ПРИЛОЗИ. Одд. за мед. науки, XLVI 3, 2025 МАНУ
CONTRIBUTIONS. Sec. of Med. Sci., XLVI 3, 2025 MASA

10.2478/prilozi-2025-0025 ISSN 1857-9345

TOTAL SOLUBLE SOLIDS CONTENT AND VISCOSITY OF COMMERCIALLY AVAILABLE MOUTHWASHES

Kushtrim Dakaj[1], Marija Andonovska[2], Vlatko Kokolanski[2], Marija Glavas-Dodov[3], Dushko Shalabalija[3], Kiro Ivanovski[2], Maja Dimitrovska[4], Teodora Tasevska[3], Julijana Nikolovska[2], Spiro Spasovski[2], Bojan Poposki[2], Maja Milosevic Markovic[5]

[1] PHI Daka Dental Care, Pristina, R Kosovo

[2] Faculty of Dentistry, Ss. Cyril and Methodius University in Skopje, RN Macedonia

[3] Faculty of Pharmacy, Ss. Cyril and Methodius University in Skopje, RN Macedonia

[4] Institute of Public Health of the Republic of North Macedonia, RN Macedonia

[5] School of Dental Medicine, Belgrade, University of Belgrade, R Serbia

Corresponding author: Vlatko Kokolanski, str. Majka Tereza no. 43, Skopje, Republic of North Macedonia, e-mail: vkokolanski@stomfak.ukim.edu.mk

ABSTRACT

Aim of the study: To evaluate the total soluble solid content (TSSC) and viscosity of commercially available mouthwashes available on the market in Macedonia.

Material and methods: A market analysis was conducted from January to October 2024. Products meeting defined inclusion criteria were analyzed using refractometry (Atago® Rx-5000i, 37°C) to determine TSSC (°Brix), and a modular compact rheometer (MCR 92, Anton Paar) to assess viscosity (mPa·s) under constant shear rate conditions. Each measurement was performed in triplicate.

Results: TSSC values ranged from 0 to 38.84 °Brix, with a mean of 11.17±5.95 °Brix. Viscosity varied between 0.81 and 74.39 mPa·s, averaging 2.86±8.69 mPa·s. Outliers included products exceeding 35.99 °Brix or 3.03 mPa·s. A strong positive correlation was found between TSSC and viscosity ($\rho = 0.722$, $p < 0.001$), suggesting increased viscosity with higher solid content.

Conclusion: The wide variability in TSSC and viscosity reflects the complexity of mouthwash formulations and their potential impact on oral health. The strong correlation between these parameters highlights the need to assess them together in both product development and clinical guidance. Further in vivo research is essential to determine their clinical relevance and support evidence-based recommendations for safe use.

Keywords: viscosity, mouthwashes, dental erosion, solubility

INTRODUCTION

When observing oral care products, one group of products that has experienced a significant expansion and development in the last few decades are mouthwashes and rinses [1]. Mouthwash is defined as a non-sterile aqueous solution used mostly for its deodorant, refreshing, or antiseptic effect. Mouthwashes or rinses are designed to reduce oral bacteria, remove food particles, temporarily reduce bad breath, and provide a pleasant taste [2].

Mouthwashes are a very popular additional oral hygiene element [3]. A survey conducted in Sweden found that 47% of adults use a mouth-rinsing product on a regular basis to avoid tooth decay and bad breath [4]. A study conducted in North Macedonia showed that more than 60% of the student population use mouthwashes on a daily basis [5]. On the other hand, a study conducted in Scotland shows that 38.1% of participants aged 25 years and over have never used mouthwashes, 17.5% use mouthwashes less than once a month, 19.4% use mouthwashes once every few days and 25.1% use mouthwashes daily [6].

Regarding the substances and practices, patients should be aware not only of their positive effects but also of the relevant side effects and negative consequences [7,8]. Among others side effects [9], mouthwashes have an erosive potential on dental tissues [10]. Erosion has been described as pathological progressive loss of dental structures caused by chemical processes without involvement of bacterial action [11]. In this perspective, there is a need to analyze the physicochemical characteristics of these products [12]. Available literature shows that the erosive potential of a substance depends on pH, viscosity, titratable acidity and total soluble solid content (TSSC) [13-19]. In a previous research that we have conducted, 59.3% of mouthwashes available on the market in North Macedonia had a pH lower than 5.5, while the titratable acidity values varied widely, with some mouthwashes exhibiting extremely high TA levels [20].

Total soluble solids content (TSSC) is the amount of soluble solid such as sugars, salts, proteins, or acids present in an aqueous solution [19]. Refractometry is the most widely used method for determination of TSSC in mouthwashes [12,21,22]. Another method used for measurement of TSSC is Gravimetric method [23]. In the past, ultrasonic method was used for determination of TSSC in mouthwashes [24].

Viscosity is also important in the erosion produced by the mouth rinses, since enamel exposure time depends on this parameter [3,20]. Namely, some ingredients in mouthwashes, like glycerin, elevate the viscosity of the solutions, resulting in the ability of the liquid to adhere to the tooth surface and potentiate erosive properties [3]. On the other hand, the viscosity of a formulation was particularly important when gargled in the mouth. The viscosity of a formulation being closer to that of water ensured a better experience of the consumer [25].

The aim of this study was to evaluate the total soluble solid content (TSSC) and viscosity of commercially available mouthwashes available on the market in Macedonia.

MATERIAL AND METHOD

Market research

A detailed analysis of the mouthwash market was carried out in North Macedonia from January to October 2024, covering both traditional retail channels – such as pharmacies, cosmetic store chains, and consumer goods outlets – as well as online sales platforms. For the study, between 1-3 units of each mouthwash products were purchased directly from sellers, following predefined inclusion and exclusion criteria, and no free samples were solicited from producers or importers. The products included in the study had to be over-the-counter mouthwash designed for oral hygiene maintenance, disease prevention, or therapeutic purposes, and available as ready-to-use solutions, regardless of whether they were classified as medicines, medical devices, or cosmetic products. Products were excluded if they were tablets for dissolving in liquids, chewing tablets, saliva substitutes, mouthwash concentrates, or if they contained antibiotics, steroids, parasympathomimetic agents, topical anesthetics, or other prescription-only substances. Oral liquids not intended for oral hygiene were also excluded, as well as products in the form of sprays, toothpastes, gels, powders, foams, homeopathic remedies, or those lacking a complete ingredient list. In total, 78 different mouthwashes met the criteria and were included in the research.

Estimation of TSSC

Refractometry was used for the measurement of total soluble solids content. For this purpose, we used three drops of each sample to obtain the °Brix value by using a specific field refractometer, model Rx-5000i, Atago® with reading range between 0–32 ºBrix and accuracy of 0.2, at temperature of 37 ºC. The results were given by the mean of three measurements.

Estimation of viscosity

The rheological profiles of the mouthwash solutions were determined using a cylindrical (CC27-1) geometry on a modular compact rheometer (MCR 92 Anton Paar Rheometer, Austria). The viscosity of the solutions was measured in triplicate (3 points) using a constant shear viscosity test. The measurements were performed at a

Table 1. *Mean values and standard deviations (SD) f or TSSC (°Brix) and viscosity (mPa·s) of the mouthwashes*

No.	Commercial name	Mean °Brix ± SD	Mean mPa·s ± SD
1	Doctor's Mint Mouth Wash	11.55 ± 0.0	1.56 ± 0.01
2	Doctor's HERBAL MOUTH WASH	11.38 ± 0.02	1.49 ± 0.01
3	Doctor's ANTITARTAR MOUTH WASH	8.92 ± 0.01	1.31 ± 0.0
4	Doctor's PROPOLIS MOUTH WASH	12.15 ± 0.03	1.32 ± 0.0
5	Doctor's SMOKERS MOUTH WASH	12.4 ± 0.05	1.6 ± 0.01
6	Alur Care Mouthwash cool mint	9.56 ± 0.01	1.13 ± 0.01
7	Bilka Dent Expert Classic Parodont Protect	10.98 ± 0.01	1.27 ± 0.0
8	Alverde Pro Climate 5 in 1 Mondspulung	9.85 ± 0.01	1.0 ± 0.01
9	Dontodent Protect & Care 10 in 1 Rundumschutz	8.77 ± 0.04	1.06 ± 0.01
10	Dontodent ZahnfleischIntensiv - Pflege	7.81 ± 0.01	0.96 ± 0.0
11	Dontodent Sensitive Intensiv - Schutz	6.95 ± 0.03	0.95 ± 0.01
12	Bilka Homeopathy Grapefruit Mouthwash	22.79 ± 0.0	1.64 ± 0.01
13	Dontodent Junior Lerneffekt - spulung	8.62 ± 0.05	0.97 ± 0.01
14	Dontodent Junior mund - spulung	7.54 ± 0.02	0.92 ± 0.01
15	Parodontax Active Gum Health	10.55 ± 0.01	14.4 ± 0.17
16	Betadine Gargle	5.66 ± 0.05	1.16 ± 0.02
17	Stomatidin	11.85 ± 0.03	1.34 ± 0.0
18	Oralsept	8.59 ± 0.01	1.15 ± 0.0
19	Elmex Caries Protection	1.83 ± 0.01	0.81 ± 0.01
20	Elmex Sensitive	2.07 ± 0.01	1.22 ± 0.01
21	Colgate Plax ICE	17.25 ± 0.02	1.62 ± 0.0
22	Lacalut Micellar Sensitive Mouthwash	10.83 ± 0.0	1.16 ± 0.01
23	Lacalut Micellar tartar protection micellar water	12.09 ± 0.01	1.59 ± 0.02
24	Listerine Total Care Clean Mint 6 in 1 Mild Taste	13.39 ± 0.01	1.19 ± 0.0
25	Listerine Total Care Clean Mint 6 in 1	14.04 ± 0.01	1.56 ± 0.01
26	Listerine Natural Enamel protect	10.61 ± 0.0	1.07 ± 0.0
27	Listerine Naturals Sabor Suave	10.48 ± 0.01	1.06 ± 0.01
28	Listerine Advanced Defence Sensitive	13.25 ± 0.02	1.16 ± 0.01
29	Listerine Advanced White Mouthwash Mild Taste	15.15 ± 0.01	1.36 ± 0.01
30	Listerine Green Tea Mild Taste	13.8 ± 0.0	1.22 ± 0.01
31	Listerine Total Care Tartar Protect	15.33 ± 0.02	1.62 ± 0.0
32	Listerine Teeth & Gum Defence	15.33 ± 0.02	1.61 ± 0.0
33	Listerine Smart Rinse	14.35 ± 0.03	1.12 ± 0.0
34	Listerine Cool Mint	12.96 ± 0.02	1.49 ± 0.01
35	Listerine Fresh Burst	13.84 ± 0.0	1.55 ± 0.01
36	Astera Total All-in-one	7.28 ± 0.0	1.02 ± 0.0
37	Parodont Active	6.93 ± 0.0	1.0 ± 0.02
38	Oral B Pro-Expert	4.61 ± 0.0	0.89 ± 0.01
39	Gengigel Oral Solution	9.83 ± 0.02	21.47 ± 0.03
40	Colgate Cool Mint	16.3 ± 0.01	1.41 ± 0.01
41	Colgate plaxwhite+charcoal	17.74 ± 0.02	3.8 ± 0.01
42	Colgate max white	17.69 ± 0.01	4.01 ± 0.01
43	Colgate plax soft mint	16.09 ± 0.01	1.37 ± 0.01
44	Edel+White Fresh+Protect	12.95 ± 0.0	1.15 ± 0.0
45	Lacalut Micellar Whitening Mouthwash	19.55 ± 0.06	1.6 ± 0.0
46	Lacalut Multi-Effect Micellar Mouthwash	19.03 ± 0.01	1.52 ± 0.0
47	Lacalut Flora	13.31 ± 0.01	1.24 ± 0.01
48	LacalutAktiv	18.52 ± 0.01	1.36 ± 0.0
49	Lacalut white	18.23 ± 0.01	1.36 ± 0.0
50	Lacalut Sensitive	18.8 ± 0.02	1.38 ± 0.01
51	Curaprox Perio Plus Balance CHX 0.05	2.6 ± 0.0	0.99 ± 0.0
52	Curaprox Perio Plus + Protect CHX 0.12	2.64 ± 0.02	0.99 ± 0.02
53	Curaprox Perio Plus Forte CHX 0.20	2.88 ± 0.02	0.99 ± 0.0
54	Curaprox Regenerate CHX 0.09	9.71 ± 0.01	8.52 ± 0.02
55	Alkmene Tea Tree Mouthwash	13.84 ± 0.01	1.39 ± 0.01
56	Aquafresh Fresh & Minty	10.38 ± 0.01	1.27 ± 0.0
57	Ben & Anna Natural Mouthwash Sensitive	14.66 ± 0.02	1.35 ± 0.0
58	Eco Denta Refresh & Protect Mouthwash	12.06 ± 0.0	1.37 ± 0.01
59	Natura Siberica Whitening & Enamel Protection	4.86 ± 0.01	1.08 ± 0.04
60	Natura Siberica Plaque Control & Fresh Breath	4.6 ± 0.0	1.01 ± 0.01
61	Natura Siberica Strong Teeth & Gums	4.89 ± 0.0	1.07 ± 0.0
62	Cosmos Organic People Mouthwash Coconut & Mint	8.75 ± 0.03	1.2 ± 0.0
63	Maxlab Silver Water	0.0 ± 0.0	0.92 ± 0.01
64	Aquafresh Big Teeth Mouthwash	14.1 ± 0.0	1.65 ± 0.01
65	IntermedUnisept Mouthwash	38.84 ± 0.0	4.25 ± 0.0
66	IntermedChlorhexil Extra 0,20% Mouthwash	12.95 ± 0.01	1.56 ± 0.06
67	IntermedChlorhexil 0.12% Mouthwash	11.62 ± 0.03	4.19 ± 0.01
68	Intermed Kids Mouthwash	17.12 ± 0.0	1.48 ± 0.01
69	ESI Aloe Fresh Collutorio	6.75 ± 0.07	1.08 ± 0.0
70	Dr. Silver Mouthwash Total Care	13.57 ± 0.0	74.39 ± 0.98
71	FrezyDerm Sensitive Teeth Mouthwash	16.5 ± 0.01	1.99 ± 0.01
72	FrezyDerm Plaque&Tartar Mouthwash	14.21 ± 0.02	1.7 ± 0.0
73	Oral B Gum & Enamel Care Fresh Mint	5.05 ± 0.02	1.03 ± 0.01
74	Dental Dream Black & White	1.82 ± 0.01	0.99 ± 0.01
75	Dental Dream Parodont Protect	5.74 ± 0.05	1.42 ± 0.01
76	Dental Dream Adcance White	4.92 ± 0.01	1.09 ± 0.01
77	Dental Dream Sensitive Teeth	2.89 ± 0.01	1.0 ± 0.0
78	Dental Dream Enamel Repair	4.56 ± 0.01	1.09 ± 0.02

constant shear rate (50/s) over a time interval of 6 seconds at a temperature of 37 °C.

RESULTS

Table 1 presents the mean values and standard deviations for total soluble solid content (TSSC, expressed as °Brix) and viscosity (mPa·s) for each of the 78 commercially available mouthwashes. The results demonstrate considerable variability among products.

Table 2 summarizes the descriptive statistics for the total soluble solid content (°Brix) across all analyzed mouthwashes. The mean TSSC was 11.17 ± 5.95 °Brix, with values ranging from 0 to 38.8 °Brix. The 25th, 50th (median), and 75th percentiles were 6.95, 11.46, and 14.21 °Brix, respectively.

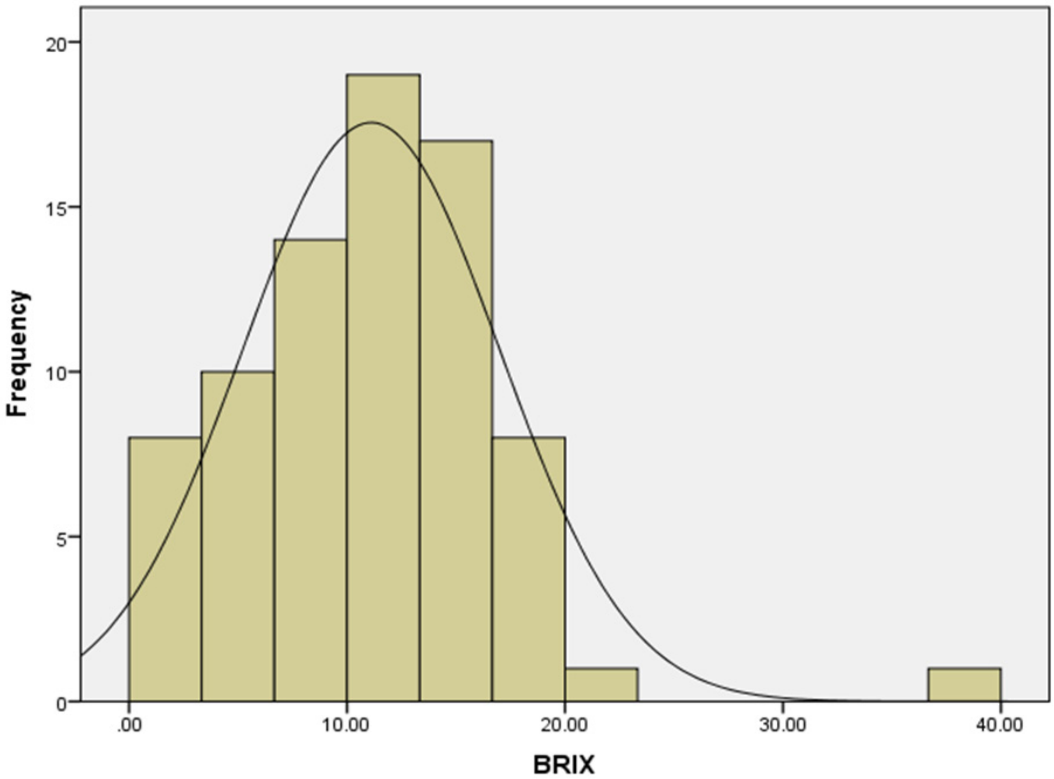
Figure 1 illustrates the distribution of TSSC values among the sampled mouthwashes. The data revealed a right-skewed distribution, with the majority of products clustered around the mean and a smaller number exhibiting high °Brix values.

Table 3 provides descriptive statistics for the viscosity of the mouthwashes, measured in mPa·s. The mean viscosity was 2.86 ± 8.69 mPa·s, with a minimum of 0.81 mPa·s and a maximum of 74.3 mPa·s. The 25th, 50th, and 75th percentiles were 1.07, 1.29, and 1.56 mPa·s, respectively.

Figure 2 shows the distribution of viscosity values for the analyzed mouthwashes. Most of the products demonstrate low viscosity, with a few notable outliers exhibiting much higher values. Interquartile range for BRIX of the mouthwashes was 7.26 (6.95-14.21). Outlier detection was performed using the extended

Table 2. *BRIX of mouthwashes*

	Mean	SD	Min	Max	Percentiles		
					25^{th}	50^{th}	75^{th}
°Brix	11.17	5.95	0	38.84	6.95	11.46	14.21



Graph 1. *Distribution of TSSC (°Brix) in mouthwashes*

boxplot criterion, with values exceeding 35.99 considered extreme outliers. The maximum observed value 38.84 (product no. 65) was classified as the only extreme outlier. The interquartile range for the viscosity of the mouthwashes was 0.49 (1.07-1.56). Outlier detection was performed using the 1.5 × IQR rule, values exceeding 3.03 were considered extreme outliers. Mouthwashes no. 15 (14.4), no. 39 (21.47), no. 41 (3.80), no. 42 (4.01), no. 54 (8.52), no. 65 (4.25), no. 67 (4.19) and no. 70 (74.39) were classified as extreme outliers.

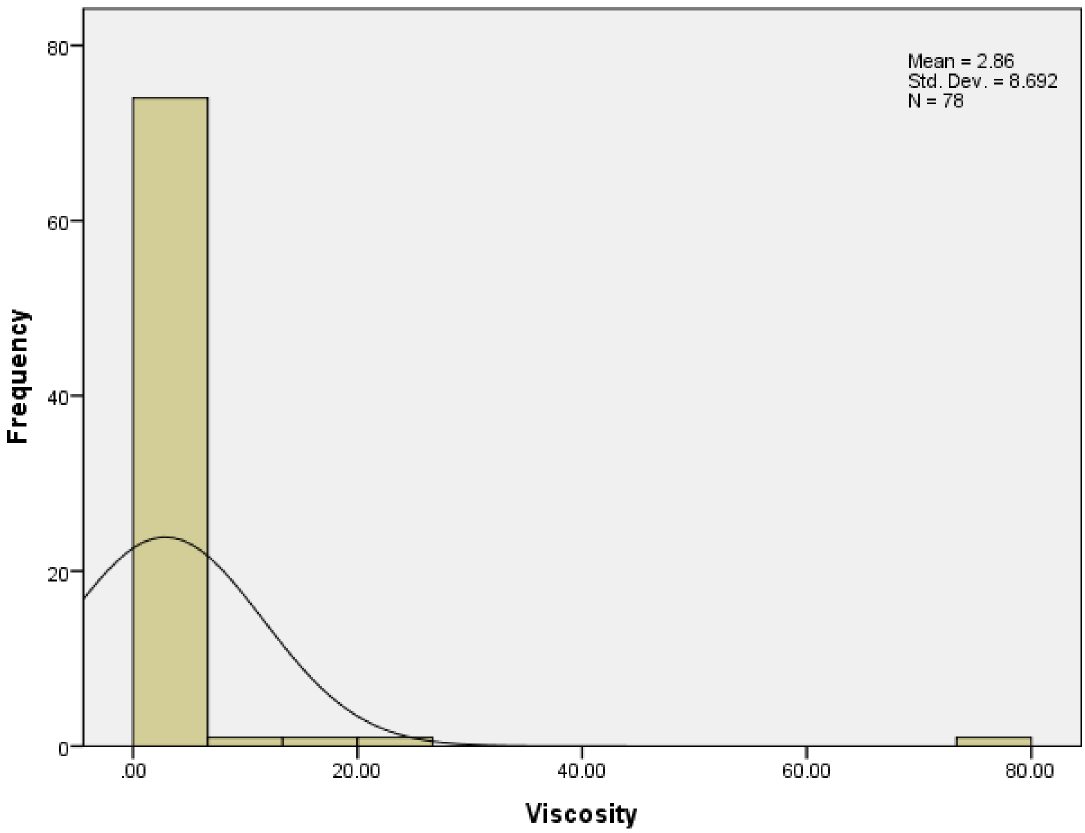
Figure 3 presents a scatter plot depicting the relationship between TSSC (°Brix) and viscosity (mPa·s) among the mouthwashes. A Spearman's rank-order correlation was performed to assess the relationship between viscosity and Brix values. There's a strong and statistically significant Spearman correlation ($\rho=0.722$, $p<0.001$) between viscosity and Brix, suggesting that as Brix increases, viscosity tends to increase as well.

DISCUSSION

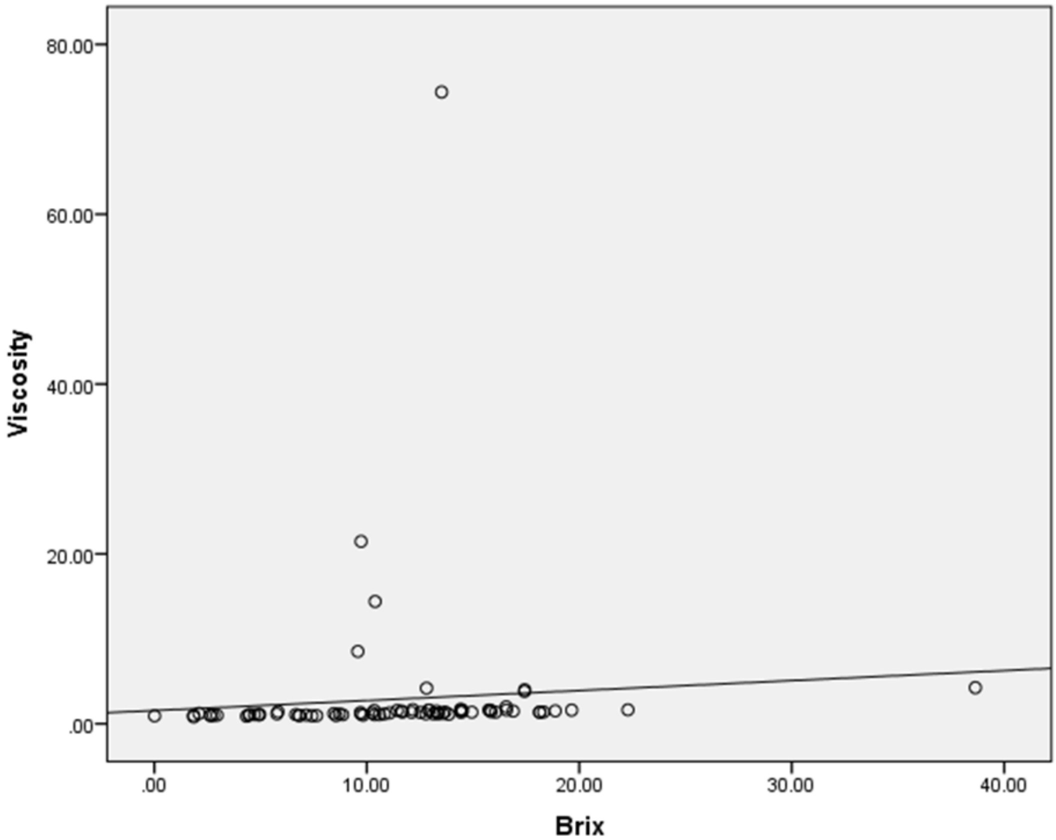
The present study provides a comprehensive analysis of the total soluble solid content (TSSC) and viscosity of 78 commercially available mouthwashes, contributing important new data to the understanding of their physicochemical diversity and potential clinical implications. The findings reveal substantial variability in both TSSC and viscosity, with TSSC values ranging

Table 3. *Viscosity of mouthwashes*

	Mean	SD	Min	Max	Percentiles		
					25th	50th	75th
Viscosity	2.86	8.69	0.81	74.39	1.07	1.29	1.56



Graph 2. *Distribution of viscosity values (in mPa·s) in mouthwashes*



Graph 3. *Correlation between viscosity and Brix values of mouthwashes*

from 0 to 38.84 °Brix and viscosity spanning from 0.81 to 74.39 mPa·s, and a strong positive correlation between these two parameters ($\rho=0.722$, $p<0.001$).

The wide range of TSSC observed in this study is consistent with previous reports from various markets, where TSSC values in mouthwashes have been shown to vary from approximately 2.8 up to 23.7°Brix [12,21]. It is commonly assumed that the °Brix values represent the sugar concentration in a solution [22]. For instance, a 25°Brix solution would be 25% (w/w), i.e. 25g of sugar per 100g of solution [22]. However, high TSSC typically reflects the presence of sugars substitutes, as well as salts, and other dissolved substances, which are added for flavor, preservation, or therapeutic effects [12]. Notably, products that target children often contain higher levels of sweeteners and flavoring agents to improve palatability, as evidenced by the frequent use of flavors [12]. For example, Cavalcanti et al. [26] assessed the TSSC in pediatric antitussive syrups, which ranged from 4.33 to 53.41, while in a later study [22], they assessed TSSC in pediatric antimicrobials, with values ranging from 11.73 to 63.83. Such formulation choices can inadvertently increase the erosive potential of the product, especially when combined with acidic pH or frequent use [27,28].

Viscosity, another critical parameter, also demonstrated considerable variability among the tested mouthwashes. Most products exhibited viscosities close to that of water (around 1 mPa·s), which is generally considered optimal for user comfort and effective rinsing [29,30]. However, several products in our study were identified as outliers, with viscosities significantly exceeding this range. Elevated viscosity is often a result of the inclusion of humectants such as glycerin or thickening agents, which are intended to enhance mouthfeel, prolong retention time or stabilize the formulation [21,31]. While higher viscosity may theoretically improve the substantivity of active agents on oral surfaces, it also increases the likelihood of prolonged contact between potentially erosive components and dental tissues, thereby increasing the risk for enamel demineralization [20,27].

The strong correlation between TSSC and viscosity observed in this study aligns with the expected physicochemical relationship: as the concentration of dissolved solids increases, so does the resistance to flow [28]. This relationship has practical implications for both the formulation and clinical use of mouthwashes. For example, mouthwashes with high TSSC and viscosity may adhere more readily to tooth surfaces, potentially enhancing the delivery of therapeutic agents, but also increasing the risk of adverse effects, particularly if the formulation is acidic or contains fermentable carbohydrates [27,28]. In general, consistent and extended use of medications with prolonged oral clearance can elevate the risk of dental caries when sugars are present, and increase the likelihood of dental erosion if the formulation is acidic [32]. Further, literature supports the notion that the erosive potential of mouthwashes cannot be attributed solely to pH, but must also consider TSSC, viscosity, and titratable acidity as co-contributing factors [21, 28].

This study represents a direct continuation of a previous research on the physicochemical properties of commercial mouthwashes in North Macedonia [20]. Earlier investigation revealed that 59.3% of mouthwashes had a pH below the critical threshold of 5.5, with a mean pH of 5.28 ± 0.98 and titratable acidity (TA) values varying widely from 0.01 to 162.4 mmol/l (mean 11.50 ± 20.58 mmol/l), highlighting significant erosive potential due to both low pH and high TA in several products [20]. Building on these findings, the current study excluded concentrates and focused on 78 ready-to-use mouthwashes, analyzing their total soluble solid content (TSSC) and viscosity. Taken together, these studies demonstrate that while low pH and high TA are critical indicators of erosive risk, elevated TSSC and viscosity – especially in products with high TSSC or thickening agent content – may further increase the retention of erosive agents on dental surfaces. This comprehensive approach underscores the importance of evaluating all these parameters to better predict the clinical safety and potential risks of mouthwash use, particularly for populations with higher susceptibility to dental erosion.

Comparative data from international studies reinforce the relevance of these findings. Cavalcanti et al. reported TSSC values ranging from 4.7% to 23.7% in Brazilian mouthwashes, with some products exceeding 20% TSSC and being classified as potentially erosive due to their high content of dissolved solids and low pH [28]. Similarly, Cunha et al. found that °Brix values of the mouthwashes ranged from 2.8 to 20.0 [12], while Hanan et al. found that the TSS content varied between 7 and 22.50% on the Brix scale [28]. The TSSC values reported in study of Crețescu et al, ranged from 9.53% to 14.57%, depending on the product and its fluoride content [27]. There is no information in the literature, or any regulatory act related to the maximum admitted value of TSSC in mouthwashes. Also, some of the measurements [12,28] of TSSC were carried out at 20°C, while in other studies the temperature of the measurements was not specified. We performed the measurements at 37OC in order to stimulate the temperature of the mouth.

Crețescu et al. found that the viscosities of the tested mouthrinses ranged from 1.46 to 2.01 mPa·s, with both fluoride-containing and fluoride-free formulations exhibiting similarly low viscosity values that are only slightly higher than water [27]. Hanan et al. found that viscosity at 20°C showed an interval from 1.28 to 2.56 mm2/s, and when at 37°C, an interval of 1.02 to 1.90 mm2/s [28], while Cunha et al. found that pediatric mouthwashes in Brazil had viscosities between 1.47 and 2.73 mm^2/s [12]. The present study extends these observations, demonstrating that even broader variability exists in the Macedonian market, with some products reaching extreme values for viscosity.

The clinical implications of these findings are significant. Although mouthwashes are widely used for their antimicrobial and breath-freshening properties, their physicochemical characteristics can affect not only their efficacy but also their safety profile [12]. High TSSC increases the retention time of acids and other erosive agents on dental surfaces [27,28]. These risks are particularly pronounced in vulnerable populations, such as children or individuals with reduced salivary flow (example patient with Sjogren syndrome), who may be more susceptible to the adverse effects of prolonged exposure to such products.

It is important to note that, despite the observed variability, most mouthwashes in the present study had TSSC and viscosity values within ranges considered acceptable for routine use. However, the existence of outliers underscores the need for regulatory oversight and clearer labeling, particularly regarding the content of sugars, polyols, and thickening agents

[12]. Manufacturers should be encouraged to optimize formulations to balance efficacy, safety, and consumer acceptability, minimizing unnecessary increases in TSSC and viscosity unless justified by therapeutic benefit.

The limitations of this study should be acknowledged. As an in vitro analysis, the results do not directly account for the complex dynamics of the oral environment, including salivary dilution, clearance, and buffering capacity, which can mitigate or exacerbate the effects of high TSSC and viscosity. Future research should aim to integrate these variables and evaluate the clinical outcomes associated with long-term use of mouthwashes with varying physicochemical profiles.

CONCLUSION

The marked diversity in TSSC and viscosity among commercially available mouthwashes highlights the complexity of their formulations and the importance of considering these parameters in both product development and clinical recommendations. The strong correlation between TSSC and viscosity suggests that these properties are closely linked and should be evaluated together when assessing the potential impact of mouthwashes on oral health. Further studies, particularly in vivo studies, are needed to clarify the clinical significance of these physicochemical properties and to inform evidence-based recommendations for safe and effective mouthwash use.

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Резиме

ВКУПНИ РАСТВОРЛИВИ ЦВРСТИ МАТЕРИИ И ВИСКОЗНОСТ НА КОМЕРЦИЈАЛНО ДОСТАПНИТЕ РАСТВОРИ ЗА ПЛАКНЕЊЕ НА УСТАТА

Куштрим Дакај[1], Марија Андоновска[2], Влатко Коколански[2], Марија Главаш Додов[3], Душко Шалабалија[3], Киро Ивановски[2], Маја Димитровска[4], Теодора Тасевска[3], Јулијана Николовска[2], Спиро Спасовски[2], Бојан Попоски[2], Маја Милошевиќ Марковиќ[5]

[1] ПЗУ Daka Dental Care, Приштина, Р Косово

[2] Стоматолошки факултет, Универзитет „Св. Кирил и Методиј“ во Скопје, РС Македонија

[3] Фармацевтски факултет, Универзитет „Св. Кирил и Методиј“ во Скопје, РС Македонија

[4] Институт за јавно здравје на Република Северна Македонија, РС Македонија

[5] Стоматолошки факултет, Белград, Универзитет во Белград, Р Србијаа

Цел на трудот: Да се определат вкупните растворливи цврсти материи (total soluble solid content – TSSC) и вискозноста на комерцијално достапните раствори за плакнење на устата на пазарот во Македонија.

Материјал и методи: Анализата на пазарот беше спроведена од јануари до октомври 2024 година. Производите што ги исполнуваа дефинираните критериуми за вклучување беа анализирани со помош на рефрактометрија (Atago® Rx-5000i, 37 °C) за одредување на TSSC (°Brix) и модуларен компактен реометар (MCR 92, Anton Paar) за мерење на вискозноста (mPa·s) при константна стапка на деформација. Секое мерење беше направено трипати.

Резултати: Вредностите на TSSC варираа од 0 до 38,84 °Brix, со просек од 11,17 ± 5,95 °Brix. Вискозноста се движеше меѓу 0,81 и 74,39 mPa·s, со просек од 2,86 ± 8,69 mPa·s. Како отстапувања (outliers) беа идентификувани производите со вредности над 35,99 °Brix или 3,03 mPa·s. Беше регистрирана силна позитивна корелација меѓу TSSC и вискозноста ($\rho = 0{,}722$, $p < 0{,}001$), што укажува на зголемена вискозност при поголема TSSC.

Заклучок: Големата варијабилност на TSSC и вискозноста ја одразува сложеноста на формулациите на растворите за плакнење на устата и нивниот потенцијален ефект врз оралното здравје. Силната корелација меѓу овие параметри укажува на потребата од нивна заедничка евалуација при развојот на производите и клиничките препораки. Понатамошни *in vivo* истражувања се неопходни за утврдување на нивната клиничка релевантност и за поддршка на препораките базирани на докази за нивна безбедна употреба.

Клучни зборови: вискозност, раствори за плакнење на устата, дентална ерозија, растворливост