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Hydrogeochemical Characteristics and Origin Of Geothermal and Mineral Waters in The Southwestern Region of Uludağ (Bursa)

Nizamettin Şentürk*, Halim Mutlu**

Abstract

This study investigates the hydrogeochemical characteristics and origin of geothermal sources and mineral waters located in the southwest of Uludağ (Bursa). The geothermal waters in the area exhibit temperatures ranging from 37 to 64.5°C, while mineral waters range from 15.6 to 22.5°C. The total dissolved solids (TDS) of these waters were measured between 451 and 2,026 mg/l, with pH levels from 7.1 to 7.3 in thermal waters and a more acidic profile (6.2 to 6.7) in mineral waters. Geochemically, thermal waters are of the Na-Ca-HCO₃ type, while mineral waters exhibit Mg-Na-Ca-HCO₃ characteristics. Tritium levels in Bursa's mineral waters vary from 0.34 to 5.96 TU, with thermal waters showing lower values (0.34-1.95 TU) compared to mineral waters (1.57-5.46 TU). These tritium results indicate that a large portion of the fluids are from modern water sources. The δ^{18} O values range from ‰-11.08 to -7.97 (Vienna Standard Mean Ocean Water (VSMOW)), and δD values are between ‰-73.81 and -57.64 (VSMOW), which confirms that Bursa's thermal and mineral waters are of meteoric origin, as indicated by their alignment between the Global and Mediterranean Meteoric Water Lines. The dissolved inorganic carbon (HCO₃⁻) in mineral waters has δ^{13} C values from %-15.3 to +10.12 (VPDB). The significantly lower carbon isotope composition in thermal waters suggests organic matter as the carbon source, while in mineral waters, the carbon is primarily derived from marine limestone. Using the deuterium-altitude relationship, it was estimated that the recharge areas of Bursa's thermal waters are at elevations between 1180 and 2300 meters. These findings underline the importance of studying the recharge sources and chemical properties of thermal and mineral waters, providing valuable insights for sustainable utilization.

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Keywords: Uludağ, hydrogeochemistry, geothermal waters, mineral waters, isotopic composition

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Label-Based Content Evaluation of Bottled Mineral Water Sold in Turkish and Swedish Markets

Selcen Şentürk,* Tuba Yoldaş,** Elif Günalan***

Abstract

Bottled mineral waters (BMWs) have great potential to modulate optimal health with content. Their contents may vary according to various criteria, such as country, manufacturer, source, and industrial process (I). Due to its location, Türkive is among the countries rich in natural mineral waters. Therefore, the mineral content has the potential to be higher than that of sparkling mineral waters, especially in European countries. Although the content of sparkling mineral waters sold in European countries' markets was frequently investigated in the literature (I-2), there was limited data regarding the contents of mineral water in Türkiye. This study aims to compare the label-based content of bottled sparkling mineral water in the Swedish market with that of their counterparts in Türkiye. In this context, the samples were selected from supermarkets in Istanbul, Türkiye (n=21), and Umeå, Sweden (n=18). Sweetened carbonated beverages were excluded from the study. Concentrations of bicarbonate, sodium, potassium, calcium, fluoride, chloride, magnesium, and sulfate were obtained from the labels on the bottles. Descriptive statistics, normality, and Welch ANOVA tests were applied via Jamovi software (version 2.6.2). The range levels of mineral content in bottles vary reasonably widely in both countries. The most remarkable difference in median mineral content was found for magnesium, with 3.1 mg/L in Sweden and 62.1 mg/L in Türkiye. All mineral concentrations except sulfate and fluoride were significantly higher in mineral waters in the Turkish market than in Sweden (p<0.05). Fluoride concentration in Swedish BMWs was significantly higher than in Türkiye (p<0.05). The vast range of mineral contents in BMWs can be a concern for hypertension, kidney, and urological diseases. Therefore, label-based interventions, legal regulations, and legislation should provide consumer and manufacturer awareness. Considering the limited data in this study, more comprehensive studies on the contents of natural mineral waters should be planned in the future.

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Keywords: Fluoride, label, mineral water, magnesium

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A Bibliometric Analysis of The Health Effects of Mineral Water

Hasan Hüseyin Kara*, Beyzagül Arslan*, Şenay Burçin Alkan*

Abstract

Mineral water is a special form of groundwater distinguished by its specific mineral composition and physicochemical properties. It is a commonly consumed beverage, particularly in developed countries. Due to its rich content of essential minerals, including magnesium, potassium, and calcium, mineral water consumption is often associated with various health benefits (1, 2).

This bibliometric study analyzes II.618 publications from 1980 to 2025 using the keymords "mineral waters" and "health" on the Web of Science database. Bhattacharya, P. leads in document production with 24 articles. The co-author network includes a total of 51.241 authors, and Bundschuh, J. has the highest number of connections (I.829) in this network. Most studies belong to the fields of environmental sciences (3.808), water resources (I.327), and environmental engineering (I.191).

The Chinese Academy of Sciences leads inter-institutional collaborations with 288 publications. The United States (2.542 documents) and the People's Republic of China (1.878 documents) are the top countries in publication output. In the overall analysis, Türkiye does not rank among the countries with the highest document production. India, Germany, Australia, Spain, Italy, Canada, and the United Kingdom are notable among those included in the ranking. Türkiye has produced 61 documents on mineral water's health effects, ranking 66th with 183 citations. Common keywords in this research area include "groundwater" and "arsenic".

In conclusion, this bibliometric analysis synthesizes the current literature on mineral water and health, highlighting influential authors, institutions, and countries within the research domain. While findings indicate that studies in this field in Türkiye remain limited, they underscore substantial potential for further research. These insights serve as a valuable resource for guiding future studies and fostering collaborative partnerships.

^{*} Necmettin Erbakan University.

Keywords: Mineral water, health, bibliometrics

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A Bibliometric Analysis of The Mental Health Effects of Mineral Water

Beyzagül Arslan*, Hasan Hüseyin Kara*, Şenay Burçin Alkan*

Abstract

In recent years, the incidence of mental health disorders, particularly depression, has risen significantly. Empirical studies suggest that patterns of fluid consumption may influence mental health outcomes (1, 2).

This study provides a bibliometric analysis of 73 publications on the relationship between mineral water and mental health, identifying research trends, key authors, institutions, and collaborations. A search in the Web of Science database on October 26, 2024, using "mineral water" and "mental health" as keywords, yielded articles from 1991 to 2024 across fields such as environmental sciences, water resources, engineering, and nutrition and dietetics.

This bibliometric study analyzed citations by author and institution, identifying eighteen prolific authors and the Russian Academy of Sciences as the leading document producer. Indexed Web of Science publications were examined to assess scientific productivity.

Analyses reveal contributions from researchers across 40 countries, with the United States, China, the United Kingdom, Italy, Germany, and India being most prominent. The United States and the United Kingdom also showed the highest co-citation link strengths. Frequently used keywords include "health claims", "health", "silicon", "minerals", "vitamins", and "heavy metals", offering insights into the potential mental health benefits and composition of mineral water."

In conclusion, this bibliometric study seeks to provide a foundation for future research by mapping the scope of studies on mineral water and mental health and identifying key authors and countries. Notably, the limited research on this topic in Türkiye highlights significant potential for exploration in a country with abundant mineral water resources.

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Keywords: Mineral water, mental health, bibliometrics

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Assessment of The Cytotoxic Effects of The Powder of Şalgam, a Lactic Acid Fermented Beverage Based on Black Carrot, on Breast Carcinoma

Göksu Şener*, Hale Öksüz Üçkayabaşı*, Ali Üçkayabaşı*, Nermin Seda Ilgaz*, Bilal Ağırman***, Hüseyin Erten***, Ayfer Pazarbaşı*, Mehmet Bertan Yılmaz*

Abstract

Recent advancements in phytotherapy have led to a surge in research focused on the therapeutic potential of plant extracts for the management and supportive care of various medical conditions. Emerging research has increasingly focused on the health benefits of traditional fermented foods and beverages. Salgam beverage has also recently attracted the attention of researchers. It has gained popularity as a staple food not only in Türkiye's southern regions but also in other parts of the country (I). Salgam is rich in essential vitamins, minerals, antioxidants, phenolic compounds, and anthocyanins. Epidemiological studies suggest that the consumption of Salgam may correlate with a reduced incidence of various diseases due to their bioactive compounds (2). This study aimed to investigate the efficacy of Salgam extract on breast cancer. We used MCF-7, a breast cancer cell line, and NIH₃T₃, a healthy fibroblast cell line, as controls in the study. We treated the cells, whose development we followed in a cell culture medium, with Salgam extract dissolved in different doses. Our study also included a serum starvation group. The cytotoxic effects were quantified using the 3-[4,5-dimethylthiazol-2-yl]-2,5 diphenyl tetrazolium bromide (MTT) assay, a standard method for evaluating cell viability. While NIH3T3 fibroblast cells exhibited no significant differences in cytotoxicity when compared to the control group post-treatment, a notable reduction in viability was observed in MCF-7 breast cancer cells across all treatment groups, including those supplemented with fetal bovine serum (FBS). The serum starvation cohort demonstrated a pronounced decrease in cell viability in MCF-7 cells, with the most significant effects noted in the stock solution treatment. These

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findings suggest that Salgam extract has a discernible impact on the viability of cancer cells and highlights its potential as a subject for further therapeutic investigations.

Keywords: Breast carcinoma, cytotoxic effect, salgam

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Bioavailability of Minerals in Mineral Water and Their Effects on Mental Health

Nursena Nahya Servi*, Cemaliye Süt*

Absract

One of the key challenges today is enhancing human health and preventing disease, particularly mental disorders observed worldwide. Recent studies indicate that lithium in mineral water may help stabilize mood and improve cognitive function, potentially due to its bioavailability. This review examines the role of lithium in mental health by searching keywords like "mineral water" and "mental health" in databases such as PubMed and Google Scholar. Lithium is an essential trace element in human nutrition and medicine. Mineral waters may represent a significant dietary source of lithium. According to a study by Seidel et al., the consumption of mineral water with a lithium concentration of 1724 µg L-1 led to significant increases in serum lithium levels (up to $10-12 \mu mol L^{-1}$), and these levels remained high for a prolonged period. These results suggest that lithium obtained from lithium-rich mineral water has a high dose-dependent bioavailability, and consuming certain mineral waters could significantly improve lithium status in humans. Similarly, Neves et al. highlighted the health benefits of lithium in bottled natural mineral waters in Portugal, suggesting that regular consumption could positively impact mental health outcomes. Additionally, Ng et al. discussed the ethical aspects of lithium in drinking water, noting its association with reduced suicide rates. It should also be noted that lithium is an FDA-approved agent for treating bipolar disorders and is recommended in guidelines by major authorities like CANMAT, ISBD, NICE, and BAP. Lithium is an element that can be toxic to human health, but toxicity is dose-dependent. The data on this topic is limited, and further studies are needed. Due to its rich mineral content, mineral water could provide therapeutic effects, serving both as a natural dietary supplement and supporting mental health through the bioavailability of its minerals (I, 2).

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Keywords: Mineral water, mental health, lithium, bioavailability

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Can Mineral Water be a Safe Alternative in Sports Parameters and Sustainable Health to Energy and Sports Drinks for Adolescent Athletes?

Ömer Mor*, Ece Öz*, Kürşat Bakdım**, Elif Günalan***

Abstract

Energy and sports drinks (ESDs) are frequently consumed for improved hydration and sports performance by athletes in various branches, including fencing, road cycling, football, tennis, handball, and rugby. Statista Consumer Market Insights data declared that the global revenue of the energy and sports drinks (ESDs) industry was 195,74 billion U.S. dollars in 2023. Moreover, the total revenue was projected to increase by 24.05% between 2024 and 2029 (I). However, the ESD consumption routine may become a health concern in the future, particularly in adolescent athletes. Excessive consumption of ESDs is related to dental erosion, tooth decay, obesity, type II diabetes, and several chronic disorders due to their high sugar content and low pH levels. Therefore, alternative solutions with high pH levels, sufficient minerals, and low sugar content must be found. This review discusses the effect of natural mineral waters (NMWs) on sports parameters and sustainable health compared to ESDs for adolescent athletes. In this context, related publications in the last 30 years have been obtained from Google Scholar, Scopus, and PubMed databases. Scientific literature was evaluated in terms of sports parameters, dental health, and risk of chronic disease development. Firstly, NMWs can contribute to rehydration, improved acid-base balance, and relieving muscle fatigue post-exercise. However, more evidence is required to impact performance directly. Secondly, NMWs with high pH and fluoride content may be safer for dental health than ESDs. Lastly, the consumption of non-sweetened NMWs does not result in obesity, but it may cause hypertension and urological diseases. In conclusion, consumption of ESDs or NMWs alone is insufficient for sports performance and sustainable health. Therefore, the effects of combined consumption of ESDs and NMWs on adolescent athletes should be investigated in the future, and their optimal consumption amounts for sustainable health should be determined.

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Keywords: Dental erosion, mineral water, oxidative stress, sports drinks, sustainable health

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Potential Effects of Mineral Water on Gut Microbiota

Tuğba Şimşek*, Murat İntepe*, Gamze Yıldırım*

Abstract

Mineral water is a natural beverage with beneficial effects on gut microbiota and digestive health. The gut microbiota is a community of numerous microorganisms living within the digestive system, having significant impacts on digestion, the immune system, and metabolism. Mineral-rich waters can contribute to the balance and diversity of gut microbiota.

Mineral waters, rich in calcium, magnesium, potassium, and sodium, provide various benefits for gut health. Magnesium, in particular, supports the regular functioning of intestinal muscles, thereby increasing bowel motility and helping to prevent constipation. Natural mineral waters with high magnesium sulfate content have been supported by clinical studies, showing their potential to improve stool consistency and bowel movements.

Mineral waters that are rich in calcium and bicarbonate help regulate the pH balance of the digestive system, balancing stomach acidity and easing digestion. These components contribute to the healthy functioning of the digestive system and can help alleviate problems such as heartburn. The benefits of mineral water are not limited to its mineral content alone. Consuming mineral water with prebiotics, which are indigestible fibers that promote the growth of beneficial bacteria in the gut, can further enhance its effects. These fibers encourage the proliferation of probiotic bacteria such as *Lactobacillus* and *Bifidobacterium*, helping to balance the gut flora. These microorganisms are particularly beneficial in the treatment of digestive issues such as functional constipation.

In recent years, postbiotics have also become important for gut health. Postbiotics are compounds produced through the fermentation of probiotics that have positive effects on gut microbiota. For example, short-chain fatty acids like butyrate support the health of intestinal cells and can reduce inflammation in the gut. Therefore, when mineral water is enriched with probiotics and postbiotics, it becomes a potent functional beverage that contributes to gut health.

^{*} Kızılay Beverage.

Keywords: Mineral water, gut microbiota, probiotics, postbiotics, digestive health

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Efficacy of Tunnel Pasteurization System for Preservative-Free Production in Mineral Water Products

Ridvan Furkan Bilyay*

Abstract

In the mineral water production process, pasteurization is conventionally carried out in tunnel pasteurizers, where the product is gradually heated and cooled. During this process, there may be losses in flavor and aroma. To reduce the long processing time and ensure a uniform temperature distribution within the product, the effect of applying a vertical-rotation motion to mineral water bottles was examined through mathematical modeling. The models developed for this purpose were validated using experimental results.

Food preservatives are natural or synthetic chemicals added to foods to delay spoilage caused by microbial growth or undesirable chemical changes. According to the Turkish Food Codex, food additives are used to preserve, improve, or prevent unwanted changes in foods' taste, smell, appearance, structure, and other qualities. However, it is known that high levels of preservative use can lead to toxic effects and allergic reactions in some consumers.

In our mineral water production, we aim to eliminate food preservatives from formulations to prevent microbiological risks, replacing them with Tunnel Pasteurization to mitigate these risks.

The goal of the pasteurization process is to measure the Time Above Temperature (TAT), which is the duration for which the product inside the bottle remains above the set pasteurization temperature. TAT measurements are validated with Data Logger devices, which regularly monitor the accuracy and effectiveness of the tunnel pasteurization machine.

Preservative-free production is also supported by technologies like tunnel pasteurization to maintain the safety and freshness of beverages, thereby eliminating the need for traditional preservatives and offering more natural and healthier products.

^{*} Kızılay Beverage.

Keywords: Pasteurization, preservative-free, mineral water, microbiology

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Evaluation of Mineral Water Production and Consumer Behavior in Türkiye

Gönül Ünal*, Erdoğan Güneş**

Abstract

Since ancient times, people have believed in the healing power of water and have used water to treat some diseases. When the literature data was examined, it was noted that there was no similar comprehensive research on mineral waters in the healing water group.

The EU average annual consumption of natural mineral water in 2022 is 121 liters per person (I). In Türkiye, the annual per capita consumption of mineral water in 2022 is 13.5 liters (2). This study aims to investigate the situation and structural nature of mineral water enterprises, supply and demand direction, basic problems and development in the production and marketing process, labor resources, company structure and organization, financing sources, as well as socio-economic characteristics and consumer behavior of consumers according to various criteria. It is important because it examines mineral water as a whole by considering the producers and consumers under one roof.

The main material of the research consists of survey forms obtained from 12 mineral water companies in 6 provinces of Türkiye and 384 mineral water consumers in these provinces. Problems faced by companies regarding production, marketing and consumer behavior; Consumers' preferences, attitudes and behaviors are revealed with Likert scale judgments..Frequency calculation, ANOVA test, independent sample t test, Chi-Square, Factor Analysis and Cronbach Alpha Test were used to evaluate the analysis.

In the study, solution-oriented suggestions were presented for companies and consumers in order to make production more active and efficient, to increase the awareness of consumers and to contribute to their solution-oriented behavior in the face of problems encountered.

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Keywords: Mineral water, producer, consumer, consumption habits

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The Investigation of Public Interest to Mineral Water: a Google Trends Study

Esra Aladağ^{*}, Merve Sadık^{*}, Elif Günalan^{**}

Abstract

The global bottled mineral water market tends to grow thanks to rising awareness of health and well-being. This industry is classified as manufactured mineral water and natural mineral water. Although Türkiye is among the countries rich in natural mineral waters, Asia-Pacific regions are primarily known in the natural mineral water market (I). Increasing the market volume and providing consumption motivation depends on understanding the public's interest. This study aims to understand global and local public interest' in mineral water via the Google Trends (GT) tool. GT provides daily, monthly, and yearly relative search volumes (RSV) of search queries in different countries and languages (2). This study selected the "shopping" category, and searches were conducted in Türkiye and worldwide. Keywords were searched in Turkish and English, and the search spectrum was "I October 2014-I October 2024" to determine monthly search queries. Search queries were classified into three parts: mineral water, different types of non-alcoholic beverages, including mineral water, and different terms of mineral water. Lastly, RSV values for search queries from 2014-2019 and 2019-2024 were also compared. Statistical analyses were completed with Jamovi software (version 2.6.2). Mineral waters' mean RSV in Türkiye are consistent with seasonal temperatures. Globally, the mean RSV of mineral waters has been higher than those of soft drinks, sports drinks, and fruit and vegetable juices. In the Türkiye, soft drinks have higher mean RSV than mineral waters. The mean RSV in mineral waters has significantly increased in 2019-2024 compared to 2014-2019, both local and global (p < 0.05). It could be related to changed health perceptions with the pandemic. Understanding search queries about mineral water will contribute to consumer health and raise awareness and market volume. According to the findings, the manufacturers should be informed about the opportunities and trends.

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Keywords: Google Trends, .mineral water, public interest

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Traces of Sustainability on Bottled Mineral Water Packaging: Türkiye vs. Sweden

Tuba Yoldaş*, Selcen Şentürk**, Elif Günalan***

Abstract

Globally, the bottled water market is one of the most enormous volume categories in the beverage industry. Massively using these packaged beverages is a concern for environmental sustainability due to the production process and plastic waste (I). In this context, mineral waters that support sustainable health are especially expected to be environmentally friendly. In the European Union (EU) member states, the legal regulations regarding sustainable environment attract attention (2). However, the literature could be more comprehensive in comparing EU and non-EU member states. This study aims to compare the bottled mineral water market in Türkiye and Sweden regarding sustainability-related traces in labels and packaging. For this purpose, the largest supermarket chains were visited in İstanbul, Türkiye (n=5), and Umeå, Sweden (n=3). Bottled mineral waters were determined (n=21 in Türkiye, n=18 in Sweden), and the environmental sustainability-related label information was recorded from the bottles supplied by the manufacturers. The data were analyzed with descriptive statistics via Jamovi software (version 2.6.2). The distributions of sustainability regarding logos, information, and package design in total products (n=39) were PET-I (10.3% in Türkiye; 17.9% in Sweden), GL-71 (43.6% in Türkiye), recyclable packaging (51.3% in Türkiye; 46.2% in Sweden), green dot (48.7% in Türkiye), deposit mark (46.2% in Sweden), and tethered caps (17.9% in Türkiye; 43.6% in Sweden). Additionally, while a Turkish brand's products were vegan, a brand's drinks in Sweden were produced with renewable energy. This study was only label-based and assessed the mineral waters market in Türkiye and Sweden. A comparison of the assessed sustainable indications revealed several variations. The widespread use of tethered caps and deposit payments in Sweden encourages consumers to recycle plastic garbage and prevent environmental pollution with a planned recycling system. For a sustainable future, similar practices must also be expanded in Türkiye.

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Keywords: Sustainability, label, mineral water, sparkling water

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Development of Functional Mineral Water Using Apple Polyphenols and Soluble Dietary Fibers Extracted From Apple Pomace Waste Through Sequential Extraction Technology

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Abstract

Approximately 70-80% of apples produced worldwide are used for consumption, while 65-70% of the remainder is allocated to apple juice concentrate production. In 2019, around 5.5 billion liters of apple juice were consumed, highlighting apple pomace as a significant byproduct, constituting 25-30% of processed apples (1). Türkiye, with an annual apple production of 4.8 million tons, ranks among the top apple-producing countries. In the country, apple concentrate facilities process an average of 250,000 tons of apples per year, generating approximately 60,000 tons of pomace waste per facility. However, a majority of this pomace is not commercially utilized, posing a major waste issue for apple production.

This project aims to recover health-promoting polyphenols and soluble fibers from apple pomace using environmentally friendly extraction technologies. These bioactive compounds will then be incorporated into mineral water formulations to create a functional beverage that supports immunity, brain health, and overall well-being. Apple pomace is a valuable raw material due to its high fiber and polyphenol content, though it is typically used as animal feed or compost.

In our project, apple pomace will first undergo suitable drying methods. Polyphenols will then be extracted using "green" solvents, specifically deep eutectic solvents. Subsequently, the remaining pomace will be processed to extract soluble fibers using techniques similar to pectin extraction. These fibers are known for their prebiotic effects, supporting gut health.

This research aims to obtain high yields of polyphenols and soluble fibers with deep eutectic solvents, leveraging apple pomace as a source of bioactive compounds. Ultimately, this project exemplifies a circular economy approach, transforming waste into value-added products through advanced biotechnological methods (2).

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Keywords: Apple pomace, polyphenols, soluble fiber, deep eutectic solvents, circular economy

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Acute Toxicity Assessment of Powdered and Liposomal Resveratrol That Can be Used in Mineral Water

Gül Sinemcan Kabataş*

Abstract

Liposomes are now considered the most commonly used nanocarriers for various potentially active hydrophobic and hydrophilic molecules due to their high biocompatibility, biodegradability, and low immunogenicity. Liposomes also proved to enhance drug solubility and controlled distribution, as well as their capacity for surface modifications for targeted, prolonged, and sustained release. Resveratrol (RES) is a polyphenolic compound, has several pharmacologic functions including anti-inflammation and anticancer effects. To investigate the potential therapeutic effects of liposomes and RES, RES-loaded liposomes were produced using the thin-film hydration method. The acute toxicity studies of powdered and liposomal-RES aim to evaluate and investigate their potential toxic effects. The liposomes were characterized by particle size, zeta potential, FTIR, DSC, TEM, LC-MS/MS, and in vitro release kinetics tests. Subsequently, in silico release and distribution studies were conducted. The in vivo pharmacokinetic parameters of the resveratrol-loaded liposomes were determined, followed by a 28-day acute toxicity study. At the end of the 28-day-period, animals were sacrificed by decapitation, and blood samples, as well as brain, lung, liver, and kidney tissues, will be collected for ELISA/histological analyses. Statistical analyses were performed using the GraphPad software. Initially, the characterization analyses and release tests for the RES-loaded liposomes were successfully completed. In the histopathological study, it was observed that the organs in all treated groups showed no changes at the cellular level in comparison to the control. Histopathological slides also confirmed that no toxicity was observed in groups treated with different doses of RES-loaded liposomes. Also, the results suggested from our study that the levels or activities of biochemical parameters in animals have no significant variations occurred in ALT, AST, urea, and creatinine levels at all tested dose in comparison to control. Therefore, the combination of liposomes and resveratrol may offer a novel therapeutic strategy for tissue damage in various disease models.

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Keywords: Liposomes, resveratrol, acute toxicity, in vivo

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Antimicrobial Effects of Silver Nanoparticles Possibly Used in Food Packaging

Gülsüm Ercan** Gita Parviz**, Erkan Rayaman***, Muhammet Emin Çam*

Abstract

Microbial contamination in food industry is a major issue resulting in wasted products and poses a threat to public health through foodborne illnesses. Silver nanoparticles (AgNPs) have strong antimicrobial properties against various microorganisms such as bacteria, yeast, and mold. It was also used for disinfection of potable water leveraging their antimicrobial effect as early as 1000 B.C (I)..AgNPs destructively interact with microorganisms and exhibit effective antimicrobial activity compared to other silver salts due to their extensive surface area derived from the spherical shape. Therefore, utilizing this antimicrobial material in the food industry can be beneficial for prolonging the shelf life of food products by inhibiting the growth of spoilage and pathogenic microorganisms.

In this research, AgNPs were produced using the chemical reduction method at room temperature and aimed to observe the most effective shaped and sized AgNP sample among the AgNP samples. Eight different samples were obtained by adding H_.O_.. AgNPs with different sizes and shapes were analyzed for their antimicrobial activity against Pseudomonas aeruginosa (ATCC 27853), Staphylococcus aureus (ATCC 43300), Klebsiella pneumoniae (ATCC 4352), Enterococcus faecalis (ATCC 29212), Streptococcus pyogenes (ATCC 19615), Escherichia coli (ATCC 25922), Candida albicans (ATCC 90028) and Aspergillus brasilinesis (ATCC 16404). The cyto-safety of administration was assured in vitro on human epidermal keratinocyte (HaCaT) cells via 3-(4, 5-dimethylthiazolyl-2)-2, 5-diphenyltetrazolium bromide (MTT) assay. UV-Visible spectroscopy (UV-VIS), fourier-transform infrared spectroscopy (FT-IR), X-Ray Diffractometer (XRD), and zeta potential results showed that adding H₀ changed the color, shape, and particle size, hence the antimicrobial effect of the AgNPs. According to all results, AgNPs were seen to have promising potential for food (mineral water) packaging due to their high antimicrobial activity.

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Keywords: Silver, silver nanoparticles, antimicrobial effect, food packaging

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Advantages of Multivitamins Developed With Liposomal Technology

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Abstract

Liposomal multivitamins are supplements formulated using liposome technology to increase the bioavailability of nutrients. Liposomes are nanoscopic capsules consisting of lipid bilayers and containing nutrients dissolved in water. These unique structures allow vitamins and minerals to be absorbed more effectively through the digestive system. Unlike traditional multivitamins, liposomal formulations facilitate nutritional groups and provide the vitamins and minerals necessary for a better healthy life. Studies show that liposomal formulations have higher absorption rates. Chaves et al. (2023), stated that use of liposome multivitamins supports quality and efficiency in the products. Especially, fat-soluble vitamins such as vitamin C or vitamin E, when they are taken in liposomal forms, offer more bioavailability with less loses. This increases the efficiency of liposomal multivitamins for daily vitamin needs. They also affect the digestive system negatively like stomach upset, gas, and irritation, which are often seen in traditional supplements, can be greatly reduced with liposomal formulations. Moreover, some researches continue on the potential of these formulations to support the health system, reduce oxidative stress, and store general health. Liu et al. (2020), proposed that the liposamal vitamins provide more positive interaction for ingestion. Regarding this view, liposomal multivitamins have an important role among modern nutritional supplements as they offer better absorption, fewer side effects, and various potential health benefits contrast to traditional multivitamins. However, more research is needed on the long-term effects and for the safety. Thus, the positive effects of liposomal multivitamins on health lead to better capacity and potential maximum deterioration.

³⁶

^{*} Kızılay Beverage.

Keywords: Liposomal, multivitamin, supplementary

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In Vitro Investigation of Antimicrobial Activities of Camellia Sinensis, Salvia Officinalis, Aloe Vera and Thymus Vulgaris

Şevval Gülşah Tekinalp*, Erkan Rayaman**, Muhammet Emin Çam***

Abstract

Acne vulgaris is a skin condition that affects people of various age groups worldwide. It can lead to psychological disorders by negatively impacting individuals' social lives, self-confidence, physical appearance, and even employment opportunities. The fact that traditional treatment strategies in the treatment of acne vulgaris cause serious side effects such as gastrointestinal discomfort, liver function abnormalities, and teratogenicity has led researchers to develop natural, herbal, economical, easy-to-apply, innovative treatment strategies using nanotechnology, one of the popular technologies of recent years). In this study, Camellia sinensis (L.) Kuntze, Salvia officinalis L., Aloe vera L., and Thymus vulgaris L. were chosen based on their reported effectiveness against acne vulgaris in the literature (2). Extracts of these plants were prepared and their antimicrobial activities against *Cutibacterium acnes*, Escherichia coli, Staphylococcus aureus, Staphylococcus epidermidis, Enterococcus faecalis, Pseudomonas aeruginosa, and Candida albicans were evaluated using agar well diffusion and microdilution methods. The minimal inhibitory concentration values of the extracts against the bacteria range from 0.13 to 31.25 mg/mL, while the minimum bactericidal concentration values range from 0.26 to 125 mg/mL. None of the extracts showed an antifungal effect against C. albicans. EaseState 360 software (v.3.12.9.1, Boston, MA, USA) was used to find out whether these plant extracts increased antimicrobial activity when used in combination and to facilitate the experimental design process. Then, the antimicrobial effectiveness of various combinations will be assessed, and the top three combinations will be selected. Among these selections, the formulation that demonstrates the strongest antioxidant effect will be loaded into nanocarrier systems. This approach aims to develop a product that prevents the formation of acne vulgaris minimizes side effects and improves compliance, thereby providing a patient-friendly experience.

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Keywords: Antimicrobial activity, plant extracts, nanotechnology, acne vulgaris, skin health

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Investigation of The Antimicrobial Activity of Some Plant Extracts

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Abstract

The use of antimicrobial plants in mineral water prevents the growth of pathogenic microorganisms, extends the shelf life of the product, and provides a natural alternative to chemical preservatives (I). Furthermore, they contribute to the addition of health-beneficial components to the beverage. In this study, the antimicrobial effects of Rubus fruticosus L. (blackberry), Olea europaea L. (olive leaf), Punica granatum L. (pomegranate peel), Althaea officinalis L. (marshmallow flower), Vaccinium myrtillus L. (blueberry), Ocimum basilicum L. (basil) plant extracts were investigated. Antimicrobial activity was primarily determined by the disc diffusion method. Also, minimal inhibitory concentration (MIC) and minimal bactericidal concentration (MBC) of plant extracts were determined. Escherichia coli ATCC 25922, Staphylococcus aureus ATCC 25923, Staphylococcus aureus ATCC 43300, Staphylococcus epidermidis ATCC 11228, Enterococcus faecalis ATCC 29212, Pseudomonas aeruginosa ATCC 27853, and Candida albicans ATCC 90028 were used in antimicrobial activity tests. According to the data obtained from the disc diffusion test, Punica granatum and Vaccinium myrtillus extracts were found to generate the largest zone of inhibition on microorganisms. However, none of the plant extracts exhibited an inhibition zone for C. albicans. Considering the MIC and MBC of all plant extracts against the tested bacterial and fungal strains, the lowest MIC values were observed in Punica granatum extract (mean 3.67 mg/mL). This value was followed by Rubus fruticosus and Vaccinium murtillus extracts with an average value of 5.17 and 5.78 mg/mL, respectively. According to these results, three of the six different plant extracts showed antimicrobial activity within the desired level. This study suggests that plant extracts may offer an innovative solution to provide antimicrobial protection in mineral water. The findings of the study encourage the use of natural antimicrobial agents as an alternative to chemical preservatives in the food and beverage industry to contribute to the development of healthier and safer products in mineral water production.

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Keywords: Antimicrobial effect, mineral water, plant extracts, natural preservatives

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Liposomal Coenzyme Q10/Vitamin C: An Innovative Approach to Enhance Bioavailability Andanti-Inflammatory Effects in Neurological Diseases Via In Vitro Cell Culture And In Vivo Animal Tests

Ece Güler*

Abstract

Internal or external stressors may trigger a systemic hyperactive immune response that results in widespread dysregulation and the potential for irreversible damage to vital organs. The potential of antioxidants such as vitamin C (VitC) and coenzyme QIO (CoQIO) to reduce these inflammatory reactions has been investigated by many researchers. Taking VitC and CoQ10 orally presents serious difficulties because of their limited absorption. The large molecular size and lipophilic structure of CoQ10 limit cellular transport and gastrointestinal absorption, while the complex pharmacokinetics of VitC frequently require the application of the vitamin intravenously to achieve therapeutic plasma levels.(1, 2) Liposomal drug delivery systems have been created to solve these problems by utilizing a phospholipid bilayer structure that improves stability and bioavailability. Liposomes improve therapeutic efficacy by providing controlled release, preventing environmental degradation of encapsulated drugs, and facilitating effective transport of hydrophilic and lipophilic compounds. In this research, the liposomal CoQ10/VitC was produced, and their effects were investigated for oral administration. The CoQ10 and VitC release profiles demonstrate the limited stability of the supplement form, with reduced release at acidic pH values (1.2 and 4.5) and improved release at pH 6.8, reaching an increase of almost 80% at the end of 24 hours. However, the liposomal formulation offers stability even in acidic conditions and sustained release at all pH levels, exceeding 80% at neutral pH. In vitro cell efficiency of liposomes was evaluated on Alzheimer's disease, Parkinson's disease, celiac disease, and phenylketonuria cell lines and their anti-inflammatory effects, proven by performing Western blot and PCR, immunofluorescence imaging, and the measurement of ROS level experiments were conducted. In addition, in vivo toxicity assay was performed using Sprague Dawley rats and histological analyses were performed. Liposomal CoQ10/VitC is considered to be a potential functional food and beverage product.

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Keywords: Liposome, vitamin C, coenzyme Q10

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Targeted 'Tfam' Activation and 'Mitoq' Therapy for Pearson Syndrome

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Abstract

This study investigates a novel therapeutic strategy for Pearson syndrome by combining Mitochondrial Transcription Factor A (TFAM) activation with the antioxidant MitoQ in a dual-loaded nanoparticle system. Pearson syndrome, a mitochondrial disorder characterized by severe multi-systemic effects due to mitochondrial DNA deletions, necessitates targeted interventions aimed at restoring mitochondrial function and reducing oxidative damage. (I) In this study, we developed a dual therapeutic platform encapsulating siRNA targeting TFAM alongside MitoQ, aiming to simultaneously enhance mitochondrial biogenesis and neutralize reactive oxygen species (ROS).

The nanoparticles were successfully formulated with two distinct particle populations, concentrated at 97 nm and 132.7 nm, with an average particle size of 116.3 nm, ensuring optimal cellular uptake and mitochondrial targeting. The surface charge, measured as +53.5 mV, indicated strong colloidal stability and facilitated intracellular delivery. Both the siRNA and MitoQ demonstrated high loading efficiencies, achieving 93.4% and 94.4% encapsulation, respectively, with an overall system encapsulation efficiency of 92.3%.

The therapeutic efficacy of the system was further supported by functional studies. ROS levels were significantly reduced by 2.1-fold with MitoQ treatment alone, while the combined siRNA-MitoQ system achieved a 1.9-fold reduction, highlighting the synergistic effect of antioxidant activity and TFAM modulation. Additionally, ATP production, a critical indicator of mitochondrial function, was elevated by 3.4-fold in cells treated with the dual-loaded nanoparticles, demonstrating the system's potential to restore energy production in mitochondria-compromised cells.

These results suggest that this dual-targeted nanoparticle system, leveraging the complementary actions of siRNA-induced TFAM activation and MitoQ's antioxidant properties, presents a promising therapeutic approach for mitigating mitochondrial dysfunction and oxidative stress in Pearson syndrome.

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Keywords: Pearson syndrome therapy, mitochondrial biogenesis, nanoparticle based therapy, oxidative stress reduction

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Mitochondria-Targeted Spathulenol-Loaded Retinosomes for Age-Related Macular Degeneration

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Abstract

Age-related macular degeneration (AMD) is a leading cause of vision loss, with mitochondrial dysfunction playing a key role in its progression. This study explores the use of spathulenol, a natural sesquiterpene with anti-in-flammatory and antioxidant properties, encapsulated in retinosomes—innovative exosome-derived nanoparticles from retinoid cells—for targeted drug delivery to retinal mitochondria. Retinosomes, with their innate affinity for retinal tissue and ability to cross biological barriers, provide a promising platform for this purpose (I, 2). The spathulenol-loaded retinosomes were characterized by a mean size of 97.3 nm, a zeta potential of +34.2 mV for colloidal stability, and an impressive encapsulation efficiency of 95.4%, ensuring efficient drug loading. In vitro release studies showed sustained spathulenol release from the retinosomes using a diffusion platform.

To assess in vivo efficacy, an AMD mouse model was administered a single intravenous dose of 300 mg/kg spathulenol-loaded retinosomes. Drug concentrations in the vitreous humor and circular vein were measured at multiple intervals, providing valuable pharmacokinetic data on ocular distribution and bioavailability. Further, genetic analysis before and after treatment aimed to reveal spathulenol's influence on mitochondrial function and AMD progression, potentially uncovering its effects on mitochondrial gene expression and related pathways.

This study offers a thorough evaluation of mitochondria-targeted, spathulenol-loaded retinosomes, encompassing their physicochemical properties, release kinetics, and in vivo pharmacokinetics and genetic effects. The findings support the potential of this exosome-based delivery system for AMD therapy by addressing mitochondrial dysfunction.

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Keywords: Age-related macular degeneration (AMD), targeted drug delivery, nanocarriers, exosomesl mitochondria-targeted therapy

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Alternative Food Sources as Functional Ingredients for Beverage Production

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Abstract

Nowadays, consumers have shown great interest and concern about their health and quality of life through healthy eating (I). Compounds obtained from alternative sources such as plants, microorganisms, and insects have attracted considerable interest in the formulation of new food products that have a lower environmental footprint and offer means to feed a growing world population (2).

The aim of this study was to determine nutritional (dry matter, ash, fat, crude protein content, mineral compound composition) and antioxidant properties (antioxidant activity and total polyphenol content) of edible insects – cricket and mealworm powder purchased from certificate farm (Czech Republic).

The dry matter content was in line ~ 95 %. The values of ash content were similar – in cricket 3.43 % and in mealworm 3.33 %. The crude protein was very high in both samples: cricket – 66 % and mealworm 54 %, which confirmed, that edible insect is one of the best alternative sources of proteins with good amino acid score. Higher fat content was detected in mealworm (28 %) compared to cricket (21 %). In cricket from mineral compounds dominated potassium (6647 mg/kg) followed by sodium (3149 mg/kg) and calcium (1767 mg/kg). In mealworm the highest content of potassium (6913 mg/kg) followed by sodium (1432 mg/kg) and calcium (910 mg/kg) was detected. Risks elements like lead, cadmium and nickel were under the detection limit in both samples. Antioxidant activity was similar in both species – 2.42 mg TEAC/g (TEAC – Trolox equivalent antioxidant capacity) in cricket and 2.34 mg TEAC/g in mealworm and the same tendency was observed in parameter total polyphenols: 5.61 mg GAE/g in cricket and 5.12 mg GAE/g in mealworm (GAE – gallic acid equivalent; CAE – caffeic acid equivalent).

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From obtained results, it can be concluded that cricket and mealworm can be a good source of bioactive compounds, especially proteins and mineral compounds, which can be applied in functional food industry. Beverages with added value can be one of the model foods, whereas these kinds of beverages start to be very popular especially among the young generation.

Keywords: Edible insects, protein, mineral compounds, antioxidant activity

Funding: This work was supported by the project Edible insects and mushrooms as perspective alternative sources for food industry SK-PL-23-0001.

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Natural Mineral Water With High Antioxidant Fruit (Aronia and Blueberry) and Vitamin D3

Bilgihan Baştuğ*, Onur Yolay*, Samet Çiçek**, Murat Kartal***

Abstract

Today, healthy living trends have increased the search for antioxidant-rich and sugar-free beverages. In this study, an antioxidant-rich, sugar-free mineral water was formulated using aronia and blueberry fruits.

To provide a healthy beverage enriched with fruits containing powerful antioxidants such as aronia and blueberries, which promotes cell regeneration and has multifaceted health benefits.

The antioxidant capacity, pH balance, and vitamin and mineral content of the ingredients were analyzed and their benefits were investigated.

Aronia boosts immunity with high levels of vitamins C, B, E and minerals, while blueberries support memory, heart, and eye health (I).

This sugar-free drink is characterized by its anti-aging and health-promoting effects (1). The results of this study suggest that this sugar-free, antioxidant-rich mineral water made with aronia and blueberries is a promising option to boost the immune system, slow down aging, and improve overall health for individuals with a healthy lifestyle (2). Future research could further investigate the long-term effects of this formulation and the stability of its antioxidant components.

Keywords: Mineral water, aronia, blueberry, antioxidant

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Production and Characterization of Propolis-Loaded Liposomes With a New Formulation That Can be Used in Mineral Water

Muhammet Sait Toprak*

Abstract

The use of food supplements has increased significantly all over the world in the last decade. Propolis, which is frequently preferred as one of the food supplement ingredients, plays a role in antioxidant and anti-inflammatory activity. Preclinical data support that propolis improves the symptoms of various chronic diseases including heart disease, diabetes, hypertension, and neurodegenerative diseases such as Alzheimer's disease. Propolis has a low absorption and high urinary excretion, which leads to poor bioavailability. In our study, we loaded propolis in liposomes to increase their bioavailability and reduce their toxicity. This study aims to develop a new formulation of propolis-loaded liposomes and to increase their efficacy. In our study, propolis-loaded liposomes were produced by ultrahomogenization and ultrasonication methods. FTIR, DSC, and 15-day drug release studies were conducted to prove the production's success. The cytotoxic effects of liposomes were analyzed using an MTT assay. The particle size of the produced liposome was 163.9 nm, and its zeta potential was -9.27. It has been proven that propolis is successfully retained in liposomes, does not melt at body temperature, provides a controlled release up to 15 days after initial release, and has no cytotoxic effects. Our findings will help improve the development of liposomal formulations and optimize the therapeutic use of these dietary supplements, which can be also used in mineral waters.

Keywords: Propolis, food supplement, antioxidant, liposome

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Development and Characterization of Liposomal Systems for Improved Resveratrol Delivery

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Abstract

After the COVID-19 pandemic, consumer awareness of health and wellness has increased global interest in dietary supplements. The global food supplement market has grown rapidly and is expected to continue. Resveratrol is a polyphenolic compound that displays various health benefits, such as antioxidant, anti-inflammatory, and cardio-protective effects. However, its effectiveness is limited by poor solubility, susceptibility to oxidation, photosensitivity, and low absorption when taken orally). More recently, encapsulating RS into liposomal systems (LS) has gained a promising approach aimed at enhancing their efficiency, stability, release, and palatability due to their self-assembled phospholipid vesicles that can encapsulate both hydrophilic and hydrophobic drugs. Such encapsulation has several advantages, including improved stability, protection from exogenous factors, controlled release, and targeted delivery). Thus, this study focuses on producing and characterizing LS loaded with RS (RSLS) to enhance nutritional efficacy and stability. Ultra-homogenization and ultrasonication were employed to encapsulate RS. The in-vitro release profile of RSLS showed controlled and sustained release of the active ingredients in the different pH conditions, while the release was significantly increased under conditions mimicking the intestinal environment, which ranged from a pH of 6.8. Release patterns are essential for the maximizing of nutritional efficacy of the encapsulated compound. Besides, FTIR analysis confirmed that RS were entrapped into the LS, as supported by the presence of characteristic absorption peaks corresponding to the RS functional groups. The physical characterizations of RSLS were determined by zeta potential and X-ray diffraction (XRD) analyses for measuring their stability and structural properties as well as crystal formations. The MTT assay was used to assess RSLS cytotoxicity in cell culture. The RSLS had high cell viability, indicating low cytotoxicity and safe for nutritional application. This study suggests that the developed RSLS could improve bioavailability, stability, and targeted release, improving health outcomes.

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Keywords: Liposome, resveratrol, vitamin, supplements, nutritional delivery

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III. INTERNATIONAL MINERAL WATER CONGRESS Proceedings and Books of Abstracts

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