Food technology represents a complex, concentrated and dynamic chain of activities, beginning with the production of raw agricultural products on farms and orchards, which moves to processing, increasing the value of the product itself, and ends with final product, which comes to the market and is thus processed to consumers themselves. Because of its composition, pH and aw value, food represent powerful environment for the development of different microorganisms. Nowadays, ready-to-eat (RTE) foods become very popular, since it could be consumed without significant preparation. Also, RTE could be one of the main routes for the spread of foodborne pathogens: Enterobacteriaceae, Staphylococcus aureus, Salmonella and Listeria monocytogenes. Likewise, confectionery represents a suitable environment for the growth and development of microorganisms, because of their composition and high humidity. Cheeses also represent appropriate matrix for development of different pathogens, like coagulase positive staphylococci and Listeria monocytogenes. During recent years, laboratory of Department for Technological Microbiology at Faculty of Agriculture University of Belgrade, had analyzed different food products from Serbian market, including Pirot kaschkavala, confectionery, sandwiches, salads according to the Regulation.

Obtained results showed that in Pirot kachkhavala was not detected presence of Listeria monocytogenes or coagulase positive staphylococci. In confectionery products like cream desert with cacao cream, E. coli was detected only in one sample, while Salmonella spp., S. aureus and C. prefrigens were not detected. In candy products with chocolate coating from Serbian market, Enterobacteriaceae was detected in 4 samples out of 8, while S. aureus was detected in 6 samples in range 2-3,23 log cfu/g. Sandwiches and salads as a type of RTE food showed high presence of Enterobacteriaceae and S. aureus, while Salmonella spp. and L. monocytogenes were not detected in any of the samples.

After summarizing all the collected results, it can be concluded that humans and improper food handling are the main factor for the presence of bacteria. In order to reduce the number of bacteria, certain measures should be taken, such as improving hygiene and disinfecting surfaces, storing food properly and creating suitable environmental conditions.

By improving existing technologies for the production of different kind of foods and implementation of some antimicrobial compound like bacteriocins or protective lactic acid bacteria, potential solutions for improvement of microbiological safety of products can be achieved that will ensure better, faster and safer production, which would aim precisely at obtaining stable and safe products.

The impact of bacterial biofilms on food safety

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Biofilm formation is an important survival strategy of bacteria due to adverse environmental conditions. Materials used in food industry, including plastics and stainless steel, when reused become rough and ideal harbor for microorganisms. Food residues on the food contact surfaces can provide the opportunity for microbial growth and attachment. Therefore, food contact sur-

faces are of particular significance in food safety as they have the potential to become a source of bacterial contamination. This leads to serious hygienic problems, food spoilage, foodborne disease, and economic losses in food industries. Biofilms are the cause of approximately 60% of the world's foodborne outbreaks. The main pathogens that need to be controlled in the food industry are Campylobacter and Salmonella, followed by Yersinia, shiga toxin-producing Escherichia coli and Listeria monocytogenes, being the most reported zoonoses in humans often associated with food. Biofilms are a major challenge in the food industry. Traditional prevention and control strategies in food industries usually include mechanical and chemical cleaning, with sanitation procedures that combine detergents and disinfectants. Strategies for the prevention and control of biofilm formation are inhibition of initial adhesion and colonization of the surface, interference with signaling molecules that stimulate the growth and destruction of biofilm.

Environmentally transmitted parasites and the sustainability of free-range meat production

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Parasites that are environmentally transmitted (ETP) have resistant life stages that can tolerate wide variations in temperature and even humidity and remain viable and infective for a considerable time, facilitating food- and water-borne transmission of zoonotic pathogens. This makes organic and free-range farming of animals destined for meat production difficult to sustain in the context of One Health due to the perceived higher potential of such livestock to transmit parasites to humans, counteracting the nutritional benefits of organic products for consumers. In addition, the challenge of providing sufficient, affordable, and healthy food for a growing human population is constantly rising. Ironically, a persistent reduction in the number of pigs in the last two decades was noted in Serbia.

Studies have shown that as much as 60% of the pork consumed in Serbia originates from backyard pigs, which are heavily exposed to ETP, such as Toxoplasma gondii. A small share of pork is from eco-friendly farms raising Mangalitza breed pigs, which have been proven to be even more infected with this parasite. However, the well marbled meat of this pig breed is highly valued among consumers, as well as the lard which has a higher level of monounsaturated fats and a more balanced n-3 to n-6 polyunsaturated fatty acids content as compared to that of industrially raised modern breeds and hybrids.

As toxoplasmosis is a zoonotic disease with a burden estimated to be among the highest for foodborne infections, and since one of the major risk factors for human infection is consumption of undercooked or insufficiently cured meat, infected free-range pork and pork products can present a real food hazard. In turn, compromised food safety could reflect badly on the sustainability of free-range pork farming. Furthermore, there are no practical or cost-effective methods to detect T. gondii at slaughter, nor any official regulations for the prevention of T. gondii infection by consumption of pork. The recommended post-harvest procedures for inactivating the parasite include freezing, thorough cooking, and proper curing of meat, which could include innovative processing and preservation methods. Therefore, the sustainability of free-range pork production would rely on mitigation actions both at the producer and consumer levels to ensure safe meat products.

Keywords: food safety; organic farming; pork; Toxoplasma gondii; zoonoses.

The Silent Threat: Antibiotic-Resistant Bacteria in food of animal origin

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Background: Antibacterial resistance is a critical global health issue, with multidrug-resistant (MDR) bacteria posing significant challenges to treatment and infection control. The spread of MDR bacteria in both hospitals and communities contributes significantly to the overall increase in antimicrobial resistance. The objective of this study was to explore the role of food originating from animals as a reservoir for MDR bacteria, particularly those exhibiting resistance to carbapenems and producing extended-spectrum beta-lactamases (ESBLs). Methods: A total of 50 non-duplicated specimens of raw milk and 37 unique samples of meat carcasses, were analyzed. MDR bacteria were isolated using selective chromogenic media designed to detect carbapenem- and ESBL-producing strains. The identification of isolated bacteria was performed using Matrix-Assisted Laser Desorption Ionization–Time of Flight (MALDI-TOF) Mass Spectrometry. Results: Overall, 310 MDR Gram-negative bacteria were isolated from the tested specimens. Most of them were Gram-negative non-fermentative bacilli, comprising 87.4% of isolates (n=271). Out of the 310 MDR bacteria, 228 were found in milk samples and belonged to 59 different bacterial species. Of these, 30 species (50.8%) were identified as Pseudomonas spp. Furthermore, this genus was also the most frequent bacteria harbouring carbapenem- and ESBL-encoding genes in milk, with 83 (61%) and 31 isolates (33.7%), respectively. It was followed by Stenotrophomonas maltophilia, with 31 carbapenem-resistant (22.8%) and 21 ESBL positive isolates (22.8%). In meat samples, a total of 82 MDR bacteria were identified, with Acinetobacter being the most common (n=33; 40%). In addition, Acinetobacter spp. had the highest number of ESBL producers (n=30; 50.8%), whereas Pseudomonas spp. and S. maltophilia were predominant producers of carbapenemases with 9 (39%) and 6 (26%) isolates, respectively. Overall, Pseudomonas spp. was the predominant producer of OXA-48 carbapenemase in both milk and meat samples, with 37 (64.9%) and 7 isolates (46.7%), respectively. Among clinically significant pathogens, carbapenem-resistant Klebsiella pneumoniae and ESBL-producing Escherichia coli were detected in meat samples, whereas carbapenem-resistant Pseudomonas aeruginosa and Acinetobacter baumannii were detected in milk. Conclusion: The obtained findings indicated that foodborne sources, particularly raw meats and milk, are critical in harboring and disseminating MDR bacteria and resistance genes, including clinically significant pathogens. Addressing antibacterial resistance requires a holistic approach that includes rigorous monitoring of food sources, improved hygiene practices, and regulatory measures to mitigate the risk of MDR bacteria entering the food supply. Collaboration across human, animal, and environmental health sectors is essential to combat this growing threat.

Monitoring and Antimicrobial Resistance in Food Producing Animals in Croatia

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Directive 2003/99/EC of the European Parliament lays down the basic conditions for the monitoring and reporting of antimicrobial resistance (AMR) of bacteria isolated from animals and foodstuffs. The Republic of Croatia has been participating in this programme since 2014. In

even-numbered years, the AR of bacterial isolates from broilers and laying hens was determined, while in odd-numbered years, the AMR of isolates from pigs and cattle was determined. During this period, the AMR of Salmonella spp., Campylobacter jejuni/coli, indicator Escherichia coli and Escherichia coli producing ESBL and/or AmpC and/or carbapenemases was monitored.

In the period from 2014 to date, bacterial isolates of the genus Salmonella spp. isolated from broilers and Campylobacter jejuni/coli isolates from broilers, cattle and pigs were found to be highly resistant to quinolones (65%-100%). Salmonella spp. isolates from laying hens and cattle were found to be moderately resistant to all antimicrobial drugs, with the resistance of isolates from laying hens to quinolones tending to increase. High resistance to ampicillin, tetracycline and sulfamethoxazole (up to 80 %) was found in Salmonella spp. isolates from pigs.

Very high resistance to quinolones (80%-90%) and high resistance to ampicillin, tetracycline and sulfamethoxazole (40%-60%) was found in indicator Escherichia coli isolated from the caecum of broilers. High resistance to tetracycline (50%-60%) and moderate resistance to ampicillin, sulfamethoxazole, ciprofloxacin and trimethoprim (10%-40%) was found in isolates of indicator Escherichia coli from pigs. Moderate resistance to sulfamethoxazole and tetracycline (approx. 30%) was found in bacterial isolates of indicator Escherichia coli isolated from the cecum of cattle.

The prevalence of ESBL- or AmpC-producing Escherichia coli from broiler meat samples shows a constant downward trend and was around 30% in 2022, while in beef and pork it was between 2%-8%. The prevalence of ESBL- or AmpC-producing Escherichia coli in caecal samples from broilers was in the range of 55%-60%, while in cattle and pigs it was 20%-60%, with an upward trend.

Keywords: Antimicrobial resistance, cecum, food

Incidence of salmonellosis and antimicrobial susceptibility in isolates of Salmonella strains from human cases in Belgrade, 2016-2023

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INTRODUCTION Non-typhoidal Salmonella serovars (NTS) are among the most common foodborne pathogens. They are the leading cause of gastroenteritis and one of the major causes of diarrhea in humans worldwide. Both clinical manifestations are also known as salmonellosis. Moreover, the emergence of antibiotic-resistant Salmonella strains contributes to a possible concern for public health safety.

OBJECTIVES To analyze the incidence trend of salmonellosis and the results of antimicrobial susceptibility in Salmonella isolates of patients with clinical manifestation of disease, in Belgrade from 2016-2023. METHODS Data on reported cases, laboratory-confirmed and identified Salmonella, as well as the results of antimicrobial susceptibility testing of Salmonella isolates, were obtained from the Department of Epidemiology and Microbiology at the Institute of Public Health of Belgrade (IPH). Antimicrobial susceptibility testing was performed according to the European Committee on Antimicrobial Susceptibility (EUCAST) guidelines. The number of reported cases, incidence rates, and susceptibility of strains were monitored over the study period 2016-2023, but also compared results for the first and second four-year study period (2016 -2019: 2020-2023).

RESULTS During the 8-year study period, 1,874 cases of salmonellosis were reported with an average annual incidence rate of 14.05/100,000 inhabitants of Belgrade. There was observed a decreasing trend in the incidence of disease. The highest incidence rate was in 2017 (25.31/100,000), and

the lowest in 2022 (4.39/100,000). The exception is 2023, with an increase in the incidence rate (18.14/100,000). At the same period, 2,410 Salmonella isolates were identified and analyzed in the Laboratory for bacteriological diagnostics of the IPH. The most common isolated serotype was S.enteritidis (77.9%), followed by S.Typhimurium (10.4%). The sensitivity of Salmonella isolates to trimethoprim-sulfamethoxazole and ampicillin between the first and second study periods did not change significantly (98.7%:98.4% and 95.4%: 92.9%, respectively). The proportion of isolates sensitive to ciprofloxacin continuously decreased, particularly with the years of the COVID-19 pandemic. The comparison of data for the years 2016-2019 and 2020-2023 showed a decrease in sensitivity to ciprofloxacin for 11.7% (85.8%:74.1%). Moreover, the occurrence of resistance to ciprofloxacin in Salmonella isolates showed a significant difference between the first and second four-year study period. CONCLUSION The results of this study indicate the importance of controlling the spread of salmonellosis, conducting monitoring of antimicrobial resistance in Salmonella, and putting in place measures to reduce antimicrobial resistance.

Keywords: Salmonellosis, incidence rate, Salmonella, antimicrobial susceptibility, antimicrobial resistance

Antimicrobial Resistance of ESKAPE Bacteria in the Food Chain: Challenges and Current Status in Serbia

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ESKAPE bacteria (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, Enterobacter spp.) due to their wide prevalence in the environment, are often found as isolates in samples of meat and other food products. Their presence poses a great problem in the hospital settings, as the constant circulation of patients and medical staff makes it difficult to maintain sterility and implement regular hygiene protocols. By themselves, they rarely cause clinical symptoms like those caused by typical food poisoning pathogens and, because of that, are considered opportunistic pathogens. The irrational use of antimicrobial drugs, their improper application and misuse such as adding them to animal food for faster and better growth, lead to negative selection of bacteria with a high degree of resistance. These bacteria are capable of producing antimicrobial resistance (AMR) genes, which can easily spread horizontally among bacteria of the same or different species, resulting in the spread of antimicrobial resistance. AMR genes can be transmitted to humans through the consumption of meat from improperly treated animals, highlighting the importance of the One Health approach regarding antimicrobial resistance. To ensure food safety for consumers, it is necessary to address not only microbiological threats but also issues related to antimicrobial-resistant bacteria (AMR), as well as to improve the monitoring of antimicrobial drug use in human and veterinary medicine. This article aims to provide a current overview of the situation regarding the transmission of ESKAPE bacteria's AMR genes from animals to humans through the consumption of meat and meat products in Serbia.

Keywords: ESKAPE bacteria, Antimicrobial Resistance (AMR), Food Safety, One Health Approach, Transmission of AMR Genes

Antimicrobial resistance profile of foodborne pathogens in human samples

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Antimicrobial resistance (AMR) in foodborne pathogens is a significant public health and food safety concern, as the spread of antibiotic-resistant bacteria through the consumption of contaminated food compromises treatment efficacy and increases the risk of severe infections. This study aimed to assess the prevalence and trends of AMR in three foodborne pathogens isolated from human samples between 2019 and 2023, including Escherichia coli from urine, Salmonella spp. from stool, and Staphylococcus aureus from nasal swabs and skin lesions.

Data were collected from the Center for Medical Microbiology at the Institute of Public Health of Montenegro, and antibiotic susceptibility was assessed using the Kirby-Bauer disk diffusion method and the VITEK2 system (bioMérieux).

Escherichia coli isolates have shown significant resistance to various antibiotics, with the highest levels of resistance recorded to ampicillin (51%), followed by trimethoprim-sulfamethoxazole (34%) and ciprofloxacin (23%). Resistance to gentamicin was recorded in 15% of isolates, while nitrofurantoin showed the least resistance (2.6%). Over a five-year period, trend analysis showed a steady increase in resistance, particularly to ampicillin and ciprofloxacin. Salmonella spp. isolates showed the highest resistance to ciprofloxacin, with 58% of isolates resistant in 2023, maintaining high levels of resistance throughout the study period. Resistance to ampicillin was lower, at 5.8%, while resistance to ceftriaxone was minimal, present in only 1.4% of isolates. Methicillin resistance in Staphylococcus aureus (MRSA) increased from 6.78% to 10.49% in nasal swabs and from 6.78% to 8.20% in skin lesion isolates between 2019 and 2023. This slow but steady increase underscores the growing concern over MRSA in clinical settings.

Spearman's correlation analysis revealed statistically significant correlations between different antibiotics and resistance levels. Resistance to ampicillin in Escherichia coli showed a weak but statistically significant positive correlation over the observed period ($r = 0.038$, $p < 0.001$), indicating a gradual increase in resistance. Similarly, resistance to ciprofloxacin in Salmonella spp. demonstrated a stronger positive correlation over time ($r = 0.224$, $p < 0.001$), reflecting persistently high resistance levels. Methicillin resistance in MRSA also shows a significant positive trend, with resistance continuously increasing over the years ($p < 0.05$).

These results highlight a gradual increase in antimicrobial resistance among foodborne pathogens, particularly in E. coli and Salmonella, underscoring the need for continuous surveillance, responsible antibiotic use, and enhanced strategies to prevent the spread of resistant strains.

Antimicrobial resistance of environmental strains in South Backa region of Vojvodina, Serbia

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Introduction: Antimicrobials were heralded as humanity's ultimate weapon against bacteria and infectious diseases, at least till the emergence of antibiotic resistance. Antibiotics enter the environment from anthropogenic sources, including effluents from hospitals, veterinary waste,

municipal effluents and aquaculture farms. The spread of antimicrobial resistance, particularly in causative agents of infectious diseases, is of concern due to associated human health risks and economic losses. Antibiotic resistance due to the excessive use and abuse of antibiotics, the increased frequency of antibiotic-resistant bacteria, and mechanisms of antibiotic resistance in the environment are now referred to as 'antibiotic resistance pollution'. The ecosystem serves as a bridge for various compartments of animals to soil to water to sand and to sewage. The role of environmental factors in antimicrobial contamination and the spread of antimicrobial resistance is often overlooked. Objective: Antimicrobial susceptibility of environmental strains from Danube. Methods: Prospective study conducted in the period from August 1 to August 31, 2023. The total of 40 samples were taken from four different swimming locations along the Danube River in the territory of South Bačka region of Vojvodina province, bacteriological examination with the standard membrane filter method according to Regulations on limit values of polluting substances in surface and underground waters and sediment and deadlines for reaching them ("Official Gazette of RS" No. 50/2012) was processed, and the final identification of coliforms to the species level using MALDI TOF was performed. For each identified strain antimicrobial sensitivity test was conducted according to EUCAST 2023. Results: Out of a total of 40 examined recreative surface water samples from the Danube, 80 isolates of bacteria from the family Enterobacterales were isolated. The most frequently isolated bacteria were Klebsiella pneumoniae (40%), consequently Escherichia coli (31.25%), Klebsiella oxytoca (17.5%) and Citrobacter freundii (11.25%). Among tested bacteria 50% of Citrobacter freundii showed multiple resistance, with resistance to aminoglycosides, quinolones and trimethoprim-sulfamethoxazole, while Klebsiella strains (17.4%) showed similar resistance, with the exception of resistance to beta lactams instead of trimethoprim-sulfamethoxazole. Several Klebsiella isolates had as many as 9, 10 and 11 markers of resistance. Conclusion: These results indicate that multiresistant isolates from recreative surface waters can represent serious health risk both for swimmers and other participants and water sports enthusiasts. For the management of antimicrobial resistance, different biocontrol strategies must be explored, emphasizing the importance of developing a systematic human and environmental health risk assessment for antimicrobial resistance.

Keywords: Surface water, Enterobacterales, antimicrobial resistance

Sustainable use of pesticides as a prerequisite for sustainable food production

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One of the main obstacles in production of quality and healthy agricultural products is the inappropriate use of plant protection products (PPP-s). PPP-s leads to pesticide residues in feed and food, risk in human and animal health, environment pollution, loss of biodiversity and financial losses. With growth of human population, limited capacity of agricultural land and demand for safe food and feed, the humanity cannot afford the reduction of food production. Also, the majority of human population cannot afford higher prices for agricultural products. In this safe food/high yields/affordable prices triangle the only solution is the sustainable use of plant protection products. Significant reduction or complete ban of PPP-s can result in lower yield and higher prices. Unprofessional and uncontrolled use of PPP-s is unacceptable for consumers, making a risk for humans of health. Climatic changes increase the problems in agricultural production, as well as in safe use of PPP-s. Sustainable use of PPP-s is possible by strict implementation of Directive 2009/128/EC on the sustainable use of pesticides. Its implementation relies on high level of professionalism both from sides of farmers, experts in plant protection and local authorities. Good cooperation between those actors in agricultural production can secure sustainable food production, without risk of PPP-s residues.

Estimation based on pesticides production and quantity of import in Republic of Serbia, the yearly use of plant protection products is about 22,000 tons. Use of pesticides is regulated with Law on Plant Protection Products (Official Gazette RS", No. 41/2009 and 17/2019). According to this regulative farmers will have to pass mandatory training about sustainable use of PPP-s and just with the certification buy and use pesticides. Also, regular control of equipment for PPP-s application is obligatory by accredited laboratories.

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Principles and methodology of risk analysis of aflatoxin M1 in milk: recent and present challenges

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Mycotoxins are toxic secondary metabolites produced by molds mainly belonging to genera Aspergillus, Penicillium, and Fusarium species, that can contaminate a variety of agricultural products, including milk. Aflatoxins, particularly aflatoxin M1 (AFM1), are among the most concerning mycotoxins in dairy products due to their potent carcinogenic properties. When animals consume feed contaminated with AFB1, it is metabolized in their liver and excreted in milk as AFM1. AFM1 is classified by the International Agency for Research on Cancer as a Group 1 carcin-

ogen. Long-term, exposure can lead to liver cancer and other chronic health issues. The presence of aflatoxin M1 in milk poses significant health risks, particularly in populations with high dairy consumption such as children. Due to the facts, different countries have set varying maximum allowable limits for AFM1 in milk. The European Union, has a stringent limit of 0.05 µg/L, while the existing legislation in Serbia allows up to 0,25 µg/L. Climate change poses a significant threat to food safety in Serbia, particularly concerning aflatoxin M1 residue in milk and dairy products since 2012 till now. Comprehensive risk assessment and management strategies are essential to mitigate these risks and ensure safety and quality of dairy products. A comprehensive risk assessment of AFM1 involves understanding its occurrence, exposure levels and health effects. Furthermore, risk ranking involves prioritizing the risks based on their potential impact on public health. Given its high toxicity and the potential for increased contamination due to climate change, AFM1 ranks high among food safety risks.

This article outlines the essential components and considerations for assessing and ranking the risk of AFM1 in milk, providing a foundation for developing effective risk management strategies, particularly in regions like Serbia where climate change may exacerbate contamination issues.

Keywords: Aflatoxin M1, milk, risk assessment, risk ranking, management strategies

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Mycotoxins: A threat to food chain from farm to consumer

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As natural and unavoidable contaminants of various food and feed products, mycotoxins have continued to severely affect human and animal health, leading to diseases known as mycotoxicosis. These toxic substances are mainly associated with the contamination of cereals, which can occur in the field before harvest and/or afterwards in warehouses and silos. The extent of contamination depends primarily on temperature and rainfall during cultivation and later on storage methods and conditions, including humidity, mould growth, ventilation, insect infestation, mechanical damage to the stored material and more. Climate change studies clearly show that a general increase in mycotoxins is to be expected, with levels varying widely across geographic and climatic regions, suggesting that environmental stress has a significant impact on mould-related mycotoxin formation. At the same time, regulations to minimise human exposure to mycotoxins result in high economic losses for producers, processors, traders and marketers of crops. Among the hundreds of mycotoxins discovered to date, the aflatoxins and ochratoxins pose a particular threat to food and feed safety, especially the most toxic aflatoxin B1 (AFB1) and ochratoxin A (OTA), as well as the Fusarium mycotoxins fumonisins (FUMs), zearalenone (ZEN), deoxynivalenol (DON) and T-2/HT-2 toxin (T-2/HT-2). Human exposure to mycotoxins usually occurs through ingestion, either directly through the consumption of contaminated food or indirectly through products of animal origin derived from animals that have been exposed to contaminated food during feeding (carry-over effects). Thus, it has been demonstrated that meat products, other than through naturally contaminated spice mixtures used in their production, can contribute to human ingestion of mycotoxins as they are contaminated with toxicogenic moulds that overgrow their surface during their long period of ripening and produce some mycotoxins, in particular OTA and AFB1. Evidence shows that the global occurrence of mycotoxins is almost inevitable and that every day these substances pose a greater threat to food safety, human health and animal productivity, as well as having a negative impact on national economies and international trade. Overall, future research aspects to protect consumer health should focus strongly on the occurrence of previous-

ly unknown mycotoxins in the different stages of food and feed production and storage, paying particular attention to climate change, the toxicity of unexplored mycotoxins and methods to prevent and reduce contamination, as well as studies on the cumulative and synergistic effects of these substances in the body.

Precision Agriculture Integrating Tools for Sustainable and High-Quality Food Production

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Precision agriculture (PA) revolutionizes modern farming by integrating advanced technologies to enhance efficiency, sustainability, and food quality. Tools such as remote sensing, GPS, GIS, soil and crop sensors, variable rate technology (VRT), automation, robotics, data analytics, and smart irrigation systems collectively optimize resource use and improve crop management.

Remote sensing and drones provide real-time data on crop health, soil conditions, and water usage through satellite imagery and aerial photography. This early detection capability enables timely interventions like pest control and disease management, crucial for maintaining crop health and yield. GPS and GIS create detailed field maps, facilitating precision planting, fertilizing, and harvesting. These technologies ensure accurate input application, minimizing waste and maximizing productivity. Soil and crop sensors offer insights into soil properties and crop conditions, informing decisions about nutrient application and irrigation. Real-time data collection enhances soil fertility and crop health. VRT refines input application by adjusting rates based on sensor and map data, ensuring efficient use of fertilizers and pesticides, reducing environmental impact, and improving crop uniformity and productivity. Automation and robotics bring precision and efficiency to farming operations. Autonomous machinery and robots perform tasks such as planting, weeding, and harvesting with high accuracy, reducing labor costs and human error. These technologies are especially beneficial in challenging conditions. Data analytics and machine learning analyze vast amounts of agricultural data, providing predictive insights to optimize farming practices and manage risks. These tools enhance decision-making and adaptability, increasing the resilience of farming systems. Smart irrigation systems with sensors and controllers optimize water use, ensuring precise delivery, conserving water, and improving crop quality. The synergistic benefits of these technologies create a holistic system that enhances sustainability, efficiency, resilience, and food quality. PA reduces resource usage, minimizes environmental footprint, and improves crop outcomes, ensuring food security and sustainability for future generations.

In conclusion, precision agriculture embodies a transformative approach to farming, combining advanced technologies to create a sustainable and efficient agricultural system. By adopting PA tools, farmers can achieve higher productivity, better environmental stewardship, and improved crop quality, addressing modern agricultural challenges and contributing to global food security.

Interactions of food, dietary supplements, herbal preparations with drugs: Definition, Significance, Nutrivigilance

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Progression in the fields of medicine and paramcaology have lead to the development of wide variety of medications for various disase ansd conditions. Drugs, by definition, are any chemicals that can affect living processes. Pharmacy studies drugs and their interactions with human body systems. Interactions between food and drugs can be inconsequential, but they can have a significant impact on a human health and the effectiveness of drugs.

Epidemiological calculations indicate that 2.% of hospitalizations are a direct consequence of drug interactions. Experts in the field of interactions of food, dietary supplements and drugs say that the stated prediction is lower than the real situation because cases of interactions are more often reported as side effects of drugs.

The terms drug-nutrient interaction and food drug-drug interaction are often used as professional synonyms. Drug-nutrient interactions include specific changes in drug activity caused by nutrient(s) or regulatory substance(s). Drug-nutrient interactions are part of the much broader field of food-drug interactions. Various beverages and alcoholic beverages can also interact with medications.

Food-drug interactions are a broader professional term that includes the influence of drugs on nutritional status. Side effects of drugs can affect nutritional status through effects on appetite, gastrointestinal tract, metabolic effects, effects on renal elimination abilities and other organ systems.

Drug-drug interactions are given enough professional attention, they are considered clinically significant and are included in the pharmacovigilance system, while food-drug interactions are not given enough research, nor enough time (hours) of education about food-drug interactions and the public health significance of interactions between food and medicine is not yet clearly defined. Nutrivigilance is defined as "the science and activities relating to the detection, assessment, understanding, and prevention of adverse effects related to the use of a food, dietary supplement, or medical food". Some European countries have adopted a nutrivigilance system to better protect consumer health.

The Italian Nutrivigilance System

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Food supplements, even if not marketed for therapeutic purposes, contain active substances that can be responsible for undesired effects. Despite the perception of these substances, particularly botanicals, as "natural" and therefore safe by a large part of the population, interactions between the individual components of a food supplement, with other food supplements or drugs can also cause adverse reactions. Since there is no mandatory evaluation before marketing, spontaneous reporting systems of suspected adverse reactions are the only tools for assessing the safety of food supplements. Thus, it is important to monitor adverse reactions through spontaneous reporting systems to assess risks and identify early warnings to provide regulatory bodies with supported scientific evidence.

Methods: In Italy, a system for collecting and analyzing spontaneous reports of suspected adverse reactions to food supplements was established in 2002 at the National Institute of Health (Istituto Superiore di Sanità). In 2012, the Ministry of Health, which in Italy is the regulatory body responsible for food supplements, recognized this system as an important source of information. Since 2018, online reporting has been made possible through a website called "Vigierbe," also accessible via mobile systems. This has simplified the reporting process.

Results: Up to May 2024 a total of 3450 reports were collected. 61% of reports are related to women. The median age is 48 years. 36% of reports were related to serious reactions that required hospitalization, and in 23% of these, at least one concomitant drug, was indicated. As for the system organ classification, gastrointestinal problems were at the first place, followed by liver injuries, in which the proportion of serious reaction was higher. The reason for use, when indicated on the reports, were weight loss, hypercholesterolemia, upper respiratory tract infections, mild psycological problems. The first step in the evaluation of reports is causality assessment, which considers several factors, as in all pharmacovigilance systems. We use for the assessment of causality a modified WHO scale.

Conclusions: The safety issues that emerged from the reports were related to quality, such as adulteration of some products, not allowed dosage of ingredients, contamination of the raw substance (plant), products purchased by the internet, interaction with drugs. Undereporting ("natural is safe") is certainly very high and a coordinated nutrivigilance system in Europe could be very useful for early identification of risk signals, through exchange of information, to support regulatory measures.

Clinically significant interactions of phytopreparations with drugs and food

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The use of phytopreparations is gaining significant global popularity due to perceived natural origin and acceptable profile of adverse effects. Moreover, the interactions occurring as a result of concurrent use of phytopreparations and conventional drugs and/or foods are often underestimated and rarely reported by patients. However, the available evidence-based data suggest that application of some of the most popular phytopreparations can lead to clinically significant adverse effects, especially in combination with conventional drugs. Namely, phytopreparations can interact with drugs through various pharmacokinetic and pharmacodynamic mechanisms. Pharmacokinetic interactions often involve alterations in drug absorption, distribution, metabolism, and excretion, while pharmacodynamic interactions involve synergistic, antagonistic, or additive effects on drug action. For instance, St. John's Wort is known to induce cytochrome P450 enzymes, ginkgo has antiplatelet properties that can potentiate the effects of anticoagulants, thus consequently increasing the risk of bleeding, herbs with anxiolytic effect cat enhance the sedative effects of central nervous system depressants, etc. If considering the population of Serbia, data suggest that phytopreparations are usually applied for treatment/co-treatment of urinary tract infections, hormonal disbalance, hypercholesterolemia, benign prostatic hyperplasia, chronic obstipation, liver failure treatment, mood disorders… The chronic nature of these conditions implies prolonged treatment with conventional drugs, as well as long usage of phytopreparations, which increases the risk of adverse effects. This underscores the importance of healthcare professionals being constantly educated on stated subject, as well as patients being informed on the significance of reporting the application of all used preparations during regular clinical exams.

Interactions of vitamin- and mineral-containing dietary supplements with medications

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Introduction: Vitamin- and mineral-containing supplements are usually the most frequently used dietary supplements among adults. Oftentimes, they are used concomitantly with medicines. Aim: The aim of this work was to summarize some of the most important interactions of vitamin- and mineral-containing dietary supplements with frequently used medications. Methods: The data on the interactions of interest were obtained from scientific literature databases (PubMed, Google Scholar, ScienceDirect) using theme-relevant search strings. Results: Vitamins in the interactions spotlight include vitamin D, folic acid, vitamins C, E and B12. Chronic use of corticosteroid drugs may require vitamin D supplementation as it decreases vitamin D serum concentrations. In addition, vitamin D supplementation may increase the rates of absorption of aluminium from aluminium-containing medicines raising the risk of aluminium toxicity. Folic acid supplements' kinetics may be altered by multiple medicines and vice versa. Medicines of interest in this case are some anticonvulsants (phenytoin, carbamazepine, valproic acid), antimetabolites (methotrexate) and pancreatic enzymes. Excessive intakes of vitamin C and E might decrease the efficacy of anticoagulant medicines. Vitamin C is hypothesized to interfere with the effects of some antineoplastics. Regardless of their mechanism of action, long-term use of medicines that increase the pH in the stomach (e.g. antacids, H2 blockers, proton-pump inhibitors) may negatively affect the pH-dependent absorption of vitamin B12 and therefore require supplemental vitamin B12. Among minerals, absorption of iron is susceptible to a decrease in absorption if administered together with pH-increasing medicines. In general, several minerals tend to affect the absorption of some medicines by chelation. Namely, calcium and magnesium supplements form complex salts with tetracyclines and fluoroquinolones, as well as bisphosphonates and possibly levothyroxine, decreasing their absorption and, consequently, their efficacy. Similarly, iron can bind tetracyclines, fluoroquinolones, levothyroxine, but also digoxin, levodopa and methyldopa interfering with their effects. Conclusion: Healthcare providers should hold adequate competencies to inform patients on the possibilities of vitamins and minerals from their supplements interacting with their prescribed medications and advise them on proper interactions-avoidance strategies. This can decrease the risks of patients being negatively affected by supplements-medicines interactions and, in turn, better their therapeutic outcomes.

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Medical nutritional therapy of diabetes

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Diabetes mellitus (DM), generally known as diabetes, is a chronic noncommunicable disease characterized by persistently high blood glucose levels due to inadequate insulin production or when the body fails to utilize the insulin when it is produced. Type 2 diabetes mellitus (T2DM) as the most common type is a major global health problem with a major impact on both economic and social aspects. The International Diabetes Federation estimated that nearly half a billion people worldwide live with diabetes, and nearly 80% of those live in low- and middle-income countries. This number is predicted to rise to 643 million by 2030 and 783 million by 2045. Over 3 in 4 adults with diabetes live in low- and middle-income countries. Diabetes is responsible for 6.7 million deaths in 2021 - 1 every 5 seconds. Since is often associated with obesity it is necessary to start Medical nutritional therapy (MNT) and lifestyle changes. It should be noted that obesity and T2DM are included as risk factors for metabolic syndrome. Medical nutritional therapy represents a set of measures and procedures aimed at treating diseases caused by improper nutrition and includes a multidisciplinary approach. MNT in patients with T2DM is created after assessing nutritional status, i.e. establishing a nutritional diagnosis, which defines specific nutritional problems, which can be solved or improved by adapted nutritional intervention. Generally, the aim being for an initial 5–10% weight loss. In relation to energy needs, a hypocaloric diet is determined, with obese patients deducting 500 to 1000 kCal. The general recommendations advises incorporating non-starchy vegetables, legumes, fresh fruits, whole grains, and low-fat dairy products while limiting processed foods, refined carbohydrates, added sugars, and trans-fat. In order to ensure the maintenance of body mass, it is necessary to adjust the diet individually based on energy needs and physical activity. Dosed and regular physical activity is a very important part of T2DM therapy. The MNT should adapt to each patient individually and regularly check the success of the therapy and the motivation of the patient. At the same time, it is necessary to constantly work on the education of both patients in order to treat and prevent complications of the disease, as well as the population in order to prevent diseases.

Impact of diabetes mellitus and nutrition on carotid endarterectomy outcomes

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Introduction: The aim of the present study was to investigate the impact of diabetes mellitus (DM) and nutrition on early and late carotid endarterectomy (CEA) outcomes. Methods: Cohort study comprised 1533 patients in whom 1597 CEAs were performed at the Clinic for Vascular Surgery in Belgrade, from 2012 to 2017. Patients were followed for 4 years after surgery. Patients with DM were considered those with a previous diagnosis of type 1 DM (T1DM) or type 2 DM (T2DM). Dietary data were obtained using specific questionnare, and diet score was created. The diet score consisted of 10 components selected based on available dietary data to represent usual intake and dietary habits. Components of the diet score were as follows: rhythm of meals, intake of diary products, fruits, vegetables, protein food, sweets and sugar-sweetened beverages, type of bread, type of fat for cooking, adding salt and frying. The association of diabetes mellitus and nutrition with early and late complications after CEAs were assessed by univariate and multivariate logistic

and Cox regression analyses. Results: Out of 1597 CEAs performed during the period observed, 126 were performed in patients with T1DM, 368 in those with T2DM and 1103 interventions were performed in patients without DM. T1DM was not associated with early adverse outcomes of CEA. Regarding the late adverse outcomes, patients with T1DM had myocardial infarction ($p<0.001$), death ($p<0.05$) and restenosis ($p<0.01$) more frequently. Patients with T2DM had more freaquently TIA/stroke ($p<0.10$), death ($p<0.05$), respiratory complications ($p<0.05$) and reoperations ($p<0.05$) as early adverse outcomes, as well as all late adverse outcomes except myocardial infarction. Dietary data were obtained for only 506 CEAs underwent in 484 patients, who were alive and could be contacted. Regarding the diet score, there were no significant differences between CEAs with and whithout early complications ($p=0.473$), as well as between those with and without major late complications ($p=0.424$) and restenosis ($p=0.229$). Conclusion: According to the results obtained, T1DM was not associated with an increased risk for early adverse outcomes of CEA, but increase the risk for some late adverse outcomes. T2DM increases risk for both early and late adverse outcomes of CEA. Nutrition is not significantly related to complications after CEAs, both early and late.

Nutritional status as an important indicator for dietary approaches in patients with chronic kidney disease

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The prevalence of chronic kidney disease is increasing, especially in the elderly. Chronic kidney disease can significantly influence a patient's nutritional status, leading to malnutrition, characterized by protein energy wasting and micronutrient deficiency. In patients with chronic kidney disease, nutritional status is directly connected with disease progression, longevity, quality of life, rate of hospitalization, medical cost and mortality. Multiple factors can affect nutritional status of patients with chronic kidney disease, including reduced dietary nutrient intake, inadequate dialysis, systemic inflammation, frequent hospitalization, multiple medications, comorbidities, uncontrolled anaemia, uremic toxins, gastroparesis, depression, low social status, solitude and an inability to prepare meal. Although protein energy wasting is a very common problem, it often remains undiagnosed and untreated, perhaps because there is no single measurement that can be used to determine the presence of protein energy wasting. Therefore, assessment of nutritional status of patients with chronic kidney disease should include a number of assessment tools including history and physical examination, dietary assessment, anthropometry, subjective global assessment and some biochemical examinations that correlate with nutritional status. Dietary modifications help in prevention and treatment of protein energy wasting, mineral abnormalities and electrolyte imbalances. Modifications started in the early stages of chronic kidney disease may slow the progression of disease, while in later stages, this may delay the need for renal replacement therapy. Thus, nutritional treatment has equal, if not more, importance compared to other medical therapy. The nutritional status of patient with chronic kidney disease should be reassessed every 3–6 months and the dietary regimen should be modified according to changes in patient preferences and clinical status. Early identification of patients at high nutritional risk through a periodic monitoring of nutritional status, as well as the implementation of a nutritional intervention programs, are essential for improving outcomes and quality of life in this population.

Diabetes in children and adolescents - importance of monitoring diet habits and physical activity for evidence based prevention

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Diabetes is one of the leading chronic diseases worldwide, posing serious public health challenges especially having in mind an increase in prevalence over the years. It is the most common metabolic disease in children in youth. In Serbia, approximately 600,000 people or 8.1% of the population suffer from diabetes. Increase in newly diagnosed cases of diabetes is evident in the 10-14 age group, indicating probable influence of environmental and behavioural factors triggering onset of disease in susceptible individuals. Diet and physical activity are well-known factors that influence metabolic response. Eating habits are of particular importance not only because of their direct impact on growth and development in children and adolescents, but also because once established tend to be maintained and have a crucial impact on health in adulthood. Despite widespread acknowledgement of the health benefits of physical activity (PA), the majority of children and adolescents do not meet recommendations for daily PA level. Young people spend approximately 60% of their waking time sitting.

The aim was to provide an outline of diet, diet-related behaviours as well as physical activity and leisure time activities in children and adolescents in Serbia using the data from available surveys (the National Health Interview Survey and Health Behaviour in School-aged Children Survey, HBSC).

According to the National Health Survey in Serbia from 2019, 12,9% of children aged 5-14 years were either overweight or obese, while HBSC results from 2022 showed that among 11, 13 and 15 year olds 24,8% of boys and 13,8% of girls were either overweight or obese. Although the majority of young people eat breakfast daily, every tenth girl aged 15 years never ate breakfast during the working week. Less than half of adolescents ate either fruit or vegetable daily (39,6% fruit, 39,7%). More than one third of adolescents eat sweets and drink soft drinks at least once a day. At the same time both surveys showed that less than a third of the adolescents meet recommended one hour of physical activity daily.

Adoption of a healthy lifestyle early in life and its maintenance during the life course, represent the cornerstone of chronic disease prevention. Surveys are needed not only to identify health risks but also to better understand the context in which they occur, allowing for evidence-based health promotion and prevention.

Keywords: diabetes, nutrition, physical activity, health promotion, adolescents

Optimal nutrition to support the immune system with aging

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The immune system is key to host defense against pathogenic organisms (harmful bacteria, viruses etc.). The system includes many different cell types and chemical mediators that circulate in the bloodstream and are dispersed in tissues. It includes barrier functions, the ability to recognise microbes and identify them as harmful or not, the capability to eliminate harmful microbes, and the development of memory of immunological encounters. Aging is associated with changes in the immune system, with a decline in protective many components (this is termed immunosenescence), increasing susceptibility to infectious disease, and a chronic elevation in low-grade inflammation (termed inflammaging), increasing the risk of multiple noncommunicable diseases. Nutrition is an important determinant of immune cell function and of the gut microbiota. In turn, the gut microbiota shapes and controls the immune and inflammatory responses. Many older people show changes in the gut microbiota as well as in the immune system. Age-related changes in immune competence, low-grade inflammation, and gut dysbiosis may be interlinked and may relate, at least in part, to age-related changes in nutrition. A number of micronutrients (vitamins C, D, and E and zinc and selenium) play vital roles in supporting the function of many immune cell types. Some trials report that providing these micronutrients as individual supplements can reverse immune deficits in older people and/or in those with insufficient intakes. There is some evidence that this will reduce the risk or severity of infections including respiratory infections, although the evidence is inconsistent. Other essential and non-essential nutrients are also important in supporting immunity including a number of amino acids and fatty acids. Probiotics, prebiotics or synbiotics that modulate the gut microbiota, especially by promoting the colonization of lactobacilli and bifidobacteria, have been demonstrated to modulate some immune and inflammatory biomarkers in older people and, in some cases, to reduce the risk and severity of gastrointestinal and respiratory infections, although, again, the evidence is inconsistent.

Keywords: Immunity, Infection, Ageing, Nutrition, Microbiota

Omega-3 Fatty Acids, Inflammation and Immunity

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Omega-3 fatty acids, especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), play a significant role in regulating inflammation and supporting the immune system. EPA and DHA are known for their anti-inflammatory properties, decreasing the production of arachidonic acid (AA)-derived eicosanoids and other inflammatory markers, including various cytokines and chemokines, acute-phase proteins, and adhesion molecules. EPA and DHA are also precursors for the synthesis of novel specialized pro-resolving mediators (SPMs), i.e, resolvins, protectins and maresins, which help resolve inflammation. SPMs synthesized from DHA include D-series resolvins, protectins, and maresins, while E-series resolvins are synthesized from EPA. SPMs are produced through pathways that involve cyclooxygenase (COX) and lipoxygenase (LOX) enzymes. These pathways use the enzymes involved in the pathways of synthesis of eicosanoids. Chronic inflammation has been long recognized to play an important role in diseases such as rheumatoid arthritis, cardiovascular disease, and metabolic disorders, and omega-3s help to dampen this persistent low-grade inflammation. Additionally, they influence various aspects of the immune response,

from inflammation control to the regulation of immune cells. EPA and DHA regulate the activity of T-cells (which manage immune responses) and B-cells (which produce antibodies). By balancing the activity of these cells, omega-3s prevent overactive immune responses, reducing the risk of autoimmune reactions while still allowing the body to fight off infections properly. Omega-3s may improve the body's response to infections by enhancing the function of macrophages and neutrophils, which are essential for fighting pathogens. In autoimmune diseases like rheumatoid arthritis and multiple sclerosis, omega-3s seem to reduce disease activity by lowering the production of pro-inflammatory immune mediators.

Omega-3 fatty acids offer the dual benefit of reducing harmful inflammation while enhancing immune function. This makes them valuable in managing conditions from cardiovascular disease to autoimmune disorders and infections.

Keywords: omega-3 fatty acids, anti-inflammatory response, immune homeostasis

Physical Activity and Immune Response

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The topic of sports nutrition has received considerable attention over the past few decades, and it is likely to get even more attention, considering that nutrition plays an important and even crucial role in an athlete's performance. To fulfill athletes´ nutrition needs, different from non-exercising individuals, well balanced nutrition is crucial. Poor nutrition is associated with worse stamina and less strength, and some other unwanted outcomes. Foremost, adequate energy intake must be fulfilled to achieve exercise goals; then appropriate intake of macro- and micronutrients is required, taking into account that athletes´ demands are often higher. On the other hand, intense physical activity can contribute to decrease of immune response. This relationship is well documented through the so called J-curve that reflects the increase of upper respiratory tract infections (URTI), especially during athletes´ winter season. Factors of mucosal immunity, such as absolute concentration and rate of secretion of salivary IgA (sIgA) antibodies, are the only immunological parameters that show a consistent relationship with the risk of URTI in the athletes´ population. Recent research gave more light on increased post-exercise number of circulating regulatory T cells (Treg), whose secretion of interleukin-10 (IL-10) and transforming growth factor beta 1 (TGF-b1) can influence Th1 immune response. Beside this, acute bouts of strenuous exercise might also lead to the disturbance of other cellular and humoral aspects of immunity, such as proliferation of T lymphocytes and the kinetics of specific immunoglobulin production. Also, prolonged period of intense physical exercise might cause a chronic immune depression and even lead to clinical manifestations. One of the premises is that appropriate nutrition interventions could lessen the number of respiratory infections, as well as their duration. Nutrition interventions comprise better balancing of nutrients, as well as dietary supplementation. Among various well documented bioactives, probiotics have proven promising in promoting athletes´ immune response.

Keywords: sports nutrition; athlete´s performance; immune response

Gut microbiome-mediated mechanisms in aging-related, metabolic and neurodegenerative diseases

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There has been an epidemic of various non-communicable degenerative and autoimmune diseases, strongly associated with gut microbiota. Gut microbiota composed of trillions of microorganisms emerged as an important player in functioning of the gut and other distant organs. The research on gut microbiota-host cross-talk has been greatly improved due to development of molecular high-throughput 'omics' techniques coupled with bioinformatics and data science. The change in gut microbiota diversity, so-called dysbiosis, mainly results in the alteration of the composition and concentration of microbial-derived metabolites (MDMs), while a systemic decline of MDMs have been linked to numerous diseases suggesting their involvement in microbiota-host interaction. The Western type diet characterized by high daily intake of saturated fats and refined carbohydrates leads to disturbance in gut microbiota and prolonged low-grade inflammation, linked with cognitive impairment, emotional disorders and dementia, diabetes, and accelerated ageing. So, preventing the occurrence of these diseases through innovative "healthy aging" solutions is essential. After more than 30 years of deep scientific research we have carefully selected natural isolates of lactic acid bacteria from artisanal dairy products with probiotic features and combined them in starter cultures for production of innovative added-value dairy products.

The probiotics present in our starter cultures exhibit excellent antioxidant activity, have exceptional anti-inflammatory effects, strengthen the epithelial intestinal barrier, upregulate the tight junctions between the epithelial intestinal cells preventing the passage of harmful substances from the intestine to other organs, stimulate cell autophagy, activate the antimicrobial defense, have antidiabetic effects (by specific immunomodulatory activity and lowering the blood level of fasting plasma glucose and HbA1c) and extend the lifespan of C. elegans animal model which represent an internationally scientifically recognized model system for the aging studies. The most recently, we have isolated and characterized 141 novel gut bacteria as candidates for Next Generation Probiotics, belonging to Dorea sp., Blautia sp., Bacteroides sp., Roseburia sp., Sellimonas sp., Faecalicatena sp., Phascolarctobacterium faecium, and Faecalimonas sp. among others. The most prominent candidates with ability to upregulate expression of genes involved in neurotransmission are further tested in EAE (an animal model for MS) and CUMS depression model. The specific MDMs have been identified as potential neuro- and psychobiotics.

Role of nutritional status assessment in the framework of 4P medicine "Personalized, Predictive, Preventive and Participatory"

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Public health recommendations for lifestyle modification, including diet and physical activity, have been widely disseminated for the prevention and treatment of diseases. At present, the guidelines are still intended for the overall population without significant consideration for specific individual characteristics. In recent years, there have been innovative changes in nutrition services through a convergence with information and communication technology (ICT) and a shift of the healthcare environment from a service focused on medical treatment to a preventive and personalized intervention.

Therefore, a medicine centered on Personalization, Prediction, Prevention, and Participation (4P medicine) in nutrition sciences will allow to personalize the diet therapies based on the individuality of the subjects/patients. Personalized nutrition refers to tailored nutritional recommendations aimed at the promotion, maintenance of health and prevention of diseases, where we can adapt dietary aspects, including food choices, cooking recipes, and daily nutrition. Prediction in nutrition allows to identification of individual risks of developing a disease as a function of the genetic profile. Participation empowers the individual to participate in overseeing his own health. The assessment of nutritional status plays an important role not only in monitoring the health of people, but also in the prevention and monitoring of nutrition-related conditions, at both individual levels (clinical practice) and among populations (epidemiologic and public health research). In the era of digitalization, nutrition assessments can be supported by ICT in order to build personalized nutrition treatment, considering both individual and environmental characteristics, all elements essential for disease prevention.

Keywords: Nutritional status, personalized nutrition

Study of lifestyle habits among young adults in Albania: focus on chronic diseases prevention

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Background: Chronic diseases represent a major public health concern nowadays. It is already known that lifestyle habits have a significant impact on the chronic disease development.

Objectives: The objective of this study was to evaluate lifestyle habits in young Albanian adults and the prevalence of diseases in their family, in order to early detect and prevent chronic diseases development. Methods: Albanian young adults attending mainly the University of Medicine, Tirana were interviewed through an online structured questionnaire divided in three parts: demographic data, chronic diseases among their families and data related to their lifestyle habits. The survey was conducted during August and September 2023. Results: 160 students in medical fields (male-female ratio 28:72; aged 20-24 years) fulfilled the questionnaire. They live mostly in urban areas (mostly in Tirana). The main chronic diseases or causes of death reported for grandparents were: cardiovascular diseases (47%), tumors (28%), and diabetes (17%); some had multimorbidity.

49% of the parents use tobacco (started at the age of 18-20 years), and 48.4% had a chronic disease on treatment. Among the interviewed, 19% were smokers (started mostly at the age of 18 years); 30% practiced physical activity regularly (3-5 hours/week). Concerning good eating habits 89.4% consumed regularly 2-4 meals per day; 97.5% consumed regularly fruits (≥5 portions/week); 90.5% consumed less than 3 portions/week of sweets; 87.3 % used olive oil as the principal oil in their diet. A quite high number of people (20%) reported having a food intolerance. Conclusion: The lifestyle habits of the sample of university students have shown to be quite good, especially in diet and physical activities. More education should be provided for quit smoking. However, we acknowledge the need to enhance nutrition education in young adults since they come from families with a high prevalence of chronic diseases.

Keywords: young adults , lifestyle habits, nutrition

Perceived obesity and nutrition among people with Diabetes

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Introduction: Diabetes Mellitus (DM) is a metabolic disease characterized by inappropriately high levels of glucose in the blood. According to the IDF, in 2021, the prevalence of diabetes in the Albanian population was estimated at 10.2%, placing the country third in Europe for diabetes prevalence. The global increase in obesity prevalence has led to a concomitant rise in the prevalence of type 2 diabetes.

Screening for diabetes is recommended for all patients with obesity, and treating obesity is important in the prevention and management of type 2 diabetes. Weight reduction leads to prevention, control, and, in some cases, remission of diabetes.Self-perception of weight is crucial in promoting weight loss. Underestimating weight status can result in challenges in promoting weight loss and managing the glycemic profile.

Objectives: The aim of our study is to assess the perception of obesity in the diabetic population in Tirana.

Methods: Using a cross-sectional design, anthropometric and clinical variables were assessed. We evaluated the perception of obesity through a questionnaire, asking people with diabetes how they perceive themselves in terms of obesity, overweight, or normal weight. The participants (200) were divided into two groups: one consisting of people diagnosed with type 2 diabetes and the other consisting of people without diabetes. Other data related to risk factors, glycemic, and lipid profiles were assessed.

Results: The mean BMI in the diabetic population was 29.8 kg/m^2, while in the non-diabetic population it was 30.9 kg/m^2. In the diabetic population, there was a notable distortion in the self-perception of weight status, particularly among individuals classified as obese. Only 33% of individuals accurately perceived themselves regarding body status in this group, compared to 50% in the non-diabetic population. The two most common comorbidities were found to be dyslipidemia and hypertension. In the diabetic population, dyslipidemia was undertreated and mistreated, which resulted in an increase in chance of cardiovascular incidents.

Conclusion: We found a substantial discordance between BMI-measured and self-perceived weight status. Factors that wereassociated with underestimation of weight status were being; overweight/obese, not married and never tried to lose weight.Diabetes patients should be provided with information about weight guidelines.

Lifestyle, nutritional status, body composition and Vitamin D in young adults

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Background: Nutrition plays a critical role in maintaining the health and well-being of individuals. Therefore, nutritional assessment, in early adulthood, is crucial for the prevention of numerous chronic diseases. During the last recent years, significant breakthroughs and discoveries have been made in vitamin D research. However, research measuring vitamin D levels in young adults is still limited.

Objectives: This study aimed to evaluate the nutritional status of university students in Albania, their eating habits and lifestyles, with a particular focus on vitamin D values. Methods: A cross-sectional analysis was conducted through a Google form questionnaire (May-June 2024) on students attending medical and pharmacy sciences (Italian and Albanian) courses at the University "Our Lady of Good Counsel" (Tirane, Albania). Information included: lifestyle and dietary habits (PREDIMED score), anthropometric data (weight, height, BMI, body composition, such as fat mass (FM), serum level of vitamin D. Results: a sample of 118 students (68.6% females) filled the questionnaire. The mean age was 22 years. As regards anthropometric measures, despite the mean BMI showing normal values (22.5 ± 3.5 SD), the analysis of body composition revealed nearly 23% of the sample having FM<15% and more than 38% having FM>30%. The PREDIMED results showed most of the sample (over 90%) having a good/high adherence to the Mediterranean Diet (MD). The mean vitamin D level was 30.6 ± 19.5 SD, with more than 63% of the sample having low and very low values (<30 mg/dl). Conclusion: Despite showing a normal BMI and reporting good adherence to the MD, we detected a high level of malnutrition (either under or over). Furthermore, our sample reported very low values of Vitamin D, quite worrying in a young adult population. Therefore, causes at the root level of these conditions should be better investigated in future studies. Results: Eleven observational studies with a total of 2 503 participants were included in this systematic review. The qualitative synthesis revealed a possible association between recurrent tonsillopharyngitis and vitamin D deficiency. All studies, except one study, demonstrated a statistically significant association between the two conditions. As per our quality appraisal, all papers were deemed to be of moderate or good quality. Conclusion: This study shows a potential association between vitamin D deficiency and the development of recurrent tonsillopharyngitis. Future studies should not only investigate this association in a more comprehensive manner but also assess the prevention potential of vitamin D supplementation on tonsillopharyngitis pathogenesis.

Keywords: nutritional status, vit D, young adults

Health risk associated with biogenic amines exposure through fermented soy food

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Fermented soy food, as any other fermented food, is of particular concern in relation to contamination with biogenic amines, chemical hazards formed as a consequence of microbial activity. Among them, histamine and tyramine cause special concern due to their adverse effects on neurological and cardiovascular systems, and therefore they were in the focus of this risk assessment study. A search of Serbian market resulted with 28 fermented soy products (sauces, meat and dairy substitutes, tofu and miso), whose biogenic amine profiles were obtained by high-performance liquid chromatography. The corresponding dietary intakes of histamine and tyramine, calculated based on national food consumption data (mean and high consumption level), were further used for the assessment of the acute risk in different population groups (consumers only), considering gender differences.

In this study, only dairy substitutes were free of histamine and tyramine. Histamine was found in 11 samples, most frequently soy sauces, followed by tofu, meat substitutes and miso, while tyramine occurred more frequently (18 samples). Regarding the probability of adverse effects in healthy people, which could tolerate up to 50mg of histamine and 600mg of tyramine in one or daily dose, the highest exposure to histamine, recorded for vegetarians, would correspond to 13 and 37% of the threshold in case of females and 21 and 54% in case of males, at mean and high consumption level, respectively, while tyramine exposure was below 10% for all. Related to tyramine sensitivity of patients taking inhibitors of monoamine oxidase (MA(O), an enzyme that breaks down excess tyramine in the body), threshold dose related to those taking R(eversible) IMA drugs (50mg) was exceeded only in case of one sauce consumed in high quantity by male vegetarians. For those taking classic MAOI drugs (6mg), multiple sauce samples caused excessive exposure of vegetarians and general adult population at both mean and high consumption levels, and additionally for high-consuming pregnant women. Furthermore, one meat substitute sample was responsible for too high exposure of all adult groups (including elderly), at both mean and high consumption level, along with two tofu samples consumed in high amounts by vegetarians of both sexes. As mere presence of histamine poses serious risk for individuals with histamine intolerance, they shall be very careful about fermented food. For those on MAOI therapy, portion reduction of fermented foods and caution in their combining could help to mitigate the risk of adverse health effects, along with food producers efforts.

The French Paradox in Serbia: A Decade of Research on the Polyphenol Profile and Biological Activity of Serbian Wines

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There is substantial evidence supporting the health benefits of moderate wine consumption, often referenced through the term "French paradox." This term is based on epidemiological data from the French population, which exhibits a low incidence of coronary heart disease (CHD)

despite a diet high in saturated fats. This phenomenon has been positively correlated with the polyphenolic constituents of wine.

Herein, we present a segment of the results from an extensive investigation regarding the polyphenolic profile and in vitro biological activities of Serbian (SRB) other European (EU) red wines. We will summarize the results on chemical characteristics (polyphenolic profile by HPLC-UV/VIS analysis) and in vitro biological activity (biochemical and cell-based assays related to enzyme inhibitory, antioxidant, and anti-inflammatory activities) of more than 50 samples, including Merlot, Cabernet Sauvignon, Dionis, and Cabernet Franc varietal wines, with particular focus on positioning Serbian samples relative to European counterparts. HPLC-UV/VIS analysis considered the presence of 22 common polyphenols in red wines, including 9 phenolic acids (benzoic, caffeic, chlorogenic, gallic, 4-hydroxybenzoic, p-coumaric, syringic, trans-cinnamic and vanillic acid), 6 flavonoids (catechin, hesperetin, kaempferol, naringenin, quercetin, rutin), 2 stilbenes (resveratrol, rutin), and 5 anthocyanins (malvidin 3-O-glucoside, cyanidin 3-O-glucoside, delphinidin 3-O-glucoside, petunidin 3-O-glucoside, and peonidin 3-O-glucoside). In general, the most abundant polyphenols in all examined wines were gallic acid (mean concentration in Serbian wines: 42.00 ± 18.86 mg/L; in European wines: 47.04 ± 32.85 mg/L) and catechin (Serbian wines: 23.74 ± 12.79 mg/L; European wines: 26.28 ± 8.75 mg/L), while malvidin 3-O-glucoside was the leading anthocyanin (Serbian wines: 22.61 ± 21.63 mg/L; European wines: 16.29 ± 15.19 mg/L). The stilbene resveratrol was also detected, but in lower amounts (Serbian wines: 1.11 ± 1.17 mg/L; European wines: 1.41 ± 1.00 mg/L). Although Principal Components Analysis (PCA) revealed partial grouping of the samples, there were no statistically significant differences in the content of major compounds.

All samples demonstrated inhibitory effects on α-amylase, α-glucosidase, and lipase activities (local effects), with some variations observed between Serbian and European wines. Antioxidant activity results (inhibition of lipid oxidation and AAPH-induced ROS generation in U937 cells), showed varying levels of activity among the wines. Certain samples inhibited prostaglandin E2 and thromboxane A2 production. No significant correlation was found between dominant compound amounts and biological activity. Our ongoing research focuses on elucidating the mechanisms of anti-inflammatory activity of polyphenol metabolites, which act as active principles in vivo and can exhibit systemic effects.

Population dietary intake of soy isoflavones and associated health benefits (Serbia and Republic of Srpska)

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There is an increasing interest of consumers and researchers into the role of soy isoflavones in health maintenance and prolonging productive quality of life. The purpose of this study was to estimate dietary intake of soy isoflavones in population of the Republic of Serbia and Republic of Srpska, identify the main food contributors and evaluate the capacity of dietary isoflavones to exert health benefits in terms of protective effects against menopausal symptoms, osteoporosis and cardiovascular diseases. A total of 94 soy-based foods was collected from the market and subjected to analysis by high-performance liquid chromatography. Obtained concentration of isoflavones were combined with the national food consumption data in order to estimate the intake in different population groups, considering consumers only and all population as well as gender differences. The isoflavones intake, expressed as total aglycone equivalents (mg/day), in Serbia was the highest among vegetarians, with intake of 119 and 156mg/day in female and male consumers, respectively. On the level of all population, intake was much lower, around 8 mg/day. Population of adults was the next one in the order of intake, with 56.5-58.2 and 0.41-0.26mg/day

(female-male, consumers only and all population, respectively). Results for elderly people were close to the ones for adults, while pregnant women showed by far the lowest intake. Regarding the regional differences, approximately 3.5-fold lower intake (16 mg/day) was observed in adult consumers in Republic of Srpska, but on the level of all population (around 0.3mg/day) the intakes were very similar. Soy-based foods that contribute the most to isoflavone intake in Serbian population were flour, soybean and tofu in vegetarians and soyabean-based meat substitutes, soybean and flour in adults, while adults in the Republic of Srpska ingested isoflavones mainly through dairy substitutes, flour and soy sauce. With respect to health benefits associated with soy isoflavones, the most favorable were expectations for vegetarian consumers in Serbia, fully supporting relief of menopausal symptoms (intake over 70mg/day) and protective effect against osteoporosis in women (intake over 90mg/day) as well as cardioprotective effect (intake over 90mg/day, women/men). For adult consumers, the contribution to the intake estimated to be beneficial was 80 and 63% for menopausal symptoms and osteoporosis in women, respectively, and slightly above 60% for cardioprotective effects. As the extent of benefits corresponds directly to the intake level, adult consumers in the Republic of Srpska could expect much less benefit compared to the ones in Serbian population.

Regulatory validity of health claims on omega-3 fatty acid food supplements

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When labeling, advertising, and presenting food supplements, mandatory information, such as the origin of the raw materials, usage instructions, warnings, etc., must be provided. On the other hand, use of health claims (HC) is voluntary, providing that they are accurate and comply with the list of approved HC. Is that always the case? This study aimed to evaluate regulatory validity of health claims listed on the labels of omega-3 fatty acid (omega-3-FA) supplements. Among 97 supplements collected on the market of the Republic of Serbia and Republic of Srpska (produced in 23 countries), 10 had no verbal HC or featured single-word suggestions (e.g., power), while 11 had HC referring to the entire product, which is not in compliance with regulations. Most supplements contained only one HC (24), followed by those with two to six (50), but two stood out with 15 and 17 HC. Among 76 supplements bearing HC, 68 listed HC related to omega-3-FA, of which 59 carried authorized HC, evenly represented on the supplements presenting one (31) or multiple claims (28), totaling 107 HC. The remaining 9 supplements had claims not aligned with regulations. Regarding the type of omega-3-FA, 43 supplements had HC related to both docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), 32 to DHA alone, two for alpha-linolenic acid (ALA), while 4 had general omega-3-FA HC. The justification for a supplement to carry HC was assessed based on the labelled omega-3-FA content and the recommended intake pattern, enabling calculation of omega-3-FA daily intake which was further compared to the intake requirements for foods bearing HC related to omega-3-FA. Such evaluation supported 91 of presented HC. Five HC were deemed unjustified due to the lack of capacity to provide required amount of omega-3-FA, while for 11 HC the data were lacking. Unjustified claims related to the impact of DHA+EPA on blood pressure regulation (2) and DHA+EPA or DHA on triglycerides (3). The supplements also included HC related to minerals (17, all authorized; Zn, Ca, Fe, I) and vitamins (total 73/9 unauthorized): vitamin D (26/1), E (20/3), A (9/1), B group (23/4), and C (4). Two supplements carried HC related to plants (Ginkgo biloba, Evening Primrose) from the so-called on-hold HC list.

Study findings indicate the necessity of increased efficiency of supplement labelling control during the process of registration for market release in order to prevent misuse of information and violation of consumer trust.

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Are culinary herbs and spices always pure herbs and spices?

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This is one of the questions that arises in light of the increased awareness of the tremendous importance of the safety of our food environment for quality of our lives. Added to meals to enhance their colour and aroma, herbs and spices could unintentionally become a vehicle for the introduction of numerous hazards in our diets. To manage such risks, we need to determine which hazards are present in which spices? Rapid Alert System for Food and Feed (RASFF) records are of great value for the assessment of the probability of the occurrence of various hazards in foods. The current study aimed to reveal several aspects of the safety of herbs and spices, such as risks associated with organic production, climate conditions, carcinogenic substances, allergens, co-occurring hazards, origin countries, etc.

A search of the RASFF database for product category "herbs and spices" for the period 2011 – 2023 resulted in 2,547 notifications, with the highest number reported in the last three years (38.0%). Distribution of risk decisions showed a serious proportion of serious risks (65.2%), the majority of which were attributed to pathogenic microorganisms (648), followed by mycotoxins (468) and pesticide residues (248), while other hazard categories were substantially less represented (natural toxins >> allergens > food additives > environmental pollutants). Prevalently reported carcinogenic hazards were aflatoxins, but also pyrrolizidine alkaloids and residues of carcinogenic pesticides. Co-occurrence of carcinogens was recorded in 85 cases, of which 63 involved the presence of residues of up to five possible carcinogenic pesticides, two were related to mixture of proven and probable carcinogens, and 20 were combinations of probable and possible carcinogens. Regarding organic herbs and spices, presence of pesticide residues revealed violation of organic production practices. On the other hand, due to the exclusion of fungicidal pesticides, organic products were found to be prone to mycotoxin contamination, distinctly linked to climate conditions. Although allergens, in contrast to typical food contaminants, must be clearly marked on the products' labels, records showed 78 cases where allergens were hidden in herbs and spices. The highest overall incidence of contamination was recorded for paprika (mostly originating from India), followed by pepper (Brazil), spice mixes (India), nutmeg (Indonesia), curry (India), etc.

Thanks to the functioning of the RASFF, numerous food safety risks have been averted before they could harm consumers. Moreover, obtained data are of great value for the trend analyses, enabling better effectiveness of food safety systems.

Effects of supplementation with plant origin superoxide dismutase in a population of athletes

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Background: Strenuous exercise is one of the well-known causes of oxidative stress which is connected with inflammation, muscle damage, and fatigue. Therefore, the use of antioxidant supplements in sport is common. Enzymatic antioxidants are new kinds of supplements with potent protective effects. The aim of this study was to compare results from our study with data from the published research (Skarpanska-Stejnborn A, et al., 2011) in order to evaluate the effects of supplementation with superoxide dismutase of plant origin in a population of athletes. Material and methods: In our study serum samples of the professional rowers were used (N=28), and compared with the result of the Polish rowing team (N=19). Analyzed biochemical parameters were creatine kinase (CK), lactate dehydrogenase (LDH), total antioxidant capacity (TAC) using spectrophotometry, C-reactive protein (CRP) using immunoturbidimetry, and glutathione peroxidase (GPx), superoxide dismutase (SOD), interleukine-6 (IL-6, measured only in our study) using commercially available kits. Effects of oral supplementation with Cucumis melo extract reach in SOD coupled with wheat gliadin were measured during 6 weeks supplementation period. The experimental groups received 500 mg (1 mg=1 IU SOD) of vegetable SOD once daily, control groups received a placebo. All participants were tested on a rowing ergometer using an increasing interval step test protocol and a 2,000-m maximum-effort test until exhauster as a very intensive training that causes metabolic and oxidative stress in athletes. Results: After the supplementation period muscle damage parameter CK was significantly lower in supplemented group in our study ($p=0.049$), while LDH shift did not reach significance same as in study with Polish rowers. Total antioxidant capacity was the same in both groups of rowers during these two studies. However, a higher level of SOD ($p=0.0037$) was measured in the Polish rowers team same as in our study ($p<0.001$) while the level of GPx has not changed markedly. The parameter of inflammation, CRP, was lower in the experimental group in the study with Polish rowers ($p<0.001$), while in our study IL-6 was lower in a supplemented group of rowers ($p=0.035$).

Conclusion: Results of this investigation indicate that SOD of plant origin combined with wheat gliadin is a very promising antioxidant supplement that can decrease the side effects of exercise-related oxidative stress. Supplementation had anti-inflammation, antioxidant, and muscle-protective effects in a group of well-trained athletes. Further studies should be conducted to confirm these effects with encouragement to use a similar group of athletes and study protocol for better collating of the results.

Keywords: superoxide dismutase, athletes, supplementation, oxidative stress

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The influence of N-acetyl cysteine and propolis supplementation on the parameters of oxidative stress in people with chronic obstructive pulmonary disease

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Objective: The aim of this study was to determine the antioxydant status of COPD patients before and after supplementation with either N-acetyl cysteine (NAC) alone or with NAC in combination with propolis (NACP)

Patients and methods: Patient with a diagnosis of COPD in exacerbation phase were randomly divided into two groups of 20 subjects each and supplemented with NAC (600mg) or NACP (600+80mg) twice daily for a month. Among the parameters of oxidative stress, the level of superoxide anion (O2.-), advanced oxidation protein products (AOPP), malondialdehide (MDA) concentration and total oxidative status (TOS) were determined. As a measure of antioxidant protection, the activity of the superoxide dismutase (SOD), paraoxonaze 1 (PON1), concentration of total sulfhydryl groups (SHG) and total antioxidant status (TAS) were determined. By examining the prooxidative-antioxidant balance (PAB) the load of prooxidatives and the capacity of antioxidants were measured.

Results: After supplementation significantly higher SHG [0.446 (0.395-0.516) vs. 0.292 (0.270-0.325), $p<0.001$] and significantly lower TOS [50.6 (49.7-53.4) vs. 73.2 (50.9-84.6), $p<0.05$] were found in the NACP group compared to NAC group.

Conclusions: Treatment with NACP was more successful than with NAC. The inclusion of a combination of propolis and NAC in the therapy for COPD patients in the exacerbation phase could be useful.

Keywords: COPD, exacerbation, NAC, propolis

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Chemical composition and in vitro biological activities of Lycium fruits cultivated in Serbia

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Lycium fruits, produced by perennial plants from the Solanaceae family, are promoted under the common name goji berries or wolfberries. Within this genus, L. barbarum and L. ruthenicum, are the most extensively researched species, characterized by their unique morphological traits, such as differences in fruit shape, color, taste, and bioactive compound profile. While goji berries are mainly cultivated in the northwestern regions of China, recent studies suggest that they are increasingly cultivated in European countries, including Serbia, where they are recognized as a "superfood" due to their rich composition and potential health benefits.

The aim of this study is to conduct a comparative analysis of the nutritional value and chemical composition of red (L. barbarum L.), yellow (L. barbarum var. aurauticarpum), and black (L. ruthenicum Murr.) goji fruits cultivated in Serbia. Furthermore, in vitro assessments of antioxidant (ABTS, FRAP, CUPRAC, DPPH, and β-carotene bleaching assays), antienzymatic (against α-amylase, α-glucosidase, acetylcholinesterase, and tyrosinase) and antimicrobial (against eight control strains) potential of methanol extracts from these goji fruits were presented.

The results show significant differences between the Lycium species, although they share common characteristics such as a low energy value and a favorable ratio of soluble to insoluble dietary fiber and polyunsaturated to saturated fatty acids. Phytochemical analysis confirmed the presence of various bioactive compounds, including polysaccharides, carotenoids, and polyphenols, with rutin, chlorogenic, and gallic acids being the predominant constituents contributing to their nutritional profile. Specifically, anthocyanins were dominant for black, carotenoids for red, and flavonoids for yellow goji berries. These phytochemicals have been linked to various biological activities and health-promoting effects. A link has been established between total phenolic content and antioxidant activity, flavonoids and antimicrobial properties, and polysaccharides with the inhibition of enzymes involved in diseases such as diabetes, Alzheimer's, and hyperpigmentation.

These bioactive effects emphasize the potential of goji fruits cultivated in Serbia for various industrial applications, including the food, pharmaceutical, and cosmetic sectors, and thus encourage the expansion of their cultivation and utilization.

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New insights into biomarkers for monitoring the efficacy of probiotics in obesity treatment

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Obesity is defined as abnormal or excessive fat accumulation that may impair health, causing serious pathophysiological, social and psychological consequences. Compared to normal weight people, dysbiosis was observed in obese individuals, which can further be one of the causes of weight increase, and thus the development of obesity and other metabolic diseases such as diabetes and dyslipidemia, and cardiovascular diseases. Therefore, by manipulating gut microbiota, probiotics are considered a new approach in the obesity treatment. Although exact molecular mechanisms underlying the beneficial effects of probiotics in obesity are not fully elucidated, microRNAs are identified as important molecular mediators in the host, microbiome and probiotics interaction. Recent studies showed that probiotics have beneficial effects on microRNAs disturbed in obesity and related comorbidities. For example, new probiotic formulation containing Lactiplantibacillus plantarum 299v, Saccharomyces boulardii, and octacosanol downregulated the expression of proinflammatory miR-155 and pro-adipogenic miR-24-3p. Bifidobacterium bifidum and Lactobacillus acidophilus supplementation upregulated the expression of miR-26b, miRNA that is decreased in adipose tissue of obese individuals. Additionally, miR-125a expression was significantly upregulated after the L. delbrueckii and Lacticaseibacillus rhamnosus intervention, while miR-181a was downregulated, suggesting that probiotics affect immune response by regulating miRNAs expression. Available literature data suggests that probiotics show anti-inflammatory effect by decreasing C-reactive protein (CRP) concentrations. Elevated CRP values are actually a consequence of the action of certain adipocytokines, especially IL-6, which is also elevated

in obese individuals. The effectiveness of S. boulardii and Lactobacillus strains in regulating IL-6 concentrations has been confirmed in obese animals and humans with diabetes. Probiotics supplementation lowers TNF-α concentrations, especially when combinated with hypocaloric diet. Knowing that obesity is very often accompanied with dyslipidemia, of note is to mention that supplementation with Lactobacillus strains decreases cholesterol and triglyceride levels in blood, dose (≥ 1010 CFU/day) and intervention time (≥ 12 weeks) dependent. Concentrations of atheroprotective HDL-cholesterol were elevated after the probiotics supplementation. Improved gut microbiota after probiotics consumption also improves glucose and insulin concentrations in obese diabetic patients. For all these reasons, miRNAs, metabolic and inflammatory biomarkers should be considered for the diagnosis or prognosis of various metabolic diseases, as well as promising new therapeutic targets for the treatment of obesity and related diseases.

Keywords: obesity, probiotics, microRNAs, anti-inflammatory effect

Fermentation in agro-waste processing: A tool to obtain bioactive products

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The vast quantities of unutilized plant waste generated during agro-industrial processes represent a valuable source of natural bioactive compounds. A convenient way to obtain biologically active substances from plants is by extraction. Nevertheless, fermenting plant matrices prior to extraction signifies a technological advancement for creating the high-quality products with improved nutritional content and therapeutic potential. Basically, fermentation is a process of partial decomposition of the fermented substrate, due to the activity of various microorganisms involved, like bacteria, yeasts and fungi. It is one of the most useful and safest methods of the biocatalytic process to produce new, active and less toxic natural products compared to chemically synthesized. During fermentation process, microbiological activity leads to the synthesis of enzymes that induce the structural breakdown of plant cell walls. This facilitates the release of various nutrients and active compounds, like phenolics, these are usually bound to other structural molecules. A phenolics versatility in health-related potential allows for diverse applications across industries, including food, beverage and pharmaceuticals, serving also as natural preservatives, flavour enhancers, and colourants. The essential impact of agro-waste fermentation may be described using the spent coffee grounds (SCG) example. SCG are major by-product of coffee processing and consumption, and their efficient utilization could reduce the estimated 6–8 million tons of waste each year worldwide. The known bioactive compounds present in coffee beverage, remain in SCG in high amounts. Among them, phenolic acids, with a prevalent chlorogenic acid, flavonoids, and tannins, are known for their antioxidant properties and have been associated with various health-promoting effects, such as anti-inflammatory, antimicrobial, and anticancer activities. The solid state fermentation of SCG with lactic acid bacteria (LAB) was proven to be effective in increasing the amounts of key compounds with favorable bioactive effects, while reducing the levels of anti-nutrients, like caffeine, in the fermented product. The LAB involved are highly correlative with food-based matrices, regarding to microbiological safety and the ability to proliferate rapidly. Based on the level-up examinations, the plant waste fermentation might be applicable to process such readily available material on a large scale, for delivering the natural value-added products. Driven by the sustainability practices, this environmentally friendly approach for producing the bioactive preparations, those might be used as food additives, has the potential to be highly beneficial.

Microwave extraction of modulators of microbial growth from medicinal plant waste

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Microwave-assisted extraction (MAE) has been efficaciously applied for the extraction of bioactive compounds (such as polyphenols) from various plants. When compared to traditional extraction methods, MAE reduces both extraction time and solvent usage while enhancing the yield and quality of the resulting extracts. Ethanol and water mixtures are usually used in the preparation of extracts in the MAE, ensuring that the extracts are safe for human consumption. The addition of iodine during MAE, as a catalyst, enables the production of extracts with enhanced

biological activity compared to extracts without iodine. The catalytic properties of iodine are exhibited through its ability to form halogen intermolecular bonds with electron-rich atoms within various functional groups, which facilitates nucleophilic attack, enabling the synthesis of various compounds. Waste generated from the processing of medicinal plants can be used as a starting material for extract preparation. Although this waste is not suitable for infusion preparation due to its fine particle size, which can easily pass through filter bags, the small particle size increases the contact area between the solvent and the sample. This facilitates deeper microwave penetration into the sample, thus improving the extraction efficiency of polyphenols. Polyphenols are bioactive compounds present in medicinal plants, vegetables, fruits, and spices. They exhibit a diverse range of biological activities, such as antioxidant, antimicrobial, anticancer, and anti-inflammatory effects. Regular consumption of polyphenols has been related to the prevention of cardiovascular diseases, certain types of cancer, and metabolic disorders. Polyphenols may exert a doubly positive effect - simultaneous inhibition of pathogens, while promoting the growth of beneficial bacteria and yeast. Probiotic bacteria such as Lactobacillus and Bifidobacterium, and probiotic yeast Saccharomyces boulardii show increased growth in the presence of polyphenols, while the polyphenols often exhibit antimicrobial properties against various pathogenic bacteria and yeast. Polyphenols support microbial growth by providing carbon sources, acting as electronic acceptors or generating proton motive forces during metabolization. Their antimicrobial effects can be attributed to several mechanisms, including disrupting the microbial cell membrane and cell wall, inhibiting enzyme activity and nucleic acid synthesis, preventing biofilm formation, and chelating essential metals.

Keywords: microwave-assisted extraction, medicinal plant waste, polyphenols, prebiotics, antimicrobial activity

Multifunctional food protein and nanocarrier structure from waste leaf biomass delivered by enzyme technology

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The development of the next generation of renewable protein with a high nutrition quality and technological functionality is becoming increasingly important due to continuous growth of the human population and increasing concern about the sustainable use of traditional meat sources and protein crops. Side-streams from the oil processing industry like pumpkin leaves appear to be highly promising source of plant proteins because of high content of protein and large availability in oil industry. However, due to the unique physical and chemical properties of leaf proteins, their production (e.g., isolation, purification & formulation) represents significant challenges.

In our research we developed and validated an innovative and sustainable concept based on carbohydrate-active and other enzymes, for the obtaining both soluble protein (mainly enzyme RuBisCO) and membrane (green) protein fractions from plant leaves as well as processes for their upgrading to high-added value, food grade bioactive peptides and carrier for nutrients encapsulation. This new concept, besides possessing known advantages of enzyme technologies, could enable new and improved technology to be opened for the achievement of innovation in bioactive peptide production from RuBisCO and in self-assembly and hybrid delivery systems for advanced nutrients encapsulation. In addition, perceive of relationship between enzyme specificity and composition of the obtained protein fractions as well as between protein/peptide structure and function will allow new perspectives in development of novel fraction of bioactive peptides

and protein nanocarriers with tailored properties and extended application. An attempt to improve the yield of white protein– RuBisCO, by integrating the enzymatic protein extraction from pressed leaves without solid/liquid separation into the conventional protocol of recovery of white protein from green juice has been done. The enzymatic extraction was optimized by determining dosage of enzyme preparations, solid/liquid ratio and time of enzymatic treatment. The obtained white protein fraction contained over 90% protein and demonstrated high potential for the development of protein-rich baked goods, as well as serving as a source of bioactive peptides or a carrier for vitamin encapsulation. By realizing the huge potential of underutilized oil crops leaves through the creation of a new value added chain, from oil crops producers, through oil crop processing industry, to functional food industry end-user, this concept could provide multiple scientific, economical, and sustainable environmental benefits.

Keywords: Green biomass, RuBisCO, Bioactive peptides, Nanoparticle structures; Rheological properties; Cookie formulation

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Past, Present and Future of salt reduction strategies

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Salt reduction strategies have evolved significantly over the years, reflecting changing public health priorities, scientific understanding, and food industry practices. Initially, awareness emerged in the mid-20th century, when studies began to link high sodium intake to hypertension and cardiovascular disease, culminating in recommendations during the 1970s and 1980s. Despite initial resistance from the food industry and consumers, the approach has shifted toward more comprehensive and innovative public health interventions.

Countries like Finland and Great Britain have effectively implemented national salt reduction programs, resulting in significant decreases in average sodium intake. Various regulatory and voluntary measures have been introduced worldwide to limit sodium levels in processed foods. Notably, the European Union (EU) Regulation No. 1169/2011 mandates that all pre-packaged food products display nutrition information, including salt content. Additionally, voluntary front-of-package labeling systems for critical nutrients, such as the Traffic Light system and Nutri-Score, empower consumers to make informed choices regarding sodium and other essential nutrients.

Advancements in food technology have led to the development of salt substitutes and flavor enhancers that can help meet global sodium reduction benchmarks without compromising taste. Ongoing surveillance of sodium intake and its health impacts informs further regulatory measures and public health initiatives.

Global collaboration among governments, NGOs, and the food industry is crucial for driving effective salt reduction strategies. Initiatives like the World Health Organization's Global Action Plan for the Prevention and Control of Noncommunicable Diseases emphasize the necessity of cohesive efforts to lower salt consumption. By fostering stakeholder engagement and leveraging technological advances, regulatory measures, and consumer education, we can make significant strides toward reducing sodium intake globally, ultimately improving population health and decreasing the burden of related diseases.

Obesity as a Risk Factor for Cardiovascular Diseases in Vojvodina

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Introduction: Obesity poses a significant public health concern in our country that adversely affects the population's cardiovascular health. The aim of this study is to assess the association between obesity and arterial hypertension, coronary heart disease, myocardial infarction, and stroke.

Method: The study is part of the National Health Survey of Serbia, conducted in 2019, as a cross-sectional study on a representative sample of the Serbian population. We used data for 2865 persons (1384 men and 1481 women) aged 18 and over from Vojvodina. Multivariable logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for the associations between obesity and selected cardiovascular diseases. All the analyses used weighting to ensure the representativeness of the population of Vojvodina. Results: In Vojvodina, one in four adults

was obese (26.1%) and over one-third of adults were overweight (37.5%). Obese adults were more likely to have cardiovascular diseases such as arterial hypertension (47.0%), coronary heart disease (14.0%), myocardial infarction (4.2%), and stroke (or its consequences) (2.8%) compared to those with normal weight. The odds of obese adults having arterial hypertension were almost three times higher (OR 2.77, 95% CI 2.74-2.80), 1.64 times higher for coronary heart disease (1.64, 95% CI 1.61-1.67), 1.88 times higher for stroke (OR 1.88, 95%CI 1.81-1.96) and 1.58 times higher for myocardial infarction (OR 1.58, 95%CI 1.53-1.62) than persons with optimal weight.

Conclusion: Obesity is associated with a higher risk of cardiovascular diseases, such as arterial hypertension, coronary heart disease, heart attack, and stroke. Preventive measures aimed at reducing obesity prevalence would also improve the cardiovascular health of our population.

Keywords: Obesity, Risk Factors, Cardiovascular Diseases, Health Survey

Nutrition and cardiovascular disease: finding the perfect receipt

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Inappropriate dietary behavior is undeniably associated with the increasing burden of cardiovascular diseases, which is evidenced to be the leading cause of death in Western countries, accounting for almost 30% of deaths worldwide. Therefore, the prevention of cardiovascular disease and its related consequences has to become a public health priority, particularly through healthy lifestyle interventions. Up until now, there is a strong scientific rationale that Western dietary patterns lead to the synthesis of a great number of proinflammatory cytokines, followed by the lower production of protective, anti-inflammatory molecules. Therefore a healthy dietary pattern should be based upon the pathophysiological observation that some food components are evidenced to be cardioprotective, owing to their pathophysiological nature. Coenzyme Q10 is evidenced as a protector of the heart and vessels, while its antioxidant properties improve endothelial function, and lipid profile, and increase ATP production in the heart and muscle cells. Multiple bioactive compounds, including omega-3 fatty acids, lycopene, or polyphenols, upon incorporation into the diet, have been associated with beneficial effects on atherosclerosis development. All of them act to reduce levels of LDL-c, improving inflammatory and oxidative stress biomarkers. PUFAs, such as Omega-3 fatty acid (Ω-3 PUFA), α-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA), have been reported as potential anti-atherogenic agents during the atherosclerotic process development. Mechanisms, through which they might reduce cardiovascular risk, include improvements in the lipid and lipoprotein profile, oxidation, thrombosis, endothelial function, blood pressure, plaque stability, cardiovascular mortality, platelet aggregation, modulating concentration or expression of pro-inflammatory markers (adhesion molecules, cytokines, etc.), and immune cells. Lycopene is a lipophilic and unsaturated carotenoid, present in red-colored fruits and vegetables, might reduce atherosclerotic risk, particularly in the early stages of atherosclerosis, preventing endothelial dysfunction and LDL oxidation, improvement of the metabolic profile (by impairing cholesterol synthesis) and blood pressure, through reductions in arterial stiffness, and modulation of the expression of pro-inflammatory markers and platelet aggregation. Polyphenols, including anthocyanins, flavonols, and flavonoids, behave similarly, whereas their incorporation in a dietary pattern is significantly associated with lowering blood pressure, improvement of endothelial function and lipid profile, and overall reduction of cardiovascular disease development. Based upon strong evidence on pathophysiological mechanisms implicated in the cardioprotective effect of nutrients, dietary antioxidants, or bioactive com-

pounds, a great number of foods account for a reduction in cardiovascular risk factors or directly decrease cardiovascular disease development. However, it is still challenging to promote healthy dietary habits, as well as an active lifestyle, as early as possible in children and young adults. Therefore, the public health community should join forces to set the stage for better implementation of scientific knowledge in a real life.

Keywords: healthy diet, cardiovascular disease, coenzyme Q10, omega-3 fatty acid, lycopene, polyphenols

Mediterranean diet and cardiovascular health

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The Mediterranean diet (MedDiet) has become increasingly recognized for its potential to enhance cardiovascular health. This dietary pattern, which emphasizes high consumption of fruits, vegetables, whole grains, legumes, nuts, olive oil, and moderate amounts of fish and poultry, prioritizes healthy fats while reducing the intake of red meat and processed foods. Recent research has provided deeper insights into how the MedDiet may mitigate the risk of cardiovascular disease (CVD). Adherence to the MedDiet is associated with a 30% reduction in the risk of major cardiovascular events, including heart attacks and strokes. This protective effect is attributed to the diet's rich antioxidant profile, primarily from fruits and vegetables, which combat oxidative stress and inflammation—two key contributors to atherosclerosis. Furthermore, the MedDiet promotes favorable lipid profiles, evidenced by a significant increase in high-density lipoprotein (HDL) cholesterol and a decrease in low-density lipoprotein (LDL) cholesterol. A 2024 cohort study demonstrated that individuals adhering to the MedDiet exhibited a 25% lower risk of developing dyslipidemia compared to those with Western dietary patterns. The inclusion of omega-3 fatty acids from fish and plant sources also plays a crucial role in reducing triglyceride levels and improving endothelial function. Additionally, the diet's emphasis on whole foods rather than processed alternatives contributes to better weight management and lower incidences of obesity—a major risk factor for CVD. A longitudinal study indicated that individuals who maintained a MedDiet were less likely to gain weight over ten years, thereby mitigating one of the primary risk factors for cardiovascular complications. Recent insights into gut microbiota further underscore the MedDiet's benefits. Studies suggest that the dietary fiber and polyphenols present in the MedDiet enhance microbial diversity, which is linked to improved metabolic health and reduced inflammation. This microbiome modulation may provide additional mechanisms through which the MedDiet supports cardiovascular health. In conclusion, the Mediterranean diet offers a holistic approach to cardiovascular health through its anti-inflammatory properties, lipid-lowering effects, weight management benefits, and positive impact on gut microbiota. As ongoing research continues to unravel the complex relationships between diet and cardiovascular disease, the MedDiet remains a cornerstone in public health recommendations for the prevention of CVD.

Keywords: Mediterranean diet, Cardiovascular health, Antioxidants, Lipid profile, Gut microbiota

Characteristics of food environment in school settings of the Republic of Srpska: barriers and drivers of cardiovascular health

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In the 21st century food environment has changed significantly, and these changes have influenced the population's food consumption, which has been hypothesized to influence the development of cardiovascular diseases. The food environment around and within school involves all the spaces, infrastructure, and conditions where food can be obtained, purchased, or consumed. Paper particularly investigate this environment as a determinant of food behaviour together with infrastructure related to physical activity of children and adolescents as important factors of cardiovascular health.

Data were collected during October and November 2023 among selected sample of 164 primary schools (response rate: 87.7%) and 65 high schools (response rate: 67.7%) in Republic of Srpska. School administration filled online form of self-administered questionnaire related to assessment of school food environment such as food availability and marketing together with infrastructure for physical activity. COM-B model (Capability, Opportunity, Motivation - Behaviour) has been used for data interpretation and for targeting further interventions. Higher percentage of primary (91.5%) than high schools (61.5%) has inside space for physical activity. High schools without space for physical activity mostly use alternative places such as school hall, municipality hall or space for physical activity of other local schools. Around 17.1% of primary and 52.3% high schools have wending machines with most present food and beverages such as candies, sugar-sweetened beverages, snacks and water. In near distance (less than 100 m) of 84.7% primary schools and 91.2% high schools are present selling points with food and beverages. Inside 27.6% of primary and 13.8% of high schools are present messages with food marketing or health information. Near one quarter of primary schools (27.5%) provide meals for children during extended stay through restaurants with catering services while half of the mentioned schools (56.7%) stated that restaurants provide analysis of nutritional value of the meals. Main criteria for selecting food providers in primary school extended stay is most affordable price (56.7%), and in lower extend nutritional value of the meals (16.7%) and geographical distance of provider (for three schools only). According to behaviour change wheel of COM-B model, interventions related to restriction and incentivization are needed in order to straight legal framework and facilitate motivation of school administration in order to improve food environment in school settings in line with training /imparting skills of school stuff for food procurement according to good nutritional practice.

Keywords: food environment, marketing, school settings, COM-B model, cardiovascular diseases

New insights in sustainable natural polymer-based food packaging

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Ensuring adequate nutrition for the growing global population requires a momentous change in the food supply chain, with one of the key issues to address being the reduction of food waste. Appropriate choice of food packaging material can help preserve food quality and safety longer, thereby having a positive impact on the reduction of food waste. However, some traditionally used food packaging materials pose a serious environmental concern. Namely, non–biodegradable plastics dominate the food packaging sector due to their cost-effectiveness and durability. In line with the linear economy model, after serving their purpose these materials end up as waste that persists for centuries causing a significant environmental burden. The raising global awareness on the environmental impact of plastic packaging pollution, impelled by the recent insights into the effects of microplastics on human health, has led to the accelerated search for environmentally friendly food packaging solutions. One of the workable means is the development of food packaging materials from natural polymers. Natural polymers derived from renewable resources, such as polysaccharides, proteins and lipids are biodegradable and readily compostable, hence their application in food packaging would help reduce the environmental burden of food packaging waste. However, in order to be a viable solution that closes the gap between the desired functionality and sustainability of food packaging, natural polymer-based food packaging needs improvement in performance and scalability. Namely, natural polymers are mostly utilized in the form of edible films and coatings, but each of these polymers has some drawbacks related to their structure that limit their commercial application. Currently, research is focused on improving moisture, heat, barrier and mechanical properties of these materials in order to make them more in line with market demands. Structural alterations and modifications of polymers via non-thermal techniques such as microwave, ultrasound, cold-plasma, irradiation, and high-pressure processing result in enhanced mechanical and barrier properties. Additional strategies include incorporating generally recognized as safe (GRAS) active ingredients, such as plant extracts, essential oils, and a variety of different antimicrobial and antioxidative substances, whether commercial or natural, in order to develop active food packaging with enhanced properties. Moreover, the application of green-synthetized nanoparticles in order to improve barrier, optical mechanical and antimicrobial properties of food packaging has also been in focus recently. Using multi-layer natural polymer films and coatings can also help overcome the shortcomings of individual polymers, offering a better solution for food packaging challenges.

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Food packaging: types, challenges and sustainability

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There are many different types of food packaging in the market. Food packaging is more than visual likeability. Below the printing surface, there are a lot of combinations of different materials. They can include 2, 3 or 4 same, similar or totally different materials. For polymer binding, industry uses adhesives, which can be solvent or solvent less and based on polyurethane basis. All combinations can contribute to adequate standing on the shells, adequate shelf life, barrier and mechanical properties, strength of the sealing etc. In addition to the listed properties, additional value is provided other packing parts, like perforation, Zipp, smart valves, caps and handles. A very important part of flexible packaging is printing. Visual appearance can include effects on the package external side, such as, partial lacquer, matt, metallic, paper touch and ''windows" which represents transparent parts in opaque packaging. Exact selection of the packaging also depends on the product price, where high price products can withstand all requirements regarding the appearance and structure of the packaging itself. The choosing process of the right packaging starts from the customer demands and product type. After that, selection of the materials and structure is carried out and depends on the product shelf life and chemical aggressiveness, WVTR or OTR barrier of the materials to preserve freshness and crispiness or the product itself. For example, some nuts like pistachios due to hard and sharp shells need materials with higher tear strength and puncture resistance. In the last few years, a lot of attention has been brought to sustainability of food packaging. Producers try to obtain mono-structure materials, based on polyethylene or polypropylene, which can replace conventional structures based on two or three different types of materials (e.g. structure with aluminum or combination two different polymer types). This is all done to enable recyclability of the packaging. The industry has gone so far as to produce adhesives that have recycling certificates and hole packaging is 100 % recyclable.

Microplastics, what is the news from the world?

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Microplastics are present worldwide, even in the most isolated areas. Primary microplastics are either manufactured as microparticles or released into the environment in this form. In contrast, secondary microplastics are formed through the fragmentation or abrasion of larger plastic items in the environment. Microplastics release additives, concentrate environmental pollutants, and provide substrates for biofilms, including pathogenic species. The potential for human ingestion of contaminated food and water raises concerns. Additionally, indoor microplastics present uncharacterized risks, compounded by the time spent indoors (over 90%) and the prevalence of polymeric products.

The abundance of microplastics increases as fragment size decreases, along with the proportion of organisms that can ingest them. Particles smaller than 20 μm may penetrate cell membranes, heightening associated risks. Exposure can negatively impact feeding, metabolic processes, reproduction, and behavior. Exposure can affect nervous system, respiratory system, digestive system as well as placental barrier. Moreover, scientific challenges include enhancing microplastics sampling and characterization methods, understanding long-term environmental behavior, assessing the bioavailability of additives, and evaluating risks to organisms and ecosystems. Proposed solutions encompass global pollution prevention strategies, the development of degradable polymers and additives, and efforts to reduce consumption while promoting plastic reuse.

Research on the Use of Dietary Supplements in Montenegro

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Dietary supplements are becoming increasingly popular among the population of Montenegro as a means to improve health and prevent disease. This study investigates the patterns of supplement use, factors influencing their application, and the level of awareness among Montenegrin residents regarding their potential benefits and risks.

Methodology: The research was conducted through an online survey that included a sample of 200 respondents from different age groups, genders, and educational levels. The questions focused on the frequency of supplement use, the types of supplements used, sources of information about supplements, and the reasons for their usage.

Results: The results show that over 75% of respondents have used dietary supplements at some point in their lives, of which 67% used some form of dietary supplement in the last 12 months. Respondents most frequently used supplements once daily, following the instructions provided on the product labels. The most common motivation for using dietary supplements was health preservation and the prevention of various diseases. Most respondents believed that supplements were necessary due to their lifestyle and diet, but the primary factor influencing their choice of supplement was the product price. The results also indicate that two-thirds of respondents felt they lacked sufficient knowledge about dietary supplements, but they most often purchased them at pharmacies after consulting with a pharmacist. Furthermore, the study reveals differences in supplement use based on gender, age group, and education level.

Conclusion: The research highlights the growing trend of dietary supplement use in Montenegro, as well as the need for better education of the population regarding the proper use of supplements and potential risks. The findings of this study could help create recommendations for healthcare professionals and relevant institutions to promote responsible use of supplements.

Keywords: dietary supplements, Montenegro, survey, research, health, nutrition

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Fruit wine as a potential functional food

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Berry fruit and its derived product are significant in well balanced nutrition. Among berries it is possible to highlight strawberry which is consume as a fruit and in many other processed forms. One of the product is a strawberry wine, which is rich source of many natural active compounds which possess beneficial health effects on the human organism. The aim of this study was to investigate phenolic profile, antioxidant properties and alpha-glucosidase inhibitory activity of strawberry wines.

Fruit wines were produced in microvinification during controlled fermentation by using pure yeast strain culture. Antioxidant properties were evaluated by FRAP and DPPH methods, while total phenolic content by application of Folin Ciocalteu method. Sample preparation for determination of alpha-glucosidase inhibitory activity consisted of fruit wine lyophilization and dissolution in DMSO. The inhibition of alpha-glucosidase was evaluated by using alpha-glucosidase and substrate solution, p-nitrophenyl α-D-glucopyranoside. Identification and quantification of some natural compounds conducted by using UPLC TQ-MS/MS.

All analyze strawberry wine samples showed significant antioxidant activity. Also phenolic content of analyzed samples revealed that strawberry wine is a rich source of phenolic compounds. Different technological approach applied in the production affected on the antioxidant properties and total phenolic content of strawberry wines. Results for the alpha-glucosidase inhibitory activity were in range 37.2-53.3 μg/mL. The control was acarbose with inhibitory activity 78.5 μg/mL. It was also estimated the content of selected phenolic compounds by usage of UPLC TQ-MS/MS. The most predominant phenolic compounds in strawberry wines were chlorogenic, ellagic, gallic acids, as well as epicatechin and quercertin. Also those compounds showed their contribution to the alpha glucosidase inhibitory activity.

The obtained results showed that the strawberry wines possess significant antioxidant properties which is results of the presence of phenolic compounds and other biologically active principles. Strawberry wine showed as rich source of selected phenolic compound which together with many other active principles showed synergistic and antagonistic effect on alpha glucosidase inhibitory activity. Taking into the account prior results fruit wine can be considered as a potential functional food.

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A Dried Fruit Sample: Maximizing Bioaccessibility and Sensory Quality by using Ripeness and Drying Methods of Persimmon

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In parallel with the growing interest in healthy snacks in modern society, the consumption of dried fruits is on the rise. While the positive health effects of fruits were previously attributed to their content of bioactive compounds, this has now shifted towards the bioaccessibility of these compounds. Factors such as fruit variety, stage of ripeness and processing techniques play an important role in determining both the bioaccessibility and sensory qualities of fruit products. Therefore, this study aims to highlight the influence of harvest timing and drying parameters on the bioaccessibility and sensory quality of persimmons, which serve as an example of dried fruit. Due to its astringent flavor and soft texture, the drying process of persimmon is different from many other fruits. This study presents findings that aim to achieve an optimal balance between the health benefits and sensory quality of dried persimmon by manipulating harvest maturity and drying processes. Recommendations are offered to producers to maximize both quality and health benefits in dried persimmon production. As with other fruits, the amount and composition of persimmon phenolic compounds affect its bioaccessibility and sensory properties. Many persimmon varieties are not suitable for immediate consumption after harvest due to their high tannin content, which gives the fruit an astringent taste. The phenolic profile, including tannins,

quercetin, catechin, kaempferol, caffeic acid, ferulic acid, epigallocatechin and proanthocyanidins, is significantly affected by fruit ripeness, drying methods and processing parameters. Although hot air drying is widely used in industry, it has been shown to lead to greater loss of phenolic content compared to newer technologies such as freeze drying or ultrasound-assisted vacuum drying. However, hot air drying has been reported to increase the bioaccessibility of phenolic compounds in persimmon to a greater extent. As persimmon ripen, their tannin content decreases and sugar concentration increases. However, as the fruit softens during ripening, drying becomes more difficult and sometimes impractical. Therefore, storage in controlled environments containing CO_2 or ethylene is recommended to reduce astringency without compromising the firmness of the fruit. During the drying process, careful adjustment of temperature, humidity and resting times according to raw material characteristics can optimize both moisture content and bitterness reduction. This reduction in astringency is achieved by the breakdown of bitterness-causing phenolic compounds into non-bitter phenols, which simultaneously changes the bioaccessibility properties of the fruit.

Introduction of Dried Persimmon Production Technologies Used in South Korea and Determination of Some Quality Characteristics and Consumer Preferences of These Products

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This research includes some studies conducted within the scope of the project titled "Development of drying technology for Turkish persimmon and survey of European consumer preferences to enter the export market for the dried persimmon of Korea" supported by the Gyeongsangbuk-do Agricultural Research & Extension Services (GARES) of South Korea and carried out through bilateral cooperation between the Atatürk Horticultural Central Research Institute and GARES. The aim of this research is to introduce the special technologies developed for dried persimmon used in South Korea and to determine the quality characteristics and consumer preferences of these products. In this context, medium-moisture whole, low-moisture whole, and sliced dried persimmons were produced in South Korea. The drying technology used varies depending on the size of the product. For whole dried persimmons, the stages include raw material variety selection, grading, peeling, hanging on racks or placing on trays, sulfurization, drying, packaging, and storage. For sliced dried persimmons, the stages of raw material variety selection, grading, peeling, stem removal, slicing, placing on trays, sulfurization, drying, packaging, and storage are applied. A sensory preference survey was conducted in Turkey with 200 participants to determine consumer preferences for these products produced in South Korea. The survey was carried out through tastings, and the results were statistically evaluated. Additionally, physicochemical analyses were conducted for medium-moisture (45-50%) whole, low-moisture (35-40%) whole, and sliced (30-32%) dried persimmons, including moisture content (%), water activity (aw), pH, titratable acidity (as % malic acid), reducing sugar, color values (L*, a*, b*), CUPRAC antioxidant activity, DPPH antioxidant activity, and total phenol content. As a result, it was determined that dried persimmons produced using methods specific to South Korea were liked by consumers in Turkey and had the desired physical and chemical properties. It is believed that dried persimmon products, which are defined as a healthy snack, may soon have a greater presence in high-purchasing-power markets such as the European Union and the United States. Therefore, the findings of this research could be beneficial for consumers, researchers, and industrialists who wish to engage in production and export.

The roles of non-coding RNAs in cardiometabolic health-promoting properties of (poly)phenols

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(Poly)phenols are secondary plant metabolites with various biological roles. Approximately 8,000 (poly)phenols have been identified in plants, several hundred of which are relevant to human nutrition. Studies have shown that dietary (poly)phenols can have beneficial health effects, such as decreasing insulin resistance, improving blood lipids and vascular function, and reducing the risk for cardiovascular diseases. However, studies have also highlighted significant inter-individual variabilities in the health-promoting effects of (poly)phenols, phenomena that require complex, in-depth analyses to fully understand. At the molecular level, the health-promoting effects of (poly) phenols are linked to the genomic modifications, including changes in both protein coding and non-coding genes. Among the non-coding RNAs, several types of RNA molecules exist, such as miRNAs, lncRNAs, snoRNAs, and circRNAs. Of these, miRNAs, and to some extent lncRNAs, are the most extensively studied. The involvement of non-coding genes in the health-promoting effects of (poly)phenols has become increasingly evident through the use of untargeted transcriptomic analytical approaches. Elucidation of their cellular effects and molecular mechanisms of action is an important task. A systematic literature search identified 27 miRNAs significantly associated with the beneficial cardiometabolic health effects of (poly)phenols in humans. Additionally, a human intervention study demonstrated that 6 miRNAs and 244 lncRNAs were significantly modulated by the consumption of an extract of (poly)phenol-rich beverage. We utilized databases and bioinformatic tools, such as Mienturnet and LncRRIsearch, to identify miRNA- and lncRNA-targets, respectively. Following this, we conducted pathway enrichment analyses to elucidate the biological roles of the modulated non-coding RNAs. These analyses identified several cellular pathways significantly affected by dietary (poly)phenols at the miRNA level, including PI3K-Akt signalling pathway, Ras signalling pathway, MAPK signaling pathway, chemokine signaling pathway, and focal adhesion. At the lncRNA level, the affected pathways include tight junction, Ras signalling pathway, phytochemical activity on NRF2 transcriptional activation, and apoptosis. Subsequent multi-level bioinformatic analyses, which integrated genomic modulations at the mRNA, miRNA, and lncRNA level, identified several common cellular pathways. Notably, focal adhesion consistently emerged as one of the key cellular pathways significantly modulated by dietary (poly)phenols. These transcriptomic and integrative bioinformatic analyses, aimed at identifying the subtle molecular mechanisms of action of (poly)phenols, revealed key cellular processes and pathways affected by dietary (poly)phenols at the level of non-coding RNAs. The results of these analyses could help elucidate genetically induced inter-individual variabilities in the cardiometabolic health-protective properties of (poly)phenols, potentially paving the way for development of personalized nutrition recommendations. Authors declare no conflicts of interest.

Keywords: miRNAs, lncRNAs, polyphenols, cardiometabolic health, integrative bioinformatics

Evidence-based nutrition interventions through the life-course: examples from Republic of Srpska

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Interventions addressing nutrition through the life-course (covering women, men, infants, children, adolescents and older persons) contribute to improving health. Addressing population diet is therefore at the core of health promotion and public health with huge potential to improve population health. Among evidence-based interventions that are cost-effective, WHO has recognized activities' devoted to promotion and support of exclusive breastfeeding for the first 6 months of life, including promotion of breastfeeding, implementation of nutrition education and counseling in different settings to increase the intake of fruits and vegetables. The aim of this paper is to review evidence-based nutritional interventions in Republic of Srpska (RS) in line with WHO recommendations.

In RS, activities aimed at improving the nutrition of the population are implemented with greater and lesser success through various WHO/UNICEF initiatives/programs: "The Baby-Friendly Hospital Initiative (BFHI)", "The Nutrition Friendly Preschool/School Initiative" (NFSI), "The Program for early detection and prevention of risk factors for the occurrence of non-communicable diseases". NFSI has been implemented in RS since 2014 covering 17 kindergartens and 3 elementary schools, over 6,622 children of preschool age and 2,293 children of school age. Nine out of 15 kindergartens that joined the evaluation and one out of three schools have so far fulfilled the basic set of indicators and received the NFSI recognition in accordance with WHO criteria. The standardization of nutrition in preschool institutions was launched as part of the initiative, and the rulebook was published in 2016. The process of standardization of nutrition in elementary schools is currently underway. Survey on the nutritional environment in preschool and school settings in RS (2023), indicated the need for additional education of in the field of nutritional literacy and understanding of certain obligations defined by the ordinance, relate to the energy and nutritional value of meals in preschool/school institutions. Although the BFHI has been implemented in RS since 2001, and the program for early detection and prevention of risk factors for non-communicable diseases since 2003, research on nutrition counseling and monitoring of nutritional status in primary healthcare centers in RS (2023) indicated the need for improvement. Counseling services in the field of nutrition and monitoring of nutritional status are not standardized, with different approach in the selection, application and interpretation of instruments used to assess nutritional status. A different approach was observed in counseling during life-course. Health workers in primary health care have noticed the need for additional education in the field of nutrition in order to increase knowledge and strengthen competence in the field.

Previous experiences in the application of evidence-based interventions in the field of nutrition in RS indicate the justification of their application and the need to expand these interventions in the community to a larger number of institutions, creating healthy communities and a healthy environment.

Association between Nutritional Habits and Quality of Life of Health Sciences Students from Eight South-East European Countries

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Introduction: Starting university education often leads to changes in students' nutritional habits due to new responsibilities and environmental influences. Studies have shown that students generally do not maintain a proper diet, often skipping meals, particularly breakfast and consuming food that is high in energy but low in nutritional value, with high levels of saturated fats, trans-fatty acids, added sugars and salt. Unhealty nutritional habits can lead to an imbalance between energy intake and expenditure, increasing the risk of overweight and obesity and the development of non-communicable diseases, which significantly decreases students' quality of life.

Aim: The aim of this study was to determine the assotiation between nutritional habits and quality of life of health science students from South-East Europe.

Methods: The study was conducted i a form of a cross-sectional study between April and September 2023 on a sample of 3,473 students from 69 faculties in 8 countries (Slovenia, Croatia, Bosnia, Serbia, Montenegro, North Macedonia, Romania, and Greece) using an online survey questionnare.

Results: In the overall sample, 30.8% of students had a satisfactory level of adherence to proper nutrition, while 69.2% did not. None of the students had dietary habits fully aligned with recommendations for proper nutrition. Students from Greece had the highest percentage of satisfactory adherence to proper nutrition (40.5%), while students from Bosnia and Herzegovina had the lowest (20.3%) ($\chi2=73.868$; $p<0.001$; $fi=0.146$). Nutrition students had the highest percentage (37.5%) of satisfactory adherence to proper nutrition, while pharmacy students had the lowest percentage (26.8%) ($\chi2=17.87$; $p=0.007$; $fi=0.072$). Satisfactory adherence to proper nutrition was associated with significantly higher mean scores across all domains of quality of life, including self-rated quality of life ($t=-10.097$; $p<0.001$), health quality ($t=-7.632$; $p<0.001$), physical health ($t=-4.584$; $p<0.001$), psychological health ($t=-3.479$; $p<0.001$), social health ($t=-4.392$; $p<0.001$) and environmental health ($t=-5.054$; $p<0.001$), compared to unsatisfactory adherence to proper nutrition. Satisfactory adherence to proper nutrition was a statistically significant predictor of all domains of students' quality of life.

Conclusions: The results of this study can be used to plan various public health activities at the national, regional and international levels in order to improve student nutrition, thereby reducing the risk of developing non-communicable diseases and enhancing quality of life.

Keywords: nutritional habits; quality of life; medical students; public health; young adults; Western Balkans

The influence of diet and vitamin D status on the risk for long bone fractures due to falls in older Serbian subjects

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Introduction: The influence of diet and specific macro- and micronutrients on the occurrence of long bone fractures in the older population in Serbia was not examined.

Objective: To examine the influence of diet and vitamin D status on the risk for long bone fractures due to falls in older Serbian subjects. Methodology: This case-control study was conducted at the Clinic for Orthopedic Surgery and Traumatology of the University Clinical Center of Vojvodina in the autumn/winter of 2022-2023, including 210 subjects >65 years old: a case group with long bone fractures due to a ground-level fall (N=105, females N=80), and a control group without fractures (N=105, females N=80). Groups were similar regarding sex, age, and body mass index (BMI). The intake of different food groups, energy, macronutrients, calcium, and vitamin D was examined through two 24-hour recalls. The serum vitamin D levels were measured by CMIA. Mann-Whitey tests, logistic regressions, and receiver operating characteristic (ROC) curve analyses were applied. Results: Daily intake of vitamin D was significantly lower in the case group [median(IQR)]: 1.4(0.9-2.7) vs. 5.8(3.3-8.6) µg/day, p<0.001, as well as intake of calcium, energy, protein, fat, and energy intake from dairy products, eggs, fish, edible fats/oils, while from sweets/sugars was higher (p<0.001 for all). Serum vitamin D values were significantly lower in the group with fractures: 40.0(23.0-50.0) vs. 76.0(57.0-91.0) nmol/l, p<0.001. The case group also had higher smoking and lower physical activity ranks. In the logistic regression models, the serum vitamin D level was the most important protective factor for fractures, in univariate analysis [OR(95%CI)]: 0.884(0.854-0.915), p<0.001 (Model 1); in multivariate analysis (adjusted for sex, age, BMI, smoking, physical activity, and season) [OR(95%CI)]: 0.878(0.841-0.916), p<0.001 (Model 2). Other significant nutritional protective factors were the intake of proteins and vitamin D (Model 3), dietary fat, fiber, and vitamin D intakes (Model 4), or the intake of fish, eggs, and dairy products, while the intake of sweets was a risk factor (Model 5). ROC curve analysis indicated that serum vitamin D values <50.5 nmol/L were associated with a significantly increased fracture risk.

Conclusion: The diet of older subjects in Serbia is characterized by a low vitamin D intake. The poor vitamin D status, with levels below 50.5 nmol/l, was the most important risk factor for fractures. Other nutritional factors also contributed to the increased risk. Dietary changes, increased sun exposure, and vitamin D supplementation should be considered for Serbian elders.

Keywords: fracture, elderly, vitamin D, diet, falls

Menopause: nutrition and weight gain

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Menopause is a critical period in a woman's life, during which body weight gain and redistribution of adipose tissue towards a more central phenotype have been observed. There is increasing evidence that estrogen deficiency and central obesity associated with menopause are

associated with metabolic syndrome and cardiovascular diseases. However, the reasons for the increase in body weight in middle-aged women are not fully understood, especially regarding the role of eating habits. In one of our studies, we examined the relationship between snacking frequency and the body weight status of postmenopausal women. Generally, we observed that a higher number of snacks is associated with lower BMI values in postmenopausal women. Moreover, snacking may improve the dietary fiber density of the diet. However, overweight-to-obese postmenopausal women reported less frequent snacking and the dietary composition of the snacks was less favorable than those of their normal-weight counterparts. The menopausal transition may affect also taste perception, and thus, through changes in fat detection, may affect food choices and metabolic outcomes. In our study we observed that low-fat taste sensitivity may play a role in the eating habits of menopausal women, leading to increased eating occasions and favoring certain types of food (e.g. meats and eggs, snacks, and fast foods).

Successful dietary strategies for obesity treatment and thus improving metabolism in postmenopausal women are of the utmost importance. In short-term dietary treatment with the Central European Diet or the Mediterranean diet MED a similar improvements in some anthropometric, lipid, and nonlipid parameters of postmenopausal women were observed; however, adequate adherence to the prescribed diet is important in weight loss success and in achieving improvements in metabolic health. Little is known about the factors affecting body weight-loss maintenance among postmenopausal women. It was suggested that less weight loss during dieting a propensity for disinhibited eating after dieting, and skipping breakfast before dieting all were significant predictors of future weight regain after weight loss treatment in postmenopausal women.

Relationship between body image and weight control behaviours among Serbian adolescents– data from Health Behaviour in School-aged Children Survey 2018

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Adolescence is considered a risk period for weight gain due to intensive hormonal and metabolic changes, but also changes in diet-related behaviours. In some adolescents, the perception of physical appearance is significantly different from the actual body weight, where they most often perceive it to be significantly greater than it is. Therefore, the change in eating behavior aimed at controlling body weight is not surprising. Although many adolescents seek professional help to lose weight, some use fasting, induced vomiting, and laxatives as ways to control their weight. The aim of the study was to explore the relationship between body image and weight control behaviour in Serbian adolescents. Secondary analysis of data obtained from the Health Behaviour in School-aged Children Survey (HBSC) in Serbia 2018 was performed. The survey was conducted as a cross-sectional study on a nationally representative sample of adolescents aged 11, 13, and 15 years. In this study only data for adolescent girls aged 13 and 15 were analyzed. According to the body mass index (BMI), 10.8% of adolescents aged 13 and 15 in Serbia were underweight, 15.2% were overweight while 2.6% were obese. One sixth of adolescents (17.0%) were dieting at the time of the study, more often girls and older adolescents. Both boys and girls who perceived themselves as fat were more likely to practice dieting behaviour to reduce or control body weight. Also, they more often applied unhealthy ways to control their body weight, primarily fasting (both sexes) and smoking more (boys). Girls who perceived themselves as thin more often skipped meals and smoked more, while boys restricted the intake of certain food groups and de-

creased fat intake. Considering the health risks associated with the way adolescents perceive their weight, especially related to weight control behaviours, identification and monitoring of these behaviors is necessary.

Vegetable consumption among adults in Serbia

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Background: Evidence suggests that diet rich in vegetables and fruits lowers blood pressure, reduce the risk of heart disease and stroke, prevent some types of cancer.

Objectives: To describe vegetable consumption among adults in Serbia according to number of portions.

Material and Methods: This is secondary analysis of the Serbian National Health Survey (SNHS) data, conducted in 2019. Statistically, SNHS used a stratified two stage cluster sample, to obtain statistically reliable estimates at the Serbia level, at the level of four regions, as well as for the population of urban and other settlements. The response rate of the total number of registered households in the SNHS was 80.7% and 97.0% (13178) for the total registered members in the households aged 15 and older. SNHS database was searched for information on the number of portions of vegetables consumed per day and 6026 respondents, men and women, were identified as providing it. Respondents were stratified according to eight age groups:15-24 years of age, 25-34,35-44,45-54,55-64,65-74,75-84 and 85+. Statistical analysis was performed using SPSS v.21.

Results: The smallest reported number of consumed vegetables portions per day was one and the largest was nine. Consumption of one portion of vegetables per day ranged from 37.80% in age group 85+ to 45.0% in age group of 75-84; consumption of two portions/day ranged from 33.50% in age group 25-34 to 41.50% in 65-74 age group; consumption of three/day ranged from 13.50% in age group 65-74 to 17.10% in respondents aged 85+; four/day ranged from 2.70% in age group 85+ to 6.20% in age group 45-54; five/day ranged from 1.40% in age group 45-54 to 2.70% in respondents aged 85+. Analyses showed that there was no statistically significant difference between the eight age groups $H(4)=2.74$, $p=0.60$ and insignificant difference between men (median=2, n= 2725) and women (median=2, n= 3301), $U= 4459816$, $z= -0.601$, $p=0.548$, in the number of consumed vegetables portions. As per all respondents, total difference between consumption of one and two portions of vegetables per day was 3.5 percentage points and between two and three portions of vegetables per day was 22.8 percentage points.

Conclusions: Findings suggest every seventh resident of Serbia eating vegetables in accordance with the recommendations, encouraging difference between intake of one and two portions of vegetables per day and challenging difference between intake of two and three portions of vegetables per day in adults in Serbia.

The author declares no conflict of interest.

Keywords: vegetables, consumption, portions, adults, Serbia

Dietary Patterns and Nutritional Status of Adolescents Aged 10-14 Years in Serbia: A National Survey Following EFSA EU MENU Methodology (2017-2022)

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Objective: This study aimed to examine the dietary patterns and nutritional status of adolescents aged 10-14 years in Serbia.

Methods: A nationally representative cross-sectional survey was conducted across different regions of Serbia from 2017 to 2022, including 507 adolescents (246 females (F), 261 males (M)). Data were collected on anthropometrics (body mass index, BMI), energy intake, and macronutrient distribution. Nutrient intake was assessed using two 24-hour dietary recalls, analyzed via the Serbian food composition database, in accordance with EFSA EU MENU methodology. Results are presented as median (IQR), and gender differences were evaluated using the Mann-Whitney test.

Results: The median age was 12.8 years (11.0-14.0) for F and 12.0 years (11.0-13.0) for M, with a significant difference between genders (p=0.015). There was no significant difference in BMI between F [19.0 kg/m^2 (17.3-20.7)] and M [19.5 kg/m^2 (17.8-21.4), p=0.085]. However, M had a higher total daily energy intake than F [2272 kcal/day (1852-2715) vs. 2054 kcal/day (1721-2439), p<0.001]. The macronutrient composition of the diet (% kcal/day) was similar between genders: fats (F: 42.7% [37.8-46.2%] vs. M: 42.8% [39.2-47.2%]), carbohydrates (F: 43.1% [39.5-47.4%] vs. M: 42.5% [37.8-46.6%]), and proteins (F: 14.0% [12.3-15.8%] vs. M: 14.3% [12.5-15.8%]), with no significant differences.

Energy intake predominantly came from grain products (F: 30.9% [25.8-37.1%], M: 30.2% [25.3-36.7%], p>0.05), followed by fats and oils (F: 13.8% [9.8-18.2%], M: 13.7% [9.9-18.1%], p>0.05), dairy products (F: 12.8% [9.3-17.5%], M: 14.1% [10.1-18.5%], p=0.043), and meat and meat products (F: 11.6% [7.1-17.6%], M: 11.4% [7.3-16.8%], p>0.05). Lower contributions were observed from vegetables (F: 6.7% [4.0-9.8%], M: 5.7% [4.0-9.5%], p>0.05), sweets (F: 5.4% [2.1-9.1%], M: 5.4% [1.6-8.7%], p>0.05), fruits (F: 5.3% [2.5-9.2%], M: 4.7% [1.9-7.6%], p=0.035), and eggs (F: 2.0% [0.6-4.6%], M: 2.8% [1.0-5.3%], p=0.018). Fish consumption was minimal, with no significant difference in energy contribution between genders. Non-alcoholic beverages contributed more to energy intake in M (F: 0.1% [0.0-3.1%], M: 1.3% [0.0-4.3%], p=0.040).

Conclusion: The diet of adolescents in Serbia, regardless of gender, is primarily based on refined grains, added fats and oils, dairy products, and meat. The low intake of fish, eggs, fruits, vegetables, nuts, and seeds highlights the need for improvement in dietary habits within this age group.

Dietary intakes of adult men and women 18-65 years old, in Serbian EU Menu Dietary Survey 2017-2022

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Objective: To examine the diet and nutritional status of adult Serbian subjects aged 18-64 years. Methods: This nationally representative cross-sectional survey, including 1182 subjects 18-44

years old, was conducted during 2017-2022 across different regions of Serbia, following the EFSA EU MENU methodology. Collected data included anthropometrics (body mass index, BMI) and the intake of energy, macronutrients, and separate food groups (examined through two 24-hour recalls, using the Serbian food composition database). Results are presented as median (IQR) for women and men, respectively, and the Mann-Whitney test's significance. Results: The survey included 597 females and 585 males, of similar age [42,7(29,0-52,0) vs 41,0(29,0-51,0) years, p>0,05]. Males had higher BMI [23,0(21,0-26,1) vs. 25,8(23,7-28,5) kg/m2, p<0,001], and total daily energy intake [1896(1519-2260) vs. 2608(2066-3178) kcal/d, p<0,001]. The macronutrient composition of the diet (%kcal/d) was dominated by dietary fats in both genders [43,1%(38,1-48,5%) vs. 43,7%(38,7-49,1%), p>0,05], then by carbohydrates [higher in women, 40,3%(34,0-46,2%) vs. 37,8%(31,5-43,3%), p<0,001], and ~15% derived from proteins [higher in men, 14,6%(12,5-17,0%) vs. 15,1%(13,0-17,4%), p=0,026]. However, the dietary requirements for proteins (0,8 g/kgBW/d) were not satisfied in about one-quarter of women (24,0% vs. 16,9% in men, p=0,003). Men also had a higher energy intake coming from alcohol [0,0%(0,0-0,0%) vs. 0,0%(0,0-4,5%), p<0,001]. Regarding food group distribution, most of the energy in both groups was coming from grain products [25,9%(19,2-33,5%) vs. 25,8%(20,1-32,6%), p>0,05], from edible fats&oils [higher in women, 15,4%(10,7-20,1%) vs. 13,8%(9,5-18,8%), p=0,001], or meat and meat products [higher in men, 11,7%(6,1-17,8%) vs. 15,9%(9,6-23,8%), p<0,001], then from dairy products [10,3%(5,7-14,9%) vs 9,9%(6,1-14,4%), p>0,05), vegetables [6,5%(4,1-10,0%) vs. 6,0%(3,8-8,7%), p>0,05], fruit [higher in women, 5,6%(1,8-10,1%) vs. 2,8%(0,0-6,6%), p<0,001], eggs [1,5%(0,4-4,6%) vs. 1,8%(0,5-5,0%), p>0,05], nuts and seeds [higher in women, 2,9%(1,1-6,5%) vs. 1,7%(0,5-4,0%), p<0,001), sweets [higher in women, (3,1%(0,4-7,4%) vs. 2,1%(0,2-5,7%), p=0,001], and alcoholic and non-alcoholic beverages [higher in men, 0,6%(0,0-4,8%) vs. 3,8%(0,1-9,9%), p<0,001]. Fish consumption was not reported by 76,5% of women and 80,5% of men, but even in those who reported fish consumption, the daily energy contribution was quite low, 6,0%(3,5-9,6%), vs. 5,2%(3,1-9,6%), p>0,05. Conclusion: The diet of the adult subjects in Serbia is characterized by a high intake of dietary fats (coming mostly from edible fats and oils, meat, and dairy products), followed by carbohydrates (coming mostly from refined grains), and a moderate intake of proteins (coming mostly from meat, grain products, dairy products, and legumes). The intake of fish, eggs, vegetables, fruits, seeds, and nuts is insufficient.

Authors declare no conflict of interest.

Correlation between water intake and birth weight in healthy pregnancy

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Pregnancy is a physiological state in which a woman's body undergoes a series of changes to support the needs of a growing fetus. These include changes to the cardiovascular, urinary, respiratory, and metabolic systems, which result in higher blood plasma volumes, as well as an increase in water loss through urine, respiration, and perspiration. Due to these changes, water balance may be altered if requirements are not met, leading to dehydration and oligohydramnios. Consequently, research suggest that there is an increased risk of adverse outcomes in babies, such as low birth weight, length, and circumferences. The aim of this study was to assess whether the differences in water consumption affect birth weight. This study included healthy pregnant women recruited at delivery (n=143, mean age 31.2 ± 4.7 years). Using a questionnaire, specifically

constructed for this study, participants were asked about the intake of drinking water on average per day and the predominant type of drinking water (tap vs. bottled vs. filtered vs. other). Upon delivery, birth weight information was collected from the medical chart. All participants gave written consent. The mean daily average intake of water reported by women was 1.9 ± 0.6 L/day. Most women drank bottled water (44.1%), followed by tap water (41.3%). Additionally, 14 women drank filtered tap water (14%), while only one consumed well water (0.7%). The average birth weight was 3448.3 ± 435.5 g. There is a small positive correlation between reported water intake and birth weight (p=0.043, rho=0.17). The choice of water did not affect the average water intake. Although this study did not assess overall water intake, including intake through beverages and food, drinking water in pregnant women could affect birth weight. These results reflect the importance of maintaining an adequate water intake to provide a safe environment for the growing baby.

CHANGE Project (CHild malnutrition & Adult NCD: Generating Evidence on mechanistic links to inform future policy/practice): a multi-country cohort study

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BACKGROUND: Child malnutrition is a major global public health problem. Wasting (low weight-for-height) alone affects some 49 million children aged <5 years and is responsible for 900,000 deaths/year. Effective malnutrition treatment programmes exist, but obstacles to their success include a need to:

àEnsure children thrive long-term, not just survive short term. Current programmes do not account for increasing evidence that survivors are at risk of later-life non-communicable disease (NCD).

àOptimise post-malnutrition weight gain (PMWG). Current programmes often encourage rapid weight gain following malnutrition. High income country data suggest that too rapid a weight gain in small infants can increase future NCD risk. Whether this applies to low-and middle-income countries (LMIC) is unknown.

OBJECTIVES: 1. To optimise severe malnutrition treatment programmes by better understanding the mechanisms linking infant/child undernutrition to longer-term (adult) NCD

2. To understand how post-malnutrition weight gain (PMWG) affects risks of cardiometabolic NCD

3. To develop biomarkers for predicting NCD risk in survivors of child malnutrition

METHODS

We are combining data from 7 cohorts in 3 countries to gather insights which are not possible from one alone:

JAMAICA

i. LION Cohort: Malnourished children treated in inpatient care (1965-93) MALAWI

ii. ChroSAM: Malnourished children treated in a hybrid inpatient/outpatient care programme in 2006-7 (+controls)

iii. MEIRU '1000': Malnourished children (+controls) from a community setting, originally identified in 2002-4

iv. MEIRU 'birth cohort': Births in a rural demographic surveillance site, 2020-21 ETHIOPIA

v. ACAM: Malnourished children treated in outpatient care in 2013-15 (+controls)

vi. 1980s famine cohort: Adult famine survivors (exposed at different stage of childhood)

vii. MAMI Participants in an large RCT of a patient support package to improve infant growth and health.

RESULTS: Key analyses to date will be shared at the meeting. Overall they confirm risk of later-life NCD following child malnutrition. They also suggest that weight gain in the ranges seen in current malnutrition programmes do not increase long-term NCD risk. In contrast, in old style inpatient programmes, highest weight gains do show possible association with future NCD risk. Further results will be available in November

CONCLUSIONS: There is an urgent need to optimise long-term as well as short-term outcomes following child malnutrition. Whilst rapid weight gain does not seem to be a major NCD risk factor, it may play a minor role. These results from low-income settings are also relevant to vulnerable and marginalised children in high-income countries.

Food system based dietary guidelines in MNE from a public health perspective

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Overweight, obesity, access to quality and nutritious foods, micronutrient deficiencies, and diet-related non-communicable diseases are the main issues in MNE. The prevalence of adult obesity is higher than the world average 25.2% of women and 26.0% of men. The prevalence of obesity in seven-year-olds (COSI 2022 after the COVID 19 pandemic) in boys was 19.4%, in girls it was 10.1%, which is higher compared to the previous round of research (COSI 2019). Eating patterns and prevalence of breastfeeding are unsatisfactory, the minimum frequency of meals among children is below 50%. Anemia in children up to 5 years old and pregnant women in Montenegro is a mild public health problem, and a significant number of children with iron deficiency (MIKS 2018, MONS 2022). Nutrition policy in MNE, including nutrition guidelines for preschool children, recommendations to reduce the consumption of foods high in sugar, fat and salt, and efforts to reformulate food products to make them healthier, signal a commitment to encouraging positive change. Methods: Qualitative and quantitative descriptive methods were used. Results: Global goals and time frames related to food and nutrition are closely related to the SDGs, and incorporated in several strategic documents. The importance of relevant national initiatives was identified through the Situation Analysis and Evidence Review. SAER REPORT mapping of national actors - team of stakeholders, review of data and data sources and existing deficiencies was carried out and current status of food system and nutrition data collection and the role of different stakeholders. It includes integrated all relevant national policies including health, agriculture, food and nutrition, public health context and data related to nutrition and nutritional status, food production and consumption, sociocultural influence, composition and availability of food.

Conclusion: Healthy diet from sustainable food system are dietary patterns that promote all dmensions of individuals' health and well-being and support the preservation of planetary health Food guideline is more than a graphic and recommendations for healthy diets directed to the general population; It has the potential to inform and guide policymaker actions, not simply to inform or encourage individuals. Our FBDG will have a objectives to promote and support healthy eating

patterns at the population level, provide evidence-based recommendations for food choices, to prevent diet-related chronic diseases and improve the nutritional status of the population.

Integrating Underutilized Crops into Sustainable Food Systems: A Multidisciplinary Approach to Enhancing Resilience and Nutrition in Europe through the DIVERSICROP Initiative

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Introduction: DIVERSICROP addresses the pressing need for sustainable food systems in Europe by integrating underutilized crops such as rye, chickpeas, and peas. These crops, historically important and well-adapted to various European climates, offer resilience against environmental stresses while providing significant nutritional benefits. By leveraging these traits, the project aims to contribute to climate adaptation, enhance dietary diversity, and improve food security and public health.

Methods: The project employs an interdisciplinary approach, combining crop science, nutrition, genetics, history, and policy analysis expertise to build a comprehensive sustainable production framework. Genetic resources are mapped, and historical data is analysed to identify socio-economic, environmental, and agronomic factors that influence the cultivation of these crops. By investigating the genetic diversity within these species, DIVERSICROP identifies varieties best suited for sustainable cultivation and climate adaptation. A harmonized dataset, integrating archaeological, plant science, nutritional, and policy data, serves as the foundation for developing evidence-based strategies to promote the cultivation and consumption of these crops across Europe.

Conclusion: DIVERSICROP aligns with the European Green Deal's Farm to Fork and Biodiversity strategies, contributing to the United Nations Sustainable Development Goals by enhancing agricultural sustainability and promoting healthier diets. The project's scientific approach and comprehensive nutritional assessments demonstrate the potential for these crops to meet dietary guidelines and be incorporated into sustainable food systems. Ultimately, DIVERSICROP seeks to reshape agricultural practices across Europe, making underutilized crops a central element of resilient and sustainable food systems.

Keywords: underutilized plants, health, nutrition, sustainability, food security

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Exploring innovative approaches to ensure adequate calcium intake

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Ensuring sufficient calcium intake is essential for maintaining bone health and overall well-being. While traditional sources like dairy products and supplements are widely recognized, innovative methods are emerging to enhance calcium intake across diverse populations. This review paper explores various strategies to improve dietary calcium intake. Biofortification of crops, which involves increasing calcium content through conventional breeding or genetic modification, is a method applicable in both developing and developed countries. This approach could effectively address dietary deficiencies in regions where access to diverse foods is limited, while also aligning with established agricultural practices. Another innovative method is fortifying commonly consumed beverages, such as fruit juices, with calcium. This provides a convenient and tasty alternative for individuals who are lactose intolerant or prefer plant-based diets. For example, strategies could incorporate the development of fruit juice concentrates fortified with eggshell calcium, flavored calcium additives for fruit juices, and small, ready-to-drink concentrated 'shots' of calcium-enriched juice. Additionally, specially formulated juice packs for children can be applied as nutritious, bone-strengthening beverages. Similarly, developing new calcium-rich food products, such as fortified cereals, snack bars, and ready-to-eat meals, offers convenient options for individuals with busy lifestyles. Promoting the consumption of traditional calcium-rich green leafy vegetables and fermented and functional foods are additional strategies that could provide added value. Furthermore, educational campaigns that emphasize the health benefits of consuming calcium-enriched foods and products, along with their sustainable sources, can attract health- and environmentally-conscious consumers. Moreover, nanotechnology could be employed for developing highly absorbable calcium particles. Finally, collaborating with food manufacturers and processors will help develop and market calcium-fortified products and ensure their widespread availability and affordability. These multifaceted approaches, from biofortified crops and fortified beverages to functional foods and personalized nutrition, aim to improve calcium intake across diverse populations. As these methods develop and become more accessible, they can significantly impact public health by reducing the prevalence of calcium deficiency and its associated health issues in both developed and developing countries.

Bermet wines as inhibitors of ICAM-1 expression in HMEC-1 cells

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Bermet is a uniquely flavoured wine, produced from grapes growing in Fruška Gora wine region (Vojvodina, Serbia) and infused with up to 26 different aromatic medicinal plants. This traditional wine has been made since the 15th century, but information on its chemical composition and

biological properties remains limited. It is well known that grape polyphenols have certain biological activity and can contribute to the health benefits of moderate wine consumption. Therefore, quantitative analysis of 7 phenolic acids, 6 flavonoids, 2 stilbenes, 15 anthocyanine glucosides, galactosides and arabinosides by HPLC-UV/VIS technique was applied to elucidate differences in the phenolic profile of 12 Bermet samples. Also, the contents of total phenols, tannins, flavonoids and anthocyanins were evaluated by spectrophotometric methods. Endothelial cells are essential for maintaining vascular homeostasis by regulating permeability and producing signaling molecules. Dysfunctional endothelial cells are characterized by reduced levels of signaling molecules (e.g. nitric oxide) and increased levels of pro-inflammatory cytokines and adhesion molecules, thus promoting leukocytes adhesion and migration, an early, key step in atherosclerosis development. This study aimed to evaluate Bermet wines' potential to inhibit ICAM-1 (Intercellular Adhesion Molecule 1) expression in the endothelial cells (HMEC-1). Cells were pre-treated for 30 min with a sub-toxic concentration of Bermet wine (300 mg/mL) or parthenolide (5 μM) as a positive control, afterwards ICAM-1 expression was induced by TNF-α (10 ng/mL). After 24 hours, cells were washed with PBS, detached with trypsin/EDTA, and fixed with formalin. Incubation (20 min) of fixed cells with the Mouse Anti-human CD54:FITC antibody, was followed by fluorescence-activated cell sorting (FACS; Becton Dickinson FacscaliburTM). The most abundant polyphenols in examined Bermet wines were gallic acid (2.3-51.3 mg/L) and catechin (to 19.5 mg/L). Stilbene piceid was mostly detected in higher content (0.3-9.9 mg/L) than resveratrol (0.1-9.9 mg/L). Anthocyanins were noticed in only four samples. Compared to the positive control (parthenolide), wines manifested weaker ability to inhibit ICAM-1 expression. Among the 12 tested wine samples, the most active one inhibited ICAM-1 expression by 18%. No direct correlation between polyphenolic profile and bioactivity was established. The presented results are part of the comprehensive research regarding the biochemical properties of Bermet wine, with an overall goal to elucidate potential health benefits of moderate Bermet consumption and enhance the recognition of Serbian Bermet in both domestic and global markets.

Phytochemical Evaluation and Antioxidant Properties of Satureja montana L. tea

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Traditional Serbian medicine is rich in the use of aromatic herbs for treating various ailments, often relying on local plants to support health and well-being. Among these, Satureja montana L. is commonly used as a tea, valued for its ability to aid digestion, relieve respiratory issues, and reduce inflammation. The aerial parts of this semi-evergreen plant, particularly during the blossoming phase, are harvested and used as Satureja herba, which is rich in essential oils and phenolic compounds. Thus, this study aimed to determine the phytochemical composition and antioxidant activity of its aqueous extracts, reflecting the constituents typically ingested through tea preparation. The monocomponent tea was spectrophotometrically analyzed to measure principal phytochemical parameters such as total phenolic content (TPC), total flavonoid content (TFC), total tannin content, and the amount of hydroxycinnamic derivatives (HCAs). To evaluate the antioxidant capacity, several assays were utilized, including ABTS•+, DPPH•, ferric reducing power (FRP), in vitro phosphomolybdenum total antioxidant capacity (TAC), and cupric reducing antioxidant capacity (CUPRAC). The results were reported on a dry weight (DW) basis. The analysis revealed the TPC of 35.40 mg/g GAE, indicating a notable presence of phenolic compounds. Furthermore, the TFC was measured at 27.13 mg/g RE, while the HCAs amounted to 5.21 mg/g CGAE, and the total tannin content was found to be 10.74 mg/g TAE. The ABTS•+ and DPPH• assays showed antioxidant capacities of 214.07 μmol Trolox/g and 148.57 μmol Trolox/g, respectively, highlighting its particular ability to neutralize free radicals. The TAC was significant at 47.40 mg/g AAE, further

demonstrating the tea's overall antioxidant strength. Additionally, the FRP assay recorded a value of 35.15 mg/g AAE, indicating effective reducing power, while the CUPRAC assay yielded 32.46 mg/g AAE. In conclusion, these results collectively underscore the tea's potent antioxidant properties and noteworthy phytochemical structure, suggesting the potential of S. montana tea as a beneficial natural source for combating oxidative stress and promoting health.

Chitosan production from Agaricus bisporus mushroom

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Chitosan is a natural nontoxic biopolymer with potential application in agriculture, biomedicine, pharmaceutical, textile and food industries. Industrially grown mushrooms are recognized as suitable for the production of chitosan due to the simple extraction processes with reduced variations in quality.

Chitosan was extracted from Agaricus bisporus (Champignon) as a crude chitosan under laboratory conditions (Faculty of Agriculture, Belgrade). In general, the extraction process consists of three steps: (1) alkaline treatment to remove protein and alkali-soluble polysaccharides with 9 M NaOH at 121 °C in an autoclave, during 1.5 h (2) acid treatment to separate chitin and chitosan with 5% acetic acid at 95 °C for 6 h and (3) precipitation of chitosan under alkaline conditions. Chemical characterization by nuclear magnetic resonance (NMR) showed a high degree of deacylation of chitosan extracts 92.7 % (1.5h), compared to commercially available mushroom chitosan 75-85%. The β-glucan content, determined using an enzymatic β-glucan assay kit (yeast and mushroom), was 229.7 mg/g (1.5 h) dry weight (DW) of the chitosan extract. The β-glucan content of the commercial sample was significantly lower, 15.0 mg/g of DW extract. Further, the antioxidant properties of prepared chitosan were determined under in vitro conditions by using spectrophotometric methods. The scavenging ability of free DPPH• radicals of the laboratory-prepared chitosan at a concentration of 5 mg/mL was 99.35%, while the ferrous ions chelating ability of this sample was 98.50% at 5 mg/mL. Antibacterial activity was tested using broth microdilution assay (C= 0.078-5 mg/ml). Low bactericidal concentrations were detected, 2.5 mg/ml for Escherichia coli (ATCC 25922) and 0.625 mg/ml for Enterococcus faecalis (ATCC 29219). The mycotoxigenic strain of Aspergillus flavus was grown on a solid medium enriched with 20 mg/ml of laboratory-prepared chitosan. The percentage of inhibition of the mycelium growth compared with the growth on the agar without chitosan was calculated. A. flavus was inhibited for approximately 36% after three days of growth on the agar with chitosan, compared with control.

The antioxidative and antimicrobial activity of crude chitosan from A. bisporus makes it a potential material for food packaging. Furthermore, composites based on natural clays and chitosan are being investigated within our project research group for decontaminating animal feed contaminated with mycotoxins.

Keywords: Antimicrobial activity, Antioxidant activity, Chitosan, Mushroom,

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Chicory bee-collected pollen as source of antioxidants for novel food preparation

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Bee-collected pollen (BCP) has been proved as an excellent functional food ingredient. It possesses well balanced all requested nutrients. However, BCP is an excellent source of different phytochemicals with expressed bioactivity such as phenolics, phenyl amides, carotenoids, vitamins, etc. However, pollen's bioactivity is strongly influenced by its botanical origin. In order to fulfil missing data current study aimed to examine general phytochemical composition of monofloral bee-collected pollen originated from Chicory (Cichorium intybus). According to palynological analysis, the obtained BCP contained more than 98% of pure Chicory pollen grains. By spectrophotometric assays total phenolic (TPC), flavonoid (TFC), dyhydroxycinnamic acid derivative (HCA) and total soluble sugar were determined in prepared methanolic (80%) BCP extracts as extractable (free fraction) as well as bound fraction liberated after alkaline digestion. Total carotenoid (TCC) content was determined in 80% acetone as solvent. In addition, antioxidant properties were determined through several standard assays: TAC, FRP, DPPH•, ABTS•+ and CUPRAC. All results are expressed based on dry weight of BCP sample. The obtained values for TPC, TFC and HCA parameters were 9.9 mg/g GAE, 8.3 mg/g RE and 4.4 mg/g CGAE for extractable fraction, respectively. For bound fraction, same parameters had values as follow: 1.2 mg/g GAE (TPC), 1.0 mg/g RE (TFC) and 0.7 mg/g CGAE (HCA). Total soluble sugar value was 113 mg/g glucose while TCC had value of 143.6 µg/g. In antioxidant assays extractable fraction exhibited higher activity that was in the line for phytochemical composition. The highest value was obtained for in vitro phosphomolybdenum total antioxidant capacity (TAC) for extractable fraction while both extracts possessed the lowest ability for ferric ion reduction. Bioactive compounds in extractable fraction showed notable ability for radicals quenching with higher activity against ABTS radical cation compared to DPPH radical assay. Based on all, it can be concluded that Chicory BCP can be a good source of different antioxidants applicable in novel food development.

Hazards in food supplements: an EU RASFF notification analysis

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The consumption and popularity of food supplements are increasing globally. However, in addition to potential benefits, there are concerns about food supplement quality and safety. In addition to excessive intake of nutrients or substances with physiological effects and potential interactions with drugs, the possible presence of contaminants in food supplements, including intentionally added unapproved substances, increases the risk of adverse effects. The European Rapid Alert System for Food and Feed (RASFF) is a tool that ensures a rapid flow of information on health risks in the food chain. The aim of the study was to evaluate the RASFF notifications on main hazards related to food supplements for the period 2019-2024. Over 93% of notifications for the product category "dietetic food, food supplement and fortified food" were reported for food supplements. Among food supplement notifications, 37% were attributed to non-authorized novel foods, including cannabinoids, L-alpha-glyceryl phosphorylcholine, and 5-hydroxytryptophan, contributing up to 62%. Other notifications were related to plants, plant products or plant ingre-

dients, prohibited or presented in doses higher than allowed (18%), chemical contaminants (18%), pharmacologically active substances (14%), nutrients and physiologically active ingredients, unauthorized or presented in non-allowed content (10%), while the rest were related to unauthorized additives and processing aids, microbiological and physical contaminants, and others. Some notifications included more than one reason for the notification. Regarding the risk decision, more than 40% of all notifications were classified as a serious risk. The United States was the most frequently notified origin country, followed by the United Kingdom, Netherlands, India and Germany. Overall, increasing RASFF notifications indicate the need for more harmonized legislation on food supplements and continuous monitoring of compliance with these products on the market by governing authorities.

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Risk and benefit of omega-3 fatty acids food supplements for pregnant and breastfeeding women

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The well-being of pregnant and breastfeeding women and their offspring is extremely important, both for themselves and for society as a whole. And well-being is not possible without quality nutrition, which ensures the intake of all the necessary nutrients through food that is safe regarding the presence of hazardous compounds. However, modern diet is often depleted of omega-3 fatty acids (ω-3-FA), especially eicosapentaenoic (EPA) and docosahexaenoic (DHA). Considering that foods rich in these nutrients, such as fish (salmon, mackerel, herring, sardines, tuna, cod, krill, etc.) and algae, are not so common on our tables, use of the ω-3-FA food supplements can be seen as a simple yet effective way for their intake. The health benefits of ω-3-FA are summarized in authorized health claims - DHA maternal intake contributes to: the normal brain / eye development of the foetus and breastfed infants / the normal visual development of infants up to 12 months of age. On the other hand, associated health concerns could not be neglected, especially in case of methylmercury, a potential contaminant of fish oil, responsible for developmental neurotoxicity. Considering that recent survey conducted in the Republic of Serbia and the Republic of Srpska showed that the use of ω-3-FA via supplements was reported by nearly half of pregnant and breastfeeding women, this study was undertaken to explore the capacity of the ω-3-FA supplements intended for them and available on these markets to fulfil the nutritional requirements as well as pose health risk. A total of 11 ω-3-FA supplements, containing fish (10) or algae oil (1), were subjected to GC-FID analysis of their FA profiles and DMA analysis of mercury contamination. The intake of EPA and DHA, assessed taking into account daily doses of supplements recommended on their labels, significantly contributed to the current nutritional recommendation for daily intake of EPA+DHA of 250mg and additional DHA intake of 100-200mg. Very low amounts of mercury found in fish oil supplements led to a practically negligible contribution of 0,03±0,04% to the oral reference dose or 0,02±0,02% to the tollerable weekly intake, corresponding to an increase of the usual dietary intake of mercury of 0.01%. In case of inorganic mercury, expected in algal oil, the contribution was even lower. In conclusion, the study findings indicate an excellent ratio of benefit obtained through intake of ω-3-FA and risk attributed to mercury contamination of the ω-3-FA food supplements for pregnant and breastfeeding women.

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Determination of anthocyanins content in three samples of herbal teas with cranberry, Vaccinium macrocarpon Aiton

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Herbal and fruit teas are very popular because of their ease of preparation and their refreshing taste and smell, as well as their positive effects on health. They are a good source of various polyphenolic compounds, especially anthocyanins, which have significant pharmacological effects (antioxidant, cardioprotective, anti-inflammatory, antitumor, antidiabetic, etc.). Anthocyanins are flavonoid compounds present in plants, especially in fruit and vegetables, from which red, purple and blue colour is derived (blueberries, blackberries, raspberries, hibiscus flowers, etc.). However, their use is limited, because they are extremely unstable compounds, and the main factors of instability are pH value, light, temperature and the presence of enzymes. The aim of this work was to determine the anthocyanin content in three commercial samples of cranberry herbal teas (Teekanne-Cranberry&Rasberry; Teasy-brusnica, voćni čaj od plodova brusnice i jabuke, sa cvetom zove; and Fructus-Exclusive, brusnica 51%), using the pH differential method. In all samples, the content of total polyphenols was determined with the FC (Folin-Ciocalteu) reagent, as well as the ability to neutralize DPPH radicals, as a measure of radical scavenging activity. The results confirm that the examined herbal teas are the significant source of anthocyanins and polyphenols, which in high percentage neutralize the DPPH radical (Teekanne: anthocyanin 24,8 mg/L, total polyphenols 294,2 mg GA/L, DPPH 80,8%; Teasy: anthocyanin 6,8 mg/L, total polyphenols 120,2 mg GA/L, DPPH 45%; Fructus: anthocyanin 35,6 mg/L, total polyphenols 467,1 mg GA/L, DPPH 87,7%). The differences observed were due to the different qualitative and quantitative composition of the samples.

Keywords: cranberry, anthocyanins, polyphenols, DPPH

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What about health benefits claimed on soy isoflavone food supplements?

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Food supplement labels often contain health claims (HC), designed as a means to communicate health benefits to consumers. HC are used voluntary, according to the manufacturer's decision, but they must comply with the regulations. The aim of this study was to assess regulatory compliance of HC listed on the labels of soy isoflavone supplements. Among 21 supplements collected on the market of Serbia, only 1 was without HC and 4 presented only claims compliant with regulations (2 HC related to vitamins/minerals and 2 "on-hold" claims from EFSA List of questions related to botanicals). Majority of non-compliant supplements (14) presented HC referring to the entire product instead to the active ingredient, of which 12 had additional authorized HC related to vitamins and minerals (52!) / "on-hold" claims from EFSA List / non-compliant HC related to active ingredients. The extent of the consumer deception can be perceived through one HC

presented on a supplement containing only dry extract of soybean: "It alleviates the symptoms of menopause: hot flashes (feeling of great heat), feeling tired and exhausted, mood changes, sleep disturbance and poor sleep, as well as reducing the risk of osteoporosis and cardiovascular diseases". It is important to stress that there are no authorized HC related to benefits of soy isoflavones. However, 2 HC stated: "Soy isoflavones improve the metabolic balance of women during menopause" and "Soybean extract alleviates the symptoms of menopause".

Presented findings clearly advocate for more stringent control of supplement labelling in order to protect consumers trust and health.

Mandatory statements on food supplements: an example of soy isoflavones

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Food supplement labels must contain certain mandatory statements that provide important information to consumers. The aim of this study was to assess regulatory compliance of soy isoflavone supplements regarding the presence of mandatory precautionary/warning statements on their labels.

The only warning provided on all 21 products collected on the market of Serbia was that the product must be kept out of the reach of children. Statement that supplements cannot be used as a substitute for a varied and balanced diet was found on 16 products, while 4 carried a statement that the product is not suitable as the only food source. The warning that the recommended daily doses should not be exceeded was carried by 20 supplements. Restrictions "not intended to/must not be used by" were listed on 18 products, relating to: pregnant and lactating women (14), individuals allergic to some of the ingredients (12), children (12); patients with pathological conditions (12 products with 18 restrictions, half of them referring to the history/presence or existing risks for estrogen-dependent cancers, which is related to the presence of soy isoflavones). The prevalent reasons for consultation with a doctor before use were simultaneous use of drugs (9) and medical supervision/special medical conditions (6), occurrence of side effects (4). Information about possible interactions with other drugs or potential side effects were listed on 6 and 2 products, respectively, and presence of allergens on 2, although soy is a major allergen. Evidently, marketed supplements do not provide all information necessary for protection of consumer well-being.

Vitamin C in food supplements- is it as presented?

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Introduction: Vitamin C is a hydrosoluble vitamin that has many important roles in the human body. It plays several vital roles in the body including: antioxidant protection, collagen production, wound healing, improving iron absorption and immune system support. The daily need for vitamin C is usually met by intake through food. However, certain conditions such as nutritional deficiencies, pregnancy and lactation, smoking, chronic illnesses, etc. require vitamin C supplementation. Considering the significance of vitamin C intake from food supplements to prevent

deficiency, the wide range of vitamin C food supplements available on the market, as well as the increasing popularization of its consumption, the aim of this research was to evaluate the compatibility between the measured vitamin C content and the labeled content in food supplements present on the market of the Republic of Srpska.

Methodology: Determination of vitamin C content was performed by high-performance liquid chromatography (HPLC). In total, 13 samples of various pharmaceutical dosage forms were analyzed.

Results: It was found that all of the tested food supplements met the quality requirements prescribed by legislative on food suplements in the Republic of Srpska.

Conclusion: The results indicate that all examined products are of satisfactory quality, but regarding the wide range of its presence and consumption, it is important to continuously monitor its content in food supplements.

Keywords: food supplements, vitamin C, content

Quality control of effervescent tablets in the Republic of Srpska market - disintegration

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Introduction: To ensure that consumers have access to good quality products, it is necessary that food supplements meet all quality and health requirements prescribed by current legislation and standards. As dosed pharmaceutical forms, food supplements in the form of effervescent tablets must meet the requirements of the Pharmacopoeia regarding disintegration time. Disintegration time is one of the pharmaceutical-technological quality indicators that must be assesed after production. Therefore, the aim of this research was to investigate disintegration of effervescent tablets that are on the market of the Republic of Srpska.

Methods: To determine the fulfillment of the conditions for the disintegration of effervescent tablets, the standard method according to Ph.Eur.10.0 was used. The effervescent tablet is placed in a flask with 200 ml of water R at a temperature of 15-25°C. Gas bubbles will appear immediately. When the formation of gas around the tablet or its parts stops, the tablet is considered to have disintegrated through the process of dissolution or dispersion. No aggregates of particles should be present. The test is repeated in the same manner with five additional tablets. Unless otherwise specified, all six tested tablets must disintegrate within 5 minutes.

Results: A total of twenty-three samples of multivitamin food supplements in the form of effervescent tablets were tested, of which twenty-one samples meet the requirements prescribed by the Ph.Eur.10.0. Two samples did not disintegrated well within 5 minutes, remaining small aggregates of particles in flask.

Conclusion: At the market of the Republic of Srpska, food supplements in the form of effervescent tablets generally display satisfactory quality. However, some samples or batches have not met these standards. Therefore, ongoing quality control is important to ensure consistent bioavailability and protect consumer rights.

Keywords: effervescent tablets, disintegration, Republic of Srpska

Health risk associated with elemental impurities in soy isoflavone food supplements

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Soy isoflavone supplements are intended mostly for relief of menopausal symptoms. To support the well-being of postmenopausal women, supplements must be proved safe regarding the presence commonly suspected contaminants, toxic metal(loid)s, and that was the main objective of this risk assessment study. Supplements containing soy extract were represented with 21 products collected in the Republic of Serbia and Republic of Srpska. Considering that, according to the product labels, some of the elements (Zn, Fe, Se, Mn, Cu, Cr and/or B) were intentionally added to seven supplements, such element-supplement combinations were excluded from the assessment. Calculation of the exposure of women to toxic metal(loid)s was based on supplement elemental profiles (23 elements, determined by inductively coupled plasma mass spectrometry) and usage pattern recommended by the manufacturer.

The ICH Guideline for Elemental Impurities risk indicator, permitted daily exposure, indicated no risk for any of the considered elements: Class 1 elements (systemic toxicants causing multiple organ injury/failure; limited/no use in the manufacture of pharmaceuticals) Hg, As, Pb and Cd; Class 2A elements (route-dependent toxicants; high probability of occurrence) Co, V, and Ni; Class 2B elements (route-dependent toxicants; reduced probability of occurrence) Se and Tl; Class 3 elements (low toxicity when orally administered) Ba, Cu, Cr, Sb and Sn; non-classified elements (low inherent toxicity) Te, Be and Sr. Only Pb, Ba and As exceeded 0.1% of the corresponding limits, while for all other elements this value was lower. The hazard quotient (HQ), another risk indicator, was in the range from 1 to 10% of the acceptable level in case of Al, V, Mn, Cu, As, Ba and Tl, and only Co reached 22% of the respective oral reference dose. What's more, the risk metric for cumulative exposure, presented as hazard index, was on average at 5% of the acceptable level, with not one of the supplements exeeding it (maximum 25%). Margin of exposure values for Pb indicated no risk, while in case of As, they were acceptable but rather low for two supplements (MOE 2 and 5), for which lifetime cancer risk estimates were above the limit of one additional case per 100 000 people. The estimated average increase of the usual dietary intake due to supplementation was 7.2% for As, 0.4% for Pb, 0.4% for Hg and 0.3% for Cd.

Considering their rising popularity, high-quality and safe supplements should be the ultimate goal of producers, public health authorities and consumers.

Safety of untreated drinking water in Montenegro

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Data on water quantities, reserves and quality are extremely important for every country. These data are the basis for sustainable water management practices and must therefore be reliable and comprehensive. Therefore, it is essential to monitor and evaluate various parameters of water quality, because water for human consumption must be safe for health. The paper systematizes data on the safety and quality of untreated water in all municipalities in Montenegro over a period of ten years. In the period from 2014 to 2023, an analysis of 24 204 of samples of untreated water in Montenegro was carried out, of which there were 11 607 of physical-chemical and 12 597 of microbiological. When it comes to physico-chemical parameters, non-compliance was determined

on average 10,02% and ranged from a maximum of 17.08% in 2015, when the smallest number of samples were sampled, to a minimum of 3.47% in 2020. When it comes to microbiological analyzes of untreated water in Montenegro, in the observed period, the deviation from conditions stipulated by the rulebook are established in 59,98% on average, which ranged from 53.34% in 2021 to 67.3% in 2016. The dominant cause of physico-chemical inconsistencies were increased turbidity, and microbiological inconsistencies were caused by the excessive presence of aerobic mesophilic bacteria and coliform bacteria. Pearson's correlation coefficients were used to examine the relationship between the number of samples and the percentage of defective samples, as well as between the physicochemical and microbiological integrity over the years. The correlation between number of samples and percentage of defective samples was very low for physicochemical (-0.06) and microbiological integrity (-0.07) and no statistical significance was established. Examining the correlation between age and percentage of defective samples revealed a negative correlation for physico-chemical correctness (-0.23) and a positive correlation for microbiological correctness (0.11), but without statistical significance. There is no significant linear association between the examined variables. Using the ANOVA test, a statistically significant difference was determined for the physico-chemical correctness over the years (p=0.0135), while it was not for the microbiological correctness. A statistically significant difference was found in the percentage of defective samples between municipalities, both for physical-chemical (P=1.95e-11) and microbiological correctness (p=0.0030). The results indicates the necessity improving water conditions by reducing pollutants and solving sources of pollution, with the aim of achieving better water quality and minimizing its negative effects on the environment and human health.

Drinking water safety in rural areas: A Case Study of Zenica Doboj Canton

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Introduction: Ensuring safe and reliable access to potable water is a fundamental public health necessity, particularly in rural areas where infrastructure limitations and environmental factors can increase the risk of waterborne contaminants. This study aims to identify the most frequent microbiological and chemical irregularities in the drinking water supply in rural areas of Zenica Doboj Canton, Bosnia and Herzegovina, by analyzing water quality data over three years (2020-2023). The research methodology includes the collection of water samples from various rural locations, followed by microbiological and chemical analyses conducted according to national standards for potable water.

Methods: Microbiological parameters assessed include total coliforms, Escherichia coli (E. coli), and intestinal enterococci, while chemical parameters encompass nitrate, nitrite, pH. Results indicate that the most frequent microbiological irregularities stem from fecal contamination, particularly the presence of E. coli and enterococci, in over 80% of the tested samples, which is above permissible limits outlined by World Health Organization (WHO) guidelines. Chemical irregularities, though less frequent, were predominantly due to increased turbidity or elevated levels of nitrates.

Results: The findings suggest that inadequate sewage infrastructure and agricultural runoff are the primary contributors to microbial contamination, while improper waste disposal and industrial activities account for the chemical pollutants. Such irregularities pose a significant public health risk, with potential long-term effects including gastrointestinal illnesses and chronic conditions related to heavy metal exposure.

Conclusions: To mitigate these risks, the study recommends strengthening water safety plans (WSPs), enhancing monitoring systems, and promoting sustainable agricultural practices to re-

duce contamination sources. Additionally, increasing community awareness and engagement in water management practices is critical for long-term improvements in water quality. The study contributes to a growing body of literature emphasizing the importance of rural water quality management and highlights the need for more stringent regulation and proactive public health measures to ensure safe drinking water access in vulnerable rural populations.

Keywords: water, safety, microbiological contamination, rural, Zenica

Near infrared spectroscopy (NIR) - analysis of proteins and fats in food

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Spectroscopy is an analytical technique that uses the interaction of optical energy with a sample to analyze its composition and which covers wavelengths invisible to the eye from 780 nm to 2500 nm. We analyze proteins and fats in homogenized triple daily meals without bread for the army. This is important because of the energy of the whole meal and this is in correlation to activity of soldiers.

We analyzed this food by near infrared spectroscopy during eight years from 2017 to 2024. and compared our results to classic techniques: Kjedahl–volumetric method for analysis of proteins and Gerber-acidobutirometric method for analysis of fats. We used samples with different concentrations of protein and fat and made their spectra for calibration curve with spectral range from 4000 to 12800 cm-1. Our findings confirm that the results are more similar from year to year, because we had more and more new spectra on the calibration curve from both proteins and fats in these kinds of samples. For example in the first year we had 60,6% of our results for proteins different in range 5-10% from Kjedahl method, and then in 2024. that percentage was 95%. It was a really good comparison. For fats 50,0% of our results were different in range 5-10% from standard Gerber method, and then in 2024. that percentage was 95%. The main advantage of spectroscopy is there is no preparation of samples and use of any reagents and also you can have results in less than 5 minutes. We have compared more than one hundred samples and made a good method for fast and precise quantifications of proteins and fats in triple daily meals for the army.

„Embellishment“ of culinary herbs and spices with food additives

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While food additives and flavourings are substances added to food to enhance, modify or maintain its characteristics such as aroma, appearance and shelf life, spices serve the same purpose when added to dishes, playing important role in culinary practices. If consumed in excessive amounts, certain food additives can have harmful effects and pose risks to public health. Therefore, the aim of the present study was to extract and collate notifications related to this issue from the EU Rapid Alert System for Food and Feed (RASFF) database, recorded during 2011-2023. Out of total 86 cases, the majority were related to the presence of colorants, among which unauthorized (not on the positive list) dominated over authorized ones (notified due to excessive quantities of additive present or unauthorized use of additive in certain foods), with 76 notifica-

tions compared to 13. The two dominantly present colorants were Sudan I (intensely orange-red) and Sudan IV (reddish brown), both unauthorized but registered in 35 and 30 consignments, respectively. Other colorants and additives from other categories (e.g. preservatives, antioxidants) were found very rarely. The most common bases for notifications were official control on the market (45 cases) and border control (38), followed by individual cases of company's own check and consumer complaints. The most frequently registered products were various herbs and spices mixtures (38.8%) and paprika (34.1%), followed by a substantially smaller number of cases related to curry (12.9%). Turkey, with 18 shipments of raw materials, stood out as the country from which the largest number of notifications originated. Although 56.5% of the notifications were deemed to pose a serious risk to public health, the majority of them were classified as information (48.2%), followed by alerts (33.0%) and border rejections (18.8%). The gathered data are significant for understanding misuse of additives in foods – in case of herbs and spices, the obvious reason is color enhancement leading to a more visually appealing product. However, this is an obvious example of food adulteration, meant to mislead consumers, which is contrary to food regulations and consumer rights and as such shall be prevented.

Challenges in developing a methodology for determining microplastics released from food contact materials

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The usage of plastic-based food packaging materials (FCM) leads to not only desired/positive but also unwanted/negative effects, the former related to food (protection, convenience, etc.) and the latter to both food and the environment (contamination and plastic waste). Thereby, despite their suitability and advantages, microplastics released from FCMs have potential adverse impact on human health, due to their small size, persistent nature, ability to adsorb and transport hazardous chemicals from their surrounding and thus serve as a vehicle for their entry into the body, where these particles can accumulate in various organs and tissues. The extensive usage of plastics comes with serious environmental issues, such as 220 million tons of plastic waste created in 2024, showing an increase of 7.11% since 2021. The packaging materials commonly consist of polyvinyl chloride (PVC), polyethylene terephthalate (PET), polypropylene (PP), low-density polyethylene (LDPE), high-density polyethylene (HDPE), and polystyrene (PS). The prolonged exposure of these materials to various environmental factors, such as light, heat, moisture and microbial action, results in their fragmentation and formation of smaller pieces-secondary microplastics. Such processes take place not only on waste materials in the environment but also on food packaging-every degradation may cause release and migration of microplastics from FCM into food. The recent research confirmed presence of microplastics in drinking and bottled water as well as in seafood, salt, sugar, tea bags, milk, etc. The estimates of the exposure of Europeans through food indicate intake of 39,000–52,000 microplastic particles/person/year. Despite growing research capacity, there is still a lack of comprehensive understanding of microplastic migration. Recent methodology reviews recommend migration testing to simulate 'real-life-use' conditions. Method development comprises sample collection (taking into consideration sampling verification procedures), pretreatment, choice of testing medium with regard to relevant food properties and experimental conditions (contact time and temperature). Important factors qualitatively and quantitatively influencing migration process also include the nature of the FCM, its interaction with simulants, the amount of simulant, simulation-physical abrasion and shaking. The most common analytical methods for identification and characterization of microplastics are scanning electron microscopy, Fourier transform infrared spectroscopy and Raman spectroscopy. In conclusion, establishing internationally recognized standared migration testing methods is of

prime importance. Adaptation to the use of safer non-plastic alternatives for FCMs such as paper, glass, stainless steel, porcelain and innovative materials, enabling reduction of the burden of microplastics that come into contact with humans and entire environment, is already in progress (somewhere legally enforced). However, the necessity of dealing with the microplastics as a food hazard will remain for a long time.

Our favorite black spice: pepper, with a burning marrow

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Black pepper is one of the most common spices added to cuisines around the world. Spicy heat and distinct biting quality are attributed to its alkaloid piperine. Numerous secondary metabolites found in pepper exert various biological activities, including antioxidant and antimicrobial effects, which aid in food preservation. Nevertheless, according to the EU Rapid Alert System for Food and Feed (RASFF), pepper is the second most frequently notified spice. The causes of notifications regarding pepper are investigated based on RASFF records from 2011-2023. The extraction of the data related to pepper (black/white/green) resulted with a total of 420 notifications, of which 85.0% were due to the presence of pathogenic microorganisms, i.e., Salmonella. Pesticide residues, among which ethylene oxide (6) and chlorpyrifos (5) were the most common, were responsible for 19 notifications. Mycotoxins followed with 14 cases (8 aflatoxins, 6 ochratoxin A), environmental pollutants (mostly polycyclic aromatic hydrocarbons) with 5, co-occurring unauthorized colours sudan I and sudan IV with 3 and toxic metals (arsenic, cadmium and lead, simultaneously) with 1. Brazil stood out as the origin country of 76.9% of consignments of raw materials, in most cases stopped at border controls (86.9%). Risk was deemed serious in 90.5% of cases, leading to border rejection in 83.8% of instances and 226 officially detained pepper consignments. Presented findings show that black pepper, the world's most traded spice, is very susceptible to microbiological contamination, which gives alternative meaning to its description "I am black on the outside, ... yet within I bear a burning marrow"!

Our favorite red spice: paprika, with a grain of salt

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The term "paprika" encompasses all forms of paprika, peppers and chillies, all used for enhancing the taste or color of food. Paprika exerts various biological activities such as cardio- and neuroprotective, anti-obesity, anti-inflammatory and pain-relief properties. However, according to the EU Rapid Alert System for Food and Feed (RASFF), paprika accounts for the highest number of notifications of all spices. Thereby, RASFF data were used to assess the nature of paprika contamination.

The majority of 483 notifications recorded within 2011-2023 period were related to the presence of mycotoxins (55.3% – 217 aflatoxins; 60 ochratoxin A, 9 aflatoxins + ochratoxin A). Other hazard included pathogenic micro-organisms (12.% - 57 Salmonella, 4 Bacillus cereus) and pesticide residues (12.0%, single or multiple). Among carcinogenic pesticides, ethylene oxide (13) (Group 1 carcinogen), was the most commonly present, followed by permethrin (5), chlorfenapyr (5), propiconazole (4), carbendazim, tebuconazole and hexaconazole (2 each), dimethoate, amitraz and

acephate (1 each) (all Group 2B), anthraquinone (2) and propargite (1) (Group 2A). Additionally, 29 recorded cases of presence of food colors, most commonly orange II (13), sudan IV (13) and sudan I (12), indicated food fraud. The predominant basis for notification was border control (71.8%; raw materials originated mainly from India). Risk decision in 330 notifications was serious, resulting in border rejections in 66.4% of cases and 19.0% of notifications classified as alerts, leading mostly to product destruction (21.7%) or official detention (16.8%). Obviously, paprika spices should be taken with a grain of salt with regard to their safety.

Materials in contact with food - bamboo

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The development of new technologies led to the use of wood, i.e. wood flour, as an additive in the production of food contact materials (FCM). Untreated wood and wood flour are authorized substances (Annex 1, Table 1,No 96, Regulation EU 10/2011), although this approval is old and lacks a detailed description of what constitutes "wood", and which materials of plant origin cannot be considered as wood, as well as the exact meaning of the term "untreated". Today on the market there are dishes made of bamboo and bamboo fibers. Actually, dishes made of melamine with bamboo fibers as an additive. Declarations of such products often include claims such as "ecological", "natural", "organic", which can mislead consumers. The European Food Safety Authority issued an opinion in 2019, which applies not only to wood but also to other plant materials, that "noted that due to the chemical differences in composition of plant materials, the safety of migrants from these materials must be evaluated on a case-by-case basis, taking into consideration also origin, processing, treatment for compatibilization with the host polymer and assessment of the low molecular weight constituents migrating into food. In EU, in the period from 2021-2022, an official control of such materials, called Bamboo-zling, was carried out, after which manufacturers, importers and distributors were asked to withdraw bamboo products or products with bamboo from the market. From 2020 to 2022., 211 unsafe products were registered on RASFF's website. Four samples were bamboo products, and the remaining 207 products were made of melamine or other plastics with bamboo as an additive. Increased migration of formaldehyde and melamine was determined in ten samples of melamine mass, increased migration of formaldehyde was find in two samples and increased migration of melamine in one additional sample. In the period after Bamboo-zling until middle of 2024, twenty-one product with bamboo were notified. Two products had increased formaldehyde migration, while the other eighteen products were declared unsafe based on a composition that was not in compliance with the Regulation. In many cases, products made of bamboo or with bamboo are intended for the most sensitive population. Observed from the aspect of exposure, the aggregate exposure of children, usually under the age of three, from cosmetic products that contain permitted preservatives that can release formaldehyde, toys, feeding accessories, is of particular importance, especially bearing in mind that all three mentioned types of products are in everyday use.

Keywords: Bamboo, Melamine Formaldehyde, Cooking and Eating Utensils, Public Health

Prevalence of Salmonella serotypes in meat and meat products in South Bačka district of Vojvodina, in the period 2017-2023

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Introduction: The genus Salmonella consists of strictly pathogenic microorganisms that cause salmonellosis, which represent a significant public health problem. The presence of Salmonella in food is most often the result of primary or secondary contamination, i.e. insufficient hygiene during production, storage and manipulation of food. The most common way of contracting salmonella is through the consumption of contaminated food. The greatest risk is raw meat (mainly poultry), followed by eggs and dairy products, but outbreaks originating from fruits, vegetables and bakery products have also been recorded.

Objective: To determine the prevalence of Salmonella serotypes in meat and meat products, originating from South Bačka district of Vojvodina, in the period from 2017 to 2023.

Methods: All samples were inoculated according to the SRPS EN ISO 6579:2017 standard. Characteristic colonies were further identified by biochemical array and the automatized Malditoff system. The final identification was made by serological confirmation and determination of serotypes. Antibiotic resistance was tested using the disk diffusion method for 16 antibiotics, suspension in saline solution of 0.5 McFarland.

Results: In the period from 2017 to 2023, a total of 11,095 food samples were examined. Salmonella was tested in 1,798 food samples, including 275 meat samples, of which 25 (9.2%) were positive for Salmonella (21 chicken meat samples and 4 pork meat samples). Salmonella Derby was found in one sample, Salmonella Enteritidis in four samples and Salmonella Infantis in the other twenty. All positive samples were tested for antibiotic sensitivity. All isolated Salmonella were sensitive to Amoxicillin+Clavulate, Ceftriaxone, Cefepime, Gentamycin Amikacin, Meropenem, Imipenem, Ertapenem, Doripenem, Tobramycin, Piperacillin + tazobactam, Chloramphenicol. Partial sensitivity was shown to Ampicillin and Amoxicillin (12% resistant), Trimethoprim+Sulfamethoxazole (8% resistant) and Ciprofloxacin (32% resistant). The largest share of positive samples was isolated from chicken meat (84%), and the most frequently isolated serotype was Salmonella Infantis (80%), which was the only one to show resistance to antibiotics.

Conclusion: In the seven-year period, the prevalence of salmonella in tested meat and meat products was 9.1% and was the highest in chicken meat. The dominant serotype was Salmonella Infantis. Proper thermal processing of all foods, especially foods of animal origin, remain a key measure in the prevention of salmonellosis.

Keywords: Salmonella, meat and meat products

Microbiological status of pig and cattle carcasses at different stages of slaughter in a large slaughterhouse

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Maintaining standard hygiene is mandatory in slaughterhouses for the purpose of production, to obtain safe meat, as well as, violations of those factors that attribute a high risk to public health and the environment. The monitoring of surface contamination of pig and cattle carcasses along the slaughter line enables checking the hygiene of the slaughter operation, as an application of good production practice. Salmonella spp., Yersinia enterocolitica and Escherichia coli belong to the family Enterobacteriaceae, a large family og gram-negative bacteria. These are bacteria that mainly lead to diseases at the level of the digestive tract, as well as other system. Diseases caused by these bacteria can be accompanied by septicemia and the death of the individuals. Sampling was carried out at different stages of slaughter line in order to determine the number of microorganisms, Enterobacteriaceae and E. coli and detect pathogenic bacteria Salmonella spp. and Y. enterocolitica, which are indicators of the hygiene of the slaughter process. Sampling of the surfaces of pig carcasses originating from two farms and cattle carcasses was carried out using SPRS EN ISO 17604:2016 at different stages of the slaughter line. Using standard microbiological methods, the numbers of microorganisms (SRPS EN ISO 4833-1:2014/A1:2022), Enterobacteriaceae (SRPS ISO 21528-2:2017) and E. coli (SRPS ISO 16649-2:2008) were determineted, and detection of Salmonella spp. (SRPS EN ISO 6579-1:2017/A1:2020) and Y. enterocolitica (SRPS EN ISO 10273:2017) were carried out. The numbers of microorganisms (3.67±0.47 log10 CFU/cm2 and 3.02±0.27 log10 CFU/cm2), Enterobacteriaceae (3.09±0.45 log10 CFU/cm2 and 2.17±0.13 log10 CFU/cm2) and E. coli (1.34±0.37 log10 CFU/cm2 and 1.66±0.18 log10 CFU/cm2) on the surfaces of pig carcasses from farms A and B were similar, without statistical significance ($p<0.05$).The number of microorganisms on the surfaces of cattle carcasses was 1.99±0.17 log10 CFU/cm2, while the numbers of Enterobacteriaceae and E. Coli were 1.19±0.28 log10 CFU/cm2 and 0.84±0.28 log10 CFU/cm2, respectively. Pathogenic bacteria Salmonella spp. and Y. enterocolitica were not detected on the surfaces of pig and cattle carcasses. Absence of pathogenic bacteria Salmonella spp. and Y. enterocolitica may indicate that pigs and cattles originated from farms with a low risk for these pathogens. Considering hygiene criteria, the number of microorganisms was unsatisfactory for 20% of pig carcasses. The number of Enterobacteriaceae was unsatisfactory in 30% of pig carcasses and 12.5% of cattle carcasses, which implies a high level of fecal contamination after evisceration, and the impossibility of sufficient reduction at the slaughter line. Continuous improvement of hygiene practices in slaughterhouses is necessary in order to obtain a safe final product and maintain a unique health approach.

Keywords: Slaughter, hygiene, Pig carcasses, Cattle carcasses, Bacterial contamination, Slaughter operations

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Nutritional Habits Of Medical Students From The Western Balkans

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Introduction: The student population includes young adults for whom proper nutrition is crucial for mental, cognitive and physical development. Upon starting university education, students often change their nutritional habits. Unhealthy eating habits, including an improper and high energy density diet, can negatively impact students' health, leading to overweight and obesity, which may result in the development of non-communicable diseases - a significant public health concern.

Aim: The aim of this study was to determine the nutritional habits of medical students from the Western Balkans.

Methods: This cross-sectional study was conducted between November 2019 and February 2020, involving 2,452 students from 14 medical faculties across five countries (Slovenia, Croatia, Bosnia and Herzegovina, North Macedonia, and Serbia). An online questionnaire was used as the research instrument.

Results: The results show that only 68.7% of students have more than three meals per day. Only 50.9% of students eat breakfast every day, while 7.3% do not eat breakfast at all. Raw vegetables are consumed by 51.7% of students, and raw fruit by 63.5%, at least 3-4 times a week or every day. Meat is consumed in one meal per day by 31.2%, in every meal by 10.4%, while 5.1% of students do not eat meat. As many as 61.9% consume fish less than once per week or never, while only 7.1% consume fish several times per week. Fast food is consumed rarely or occasionally by 70.1% of students, while the rest eat fast food several times a week or every day. A large number (77.9%) of students consume sweets every day or several times a week. It is estimated that the majority of students do not drink enough fluids, as only 12.6% reported drinking more than 2 liters of water per day. Additionally, 23.2% of students reported consuming sugary beverages daily or several times a week. Nutritional habits did not differ significantly among students from different faculties.

Conclusions: The obtained results can be used to develop public health programs aimed at improving the nutritional habits of students, thereby enhancing the health of the student population.

Dietary intake of vegetarians in Serbia: a cross-sectional study from the EU Menu Dietary Survey 2017-2022

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Objective: To examine the diet and nutritional status of vegetarian subjects in Serbia, aged 18-74 years.

Methods: This nationally representative cross-sectional survey during 2017-2022, included 299 vegetarians 18-74 years old (both vegans and lacto-ovo vegetarians), across different regions of Serbia. The advanced nutritional platform Diet Assess and Plan (DAP) was applied for data collection and analyses. Collected data included anthropometrics (body mass index, BMI), physical

activity levels (estimated by metabolic equivalents, METS), and the intake of energy, macronutrients, and specific food groups (examined through two 24-hour recalls, using the Serbian food composition database integrated into the DAP). Results are presented as median(IQR) for women and men, respectively, and the significance of the Mann-Whitney test.

Results: The survey included 157 females and 142 males of similar age, 36,0(25,6-48,0) vs. 35,0(27,9-44,0), p>0,05. BMI was higher in males, 21,3(19,9-23,6) and 23,8(22,2-25,4) kg/m2, p<0.001, as well as the total daily energy intake (kcal/day), 1684,4(1340,8-2040,1) vs. 2265,2(1825,7-2856,1), p<0,001, while the physical activity levels were similar, 1684,4(1340,8-2040,1) vs. 2265,2(1825,7-2856,1) METSmin/week, p>0,05. The macronutrient composition of the diet (%kcal/day) was not different between males and females, and was dominated by carbohydrates, 49,5%(44,7-55,9%) vs. 51,3%(43,7-58,8%), then by fats, 37,2%(31,4-42,9%) vs. 35,3(28,9-42,6%), while ~11% derived from proteins, 10,9%(9,3-12,8%), vs. 10,9%(9,4-13,1%), respectively in females and males, p>0,05 for all. The percentage of those who did not meet the dietary requirements for proteins (0,8 g/kgBW/day) was substantial, particularly in women, 61,8% vs. 50,7%, p=0,054. The energy intake coming from alcohol was low in both groups, 0,0%(0,0-0,0%) vs. 0,0%(0,0-0,1%), p>0,05. Regarding food group distribution, most of the energy in both women and men came from grain products, respectively, 28,9%(20,4-36,1%) vs. 28,0%(18,4-35,2%), then from fruit, 14,7%(7,3-21,5%) vs. 13,6%(6,6-22,4%), vegetables, 12,9%(9,0-18,9%) vs. 14,0%(7,5-20,8%), edible fats/oils, 14,0%(10,1-19,2%) vs. 11,9%(7,7-18,2%), nuts and seeds, 7,6%(2,4-14,2%) vs. 8,4%(2,5-17,2%), with a quite low contribution of dairy products 3,6%(0,1-10,8%) vs. 2,5%(0,0-8,1%), sweets, 1,8%(0,1-5,8%) vs. 0,7%(0,0-3,8%), and alcoholic and non-alcoholic beverages, 0,3%(0,0-4,6%) vs. 0,2%(0,0-4,5), while the contribution of eggs was neglectable in both genders, 0,0% (0,0-0,1%) of energy. There was a statistical difference between genders only in the energy deriving from sweets, p=0.010.

Conclusion: The diet of the vegetarian subjects in Serbia is characterized by an insufficient intake of proteins, coming mostly from grain products and vegetables (legumes), much less from nuts/seeds and dairy products. Protein intake did not meet dietary recommendations in the majority of vegetarians, particularly when the quality of protein is considered.

Keywords: dietary intake, vegetarians, macronutrients, food, nutritional survey

Citrus flavanones affect the composition of the total lipids in old age livers

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The rate of oxidative damage increases with aging, while the degree of fatty acid unsaturation is associated with the incidence of lipid peroxidation. Citrus flavanones are promising phytochemicals and potent antioxidants that could significantly contribute to this process and promote healthy aging.

This study aimed to investigate the effects of lemon extract (LE), naringenin (NAR), and hesperetin (HES) in nutritionally relevant doses on fatty acid composition in the liver of 24-month-old male Wistar rats. LE (40 mg/kg), NAR (15 kg/mg), and HES (15 mg/kg) were given orally to animals once daily for four weeks. The control animals received the vehicle (sunflower oil) alone (CON) or remained physiologically intact (ICON). Fatty acids were analyzed from total lipids extracted from 200 mg of liver using gas-liquid chromatography. The contents of individual fatty acids (from C16:0

through C22:6n-3) were expressed as a percent of total fatty acids identified, and the percentage of total saturated (SFA), monounsaturated (MUFA), and polyunsaturated fatty acids (PUFA) were calculated as the sum of the corresponding individual fatty acids. The effect of treatments on examined parameters was evaluated in comparison with the values obtained for the CON group.

Total MUFA and oleic acid (C18:1n-9) were significantly decreased in all treatment groups, while palmitoleic (C16:1n-7) was decreased ($p<0.05$) only in the NAR group, compared to CON. Total PUFA levels were significantly increased ($p<0.05$) in all treatment groups compared to controls. n-6 PUFA content was increased only in the LE group, while n-3 PUFA remained unchanged after all treatments. Regarding individual PUFA, the level of arachidonic acid (C20:4n-6) increased significantly in HES and LE groups, while NAR treatment increased ($p<0.05$) the alpha-linolenic (C18:3n-3) compared to CON. Compared to the controls, there were no changes for total SFA, while the level of palmitic acid (C16:0) was significantly lower ($p<0.05$) after LE treatment.

The lack of significant changes in SFA levels suggests that the proportion of MUFA may have decreased to offset the rise in PUFA. Also, given that citrus flavanones exert proven antioxidant properties, increased PUFA levels in the treatment groups' liver membranes do not go in the direction of lipid peroxidation. Although further confirmation is needed, these findings indicate that citrus flavanones could inhibit the activity of phospholipase A2, leading to enhanced membrane fluidity and selective permeability without promoting inflammatory pathways. This precondition for healthy aging offers a new direction in nutrition and aging research.

Keywords: citrus, healthy aging, fatty acids

Food, energy, and macronutrient intakes of adolescents 15-17 years old in Serbian EU Menu Dietary Survey 2017-2022

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Objective: To examine the diet and nutritional status of adolescents 15-17 years old in Serbia.

Methods: The nationally representative cross-sectional survey across different regions of Serbia (during 2017-2022), following the EFSA EU MENU methodology, included 351 adolescents 15-17 years old (F: 172, M: 179). Collected data included anthropometrics (body mass index, BMI) and intake of energy, macronutrients, and calories deriving from specific food groups (using twice repeated 24-hour recalls and the Serbian food composition database integrated into the advanced nutritional platform Diet Assess and Plan (DAP) for data collection and analyses). Results are presented as median (IQR) for females (F) and males (M), and the Mann-Whitney test was performed to test gender differences.

Results: The median age was 16,0(15,9-17,0) years [F:16,0(15,8-17,0), M:16,0(16,0-17,0), p=0,015]. There was a statistical difference in BMI between the two genders, F:20,5(19,3-22,4), M:22,2(20,8-23,9) kg/m2, p<0,001, and total daily energy intake (kcal/day) was higher in males, F:1828(1515-2130), M:2522(1917-3069), p<0,001. The macronutrient composition of the diet (%kcal/day) was similar in both genders (p<0,05), and was dominated equally by dietary fats and carbohydrates: fats F:42,9(38,1-47,9%), M:44,2%(39,2-48,5%); carbohydrates F:40,9%(36,9-46,9%), M:41,0%(35,0-46,0); proteins F:14,3%(12,4-16,8%), M:14,5%(12,9-16,8%). Regarding different food groups energy distribution (%kcal/day), most of the energy derived from grain products [F:30,8%(23,7-37,5%), M:28,9%(23,2-36,8%), p>0,05]; then from edible fats/oils [F:15,1%(10,6-20,4)%, 16,1%(10,6-19,6%),

p>0,05]; dairy products [F:11,8%(7,5-17,8%), M:13,0%(8,5-17,8%), p>0,05]; meat and meat products [F:12,0%(7,1-17,3%), M:13,3%(8,9-20,0%), p=0,049]; vegetables [F:6,4%(3,8-9,3%), M:6,2%(4,4-9,3%), p>0,05]; fruit [F:5,1%(2,3-8,1%), M:3,1%(0,0-7,0%), p=0,001]; sweets [F:3,2%(0,5-7,9%), M:4,1%(0,6-7,1), p>0.05]; eggs [F:1,3%(0,5-4,8%), M:2,3%(0,7-5,5%), p=0,091]; alcoholic and non-alcoholic beverages [F:0,3%(0,0-4,2%), M:2,7%(0,0-5,6%), p=0,021]; nuts and seeds [F:0,2%(0,0-1,6%), M:0,1%(0,0-0,8%), p>0,05]; and fish [0%(0-0%) for all]. Fish was not consumed by most of the examined subjects (F:83,1%, M:81,0%), while in those who reported fish consumption, its median contribution to energy intake was quite low, F:4,7%(2,0-7,6%), M:4,8%(2,3-8,3%), p>0,05. Only 11 females and 7 males reported alcohol consumption, but it substantially contributed to energy intake in those subjects [F:4,6%(2,7-10,8%), M:5,5%(3,1-11,2%), p<0,05].

Discussion: The dietary pattern of adolescents 15-17 years old in Serbia is dominated by grains, added fats and oils, dairy products, and meat, with a low contribution of fish, eggs, fruit, vegetables, nuts, and seeds. There is a need for improvement in dietary habits among this population.

Keywords: dietary intake, adolescents, macronutrients, food consumption, national survey

Diet during pregnancy and symptoms of postpartum depression

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Introduction: Postpartum depression (PPD) is a mental depressive disorder that develops in young mothers within one month after delivery. Not all factors causing this disease have been studied. It has been suggested that one of the causes of this type of depression could be the improper diet during pregnancy. Objective: This study aimed to assess the relationship between diet during pregnancy and the incidence of PPD symptoms in women after delivery. Material and methods: Sixty-nine healthy pregnant women aged 18 - 41 participated in the study. None of the recruited women had any symptoms of depression before pregnancy. Each of them completed Kompan questionnaires for nutrition habits evaluation during the third trimester of pregnancy and after delivery, the Edinburgh Postnatal Depression Scale (EPDS) was used to diagnose the symptoms of depression.

Results: The incidence of high PPD symptoms was 21% (fifteen women). Women with higher PPD symptoms had a lower quality diet than those with lower or without PPD symptoms. There were also differences in some groups of food frequency intake. Significant differences were observed also between body weight during pregnancy in groups of women with high and low symptoms of PPD.

Conclusion: Poor diet quality could be associated with higher PPD symptoms. Therefore, it is suggested that dietitians and health care providers emphasize a healthy diet during pregnancy.

Keywords: post-partum depression, diet, pregnancy, body weight

Dietary intakes of elderly population (65-74 years old) in the Serbian National EU Menu Dietary Survey 2017-2022

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Objective: To examine the diet and nutritional status of the older Serbian subjects, aged 65-74 years.

Methods: This nationally representative cross-sectional survey, including 582 subjects 65-74 years old, was conducted during 2017-2022 across different regions of Serbia, following the EFSA EU MENU methodology. Collected data included anthropometrics (body mass index, BMI) and the intake of energy, macronutrients, and food groups' energy contribution (examined through two 24-hour recalls, using the nutritional platform Diet Assess and Plan (DAP) integrated with the Serbian food composition database).

Results are presented as median(IQR) for women and men, respectively, and the Mann-Whitney test's significance. Results: The survey included 319 females and 263 males, of similar age [68,0(66,0-71,0) vs. 68,3(66,0-71,0) years] and BMI [26,1(23,6-29,4) vs. 26,2(24,1-28,9) kg/m2], p>0,05 for both. Total daily energy intake (kcal/day) was higher in men [1775(1414-2064) vs. 2291(1843-2814), p<0,001]. The macronutrient composition of the diet (%kcal/day) was dominated by dietary fats [higher in men, 42,5%(38,2-47,5%) vs. 44,4%(39,1-49,8%), p=0,006], then by carbohydrates [higher in women, 41,7%(36,0-47,1%) vs. 37,2%(32,4-42,5%), p<0,001], and ~15% derived from proteins [14,5%(12,8-16,7%) vs. 15,1%(13,0-16,8%), p>0,05]. However, the proportion of those who did not meet the dietary requirements for proteins (0,8 g/kgBW/day) was considerable, especially in women, one-third vs. one-quarter in men (37,6% vs. 26,6%, p=0,005). Men also had a higher energy intake coming from alcohol [0,0%(0,0-0,0%) vs. 0,0%(0,0-3,9%), p<0,001]. Most of the energy in both groups came from grains products [higher in women, 28,2%(21,7-34,6%) vs. 25,5%(19,7-30,9%), p=0,001], then from edible fats/oils [higher in women, 15,5%(11,5-19,7%) vs. 14,0%(10,0-19,1%), p=0,022], meat and meat products [higher in men, 12,0%(6,5-17,9%) vs. 16,1%(9,9-25,0%), p<0,001], dairy products [11,4%(6,6-15,6%) vs. 10,6%(5,5-5,7%), p>0,05), vegetables [7,1%(4,7-10,6%) vs. 7,2%(4,5-9,7%), p>0,05], fruit [higher in women, 6,3%(2,7-10,8%) vs. 4,6%(1,4-8,1%), p<0,001], eggs [higher in men, 2,3%(0,5-4,8%) vs. 3,2%(0,7-6,4%), p=0,005], nuts and seeds [higher in women, 2,9%(1,6-4,7%) vs. 1,7%(0,7-3,2%), p<0,001), sweets (2,1%(0,2-5,3%) vs. 1,9%(0,2-4,3%), p>0,05], and alcoholic and non-alcoholic beverages [higher in men, 0,1%(0,0-2,2%) vs. 1,8%(0,0-7,3%), p<0,001. In those who reported fish consumption (20,1% of women and 19,4% of men), its energy contribution was quite low, 6,5%(3,4-8,6%), vs. 5,7%(3,3-9,5%), p>0,05.

Conclusion: The diet of the elderly subjects in Serbia is characterized by a high intake of dietary fats (coming mostly from edible fats and oils, meat, and dairy products), a moderate intake of carbohydrates (coming mostly from refined grains), and a lower intake of proteins (coming mostly from meat, grains, and dairy products). The intake of fish, eggs, vegetables, fruit, seeds, and nuts was insufficient.

Keywords: dietary intake, elderly, macronutrients, food, national food consumption survey

Coffee consumption among young adults in Serbia

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Coffee is one of the most widely consumed drinks globally. As the primary source of caffeine with psychostimulant properties, the intake of coffee to increase alertness and endurance and combat fatigue is widespread among different population groups. In addition to caffeine, coffee contains many other bioactive compounds with potentially positive effects on human health. However, while moderate coffee consumption may provide health benefits, excessive intake may exert cardiovascular and other adverse effects. This study aimed to assess the habits related to coffee consumption among young adults in Serbia. Data were collected through an online survey, which collected data related to socio-demographic, anthropometric, and lifestyle characteristics and those related to coffee consumption. A total of 1076 participants aged 18-40 completed the online questionnaire. Coffee was consumed by 83.6% of participants. Among consumers, a daily intake of brewed coffee was reported by 69.3% of participants, while 42.6% reported a regular daily intake of instant coffee. Consumption of brewed coffee is more common among consumers with normal body mass index ($p<0.01$) and non-smokers ($p<0.01$), and instant coffee among consumers with regular meals ($p<0.05$). More than 95% reported consumption of 1-3 cups per day. Although the data obtained suggests moderate coffee intake among young adults, there is a need for additional studies to address the benefits and risks of coffee consumption.

Keywords: coffee, brewed coffee, instant coffee, consumption

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An assessment of iron intakes among student population

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Numerous studies have indicated that university students exhibit a variety of risky health behaviors due to demanding academic schedules, limited financial resources, and lack of time. These factors can substantially affect students' dietary patterns, potentially leading to inadequate iron intake and subsequent health issues, including anemia, reduced energy levels, and immune system dysfunction. Due to a lack of information about students' lifestyles in Serbia, the study was designed to examine variations in iron intake among students focusing on differences by gender and year of study. Seventy students from the Faculty of Pharmacy, University of Belgrade participated in this cross-sectional study by completing an electronic structured questionnaire. The study was performed in the 2023/2024 school year during the autumn semester. The survey collected data on sociodemographic characteristics, lifestyle habits, iron-rich food intake practices, use of iron-containing food supplements, and knowledge of iron-related health issues. The majority of participants were: female (81.4%), students of final year (61.4%), current non-smokers (85.7%), and engaged in physical activity 2 to 3 times per week (54.2%). Among students who self-reported having better nutritional knowledge, 87.1% identified academic education as their primary source of information. According to the survey data, the average daily iron intake among male students was 14 mg, suggesting that their iron intake exceeds the recommended dietary allowances for men. In contrast, female students had an average daily iron intake of 15 mg, indi-

cating that their intake was below the recommended dietary allowance for women. The results underscore the need for targeted strategies to improve students' dietary habits, ensuring adequate iron intake and supporting overall health. Understanding these patterns is essential for designing effective preventative interventions and educational programs to promote the health and well-being of this population.

Keywords: student, dietary patterns, iron, targeted strategies

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Dietary Disparities Between Genders among Adolescents

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Proper nutrition during adolescence is crucial for optimal growth, development, and overall health. The research was conducted between April and May 2018, encompassing a cohort of 514 students. This group consisted of 133 males and 381 females aged between 19 and 24 years. Participants were chosen from four faculties with curricula integrating nutritional elements. Nutritional status was evaluated through body mass index (BMI) calculations. The investigation employed an anonymous survey, with data analyzed using SPSS20 software. Most students of both genders have breakfast every day. More females with normal nutritional status (57.2%) have breakfast daily compared to males (51.6%), while more overweight males (63.9%) have breakfast daily compared to females (50%). 4.5% of all males and 3.7% of all females do not have a habit of consuming breakfast at all. 62% of males and 77% of females have lunch at home, while 30% of males and 17% of females eat at the student cafeteria. A small number of students have lunch at a bakery, pizzeria, or fast-food restaurant, mostly those who are overweight or obese. More than half of the respondents start their lunch with soup, followed by a cooked meal. About 10% of students of both genders have dinner on their way home, while a significantly higher number of students have dinner at home (67% of males and 79% of females). More males (20%) have dinner at the student cafeteria than females (10%). About one-fifth of students of both genders do not eat fish at all, while more than 65% of students eat fish at least once a week and about 10% more than once a week. 13% of males eat meat several times a day, while this percentage is only 3% among females. 49% of males and 35% of females eat meat every day, while less than 1% of males and 3.5% of females do not eat meat at all. Statistical significance ($p<0.01$) was observed in the frequency of breakfast consumption, the place of lunch consumption and meat consumption by gender. Most students have all three main meals and meet their meat and fish needs. Continuous education should be implemented to ensure that students have adequate nutrition and thus lay a good base for adulthood.

Isolating p-coumaric acid from Lamiaceae plants using environmentally friendly solvents

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The Lamiaceae family, comprising flowering plants, has a rich history of utilization as culinary herbs, shrubs, and medicinal plants. One of the major phenolic compounds of various Lamiaceae species is p-coumaric acid. p-Coumaric acid exert beneficial effects on human health through prevention of degenerative pathologies such as cardiovascular diseases and cancer. The aim of the work was to extraction effectiveness of p-coumaric acid with menthol-based deep eutectic solvents from herbal plants of the Lamiaceae family, produced at the Institute „Dr. Josif Pančić". 10 samples of herbal drugs, including rosemary, lemon balm, sage, mint, lavender, oregano, savory, garden thyme, basil, and wild thyme, were subjected to testing. Extraction was performed with two types of DESs (a mixture of menthol and methylsalicylate (1:1) and a mixture of menthol and dodecanoic acid (2:1)). The content of p-coumaric acid was determined using high performance liquid chromatography (HPLC). Menthol:methylsalicylate and menthol:dodecanoic acid mixtures showed significant efficiency in the isolation of p-coumaric acid from herbal drugs. The concentration of p-coumaric acid ranged from 0.024 to 0.031 mg/g of the drug for the menthol:dodecanoic acid mixture, and from 0.077 to 0.186 mg/g of the drug for the menthol:methylsalicylate mixture. The highest content of p-coumaric acid was found in lavender. An environmentally friendly, economical, and efficient extraction based on menthol and methylsalicylate, and dodecanoic acid, may be useful in the isolation of p-coumaric acid from plants. This research represents an excellent basis for further research and testing of other green solvents as new extractants.

Keywords: DES, menthol:methylsalicylate, menthol:dodecanoic, p-coumaric acid, Lamiaceae

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BioValue project – from fork-to-farm through the creation of novel recipes for dishes and food products

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The main goal of the BioValue project is to establish a holistic approach to the analysis of the link between biodiversity, the agri-food value chain, the environment and consumer preferences and health by applying a bottom-up vertical approach. The project aims to develop a dynamic and adaptive tool for analyzing the biodiversity of the agri-food value chain with the intention of introducing, modeling, evaluating, producing, and disseminating underutilized, genetically diverse crops and the final marketable products produced from them, within a design that is extendable in scale and scope.

As a part of the Biovalue project, following a bottom-up methodological approach, new food dishes and products, designed to incorporate biodiversity on the consumers' plate, were devel-

oped and consumers' preferences were evaluated. This demand-driven, bottom-up, fork-to-farm approach can offer a clear picture of consumer preferences and provide additional assurance of the potential success of proposed actions. In the frame of this work, the comprehensive literature review on nutritional properties and health-related impact of selected non- and underutilized crops (Lens culinaris, Lathyrus spp., Fagopyron spp., Tomato ideotypes, Eggplant landraces, Cucumis melo var. flexuosus and Sonchus oleraceus) was performed. Novel recipes of food dishes and products were designed based on selected crops, followed by nutritional analysis and sensory evaluation of the prototypes of novel dishes and food products (in Serbia, France, Greece, Hungary and Turkey). This includes the analysis of organoleptic characteristics, nutritional value, and potential integration of new foods into the daily diet of consumers. To this end, consumers assessed new culinary products to evaluate and improve their attractiveness. As a result, recipes for new dishes and innovative processed food products were adjusted to both appeal to consumers and enhance biodiversity on the plate simultaneously.

Further efforts are required to raise awareness about the nutritional benefits of foods and products made from underutilized plants, and to encourage their incorporation into everyday cooking.

Keywords: underutilized crops; nonutilized crops; novel food; sensory evaluation; biodiversity.

Optimizing nutritional value of non- and underutilized genetically diverse crops and related food products with suitable processing methods

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In recent years, increasing attention has been directed toward underutilized crops and their potential health benefits. These crops, particularly wild and underutilized vegetables, are often richer in essential macro- and micronutrients compared to conventionally cultivated varieties, offering a promising solution to food security challenges and micronutrient deficiencies. A key aspect of maximizing their potential lies in understanding the nutrient losses that occur during food processing. This study examines commonly used food processing methods, both at the household and industrial levels, and their impact on the nutritional content and quality of beneficial components in underutilized crops. Non- and underutilized plants are valuable sources of essential nutritional compounds, including flavonoids, phenolic components, and carotenoids, prompting increased interest in their nutritional potential and the development of innovative food products. This study also aims to analyze processing methods that maximize the preservation of nutritional quality in selected underutilized plants (Lens culinaris, Lathyrus spp., Fagopyrum spp., tomato ideotypes, eggplant landraces, Cucumis melo var. flexuous, and Sonchus oleraceus) while enhancing the palatability of food products. We examined commonly used processing practices at both household and commercial levels and documented the changes in nutrient content resulting from these methods. Processing techniques such as soaking, fermentation, sprouting, and popping can improve the bioavailability of micronutrients by breaking down anti-nutritional factors and enhancing the absorption of essential nutrients. Key findings include that cooking lentils enhances their digestibility and nutrient bioavailability, while sprouting increases certain nutrient levels. New genotypes of Lathyrus spp. with low levels of β-ODAP, combined with various

processing methods, can mitigate the risk of lathyrism. Processing buckwheat can lead to losses in minerals, vitamins, and flavonoids, while also increasing amino acids (e.g., histidine), phytates, antioxidants, and beneficial microbes. Fermentation of underutilized tomatoes introduces beneficial bacteria and enzymes, improving nutrient accessibility. Cooking methods for eggplant, such as grilling and roasting, enhance flavor and preserve nutritional value. Thermal processing of snake melon showed significant changes in vitamin C, organic acids, pH, and microbial content. Ongoing research is essential to optimize production techniques and ensure the preservation of nutrient quality through thermal processing. While this research highlights significant findings, further investigation into diverse processing techniques is essential to accurately assess the nutritional changes induced by various methods, enabling the development of food products that highlight the nutritional value of underutilized crops.

Keywords: underutilized crops; nonutilized crops; food processing; innovative food products.

Influence of maceration time on antioxidant acivity of fermented grape pomace

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The phenolic compounds are secondary plant substances that have a positive effect on human health due to their antioxidant properties. When grapes are processed, the polyphenols present remain mainly in the grape pomace due to their incomplete extraction. The most important representatives of the polyphenol compounds in this by-product are anthocyanins (only in red grape pomace), catechins, flavonol glycosides, phenolic acids and alcohols. The aim of this study was to determine the optimal maceration time during vinification to achieve the highest levels of antioxidant activity of fermented grape pomace. The experiments were conducted using red grape variety Cabernet Sauvignon and involved two different vinifications. In the first trial, the grapes were fermented with the commercial yeast BDX (Lallemand, Canada) and the maceration lasted 3, 5, 7, 14 and 21 days with twice daily punch downs. The only difference in the second experiment was that the enzyme preparation Cuvée Blanc (Lallemand, Canada) was added (2 g/hl). After these maceration times, the fermented pomace samples were separated from the wine and stored until analysis. The pomace was then freeze-dried and the extraction was optimized with methanol and deionized water. The antioxidant activity of the pomace extracts obtained was evaluated using the FRAP method and the TEAC test and expressed in mmol Fe2+/kg and mmol TE/kg of fermented pomace. The FP sample macerated with (BDX+CB) for three days showed the highest FRAP value (43.60 mmol Fe2+/kg). A prolonged maceration of up to 21 days showed the lowest FRAP values. This is consistent with the results of the TEAC test, the highest result of which was obtained for the sample macerated for three days (BDX+CB) and amounted to 22.90 mmol TE/kg. The results showed that pomace that was macerated for a shorter time had higher antioxidant activity than other samples that were macerated for a longer time.

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HPLC determination of caffeine content in ground and instant coffee beverages

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Various nutrients and non-nutritive compounds contribute to coffee beverages' distinctive flavors, aromas, and health effects. Among them, the best known is caffeine (1,3,7-trimethyl xanthine), which can improve physical and mental performance. Its psychostimulant effects make coffee one of the most commonly consumed beverages worldwide. Additionally, based on the protective potential of other bioactive compounds, like polyphenols, some recommendations suggest drinking 3-5 cups of coffee for health benefits. While moderate consumption of coffee beverages could be beneficial, due to caffeine content, excessive coffee consumption could be related to adverse health effects. However, the caffeine content in coffee beverages could vary depending on many factors, such as coffee bean type, roast level, brewing methods, and serving size. This study aimed to determine caffeine content in beverages prepared from the ground (5 samples) and instant coffee products (5 samples) available on the market. The coffee beverages were commonly prepared from commercial coffee powder samples. The caffeine content in prepared coffee beverages was determined by high-performance liquid chromatography using a photodiode array detector (HPLC-DAD) according to a European Pharmacopoeia procedure. To calculate the caffeine content per serving, a serving was 150 ml for both types of coffee beverages. As expected, the ground coffee beverages contained higher caffeine content (1.14 to 1.57 mg/mL) than instant coffee (0.24 to 0.64 mg/mL), with caffeine content differences within both types of coffee products. The average caffeine content per serving was 115.5 mg for ground coffee beverages and 58.5 mg for instant coffees. These results suggest that the safety of caffeine intake in adults (400 mg/day) could be exceeded with three serving of ground coffee beverages and seven servings of instant coffees. Considering the widespread consumption of coffee beverages, further studies on their chemical compositions and assessments of their intakes are needed to resolve controversies related to the benefits and risks of coffee consumption.

Keywords: caffeine, brewed coffee, instant coffee, HPLC method

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Food policy research and review using rapid review methodology and constructing and visualizing bibliometric networks

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Introduction: Society increasingly recognizes the connection between public health and a resilient and sustainable food system. Globally, rising incomes, urbanization, and industrialization of the food chain led to the adoption of a Western diet, rich in meat, refined sugars, and fats. Food policies can provide a strong stimulus to improve the population's health and prevent malignant disease, thus improving the entire population's well-being.

Methods: The Web of Science database was searched and review articles from relevant fields were considered. According to the keywords specified and the methodology, 1326 publications met the inclusion criteria. The literature prepared in this way was processed in the software package for bibliographic analysis "VOS Viewer".

Results: Papers were from 112 different categories related to nutrition, medicine, agronomy, and ecology. Almost 50% of the works were from the categories of Nutrition and Dietetics and Public Health. Through software analysis, 555 keywords were identified that appear 5 or more times in the selected publications. The ten most frequent keywords in the examined publications were: obesity, nutrition quality, health, politics, food, children, physical activity, consumption, and food availability.

Discussion and conclusions: The strongest connections were between concepts of food, diet/eating habits, consumption, obesity, excess, and public health, which was the main basis of the work. This methodology was used to identify food policies with the strongest effects on public health. The recommendations are to integrate modern approaches - food policies such as: establishing educational programs on food, introducing restrictions and prohibitions related to unhealthy food, providing better access to healthy food, improving monitoring and evaluation, and working on food safety.

Keywords: food policy, public health, nutrition, obesity

Efficiency of eco-friendly solvent towards extraction of bioactives from grape skin

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Introduction: Plant-based food is known to have positive health effects due to specific mineral, vitamin, bioactive, and fiber content. Biological activities of grape (Vitis vinifera) are primarily associated to the presence of numerous polyphenol structures located in seeds and skins. Procedures applied to maximize the extraction yield of bioactive compounds from grapes are usually performed using toxic, volatile, and flammable organic solvents. Recently, green chemistry has prompted the utilization of alternative solvents, such as natural deep eutectic solvents (NADES). Aim: The primary aim of this study was to evaluate the efficacy of choline chloride-based NADES-specifically, a mixture of choline chloride and citric acid (molar ratio 2:1) with 30% of water (ChCit)-for extracting bioactive compounds from red grape skin. The performance of this novel solvent system was compared with that of a conventional solvent, acidified ethanol (EtOH), to determine its potential as a sustainable and efficient alternative for the extraction of valuable phytochemicals. Material and methods: Eight different red grape varieties were used (Gamay, Vranac, Pinot Noir, Začinak, Black Tamjanika, Prokupac, Frankovka and Shiraz). Skin was manually separated. Extraction was performed in ultrasound bath under previously defined conditions (plant material:solvent ratio-1:10, time-30 min, temperature-50 °C). HPLC-MS/MS was applied for determining organic acids, catechins, proanthocyanidins and flavonols. Anthocyanins, the most common polyphenols in red grape skin, were analyzed using HPLC-UV/DAD system. Results: HPLC-MS/MS resulted in identifying 12 different compounds. Results showed that organic acids such as malic acid, tartaric acid and gallic acid were more efficiently extracted using ethanol. In contrast, the ChCit solvent demonstrated superior extraction efficiency for flavonols, with quercetin being the

dominant compound in most samples, except for Pinot Noir, Začinak, and Prokupac, where rutin was the most abundant, irrespective of the solvent used. When it comes to anthocyanin composition, four different molecules were found. Malvidin 3-O-glucoside was the most represented in all samples. Vranac, Začinak and Shiraz skins were characterized by the highest concentration of anthocyanins. Comparing the efficiency of solvents, it is notable that ChCit extracts contained higher concentrations of these bioactives than ethanol extracts. This enhanced extraction can be attributed to the polar nature and extremely low pH of ChCit, which favor the stability and equilibrium forms of anthocyanins. Conclusion: Considering obtained positive results, natural deep eutectic solvents, particularly those with organic acid, such as ChCit, can be proposed as a suitable media for extracting bioactives from red grape skin.

Keywords: grape skin, natural deep eutectic solvent, extraction, chemical composition, anthocyanins

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Dietary zinc deficiency: current insights, biomarker findings (1963-2021) and potential solutions

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Zinc (Zn) deficiency is a significant global health issue affecting both developed and developing countries, with detrimental effects on health, lifespan, and productivity. The number of people suffering from dietary Zn deficiency has risen in recent years, underscoring the need for regular international assessments to monitor its prevalence. Current challenges include a lack of accurate biomarkers for Zn status, making it difficult to assess and address the deficiency effectively. The FADS1/FADS2 gene expression and erythrocyte LA/DGLA ratio show promise as potential biomarkers, as they respond rapidly to dietary Zn changes and can detect early stages of Zn deficiency. However, further research is necessary to validate these indicators' effectiveness, specificity, and applicability across diverse populations and conditions. Biofortification of staple crops, particularly through agronomic Zn biofortification, emerges as a highly effective strategy to enhance Zn intake globally. Zn-biofortified crops have the potential to address nutritional deficiencies, but their efficiency in improving Zn status among consumers needs thorough verification. Additionally, food preparation and processing techniques that enhance Zn bioaccessibility and bioavailability from plant-based diets should be evaluated and promoted. Modern lifestyle factors, such as changes in dietary patterns, can exacerbate Zn deficiency, highlighting the importance of adapting strategies to contemporary contexts. Addressing the challenges associated with undernutrition, overnutrition, and varied dietary practices is crucial when setting dietary Zn recommendations to mitigate diet-related diseases. This review proposes actions to improve the monitoring and alleviation of dietary and physiological Zn deficiency. These include regular follow-ups to ensure that potential deficiencies of Zn are acknowledged and addressed promptly, predominantly in countries where their existence is less expected. Furthermore, developing accurate biomarkers, verifying the effectiveness of Zn-biofortified crops, and promoting food preparation techniques that enhance Zn bioavailability are required. Special attention is needed for the FADS1/FADS2 biomarkers, requiring more controlled trials to establish their reliability, particularly

in low to middle-income countries. Moreover, understanding desaturase activity under different dietary Zn intake scenarios, the relationship with other minerals, and demographic factors such as age, sex, and ethnicity will contribute to more effective Zn deficiency management strategies.

Addressing these aspects will enable the development of comprehensive strategies to combat Zn deficiency, thereby enhancing public health outcomes globally.

Analysis of salt content and Nutri-score in breakfast cereals on the AP Vojvodina market in 2023

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Objectives: The purpose of this study was to examine the sodium chloride (salt) content and calculate the Nutri-Score of breakfast cereals available on the market, as well as to determine the contribution of these products to a safe daily salt intake (5g), according to World Health Organization. The Nutri-Score is a voluntary declaration of the nutritional value on the front of the package (A, B, C, D, E) that should inform consumers and facilitate healthier choices. It represents a unique method for classifying food by considering both positive and negative nutritional characteristics.

Methods: The research was conducted through collaboration of public health institutes in the AP Vojvodina region during 2023. It involved sampling 369 breakfast cereal samples from retail outlets in the following categories: "cereal flakes", "expanded cereals", "instant cereals and flakes", "instant milling products", "muesli" and "cornflakes". The salt content was analyzed using standard laboratory methods, and the results were compared with food categories based on salt content as classified by the Food Standards Agency of the United Kingdom. For 305 (out of 369) samples, the Nutri-Score was calculated using the Nutri-Score calculator, and the results (from -15 to 40) were categorized into groups from A to E, based on the achieved scores.

Results: Analysis of the salt content in breakfast cereals showed that the average salt content across all types of cereals was 0.56g/100g. The salt content in specific subgroups was as follows: "cereal flakes" (0.24g), "expanded cereals" (0.78g), "instant cereals and flakes" (0.50g), "instant milling products" (0.73g), "muesli" (0.35g), and "corn flakes" (1.24g) per 100g of product. The contribution of a 40g portion to the recommended daily intake was 2%, 6.2%, 4%, 5.8%, 2.8%, 10% for the indicated breakfast cereal categories, respectively. The Nutri-Score ranged from A to D, with scores ranging from -7 to 17 points. The distribution of products across Nutri-Score categories was as follows: 17% for A, 45% for B, 13% for C, and 40% for D, with no products categorized in group E.

Conclusion: Breakfast cereals, due to predominantly low salt content per 100g, do not significantly contribute to the total daily salt intake. Due to their nutritional value, products labeled A and B should be preferred, and those labeled C, D, and E should be consumed rarely. or occasionally. Breakfast cereals are suitable for all population groups, especially those who need to control their salt intake.

Keywords: Sodium-Chloride, cereals, Nutri-Score

Myo-Inositol in Type 1 Diabetes - case report

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Type 1 Diabetes (T1D) is characterized by autoimmune destruction of pancreatic beta cells, leading to insulin deficiency. Myo-inositol, a naturally occurring compound, has been shown to influence insulin signaling and glucose metabolism, primarily in Type 2 Diabetes. Clinical studies specifically investigating myo-inositol's effects on T1D are limited. Much of the research has been focused on other forms of diabetes or general metabolic health. This case report try to explor its effects in a patient with T1D.

Patient Profile:

•Age: 52 years old

• Gender: Female

• Diagnosis: Type 1 Diabetes diagnosed at age 1,5

• Treatment: Insulin therapy

Aim: To investigate the potential benefits of myo-inositol supplementation in managing glycemic control and improving insulin sensitivity in a patient with T1D.

Methodology:

• Duration: 3 months, from May 2024 to August 2024

• Dosage: 4 grams of myo-inositol daily

• Monitoring: Regular blood glucose levels, HbA1c, insulin dosage adjustments and body mass. The patient also reported on subjective symptoms like energy levels and hypoglycemic episodes.

Results:

1. Glycemic Control:

o HbA1c: The patient's HbA1c decreased from 8.23% to 7.62% over the study period.

o Blood Glucose Levels: There was a reduction in average blood glucose levels, without instances of severe hyperglycemia and hypoglycemia.

2. Insulin Sensitivity:

o The patient reported needing slightly less insulin, suggesting improved insulin sensitivity.

3. Subjective Improvement:

o Increased energy levels and fewer hypoglycemic episodes were noted.

4. Body Mass:

o The patient body mass decreased from 56kg to 53.4kg over the study period. Diet and physical activity were the same as before starting to use the supplement

Discussion: Myo-inositol is thought to play a role in cellular signaling and insulin sensitivity. Although more commonly studied in Type 2 Diabetes, this case report suggests that it may also have potential benefits for individuals with Type 1 Diabetes. The improvements in HbA1c and

reduction in insulin requirements may be related to enhanced insulin action or other metabolic effects of myo-inositol.

Conclusion: This case report indicates that myo-inositol supplementation might offer benefits in managing glycemic control in T1D. However, larger, controlled studies are necessary to confirm these findings and establish the clinical relevance of myo-inositol in Type 1 Diabetes management.

Limitations: • Single case report with limited sample size • Short duration of supplementation • Need for more comprehensive studies to validate the findings and understand the mechanisms involved.

Significance of nutritional interventions in patients with metabolic syndrome

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Lifestyle changes, especially dietary habits, are the main therapeutic strategy for the treatment and management of metabolic syndrome. Specific dietary modifications, such as improving food quality or changing nutrient distribution, have shown beneficial effects on metabolic syndrome and individual parameters.

Most evidence supports the use of the Mediterranean diet and DASH as a new paradigm for the prevention and treatment of metabolic syndrome. Energy-restricted dietary patterns and increased physical activity are key to ameliorating the metabolic disturbances observed in patients with metabolic syndrome.

Allergens hidden in culinary herbs and spices

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Allergens are substances that, when ingested, mounts an immune response in sensitive individuals. The mechanisms of allergic reactions in the organism can be different, but what is most important is that their consequences can be very dangerous. Therefore, a clear indication of the allergens present in food is a mandatory requirement. The question is whether food declarations are always in compliance with the law? Driven by the public health protection, the European Commission launched the Rapid Alert System for Food and Feed (RASFF), which aims to reduce public health risks related to the presence of numerous hazards, including allergens, in various food categories, including culinary herbs and spices. Herbs and spices are traditionally used to enhance the aroma of food, making it more appealing to the consumers, but also acting as preservatives and providing health benefits. The aim of the current study is to explore allergens hidden in culinary herbs and spices. Notifications registered in the Rapid Alert System for Food and Feed RASFF database for the period 2011-2023 were extracted and collated so that the most significant characteristics of the allergens-herbs/spices set can be observed. The most frequently present allergen was mustard (24 cases), followed by celery (19), peanuts (12), gluten (9), almond (7), sulphite (6), sesame (3), wheat (3), milk (2) and soy (1). Allergens were most often hidden in pre-prepared mixtures of various spices/herbs (42.3%), followed with products such as cumin (11.5%), curry

(10.2%), paprika (9.0%) etc., with the raw materials originating from different countries, such as Spain, India, China, Egypt, the Czech Republic and others. A total of 78 notifications was predominantly reported as a result of official controls on the market (57.7% in relation to the total number of notifications) and companies' own checks (33.3%). Consumer complaints accounted for 2 (2.6%) notifications – although that number seems very small, on one hand it points to failures in the consumer protection system and in the other represents an immediate health risk. The majority of notifications were characterized as a serious risk to public health, classifying 69.2% of the notifications as alerts. These findings are valuable in comprehension of hidden presence of allergens in herbs and spices. Widely used to enhance the aroma of food, herbs and spices can be an imperceptible way for allergens to enter the body, thus endangering consumers well-being.

Intake and associated health benefits of soy isoflavone in food supplements

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Consumption of food supplements is widely spread and increasing - soy-based preparations are among the ten most used herbal supplements. Bioactive properties of soy isoflavones, a group of phytoestrogens, recommend these supplements as a natural alternative to hormone replacement therapy intended mainly for women in menopause. Additional beneficial effects indicated for soy isoflavones are reduced risk of osteoporosis and cardioprotective properties. This study aimed to evaluate the intake of soy isoflavones from food supplements available on the markets of the Republic of Serbia and Republic of Srpska, represented with 21 products, against the EFSA recommendations specific for supplements, as well as supplements capacity to contribute to the doses considered responsible for health benefits. Calculation of the intake of soy isoflavones from supplements (expressed as total aglycone equivalents) was based on their isoflavone content (previously determined by high-performance liquid chromatography) and usage pattern recommended by the manufacturer.

The daily intake of soy isoflavones varied greatly depending on the choice of supplement, ranging from 0.05 to 71mg/day, with mean level at 23.9±20.5mg/day, resulting with the mean contribution to the recommended intake range of 68.3-119.5% (against the upper and the lower end of the range, respectively). Corresponding contribution span related to the supplement with the lowest isoflavone content was 0.13-0.23%, while in the case of the supplement with the highest isoflavone content it was as high as 203-354%. Overall, 12/6 supplements out of 21 showed capacity to achieve lower/upper limit of the recommended intake range. From the safety aspect, it should be stressed that not one of the tested supplements exceeded the upper safety limit of 150mg/day (the mean contribution was 16%, maximum 47%). Regarding associated health benefits, mean contribution was 34.1±29.3% (range 0.06-101%) of 70mg/day estimated to relieve menopausal symptoms, with only one tested supplement that can fully contribute. In relation to the osteoporosis- and cardio-protective effects, for which the required dose of 90mg was indicated, the mean contribution was 26.6±22.8% (range 0.05-78.8%).

In conclusion, daily intake of soy isoflavone from supplements is in the range of the recommended intake from food supplements, does not pose safety concerns, and it is not sufficient by itself to bring the health benefits listed on the supplement label. However, if added to consumption of soy-based foods, especially those rich in isoflavones, it can significantly contribute to the total daily intake of soy isoflavones reaching the level needed to achieve beneficial effects.

Keywords: bioactive substances, supplementation, health benefit, public health

Attitudes and habits regarding drinking water in population of Tuzla canton

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Introduction: The safety and quality of drinking water are critical for human health and development. This study aims to assess the attitudes and habits of the general population regarding their choice of drinking water in Tuzla Canton, Bosnia and Herzegovina. Methods: This prospective cross-sectional study was conducted in September 2023. using a purpose-designed questionnaire. Participants from both urban and rural areas were selected through voluntary participation, ensuring anonymity. Data were analyzed retrospectively. A total of 458 individuals participated from 13 cities within Tuzla Canton. Results: Overall, 45.6% of the respondets reported water consumption from local sources, 37.8% from the municipal supply, and 16.5% bottled water. A majority of respondents (78.6%) live in rural area. Regarding perceptions of water quality control, 64% believe municipal water is monitored, 85% believe bottled water is monitored, and 58% believe local sources are monitored. Common undesirable water characteristics reported include a chlorine odor in municipal water (43%), the taste of water for bottled water (63%), and foreign particles in water from local sources (20%). The healthiest drinking water was perceived to be from local sources by 46% of respondents. Conclusion: The results underscore the need for programs to raise awareness about water quality, engage general public in water safety initiatives, and ensure comprehensive monitoring of drinking water quality.

Keywords: drinking water, water quality, attitudes, habits

Dietary intakes of adult men and women 18-65 years old, in Serbian EU Menu Dietary Survey 2017-2022

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Objective: To examine the diet and nutritional status of adult Serbian subjects aged 18-64 years. Methods: This nationally representative cross-sectional survey, including 1182 subjects 18-44 years old, was conducted during 2017-2022 across different regions of Serbia, following the EFSA EU MENU methodology. Collected data included anthropometrics (body mass index, BMI) and the intake of energy, macronutrients, and separate food groups (examined through two 24-hour recalls, using the Serbian food composition database). Results are presented as median (IQR) for women and men, respectively, and the Mann-Whitney test's significance. Results: The survey included 597 females and 585 males, of similar age [42,7(29,0-52,0) vs 41,0(29,0-51,0) years, p>0,05]. Males had higher BMI [23,0(21,0-26,1) vs. 25,8(23,7-28,5) kg/m2, p<0,001], and total daily energy intake [1896(1519-2260) vs. 2608(2066-3178) kcal/d, p<0,001]. The macronutrient composition of the diet (%kcal/d) was dominated by dietary fats in both genders [43,1%(38,1-48,5%) vs. 43,7%(38,7-49,1%), p>0,05], then by carbohydrates [higher in women, 40,3%(34,0-46,2%) vs. 37,8%(31,5-43,3%), p<0,001], and ~15% derived from proteins [higher in men, 14,6%(12,5-17,0%) vs. 15,1%(13,0-17,4%), p=0,026]. However, the dietary requirements for proteins (0,8 g/kgBW/d) were not satisfied in about one-quarter of women (24,0% vs. 16,9% in men, p=0,003). Men also had a higher energy intake coming from alcohol [0,0%(0,0-0,0%) vs. 0,0%(0,0-4,5%), p<0,001]. Regarding food group distribution, most of the energy in both groups was coming from grain products [25,9%(19,2-33,5%) vs. 25,8%(20,1-32,6%), p>0,05], from edible fats&oils [higher in women, 15,4%(10,7-20,1%) vs. 13,8%(9,5-18,8%), p=0,001], or meat and meat products [higher in men, 11,7%(6,1-17,8%) vs. 15,9%(9,6-23,8%), p<0,001], then from dairy products [10,3%(5,7-14,9%) vs 9,9%(6,1-14,4%), p>0,05), vegetables [6,5%(4,1-10,0%) vs. 6,0%(3,8-8,7%), p>0,05], fruit [higher in women, 5,6%(1,8-10,1%) vs. 2,8%(0,0-6,6%), p<0,001], eggs [1,5%(0,4-4,6%) vs. 1,8%(0,5-5,0%), p>0,05], nuts and seeds [higher in women, 2,9%(1,1-6,5%) vs. 1,7%(0,5-4,0%), p<0,001), sweets [higher in women, (3,1%(0,4-7,4%) vs. 2,1%(0,2-5,7%), p=0,001], and alcoholic and non-alcoholic beverages [higher in men, 0,6%(0,0-4,8%) vs. 3,8%(0,1-9,9%), p<0,001]. Fish consumption was not reported by 76,5% of women and 80,5% of men, but even in those who reported fish consumption, the daily energy contribution was quite low, 6,0%(3,5-9,6%), vs. 5,2%(3,1-9,6%), p>0,05. Conclusion: The diet of the adult subjects in Serbia is characterized by a high intake of dietary fats (coming mostly from edible fats and oils, meat, and dairy products), followed by carbohydrates (coming mostly from refined grains), and a moderate intake of proteins (coming mostly from meat, grain products, dairy products, and legumes). The intake of fish, eggs, vegetables, fruits, seeds, and nuts is insufficient.

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