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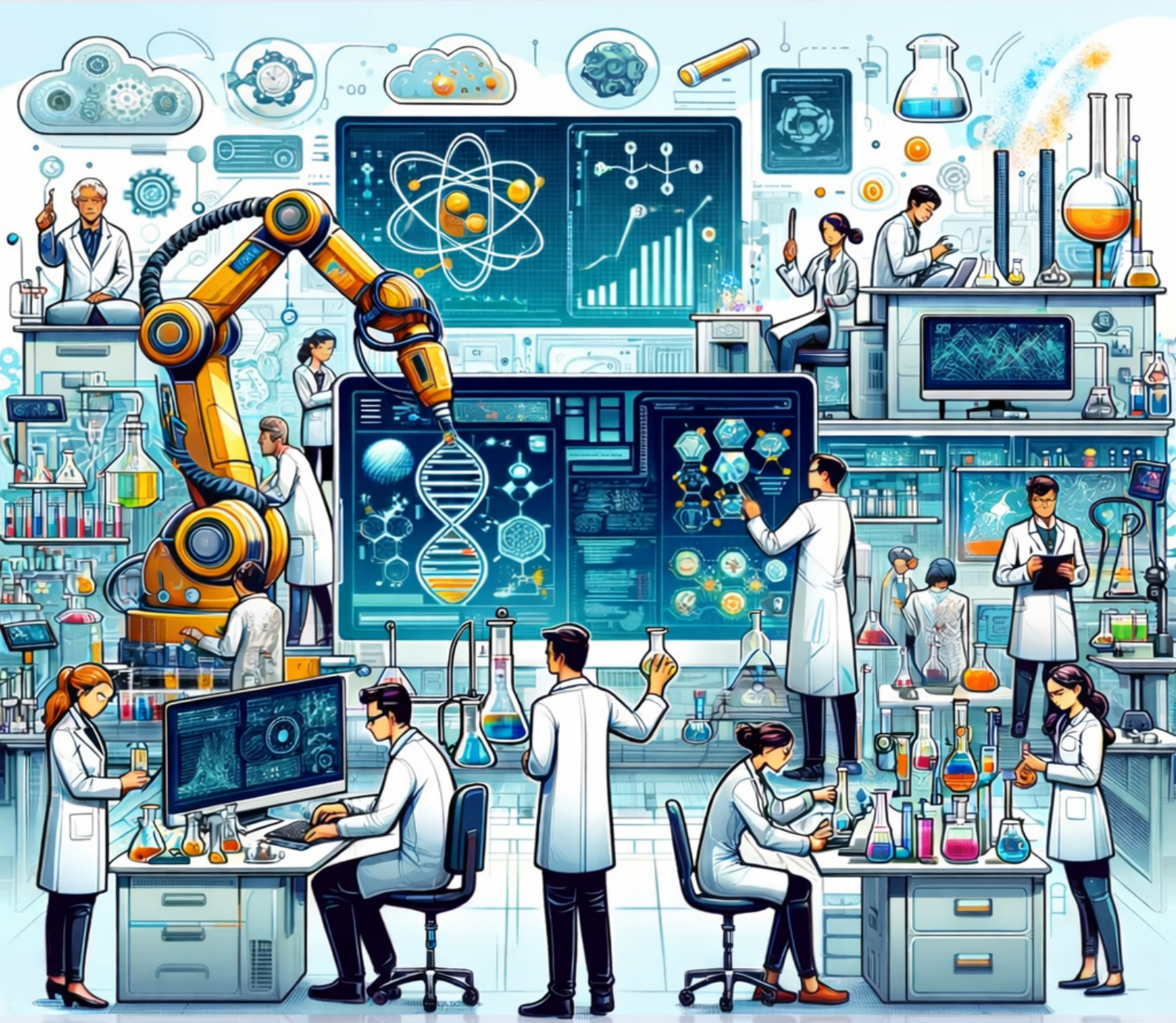

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Editorial Foreword

Prof. Dr. Sani Demiri

Editor in Chief

Dear Readers, Authors and Collaborators,

Mother Teresa University in Skopje is pleased to present **Volume 1 (2026)** of the *Journal of Technological Sciences (JTS)*. This edition builds on the momentum generated by the **TSD 2025** conference and features a selection of rigorously peer-reviewed papers addressing key sustainable development challenges in the Western Balkans and beyond.

The volume showcases advances in **green and renewable technologies**, **policy frameworks supporting**, and **AI-driven solutions for environmental sustainability**. Its interdisciplinary scope spans research on renewable energy systems, urban resilience and smart city strategies, cybersecurity as a pillar of digital sustainability, and the socio-economic dimensions of climate adaptation.

Under the leadership of **Editor-in-Chief Sani Demiri, PhD**, the contributions in this issue are closely aligned with the **United Nations Sustainable Development Goals (SDGs)** and propose practical, evidence-based pathways for regional development and long-term resilience.

We extend our sincere appreciation to the authors, reviewers, and institutional partners whose commitment and expertise made this volume possible. We invite the academic and professional community to engage with these works, contribute new research, and collaborate with us in future editions to further amplify their impact.

Sincerely,
Prof. Dr. Sani Demiri, PhD
Editor in Chief

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A CIRCULAR ECONOMY APPROACH SOAP PRODUCTION FROM WASTE COOKING OIL

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ABSTRACT

The improper disposal of waste cooking oil poses significant environmental risks, including water contamination, threats to aquatic ecosystems, and reduced soil fertility. This study investigates the transformation of waste cooking oil into solid soap via the cold process saponification method. Filtered oil was reacted with a calculated amount of sodium hydroxide in distilled water until the onset of trace, then poured into molds for curing. The results demonstrate the potential of this method to support sustainable practices, reduce pollution, and promote the principles of green chemistry. In order to incorporate used cooking oil valorization into sustainable waste management and circular economy practices, it addresses market trends, regulatory frameworks, and prospective research paths.

Keywords: *used cooking oil, cold process, saponification, environmental sustainability, circular economy*

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Introduction

The consumption of oils in food processing has been steadily increasing in recent times. Proper management of this waste is very important because studies show that service institutions and households generate thousands of liters of used cooking oil. Vegetable oils represent a very important economic sector at a global level, with palm oil reaching an annual production value of (USD 77 billion), soybean oil (~USD78 billion) and rapeseed oil (~USD32 billion), from these data it is clear that the production of these oils is a cumulative industry worth over USD180 billion per year [1]. Compared to the global market, the market in North Macedonia for cooking oils is much smaller, with revenues for 2025 reaching approximately 1 million USD, which is expected to expand further in the coming years [2]. The growing consumption of cooking oils in North Macedonia also raises concerns about potential environmental impacts, as improper disposal such as by pouring it into sewers can contribute to water pollution [3]. When spread on the water surface, it prevents the penetration of oxygen, putting aquatic life at risk. Similarly, penetration of oils into the soil can reduce soil fertility for several years [4]. Instead of being discarded into the soil or water, these oils can be converted into useful products, such as recycled soaps, biodiesel, animal feed, lubricants, building materials, detergents, and other technological applications or other chemical compounds with added value [5]. According to some research, making soap seems to be one of the viable options for recovering edible oils [6]. One practical and widely used method for converting waste oils into useful products is the saponification process, particularly for producing recycled soaps [6].

Purpose of study

The primary aim of this study is to evaluate the potential of waste cooking oil as a raw material for solid soap production using the cold-process saponification method. The study assesses the technological feasibility of this approach while demonstrating how a simple, low-energy chemical process can upcycle waste materials, reduce environmental pollution, and support the principles of green chemistry. Furthermore, the work aligns soap production from used cooking oil with circular economy concepts, including waste prevention, material recovery, and product valorization.

Research methods

The study employed the cold process soap-making technique using filtered used cooking oil as the main raw material. Sodium hydroxide (NaOH) and distilled water were used to prepare the alkaline solution, with optional essential oils or natural colorants added at the light trace stage to preserve volatile properties. pH measurements and analytical weighing ensured accuracy and consistency.

NaOH was dissolved in water following safety protocols and cooled to ~40 °C before combining with warmed oil. When the saponification value of the oil was unknown, 14–15 g NaOH per 100

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g oil was used. The lye solution was gradually added to the oil with constant stirring; a low-speed mixer was applied to achieve uniformity. The mixture was poured into molds after reaching a light trace, left to harden for 24–48 hours, and cured for several weeks [7].

Results

The results show that used cooking oil can be successfully converted into a stable soap via the cold saponification process. Pre-filtration removed burnt residues, improving the purity and consistency of the product. Based on the saponification (SAP) value of the oil, accurate measurements of NaOH and water were used to ensure complete hydrolysis of triglycerides. For example, 100 g of oil required approximately 13.6 g of NaOH and 20 g of water, yielding a total mass of about 133.6 g before curing. The mixture reached the "light trace" stage, indicating saponification. After 24–48 hours, the soap hardened, and a 2–3 week curing period allowed moisture evaporation, resulting in a final solid soap mass of approximately 120–125 g. Final pH values of 8–9 confirmed that the soap is safe for handling.

Oil (g)	***NaOH (g)***	***Water (g)***	***Total Mass Before Curing (g)***	***Approx. Soap Mass After Curing (g)***
50	6.8	10	66.8	60–62
100	13.6	20	133.6	120–125
150	20.4	30	200.4	180–185
200	27.2	40	267.2	240–250

The amount of NaOH was calculated using an average saponification (SAP) value of 0.136 g NaOH per gram of oil. The water content was set at approximately 30–38% of the NaOH weight, depending on the specific recipe. After curing, the final soap mass decreases slightly as a result of moisture evaporation.

Discussion

Applying the Circular Economy to Used Cooking Oil. By maintaining commodities in constant use, the circular economy (CE) seeks to reduce waste production and increase resource efficiency. In contrast to the conventional linear model of "take, make, dispose," the circular economy encourages waste streams to be reused, recycled, and valued. Used cooking oil (UCO) contributes significantly to trash in homes, restaurants, and food service establishments. It is frequently disposed of incorrectly, contaminating soil and water [8]. UCO is now seen as a secondary raw material that can be reintegrated into the production cycle rather than as trash in a

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circular economy paradigm. Cold process saponification, which turns UCO into soap, is an example of a closed-loop method in which waste is converted into a consumer good with added value that requires little energy and has little impact on the environment [8]. Important CE concepts like waste avoidance, material recovery, and product life extension are directly supported by this strategy. Local UCO valorization lowers the demand for virgin raw materials, promoting resource conservation and environmental preservation [9].

Soap Production's Place in the Circular Economy Loop. The circular economy's biological and technical cycles are compatible with the manufacturing of soap from leftover cooking oil. Triglycerides, a biodegradable basic ingredient, are used in the process to create a biodegradable final product. By eliminating high temperatures and excessive energy use, the cold process approach further improves sustainability [6].

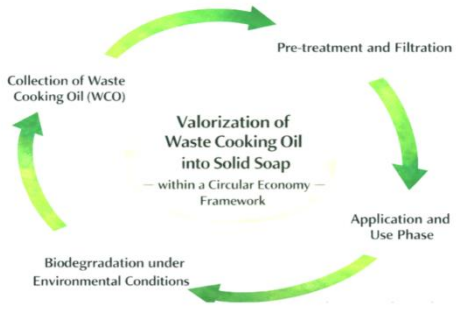

Figure 1. The circular economy loop for turning wasted cooking oil into soap (UCO collection, filtration, saponification, soap use, biodegradable degradation).

Decentralized waste management is made possible and appropriate consumption and production behaviours are encouraged when soap manufacture is integrated into local circular systems, such as homes, small businesses, or educational labs [9].

Benefits of Circular Soap Production for the Environment and Society and Reduction of Environmental Impact. When wasted cooking oil is improperly disposed of, it can lead to serious environmental harm, such as long-term soil degradation, reduced oxygen transmission in water

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bodies, and clogging of sewage systems. By diverting oil from waste streams and turning it into a safe and practical product, turning UCO into soap considerably lowers these dangers [8].

From a life-cycle standpoint, UCO's soap production:

lessens soil and water pollution reduces waste treatment-related greenhouse gas emissions

reduces the need for palm oil or other virgin oils that are frequently used in the production of soap.

Furthermore, compared to commercial soap production, the cold process saponification method has a reduced environmental impact because it takes less energy.

Benefits at the Economic and Community Level. There are significant financial benefits to producing soap in a circular manner, especially for local communities and small-scale producers. Waste cooking oil drastically lowers raw material costs because it is either free or extremely inexpensive. As a result, households, small businesses, and social enterprises can now produce soap [9].

Organized systems for collecting spent cooking oil can generate new economic opportunities at the local level, such as:

Local jobs in the processing and collecting of trash

Small-scale green business ventures

Lower expenses for municipal trash management

Additionally, making soap from waste is consistent with circular economy business models that emphasize sustainable consumption, local manufacturing, and inexpensive inputs.

Implications of Education and Policy in the Circular Economy. Through teaching, research, and community involvement, universities are essential in advancing the concepts of the circular economy. Students can gain practical experience in green chemistry and circular design by including waste oil soap manufacture into laboratory courses and sustainability programs [10].

This study shows that UCO soap manufacture can be effectively used as:

A hands-on lab experiment for courses in environmental science, food technology, or chemistry

An illustrative approach for teaching about the circular economy

An interdisciplinary learning platform that integrates waste management, sustainability, and chemistry

These teaching methods raise knowledge of sustainable resource usage and aid in the development of professionals who care about the environment.

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Compliance with Sustainable Development Goals and Circular Economy Policies. *Three Sustainable Development Goals (SDGs) of the UN are supported by the conversion of used cooking oil into soap, as follow* [3, 10]:

SDG 6: Sanitation and Clean Water

SDG 12: Conscientious Production and Consumption

SDG 13: Addressing Climate Change

Encouraging small-scale UCO recycling is in line with national and European trash reduction and circular economy initiatives. Encouraging decentralized recycling projects can enhance current biodiesel activities and increase the number of sustainable uses for UCO [5].

Conclusions and Recommendations

Used cooking oil proved to be an effective material for soap production via the cold process method, offering a practical and environmentally friendly approach to recycling kitchen waste while reducing soil and water pollution. Variability in oil composition may affect the optimal NaOH amount and the hardness of the final soap. Future studies could determine the exact saponification value or free fatty acid content of each batch to improve reagent calculations. Advanced analyses, such as FTIR or GC-MS, could provide deeper insight into the chemical structure of the product.

This study supports small-scale waste oil soap production as an eco-friendly household practice and its integration into educational laboratories to promote sustainability awareness. Further research could optimize curing time and evaluate the antimicrobial properties of natural additives [8].

The study offers a circular economy model that reduces pollution and encourages resource-efficient, low-carbon production by turning oil waste into biodegradable, useful items. According to our findings, UCOs can be turned into sustainable soaps. Although these soaps might offer an inexpensive and environmentally beneficial hygiene solution. Overall, these findings demonstrate the potential of saponification to advance green chemistry and contribute to a circular economy.

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PHYSICOCHEMICAL AND CARBOHYDRATE CHARACTERIZATION OF TRADITIONAL ROSE PETAL BEVERAGES PREPARED WITH AND WITHOUT CITRIC ACID

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ABSTRACT

Traditional rose petal beverages are widely prepared at household level and valued for their sensory and cultural properties; however, their physicochemical characteristics and carbohydrate composition remain insufficiently documented. This study aimed to evaluate the influence of citric acid on extraction efficiency and sugar profile of traditional rose petal beverages prepared as concentrates and ready-to-drink formulations. Fresh rose petals were infused in hot water to obtain acidified and non-acidified concentrates, which were subsequently diluted to simulate consumption forms. Physicochemical parameters (pH, electrical conductivity, and dry matter) were determined, while glucose, fructose, sucrose, and sorbitol were analyzed using high-performance liquid chromatography. Acidified samples exhibited significantly lower pH values and markedly higher electrical conductivity and dry matter content, indicating enhanced extraction of soluble compounds. Fructose was the only carbohydrate detected in all samples, with concentrations below 1 g/L, while glucose, sucrose, and sorbitol were not detected. The results demonstrate that citric acid plays a key role in improving extraction efficiency without increasing sugar content, supporting the potential of traditional rose petal beverages as naturally low-sugar drinks with favorable technological characteristics.

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KEYWORDS: rose petal beverage, citric acid, physicochemical properties, HPLC, sugars, low-sugar drinks

1. Introduction

Rose petal beverages are traditional products prepared in various regions by infusing fresh petals in water, often with the addition of sugar or organic acids. These beverages are valued for their characteristic aroma, color, and cultural significance and are commonly consumed at the household level as refreshing drinks. In recent years, increasing consumer interest in plant-based and naturally derived beverages has stimulated scientific attention toward traditional formulations and their potential technological and nutritional properties.

From a compositional perspective, rose petals contain relatively low levels of carbohydrates compared to fruits. Sugars such as glucose, fructose, sucrose, and polyols are present only in small amounts, reflecting the limited role of floral tissues as carbohydrate storage organs. Previous studies have demonstrated that carbohydrate concentrations in petals and sepals are substantially lower than those found in fruit matrices [6]. Nevertheless, the transfer of these sugars into beverages depends strongly on extraction conditions, including temperature, pH, and extraction time.

Acidification is a widely applied strategy in the preparation of plant-based beverages, as it influences both extraction efficiency and product stability. Organic acids, particularly citric acid, modify the physicochemical environment of aqueous extracts by lowering pH, increasing ionic strength, and promoting the solubilization of plant constituents. Studies on herbal infusions and plant extracts have shown that acidified conditions enhance the release of soluble solids, minerals, and organic compounds, resulting in higher electrical conductivity and total dissolved solids [1,4]. However, data specifically addressing the effect of acidification on the physicochemical properties of rose petal beverages remain limited.

Sugars represent important nutritional and technological parameters in beverages, as they influence caloric value, sweetness, and suitability for specific consumer groups. High-performance liquid chromatography (HPLC) is widely used for the determination of individual sugars and sugar alcohols in plant materials due to its high sensitivity and selectivity [3,5]. While HPLC-based sugar profiling has been extensively applied to fruits and fruit-derived products, information on the carbohydrate composition of rose petal beverages prepared for direct consumption is scarce.

Given the growing demand for low-sugar beverages based on traditional formulations, a systematic scientific evaluation of rose petal drinks is warranted. Therefore, the aim of this study was to characterize traditional rose petal beverages prepared with and without citric acid by evaluating their physicochemical properties (pH, electrical conductivity, and dry matter) and carbohydrate

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composition (glucose, fructose, sucrose, and sorbitol) in both concentrate and ready-to-drink forms. The findings are intended to contribute to a better understanding of how acidification influences extraction efficiency, quality, and potential stability of rose-based beverages, thereby supporting their further optimization and technological development.

2. Materials and Methods

2.1 Raw materials

Fresh rose petals were collected from garden roses intended for domestic consumption. Petals were visually inspected, gently cleaned of impurities, and used immediately for beverage preparation. Food-grade citric acid was used as the acidifying agent. Tap water was used for infusion and dilution.

2.2 Preparation of Rose Petal Beverages

Rose petal beverages were prepared following a traditional household procedure. Fresh rose petals (7 g) were infused in 600 mL of boiling water. For the acidified variant, 5 g of citric acid was added at the beginning of preparation. The mixtures were left to stand for 24 hours under sunlight exposure, after which the extracts were filtered through filter paper to remove solid residues (Figure 1).

Two concentrates were obtained: acidified concentrate (CA) and non-acidified concentrate (CNA). Each concentrate was diluted with water in a 1:1 ratio to obtain ready-to-drink samples, resulting in four sample types in total: CA, CNA, diluted acidified beverage (RA), and diluted non-acidified beverage (RNA).

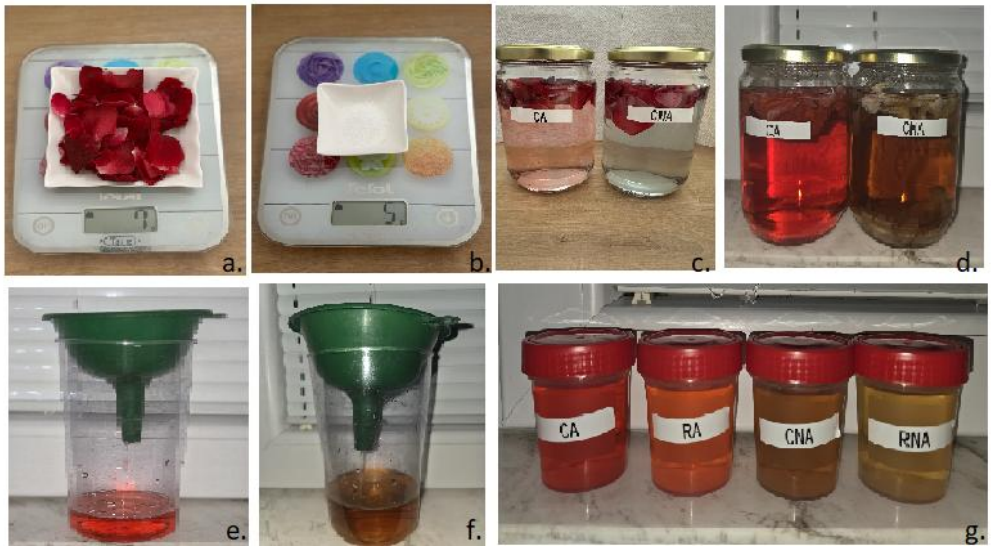

Figure 1.Figure 1.Preparation of traditional rose petal beverages: (a) weighing of fresh rose petals (7 g); (b) weighing of citric acid (5g);(c) infusion of petals in boiling water;(d) extract

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after 24 h sunlight exposure;(e) filtration of acidified sample (CA););(f)filtration of non-acidified sample (CNA); (g) prepared samples ready for analysis (CA, RA, CNA, RNA)

2.3 Physicochemical Analysis

pH was measured using a calibrated WTW inoLab pH 720 meter in accordance with MKS EN ISO 10523:2013, with automatic temperature compensation at approximately 25 °C. Electrical conductivity was determined using a WTW inoLab Cond 720 conductometer equipped with a TetraCon 325 immersion cell, following MKS EN 27888:2007, after calibration with 1413 µS/cm and 12.88 mS/cm standards at 25 °C. Dry matter (total soluble solids) was determined using digital refractometry, following Codex Alimentarius principles commonly applied for fruit juices and plant extracts. Total soluble solids were measured with a digital refractometer (Atago PAL-1) equipped with automatic temperature compensation. Before analysis, the instrument was calibrated using distilled water (0.0 °Brix) and a standard reference solution (10 °Brix) to ensure measurement accuracy. A small aliquot of each rose infusion was gently mixed and placed on the optical prism, and the reading was recorded once the value stabilized. The prism was cleaned with distilled water between measurements to prevent cross-contamination. Results were expressed in °Brix, representing the percentage of dissolved solids (mainly sugars, organic acids, and aromatic compounds) in the infusion. The main research questions were whether citric acid addition significantly modifies pH, conductivity and dry matter in rose petal infusions, and whether these effects persist after dilution to ready-to-drink form. All measurements were performed in duplicate.

2.4 Carbohydrate Analysis by HPLC

Glucose, fructose, sucrose, and sorbitol were analyzed using high-performance liquid chromatography. Samples were filtered prior to injection. Separation was performed under isocratic conditions using a carbohydrate-appropriate column and refractive index detection. Quantification was carried out using external calibration with analytical standards. Results were expressed in g/L.

3. Results

3.1 Physicochemical properties

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Table 1.Physicochemical parameters of rose petal beverages prepared with and without citric acid

Sample	pH	Electrical conductivity (µS/cm)	Dry matter (%)
CA (acidified concentrate)	2.38	1829	0.776
RA (diluted acidified beverage)	2.55	1256	0.427
CAN (non-acidified concentrate)	5.60	280	0.077
RNA (diluted non-acidified beverage)	6.10	277	0.005

Table 2. Sugar composition (g/L) of rose petal beverages determined by HPLC

Sample	Fructose (g/L)	Glucose (g/L)	Sucrose (g/L)	Sorbitol (g/L)
CA (acidified concentrate)	0.023	ND	ND	ND
RA (diluted acidified beverage)	0.038	ND	ND	ND
CAN (non-acidified concentrate)	0.013	ND	ND	ND
RNA (diluted non-acidified beverage)	0.015	ND	ND	ND

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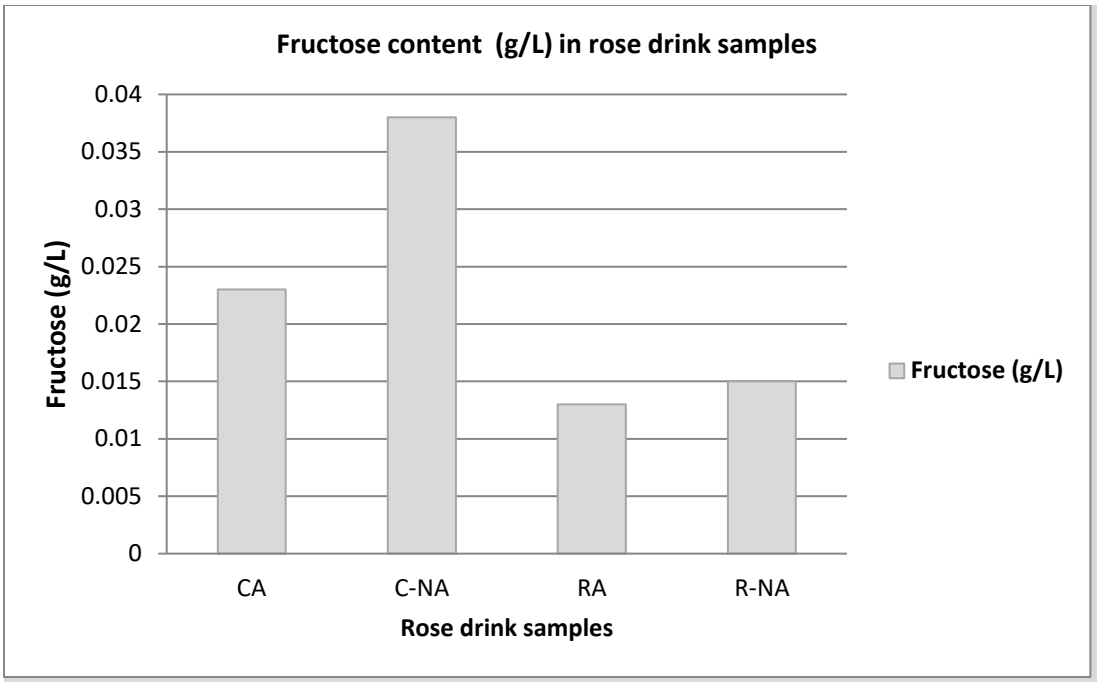

Figure 2.Fructose concentration (g/L) in rose petal beverages

4. Discussion

4.1 Physicochemical Properties

In the present study, clear and consistent physicochemical differences were observed between acidified and non-acidified rose petal beverages. Acidified samples exhibited markedly lower pH values (2.38 in the concentrate and 2.55 in the diluted sample), creating a strongly acidic environment that is known to favor the dissolution and transfer of soluble compounds from plant tissues. In parallel, these samples showed substantially higher electrical conductivity (1829 and 1256 µS/cm) and increased dry matter content (0.776% and 0.427%), indicating a higher concentration of dissolved ionic and non-ionic constituents.

By contrast, non-acidified infusions remained within a near-neutral pH range (5.6–6.1) and were characterized by very low electrical conductivity (277–280 µS/cm) and minimal dry matter content (0.005–0.077%). These results suggest limited solubilization of plant components in the absence of citric acid, reflecting a considerably weaker extraction process and reduced total soluble solids.

Taken together, the findings indicate that citric acid plays a decisive role in modifying the extraction medium and enhancing the release of soluble components from rose petals, thereby substantially altering the physicochemical profile of the final beverage. Similar enhancements in extraction efficiency, conductivity, and soluble solid content under acidic conditions have been

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reported for other plant-based infusions and extracts, supporting the trends observed in the present work [1,4].

4.2 Carbohydrate Composition

HPLC analysis showed that fructose was the only carbohydrate detected in the analyzed rose petal beverages, with concentrations below 1 g/L in all samples, while glucose, sucrose, and sorbitol were not detected. This finding is consistent with previous reports indicating that floral tissues contain substantially lower levels of carbohydrates than fruits and fruit-based beverages. In particular, Norikoshi et al. reported minimal sugar contents in petals and sepals of ornamental plants, emphasizing the limited contribution of carbohydrates from floral materials.

Acidified samples exhibited slightly lower fructose concentrations compared to their non-acidified counterparts. This reduction may be attributed, at least in part, to acid-catalyzed degradation or isomerization of fructose occurring during prolonged extraction and sunlight exposure, as previously described for reducing sugars under acidic conditions [2]. Taken together, the very low sugar levels observed across all formulations support the classification of rose petal beverages as naturally low-sugar drinks, suggesting potential suitability for consumers seeking reduced-sugar options, including individuals with dietary restrictions such as diabetes.

5. Conclusions

This study demonstrates that citric acid significantly enhances extraction efficiency in traditional rose petal beverages, as evidenced by lower pH values, increased electrical conductivity, and higher dry matter content in both concentrate and diluted formulations. Acidification clearly modifies the physicochemical profile of the beverages by promoting the release of soluble ionic and non-ionic constituents from the plant matrix.

Despite improved extraction efficiency, all analyzed formulations exhibited extremely low sugar content. Fructose was the only detected carbohydrate, present at concentrations below 1 g/L, while glucose, sucrose, and sorbitol were not detected. These findings indicate that rose petal beverages prepared according to traditional methods are naturally low in sugars and may represent a favorable alternative to conventional sweetened soft drinks, with potential suitability for consumers seeking reduced-sugar options.

From a technological perspective, the results provide a scientific basis for the standardization and further development of rose-based beverages. Acidification appears to be a key factor not only in enhancing extraction efficiency but also in shaping physicochemical characteristics relevant to product quality and potential stability.

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Future research should examine the microbiological stability of both acidified and non-acidified rose infusions, including total aerobic counts, yeasts and molds, and potential indicators of spoilage over different storage conditions. In addition, extending the analysis toward polyphenolic composition and antioxidant capacity would provide a broader understanding of the functional quality of the beverage. Further studies may also explore different infusion temperatures, acid concentrations, and storage durations to fully characterize the physicochemical and microbial behavior of rose-based drinks.Such investigations would contribute to a more comprehensive understanding of the technological and functional potential of traditional rose-based drinks.

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AGE AND SEX-SPECIFIC PATTERNS OF HYPERGLYCEMIA ACROSS AGE GROUPS

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ABSTRACT

Fasting hyperglycemia is a widely recognized marker of early disturbances in glucose regulation and an important predictor of metabolic risk. Age and sex influence glycemic status through physiological, hormonal and metabolic changes across adulthood. However, many studies rely on broad age categories, limiting insight into decade-specific differences among adults over 40 years. This study evaluates fasting hyperglycemia (>6.1 mmol/L) across four consecutive adult age groups and compares patterns between males and females using clinical laboratory data from 559 individuals. A refined demographic stratification was applied to better capture age- and sex-related variation in glycemic status. The analysis highlights clear demographic patterns and supports the importance of age- and sex-oriented screening strategies. These findings contribute to the growing body of evidence emphasizing the need for more granular demographic approaches in clinical assessment and early prevention planning.

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Keywords: hyperglycemia; fasting glucose; age differences; sex differences; clinical laboratory data; screening

1. Introduction

Hyperglycemia represents one of the earliest detectable abnormalities in glucose metabolism and plays a central role in the development of type 2 diabetes mellitus and related cardiometabolic complications [1,2]. Globally, the prevalence of elevated fasting glucose increases with age, reflecting cumulative metabolic stress, reduced insulin sensitivity, and progressive β-cell dysfunction [3].

Age-related metabolic changes are further modulated by sex-specific physiological and hormonal factors. Epidemiological and clinical studies consistently report higher insulin resistance and cardiometabolic risk in men during midlife, while women experience a marked shift in metabolic profile following menopause due to declining estrogen levels [4,5]. These sex-related differences have been recognized as key determinants of glycemic regulation across the adult lifespan.

Large population-based investigations and consensus reports have emphasized the importance of demographic factors in shaping metabolic risk [6,7.8]. Nevertheless, many studies categorize adults into broad age groups (e.g. <60 vs. ≥60 years), which may obscure clinically relevant decade-specific patterns [9]. This limitation reduces the precision of risk stratification and may delay targeted preventive interventions.

To address this gap, the present study examines fasting hyperglycemia across four consecutive age groups in adults over 40 years and compares male–female patterns using real-world clinical laboratory data.

2. Materials and Methods

2.1 Study Design and Population

A cross-sectional analysis was conducted using laboratory data from 559 adults aged over 40 years. Fasting glucose was measured using standard biochemical protocols, with hyperglycemia defined as >6.1 mmol/L in accordance with clinical guidelines. Age was categorized into four groups, and sex was recorded as male or female.

2.2 Laboratory Analysis

Fasting blood glucose was measured using standard clinical laboratory procedures in accordance with routine diagnostic practice. Hyperglycemia was defined as fasting glucose **>6.1 mmol/L**, consistent with widely accepted clinical thresholds [1].

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2.3 Demographic Stratification

Participants were stratified into four age groups:

- 40–50 years
- 50–60 years
- 60–70 years
- 70 years

Sex was recorded as male or female.

2.4 Statistical Analysis

After laboratory analysis, individual results were collected, grouped and processed for analysis. Descriptive statistics were used to calculate prevalence rates of hyperglycemia by age group and sex. Comparative patterns were assessed descriptively, with interpretation informed by established epidemiological and physiological frameworks [3,4].

3. Results

3.1 Prevalence of Hyperglycemia by Age and Sex

The results summarize age- and sex-specific patterns of fasting hyperglycemia, based on descriptive analysis of clinical laboratory data. Table 1 presents the prevalence of fasting hyperglycemia (>6.1 mmol/L) across the four adult age groups, stratified by sex.

Table 1. Prevalence of Hyperglycemia by Age Group and Sex

Age Group	Males (%)	Females (%)
40–50	7.27	7.58
50–60	36.36	31.82
60–70	32.73	36.36
>70	23.64	24.24

Hyperglycemia prevalence increased with advancing age in both sexes. In males, the highest prevalence was observed in the 50–60 age group, while in females the peak occurred in the 60–70 age group. Prevalence remained elevated in individuals over 70 years in both sexes.

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3.2 Graphical Representation

The graphical presentation provides a visual overview of the distribution of fasting hyperglycemia (>6.1 mmol/L) across the four adult age groups, stratified by sex. The figures complement the tabular results by facilitating comparison of age-specific patterns between males and females.

Figures 1 and 2 visually summarize age- and sex-specific patterns of fasting hyperglycemia (>6.1 mmol/L).

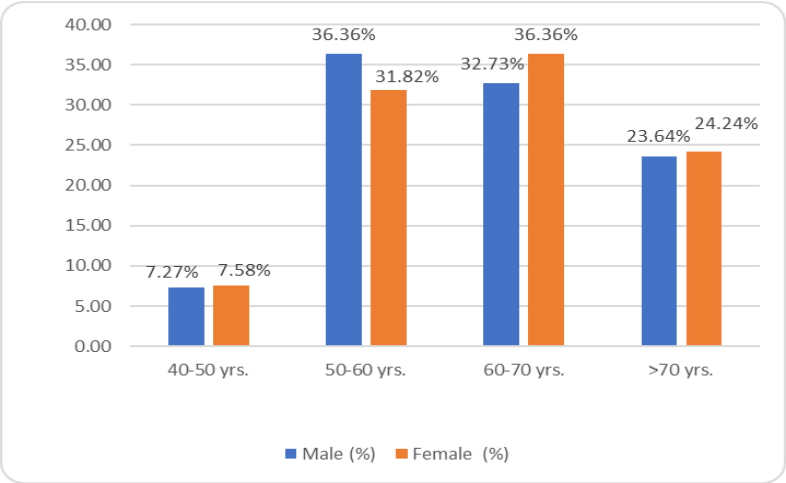

Figure 1. Graphical presentation of age- and sex-specific prevalence of fasting hyperglycemia (>6.1 mmol/L).

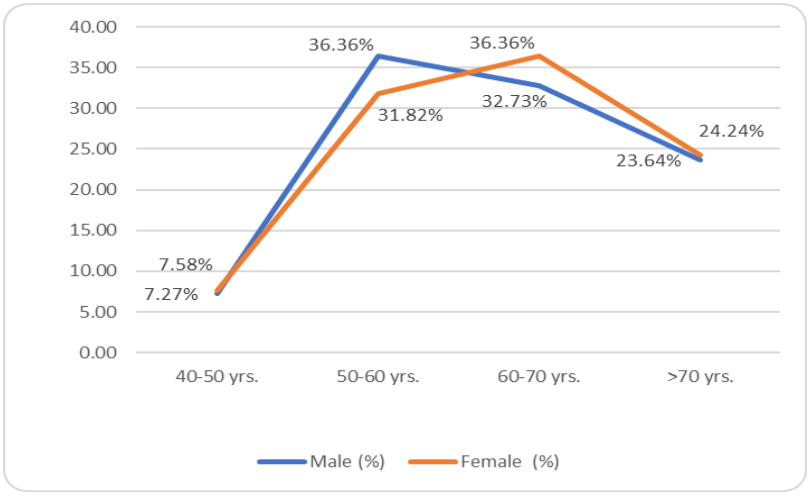

Figure 2. Graphical presentation of age- and sex-specific prevalence of fasting hyperglycemia (>6.1 mmol/L).

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The results indicate an increase in fasting hyperglycemia prevalence with advancing age, with observable differences between males and females across the examined age groups.

4. Discussion

The findings of this study demonstrate clear age- and sex-specific patterns in fasting hyperglycemia among adults over 40 years. The progressive increase in hyperglycemia with age aligns with established evidence on age-related declines in insulin sensitivity and β-cell function [2,3].

The observed peak in males during midlife is consistent with reports of higher insulin resistance and visceral adiposity in men during this period [6,10]. In contrast, the later peak in females corresponds with metabolic changes associated with the post-menopausal transition, a phenomenon widely documented in the literature [4,5,7].

These findings support the argument that broad age classifications may obscure important demographic nuances. More refined age stratification can improve identification of high-risk groups and inform more precise screening strategies.

5. Conclusions

This study confirms that fasting hyperglycemia in adults over 40 is strongly influenced by both age and sex. Distinct demographic patterns were identified, with midlife males and post-menopausal females showing the highest prevalence of elevated fasting glucose.

The results underscore the importance of age- and sex-specific screening approaches and support the integration of narrower age categories into routine clinical assessment. Future research should incorporate longitudinal follow-up and lifestyle variables to further elucidate causal mechanisms and refine prevention strategies.

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MONITORING OF AIR QUALITY BY PM 2.5 PARTICLES IN THE CITIES OF SKOPJE, MANASTIR(BITOLA) AND TETOVO FOR THE PERIOD JULY-DECEMBER 2024

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Abstract

Air pollution is an environmental and social problem, as it causes a number of harmful effects on human health, ecosystems, the built environment and the climate. Air pollution is also a complex problem that presents numerous challenges in terms of management and mitigation. There is a continuous trend by the authorities of the respective countries to mitigate air pollutants, however, the concentrations recorded at air monitoring stations in countries are a major challenge for the entire globe. This pollution continues to have significant impacts on the health of various populations, especially in urban areas. It also has significant economic impacts, affecting people's lifespan, increasing medical treatment costs, reducing productivity during working days and causing losses to the economy.

PM 2.5 concentrations in the air are posing serious problems for all countries of the world, especially for industrialized countries. Such a problem is also in cities such as: Skopje, Manastir(Bitola) and Tetovo. In recent years, these cities have had significant concentrations of PM 2.5, above the permitted norms, according to European standards, posing a serious problem for the community and causing negative effects on their health. From the research, the results show that concentrations in these cities are above the permitted threshold according to European standards. The analysis and processing of the results were done in full compliance with Directive 2008/50/EC, always for μg/m3.

Keywords : Air, pollution, measurement, quality, concentrations, PM 2.5.

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Introduction

One of the main problems worldwide has become air pollution and environmental pollution in general. While the concept of pollution includes the sense of degradation, loss of quality, departure from cleanliness and negative effects of the environment. [1] .

In the research paper; "Monitoring air quality by PM 2.5 particles in the cities: Skopje, Manastir(Bitola) and Tetovo", we focused on conducting research in these three cities , because according to statistics and environmental reports, the cities of Skopje and Tetovo have been continuously exposed to pollution in the Republic of North Macedonia in recent years, but the potential for pollution is also great. According to some research, due to the specifics of these cities, they have been constantly polluted, and for several years in a row it has been one of the most polluted cities in the world, and from the effects on the health of the population that air pollution can cause in the city of Skopje, 506,926 residents are always at risk . [2]

Also, referring to the World Air Quality Report, the Republic of North Macedonia, Albania ranks second in the European Region for poor quality regarding PM 2.5 particles. According to this report, North Macedonia has an annual average value of 25.2 (µg/m3) for PM 2.5 levels. [3]

How dangerous PM 2.5 particles are can be seen from EU reports on air quality in Europe, where "According to the latest EEA estimates, at least 253,000 deaths in the EU in 2021 were attributed to exposure to PM 2.5 particles, which were polluted beyond the level recommended by the World Health Organization," said the report of this EU agency, published on November 24, 2023 [4]

Under the EU Directive, EU member states have made commitments to reduce their pollutant emissions by 2030. The EU's expectation is that, when fully implemented, it will reduce the negative health impacts of air pollution by almost 50 percent by 2030. However, a European Commission report in June 2020 sounded the alarm about failures in its implementation, noting that "most member states are at risk of not meeting their emissions reduction commitments in 2020 or 2030." [5]

In its press release, the Commission adds that "the effective implementation of clean air legislation constitutes an essential contribution to the 'zero-pollution ambition for an environment free of toxic waste' announced by the Commission in the European Green Deal and related initiatives. [6]

Measurement method

For the research of this paper, the results for air pollution by the PM 2.5 parameter, in cities such as: Skopje, Tetovo and Manastir (Bitola), were processed for the period July - December 2024. Such results, are taken from the Ministry of Environment and Physical Planning of the Republic of North Macedonia, respectively from ; the Macedonian Information Center for the Environment – QIMMJ, or the Ambient Air Quality Monitoring Unit, which manages the State Automatic Monitoring System for Ambient Air Quality. [7]. SMASHCAA, consists of 17 automatic monitoring stations for ambient air quality located in the territory of North Macedonia , where only in the city of Skopje 5 stations have been installed since 1998. [8]

The authors have determined that the research on air pollution by PM 2.5 should be carried out in these cities, where for the city of Skopje, we have referred to the results of the "Center" station with coordinates: Longitude 21o25'25.12', Latitude 41o59'32.73', and Altitude 247m, which

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results are obtained through the Ministry of Environment, Forestry and Climate Change, while for the other two cities, we have referred to the stations of the respective cities.

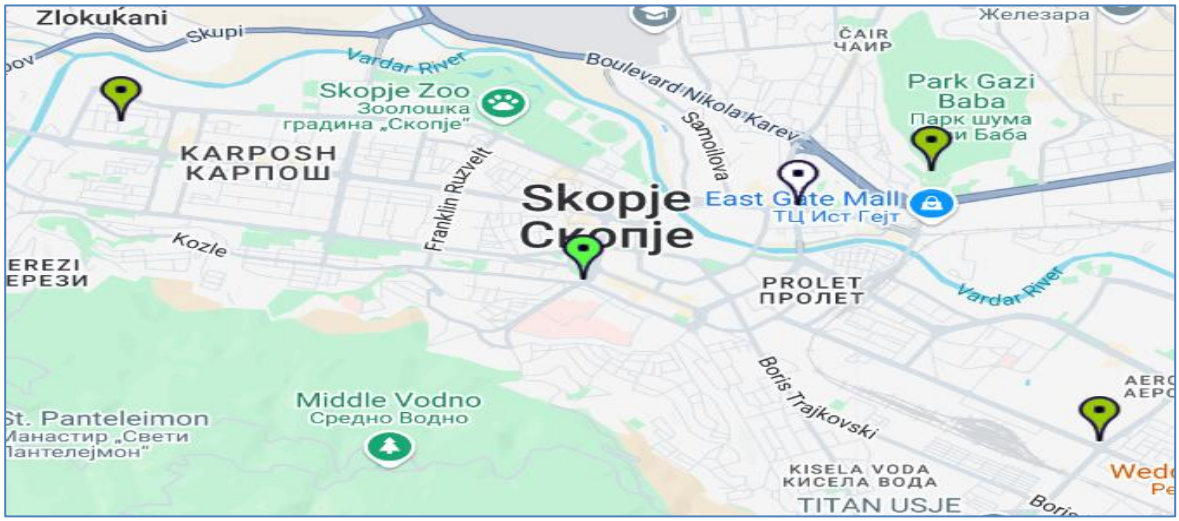
The results were obtained from these stations for the period; July-December 2024, while the analysis and processing of these results were carried out by the laws of the Republic of North Macedonia, in full compliance with Directive 2008/50/EC, always for µg/m3. [9]

Air quality monitoring in the Republic of North Macedonia is carried out through the Macedonian Environmental Information Center (MEIC), established in April 1998. [10]

This center conducts 24-hour non-stop monitoring of air pollution , recording all air pollution parameters measured in this city .

"Center" station in the city of Skopje [11]

Station in the city of Tetovo [11]



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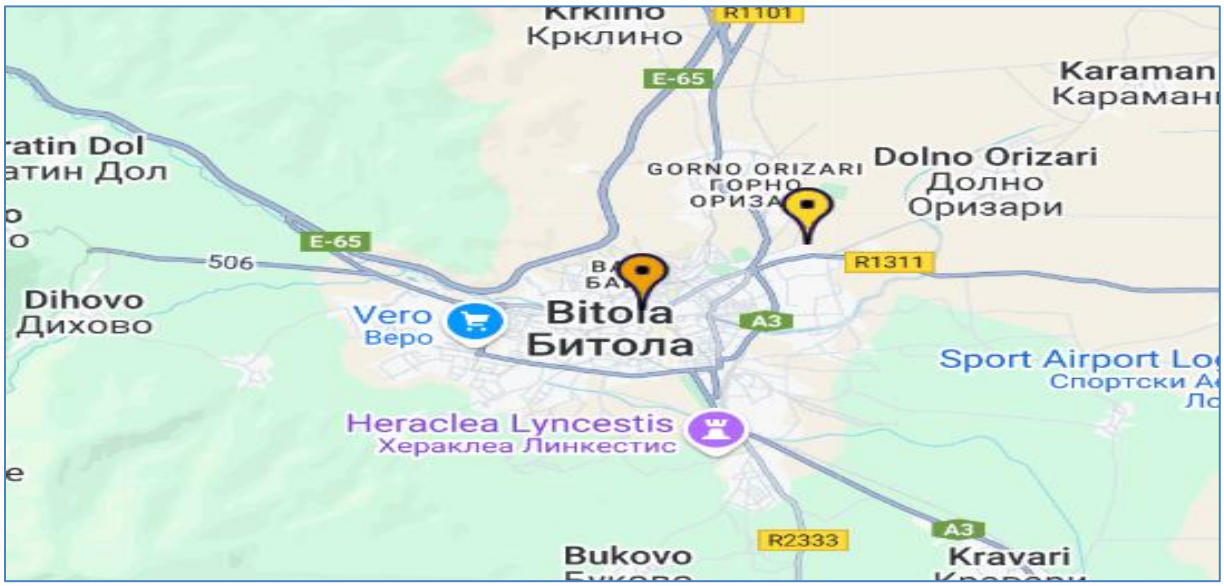
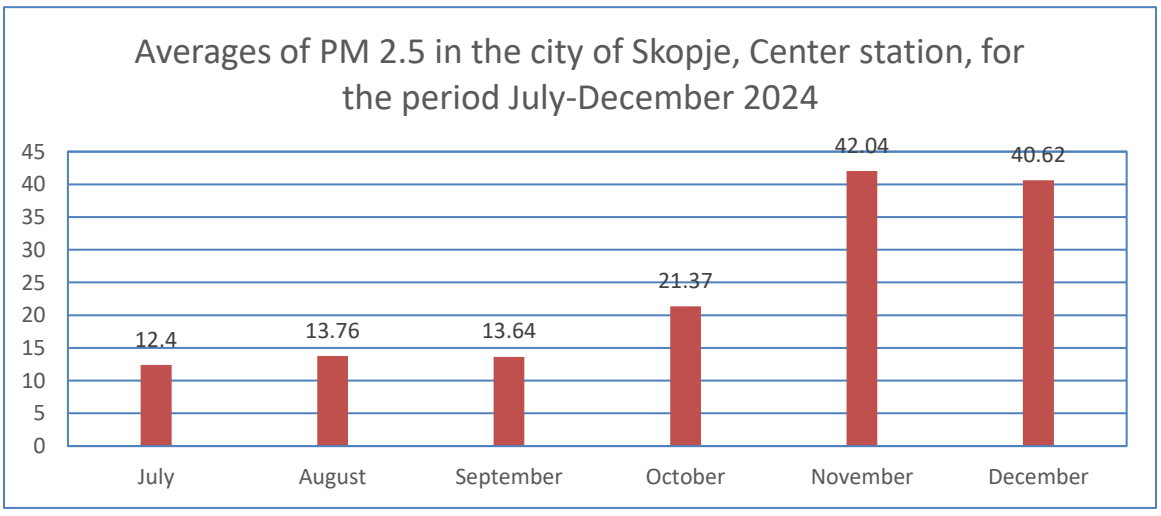


"Bitola 2" station in the city of Manastir (Bitola) [11]

Results:

Chart 1. Monthly averages of PM 2.5 for the period July-December 2024, in the city of Skopje



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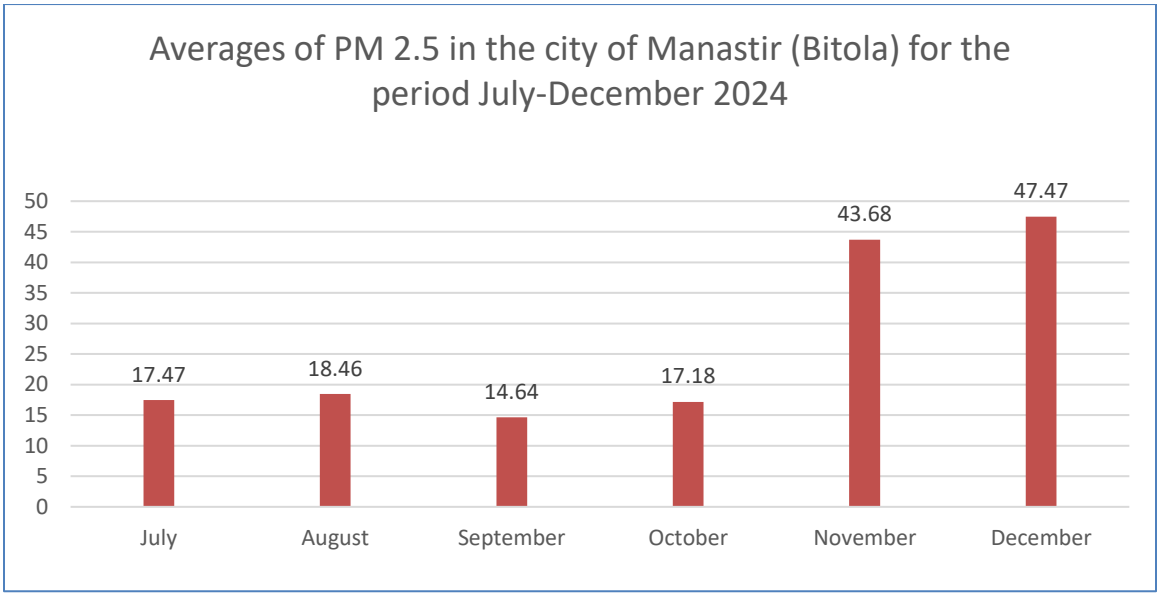
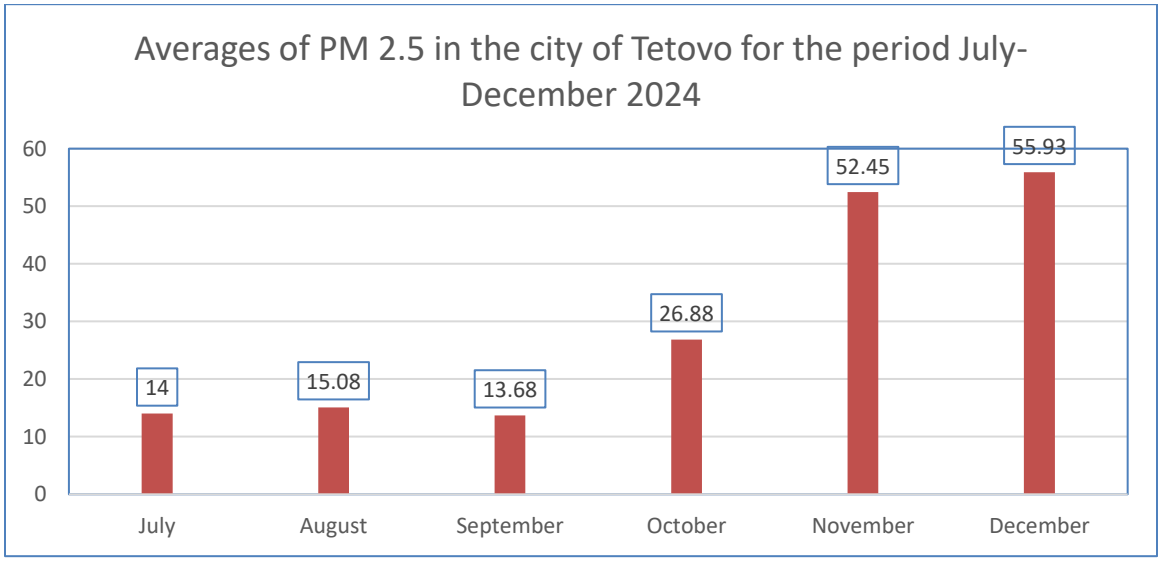
In graph 1, we present the results of the monthly averages of PM 2.5 particle pollution in the city of Skopje, central station, for the six-month period, where from these results, we have exceedances above the permitted threshold in the months of: November and December.

Chart **2. Monthly averages of PM 2.5 for the period July-December 2024, in the city of Bitola**



In graph 2, we have presented the results of the monthly averages of PM 2.5 particle pollution in the city of Manastir, for the six-month period, where even in this city, from these results we have exceedances above the permitted threshold in the months of: November and December.

Chart 3. Monthly averages of PM 2.5 for the period July-December 2024, in the city of Tetovo



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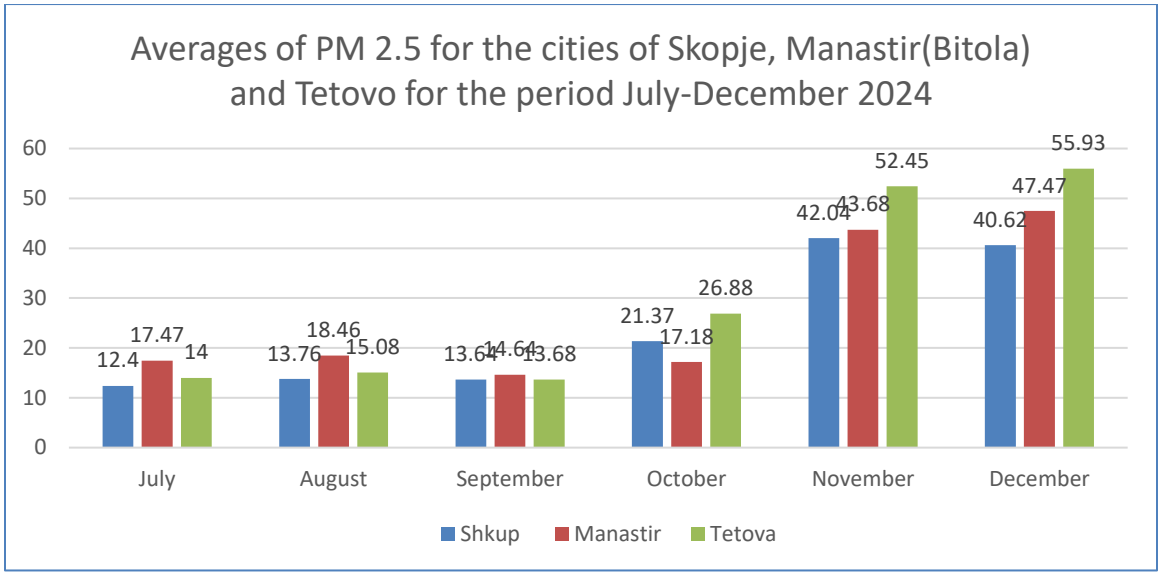
In Chart 3, we have presented the results of the monthly averages of PM 2.5 particle pollution in the city of Tetovo, over a six-month period, and from the results presented, we have exceedances of the permitted threshold in the months of: November and December.

Chart 4. Comparison of monthly averages of PM 2.5 for the three cities



Graph 4. presents a comparison of the results of PM 2.5 particle pollution for the six-month period for the cities of Skopje, Manastir(Bitola) and Tetovo. The recorded results show higher values of exceeding the permitted threshold in the city of Tetovo, compared to the other two cities.

DISCUSSION

From the results presented through graphs for air pollution in the cities: Skopje, Manastir (Bitola), and Tetovo, for the period July - December 2024 of PM 2.5, we have made a discussion and a research paper. The analyses and processing of the results were done by referring to; The Law on Ambient Air Quality, Parliament of Macedonia, 2015; The Official Gazette of the Republic of North Macedonia, No. 4 of 9.1.2013, in full compliance with Directive 2008/50/EC, always for $\mu g/m^3$.

From the results we have presented above, it can be seen that; exceedances of the permitted pollution threshold were recorded in the three cities where the research was conducted on the PM 2.5 parameter.

During this research, exceedances of the allowed threshold of PM 2.5 were recorded in 2 months for the cities of Skopje and Manastir(Bitola), respectively in the months of November and December. While, in the city of Tetovo, exceedances of the allowed threshold of PM 2.5 were recorded in the months of October, November and December.

From the results we have presented above, in the city of Skopje, the central station, the maximum value was recorded in November, with 42.04 $\mu g/m^3$, while the minimum value was recorded in July, with 12.4 $\mu g/m^3$. Meanwhile, the average value for the period July-December 2024 is 23.97

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μg/ m ^{3} .The same situation is also in the city of Manastir(Bitola). From the results presented, in this city too we have exceedances over the permitted threshold in two months of the year, namely in November and December. The maximum value of the exceedance was recorded in December with 47.47 μg/ m ^{3} , followed by November with 43.08 m ^{3} . While, the minimum value was recorded in September with 14.64 m ^{3} . And

The average value for the period July-December 2024 is 26.48 μg/m ^{3} , which means that; even the six-month value of PM 2.5 concentration exceeds the threshold allowed under Directive 2008/50/EC. The third city where this research was conducted is the city of Tetovo, where in recent years this city has presented serious concerns for its citizens, registering an excess of the permitted threshhold for years. This is also evidenced by European reports on air quality, where the city of Tetovo has been in the top three most polluted in the world. When we are in this city, namely the Republic of North Macedonia, we can conclude that this country is attacked by pollution, because from the data on deaths in absolute value, recently published by [12], and processed by Monitor in relation to the population of the respective countries. The information refers to 2015. From these data, Macedonia 0.14% of the population (3,000 deaths), ranks third in Europe.

Also, from the latest research in this city for the six-month period, we have exceeded the allowed threshold for three full months and that in the months of October, November and December.

From the results presented, the maximum value of exceeding the threshold referred to in Directive 2008/50/EC was recorded in December with 55.93 μg/ m ^{3} , followed by November with 52.45 μg/ m ^{3} . Meanwhile, the minimum value in this city is in September with 13.68 μg/ m ^{3} .

Through graph 4, we have compared the air pollution results for the three cities in the six-month period by the concentrations of PM 2.5 particles. From the results presented in July, the following concentrations were recorded: Skopje 12.4 μg/ m ^{3} , Manastir(Bitola) 17.47 μg/ m ^{3} and in Tetovo 14 μg/ m ^{3} . From these results, higher concentrations of PM 2.5 were recorded in Manastir(Bitola). While, lower concentrations were recorded in Skopje.From the results presented in August, the following concentrations were recorded: Skopje 13.76 μg/ m ^{3} , Manastir(Bitola) 18.46 μg/ m ^{3} and Tetovo 15.08 μg/ m ^{3} . Even in this month, higher concentrations of PM 2.5 were recorded in Manastir(Bitola), and lower concentrations were recorded in Skopje. In September, the following concentrations were recorded: Skopje 13.64 μg/ m ^{3} , Manastir(Bitola) 14.64 μg/ m ^{3} and Tetovo 13.68 μg/ m ^{3} . From these results, higher concentrations of PM 2.5 were recorded this month in Manastir(Bitola), and lower concentrations were recorded in Skopje.

In October, the following concentrations were recorded: Skopje 21.37 μg/ m ^{3} , Bitola 17.18 μg/ m ^{3} and Tetovo 26.88 μg/ m ^{3} . From these results, higher concentrations of PM 2.5 were recorded in the city of Tetovo, and lower concentrations were recorded in Manastir(Bitola).

In November, the following concentrations were recorded: Skopje 42.04 μg/ m ^{3} , Manastir(Bitola) 43.68 μg/ m ^{3} and in Tetovo 52.45 μg/ m ^{3} . From these results, higher concentrations of PM 2.5 were recorded this month in Tetovo, and lower concentrations were recorded in Skopje.

In December, the following concentrations were recorded: Skopje 40.62 μg/ m ^{3} , Manastir(Bitola) 47.47 μg/ m ^{3} and Tetovo 55.93 μg/ m ^{3} . From these results, higher concentrations of PM 2.5 were recorded again in Tetovo, and lower concentrations were recorded in Skopje.

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Concluding this discussion, we can conclude that; the highest value of PM 2.5 concentration, for the period July-December 2024, was recorded in the city of Tetovo in December at 55.93 μg/ m^3 , while the lowest value of PM 2.5 concentration was recorded in the city of Skopje at 12.4 μg/m^3

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AIR POLLUTION IN CITY OF TETOVO FROM PM 2.5, FOR PERIOD JANUARY – JUNE 2024

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Abstract

Air pollution is an environmental and social problem, as it causes a number of harmful effects on human health, ecosystems, the built environment and the climate. Air pollution is a complex problem that presents numerous challenges in terms of management and mitigation. There is a continuous trend by the authorities of the respective countries to mitigate air pollutants, however the concentrations recorded at air monitoring stations in the countries are a major challenge for the entire globe. This pollution continues to have significant impacts on the health of various populations, especially in urban areas. It also has significant economic impacts, shortening lives, increasing medical costs, reducing productivity during working days and causing losses to the economy. Air pollution is also a serious problem for the countries of the Western Balkans. The Republic of North Macedonia is also part of this trend, where cities such as Skopje and Tetovo have been exposed to severe air pollution in the last decade.

Meanwhile, PM 2.5 concentrations in the air are posing serious problems for all countries of the world, especially for industrialized countries. Such a problem is also present in the city of Tetovo.

Wanting to have a real picture of air pollution in the city of Tetovo, from PM 2.5 particle concentrations, we have obtained the results of air pollution in this city for the period January-June 2024.

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From the presented results, which were calculated in full compliance with Directive 20085/50/EC, always for µg/m3, we have come to the conclusion that, in the city of Tetovo, there were exceedances of the permitted threshold for the period January-June 2024. The exceedances were recorded in the months of: January, February, and March. While, in the months of: April, May, and June, we have no exceedances, according to the limit allowed by the provisions of the Republic of North Macedonia, which are harmonized with the European directives.

Key words: Air, Pollution, Measurement, Quality, Concentrations, PM 2.5, Tetovo

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Introduction

Air is a part of the environment that can be easily polluted by inorganic or organic pollutants. Air pollution is one of the most serious problems in the world. It is related to the introduction of polluting substances into the atmosphere that affect human health and the environment. The atmosphere is one of the most important routes for the distribution of pollutants in the environment. The distances of transport of pollutants in the atmosphere can be several hundred to thousands of kilometers. This makes atmospheric pollution often have a regional or even global character. These pollutants are emitted from different sources and some of them interact with each other to form new compounds in the air. Not only the dispersion of volatile pollutants (e.g. organic compounds) occurs through the atmosphere, but also solid substances in the form of dust, e.g. heavy metals.

The concept of pollution includes a sense of degradation, loss of quality, removal from cleanliness, and negative effects on the environment.[1]

Air is found in the atmosphere, which is a very important element for human health and in general for the environment that surrounds us, and which is constantly exposed to the effects of pollution. In general, air pollution comes from human activities, but it can also be affected by natural phenomena. Air pollution occurs when substances are released into the air in quantities that can harm the health of people, animals and plants or cause material damage. Some air pollutants can also have global impacts, e.g. the greenhouse effect or damage to the ozone layer. Also, the major economic and infrastructure developments in the last decade have led to immediate demands for increased environmental awareness and culture.

Therefore, the author Murtezan Ismaili rightly says; The protection and advancement of the quality of the living environment is one of the fundamental challenges of humanity, precisely because of the need to ensure the existence of new generations.[2]

We conducted the research for this paper in the city of Tetovo, which is located in the northwestern part of Macedonia, on the slopes of the Sharr, or in the Polog Valley. Today, the municipality of Tetovo covers an area of 87 km², and together with the newly created municipalities that emerge from it, the area is 1053 km².[3]

Measurement methods

The results of the air pollution research by the PM2.5 parameter were conducted in the city of Tetovo, and were processed for the period January-June 2024. These results were obtained from the Ministry of Environment and Physical Planning of the Republic of North Macedonia, namely from the Macedonian Environmental Information Center – MEIC, or the Ambient Air Quality

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Monitoring Unit, which manages the State Automatic Monitoring System for Ambient Air Quality.[4]

SAMSAAQ consists of 17 automatic monitoring stations for ambient air quality located in the territory of Macedonia, where a station has been located in the city of Tetovo since 1998.[5][6]

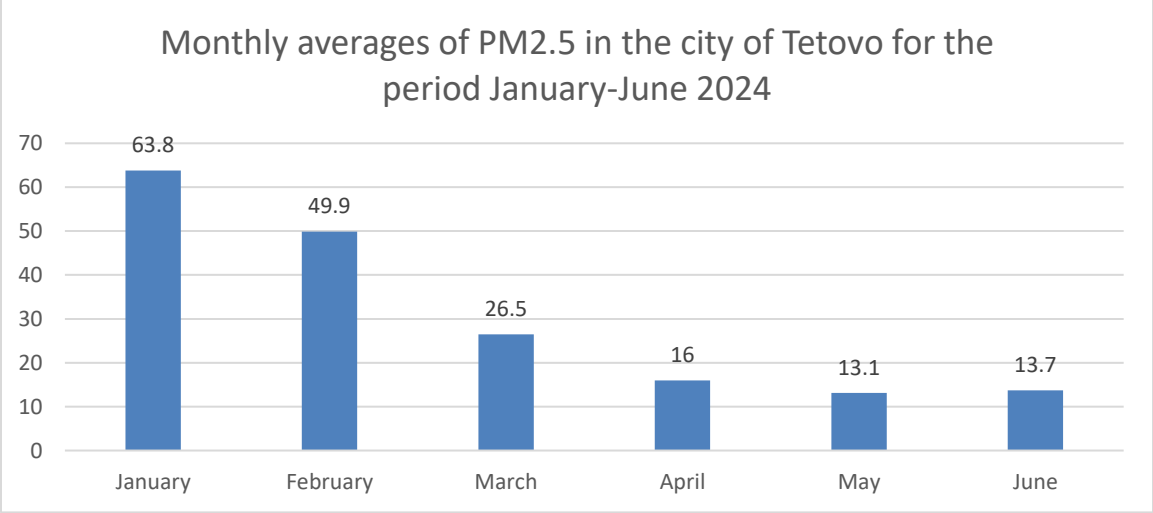
The results obtained were analyzed and processed in accordance with the laws of the Republic of North Macedonia, in full compliance with Directive 2008/50/EC, always in µg/m3.[7] Air quality monitoring in the Republic of North Macedonia is carried out through the Macedonian Environmental Information Center – MEIC, established in April 1998.[8]

This center conducts 24-hour non-stop monitoring of air pollution, recording all air pollution parameters measured in this city.

Results:

Months:	**January**	**February**	**March**	**April**	**May**	**June**
Value of PM 2.5	63.8	49.9	26.5	16	13.1	13.7

Table 1. Results of air pollution by PM2.5 particles in the city of Tetovo for the period January - June 2024



Graph 1. Graphical presentation of the results of air pollution from PM2.5 particles in the city of Tetovo for the period January - June 2024.

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In the above graph we have presented the results of air pollution in the city of Tetovo. From the presented results, which were calculated in full compliance with Directive 20085/50/EC (footnotes), always for µg/m3, we have come to the conclusion that, in the city of Tetovo, there were exceedances of the permitted threshold for the period January-June 2024. The exceedances were recorded in the months of: January, February, and March.

Discussion

Referring to the air pollution results in the city of Tetovo for PM 2.5 concentrations, presented in Table 1 and Graph 1, to confirm the hypotheses raised in this research paper, we will see during the discussion that we will have below. From the results presented above, for air pollution in the city of Tetovo, for the period January-June 2024, of PM2.5 particle concentrations, we have discussed this research paper, for the 6-month period.

We have conducted the analysis and processing of these results by referring to; the Law on Ambient Air Quality, Parliament of Macedonia, 2015 [9]; the Official Gazette of the Republic of North Macedonia, No. 4 of 9.1.2013 [10], in full compliance with Directive 2008/50/EC, always for µg/m3.From the results we have presented above, it can be seen that; exceedances of the permitted pollution threshold were recorded in several months during this period during the months of 2024 by the PM2.5 parameter. The exceedances were mainly recorded in the winter months, which we can conclude that, in the winter season, we have more pollution than in the summer season, because there are many factors that affect air pollution, such as: climatic conditions, the use of fuel during the winter, etc. During the research of this paper "air pollution concentrations in the city of Tetovo from PM 2.5, for the period January-June 2024, the hypothesis we raised was confirmed, because from the results presented, it was confirmed that we have exceeded the allowed threshold in the first three months of the year.

According to the provisions of the RMV, which are in full harmony with European directives, we have exceedances in three months: in January 63.8 PM 2.5, in February 49.9 PM 2.5, and in March 26.5 PM 2.5. From these results in numerical value, we have the month of January with maximum pollution of 63.8 PM 2.5.

Meanwhile, the months that did not record an exceedance are: April with 16 PM 2.5, May with 13.1 PM 2.5, and June with 13.7 PM 2.5.

According to the results presented in the table and graph, in this time period of the research, we have the month of May with a minimum numerical value of 13.1 PM2.5.

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THE EFFECTS OF PUBLIC HEALTH CAUSED BY COVID 19 PANDEMICS IN THE CITY OF GJILAN FOR THE PERIOD MARCH-DECEMBER 2020

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Abstract: Humanity has always been endangered by unknown viruses throughout different periods of time, which have had negative effects on the health of the population, even causing many deaths. Throughout human history, there have been a number of different pandemics and diseases, but the most fatal recorded pandemic in history was The Black Death, which killed an estimated number of 75-200 million people in the 14th century, and the flu pandemic of 1918, known as Spanish Flu (https://en.wikipedia.org/wiki/Pandemi)[i].

Today the contemporary world is facing the Covid 19 pandemic, which is continuing to cause serious problems for humanity. The virus first appeared in China, and it was thought it would not spread so quickly. However, seeing this spread of this virus so rapidly, the WHO classified it as the virus COVID-19; Global pandemic (https: //www.dw.com ›obsh-e-classifi)[ii]. Now the world is facing an emergency situation created by this virus. Meanwhile this pandemic began to spread also in Kosovo. Like all countries in the region, Kosovo began to take measures against this virus. It started with tracking cases in the field, and as a result, on March 13th 2020 the Government of Kosovo confirmed the first two cases of infection with Covid 19 (Government of Kosovo, 2020 report)[iii].

In this research we took the town og Gjilan in Kosovo, due to the geographical position which is bordered by large towns in the region, and where the possibility of virus spreading is high. The research was conducted in the period March-December 2020.

During this period, in the city of Gjilan a total of 7981 tests were performed, or 14.71% of citizens were tested. Confirmed were 3153 positive cases with Covid 19, or 39.5% of the tested population, and 4828 negative cases of Covid19, or 60.5% of the tested population.

Also 107 people have died in Gjilan from the infections with the Covid 19, or 3.39%, of those who have tested positive, while in relation to the number of inhabitants, mortality in this city was 0.19%.

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Keywords: virus, Covid 19, positive, negative, tests, pandemic, Gjilan.

Foreword

Although initially it was thought that Covid Pandemic 19 will not affect all countries of the world, now it has spread across the globe, leaving no untouched places with unpredictable effects on public health. All countries of the world were unprepared for this virus. Even Kosovo, a young state with a fragile economy, was unprepared to face such an emergency situation.

In this context, by activating all relevant mechanisms of the state, Kosovo has managed to contain the situation created by the Covid Pandemic 19. All concrete steps have been taken to overcome this challenge, using the methods of quarantine, isolation, medical assistance, and more recently the vaccination of citizens.

As in the whole world, even in Kosovo, especially in the city of Gjilan, the impact of the virus 19 in public health was high, resulting with many deaths.

Precisely for these reasons, the authors are determined to conduct the research in the city of Gjilan, inhabited by 54,239 citizens (rks-gov.net)[iv].

Gjilan is located in the eastern part of the Republic of Kosovo, and is one of the seven major municipalities of the Republic. It has an area of 392 km^2 and consists of 42 cadastral zones (https://kk.rks-gov.net/gjilan/qyteti/pozita-gjeografike/)[v]. The geographical position of this city enables good connections with other towns of Kosovo and the region, therefore the possibility of citizens to be infected with Coronavirus 19 was high. After the first reports of infections with the coronavirus 19, according to the Law on Natural and Other Disasters (Assembly of Kosovo, Law on Natural and Other Disasters No. 2006/02 / L-68)[vi], Gjilan undertook additional measures in all health structures in order to overcome this emergency situation as easily as possible.

From this pandemic the whole human world is having numerous health problems, which are then ending in fatality. Although the first cases of infection with Covid-19 appeared much earlier, officially confirmed by the Government of Kosovo, the first death in Gjilan caused by this virus was recorded on April 7th 2020 (NIPHK, 2020 report)[vii].

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Measurement methods

In this research paper, samples of the Covid 19 pandemic were taken at the National Institute of Public Health of Kosovo (NIPHK, Regional Public Health - Gjilan, 2020 report)[viii], for the period March 1st 2020 to December 31 2020, for the town of Gjilan.

According to this institute, in Gjilan during this period a total of 7981 tests were performed, or 14.71% of citizens. Out of this percentage derived the number of positive and negative cases from the Covid pandemic.

The research methods that were used to identify the Covid 19 virus in the city of Gjilan, were through tests: PCR and antigen, tracking cases in the field by the responsible state institutions, and voluntary submission of citizens to take assessment tests for their condition. The certification and formalization of these tests was done by the most credible institute in Kosovo; Kosovo National Institute of Public Health (NIPHK).

From the number of tests that were positive from the Covid pandemic 19, out of the infected citizens we derived the number of deaths.

Out of these results we also derived the number of deaths from the Covid pandemic 19 according to the age group from 0-20, 20-40, 40-60, 60-80, and over 80 years old.

To assess the realistic situation of the impact of the Covid 19 pandemic on the citizens of Kosovo, we took the results from several other cities in our country, to analyze and evaluate the effects of public health on citizens from this pandemic. For the age group, we made the comparison with Fushe Kosova town. Whereas, with Drenas town we compared the number of positive and negative tests, then the number of tests in relation to the inhabitants, and the number of infected in relation to performed tests and to the number of inhabitants.

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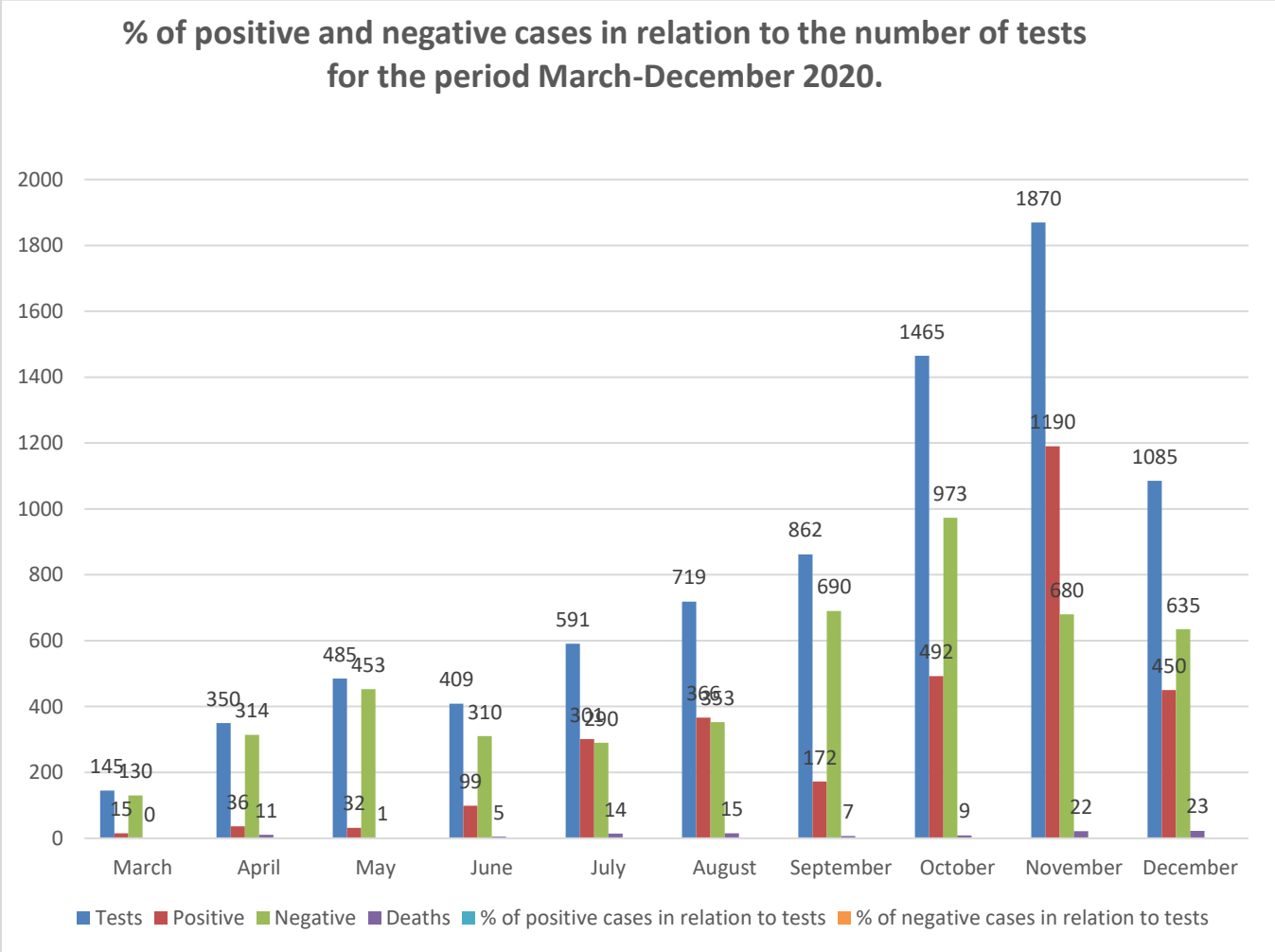
Results:

Months	March	April	May	June	July	August	September	October	November	December	Total
Tests	145	350	485	409	591	719	862	1465	1870	1085	7981
Positive	15	36	32	99	301	366	172	492	1190	450	3153
Negative	130	314	453	310	290	353	690	973	680	635	4828
Deaths	-	11	1	5	14	15	7	9	22	23	107
% of positive cases in relation to tests	10.3	10.2	6,59	24.2	50.9	50.9	19.9	33.5	63.6	41.4	39.5
% of negative cases in relation to tests	89.6	89.7	93.4	75.7	49.0	44.6	80.0	66.6	36.3	58.5	60.5

Table 1. Percentage of positive and negative cases in relation to the number of tests for the period March-December 2020



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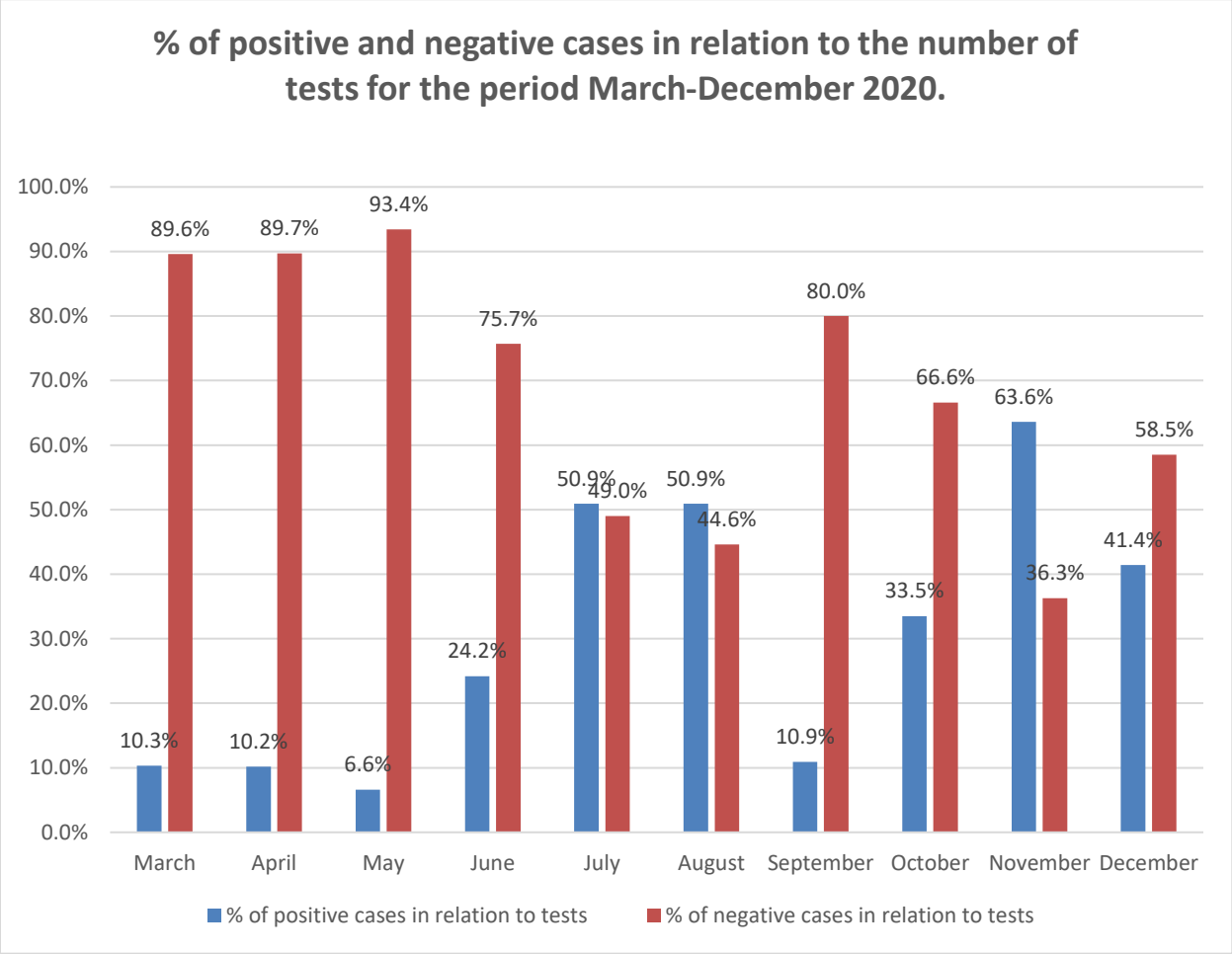
Graph1. This graph shows the percentage of positive and negative cases in relation to the number of tests for the period March-December 2020, in Gjilan town



Graph1.1. presents the percentage of positive and negative cases in relation to the number of tests for the period March-December 2020, in Gjilan town

Months	March	April	May	June	July	August	September	October	November	December	Total
Percentages of tests performed in relation to the number of inhabitants	0.26	0.64	0.89	0.75	1.08	1.32	1.58	2.70	3.44	2.00	14.7
Percentage of positive cases in relation to the number of inhabitants	0.02	0.06	0.05	0.18	0.55	0.67	0.31	0.90	2.19	0.82	5.8
Percentage of negative cases in relation to the number of inhabitants	0.23	0.57	0.83	0.57	0.53	0.65	1.27	1.79	1.25	1.17	8.9

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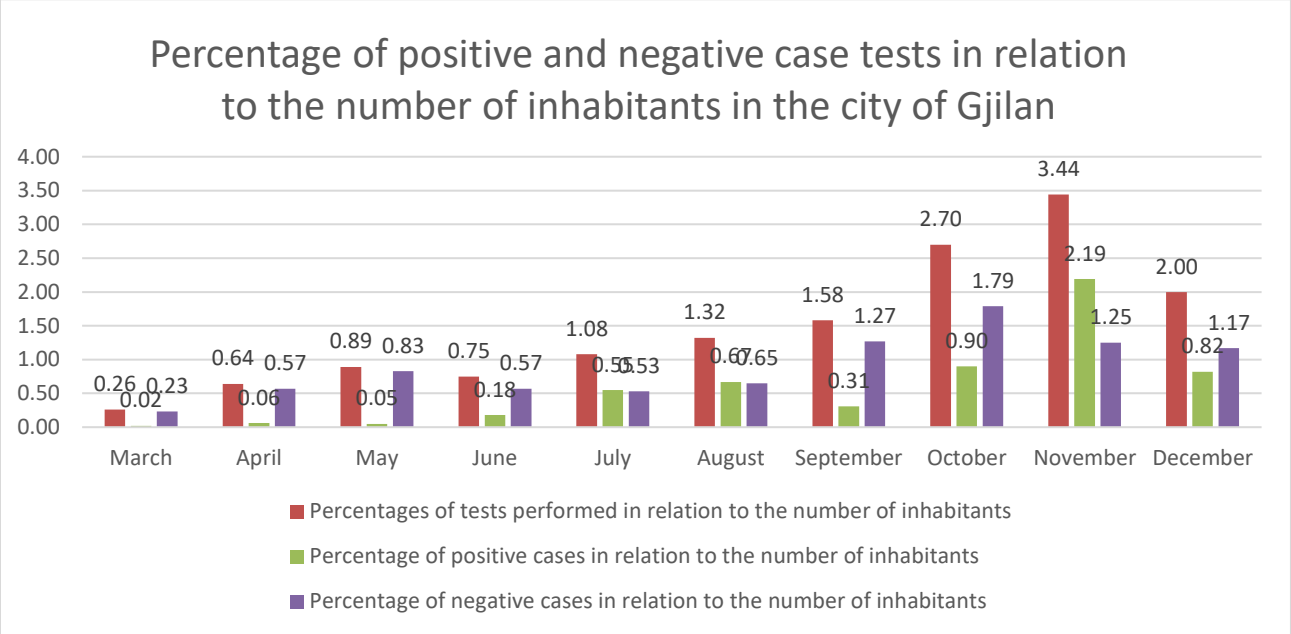
Table 2. Percentage of positive and negative case tests in relation to the number of inhabitants in Gjilan town.



Graph 2. presents the percentage of positive and negative case tests in relation to the number of inhabitants in Gjilan town, for the period March-December 2020.

Months	March	April	May	June	July	August	September	October	November	December	Total
Percentage of deaths in relation to positive tests	-	30.5	3.12	5.05	4.65	4.09	4.06	1.82	1.84	5.11	3.39
Percentage of deaths in relation to the number of inhabitants	-	0.02	0.001	0.009	0.025	0.027	0.012	0.01	0.040	0.042	0.19

Table 3. Percentage of deaths in relation to positive tests and number of inhabitants in Gjilan town, for the period March-December 2020.

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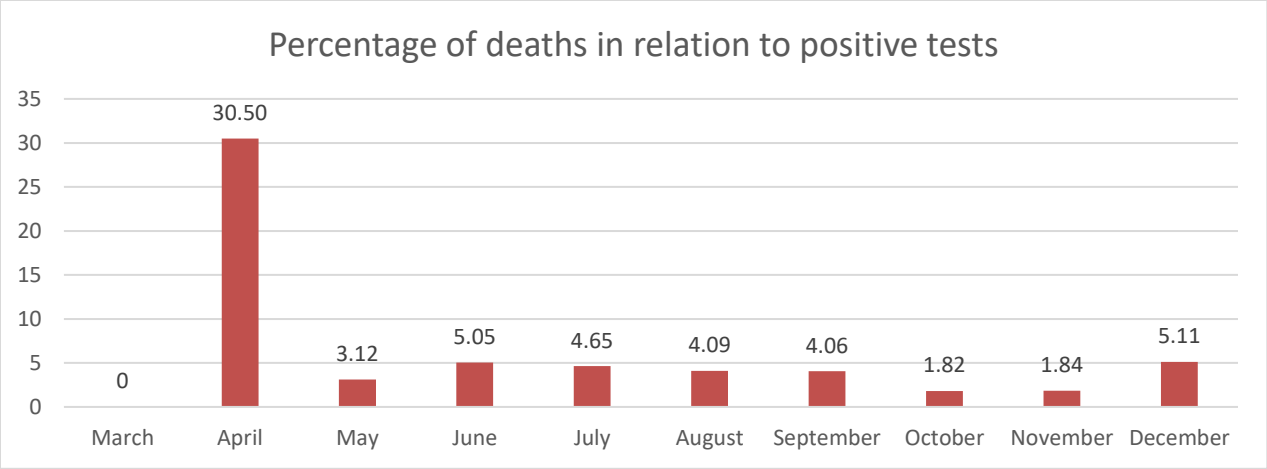
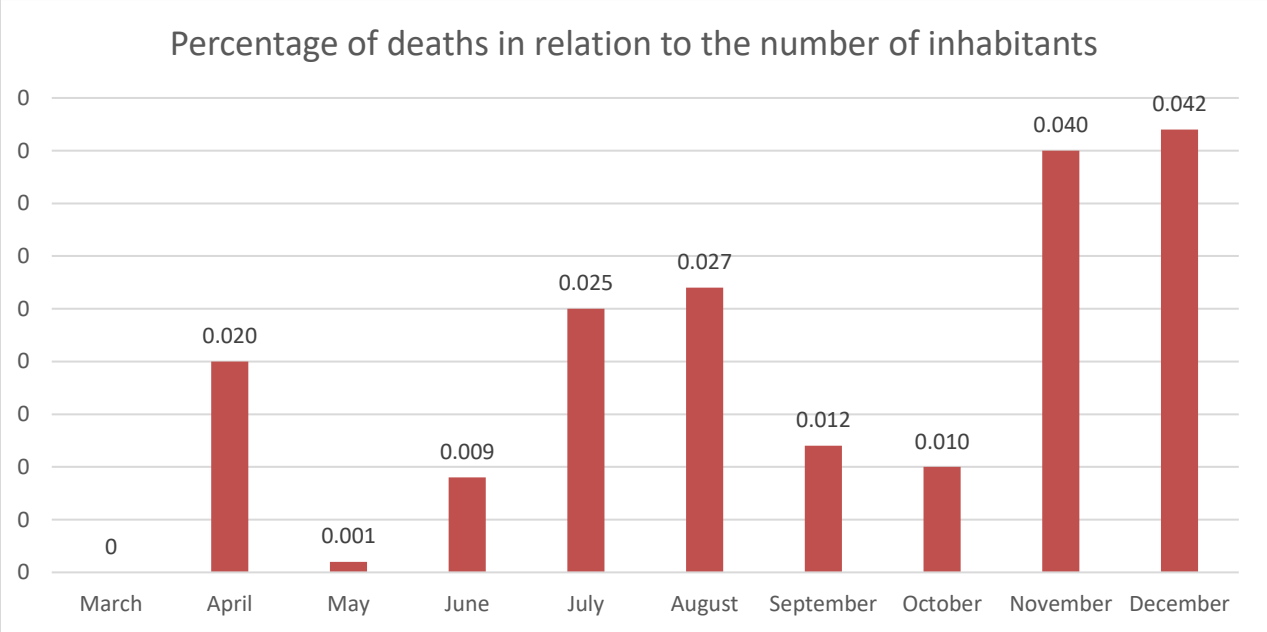


Graph 3. presents the percentage of deaths in relation to the positive tests in Gjilan town, for the period March-December 2020.



Graph 3.1 presents the death rates in relation to the number of inhabitants in Gjilan town, for the period March-December 2020.

Age group	0-20	20-40	40-60	60-80	over 80	Total
% of deaths by age group, Gjilan	0.934	-	14.95	68.22	15.88	100%
% of deaths by age group, Drenas	0	3	18	64	15	100%

Table 4. Death rates by age group Gjilan-Drenas.

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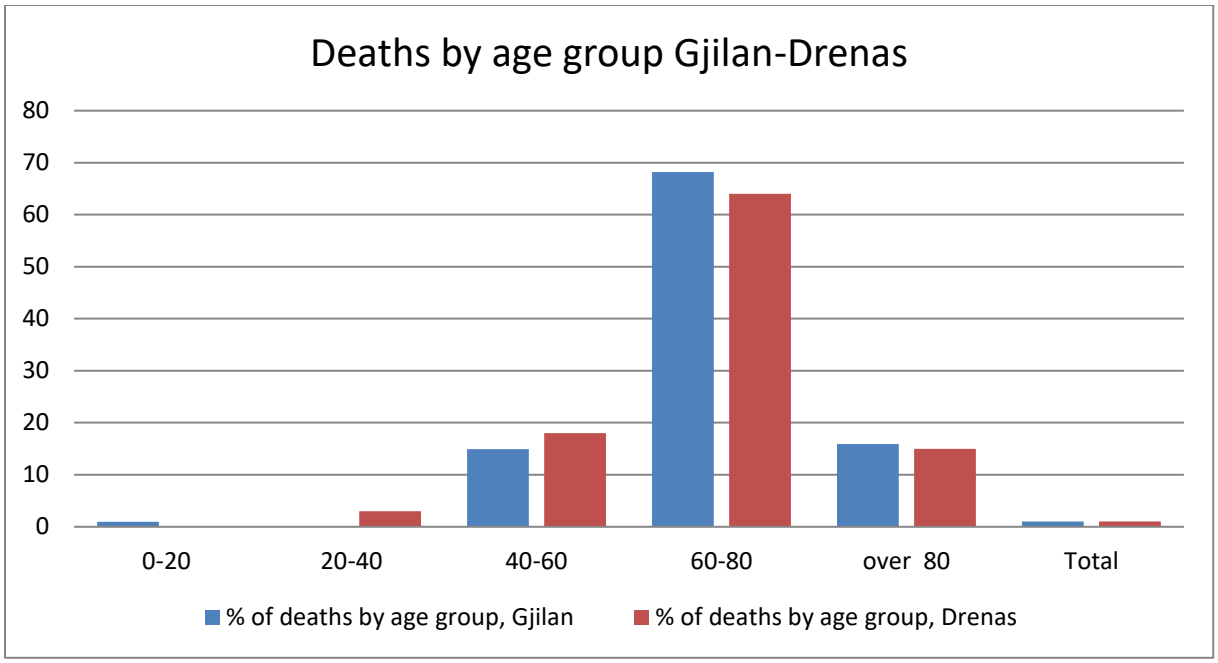

Graph 4. In this graph the comparison of deaths in percentage is made, according to age group for towns: Gjilan - Drenas.

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Discussion

Referring to the results from the Covid 19 Pandemic for the period March-December 2020, in Gjilan town, presented through the relevant tables and graphs, in the following we will discuss this research.

Across the globe the Covid 19 Pandemic is having a devastating effect on public health, causing many deaths. The Gjilan town is also affected by these effects.

In the period when the research was undertaken in this town, a total of 7981 tests were performed, or 14.71% of citizens. Out of these measurements resulted 3153 positive cases with Covid 19 or 39.5%, and 4828 negative cases with Covid 19 or 60.5%. In relation to the number of inhabitants, the citizens of Gjilan have been positive with 5.8%, while negative with 8.9%.

Infection of citizens has not been the same over the months, because in the months: July, August, November and December we had the largest number of infected citizens. In July we had 301 positive cases, or 50.9% in relation to the tests performed. In August we had 366 positive cases or 50.9% in relation to the tests performed. In November we had 1190 or 63.6% positive cases in relation to the tests performed, and in December we had 450 positive cases or 41.4% in relation to the tests performed. The month with the highest number of infections was November.

Out of those who have tested positive with the infections with Covid 19, in Gjilan town 107 citizens have died or 3.39%, while in relation to the number of inhabitants mortality is 0.19% Even the number of deaths have not been the same through the months. The highest number of deaths was in the months: April 30.5%, June 5.05% and December 5.11%. We have analyzed and evaluated the deaths in this town even by age group. From 0-20 years we have 1 death, or 0.934%, from 20-40 we have no death, from 40-60 we have 16 deaths or 14.95%, from 60-80 we have 73 deaths or 68.22%, and over 80 years we have 17 deaths or 15.88%. So, the highest mortality is in the age group 60-80 years.

To see the situation of age groups in another town, we have obtained the results of Drenas, and according to (Directorate of Health and Social Welfare, Municipality of Drenas, report 2020)[ix] in this townwe have: 0-20 years with no case, from 20-40 we have 3% of deaths, from 40-60 we have 18% of deaths, from 60-80 we have 64% of deaths, and over 80 we have 15% of deaths from infections.

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In Gjilan town we have one death of a child, while in the Drenas town we have 3% of deaths in the age group 20-40 years. We have the most deaths in both towns in the age group of 60-80 years.

To assess the effects on public health from the Covid Pandemic 19, we also took the city of Fushe Kosova, with 34,718 inhabitants

(http://www.wikiwand.com/en/Fush%C3%AB_Kosova)[x].

According to (QKMF, Municipality of Fushe Kosova, report 2020)[xi] in this town 4678 citizens were tested for Covid 19. Out of these tests 2217 were positive or 47.3%, whereas 2461 were negative or 52.7%. In Fushe Kosova town 13.47% of citizens were tested.

In the period March-December 2020 30 citizens died in this town, or 1.35% of those infected, or 0.08% in relation to the number of inhabitants.

By comparing the deaths in the two towns, it can be seen that in Gjilan town there were more deaths, compared to Fushe Kosova town.

After the analysis and evaluations performed from this research, we came to the conclusion that the possibility of spreading the Covid 19 virus is higher in larger towns or towns with larger populations.

By concluding this research paper, we can ascertain that from the Covid 19 Pandemic the effects on public health to citizens have been high, with the main symptoms: fever, cough, shortness of breath and muscle aches, (https://en.wikipedia.org / wiki / COVID-19)[xii], and in most cases have ended in fatality.

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