EFFECTS OF CANNABIDIOL EXTRACT FROM ELECTRONIC CIGARETTES ON ORAL HEALTH

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ABSTRACT

Aim of the study The purpose of this study is to highlight the harmful effects of electronic cigarettes in the daily lives of the population. As more and more people, especially young individuals, are encouraged to choose this vice as less harmful than conventional cigarettes and are attracted by different flavours or strengths to choose it, dental professionals are compelled to sound the alarm about potential oral health issues, as well as overall health concerns.

Material and methods. The subjects of this study were divided into 3 categories: non-smokers, conventional cigarette smokers, and electronic cigarette smokers; saliva samples, both stimulated and resting, were collected from each. Saliva samples were taken to determine salivary flow, viscosity, and consistency of unstimulated saliva, resting saliva pH, stimulated saliva quantity, and buffering capacity of stimulated saliva. Additionally, the conventional cigarette smoker and electronic cigarette smoker groups will be proposed the use of electronic cigarettes, whose liquid will contain an essential oil of Cannabidiol (CBD). This is the active ingredient derived from the hemp plant and is extracted from the flowers, leaves, and stems of the plant, being recognized for its impressive medicinal and antioxidant properties.

Results. The results indicated no significant differences in the average salivary pH values after CBD among the three groups. The mean buffering capacity of stimulated saliva at the initial evaluation was 8.71 for conventional cigarette smokers and 8.43 for electronic cigarette smokers. After using CBD-containing cigarettes, the average value reached 8.14 for both conventional cigarette smokers and electronic cigarette smokers.

Conclusions. Among conventional cigarette smokers, only one (14.3%) stated that they would replace their current cigarettes with Cannabidiol-based ones, while among electronic cigarette smokers, 4 (representing 57.1%) would switch to Cannabidiol-based cigarettes. None of the surveyed subjects reported mucosal lesions after using CBD-containing electronic cigarettes. Among conventional cigarette smokers, 28.6% stated that using CBD electronic cigarettes helped them relax, while among electronic cigarette smokers, 57.1% shared the same opinion. No significant differences were found in the average values of stimulated saliva quantity after CBD among groups. There are no significant differences between groups regarding the buffering capacity of stimulated saliva after CBD, confirming the limited implication of CBD in saliva. The evolution of salivary pH after using CBD cigarettes was not statistically significant for any of the groups.

Key words: Electronic cigarette, CBD, Propylene glycol, Vegetable glycerine

INTRODUCTION

The popularity of electronic nicotine delivery systems, especially electronic cigarettes, also known as e-cigs, has been continuously increasing over the past decade. This new category of nicotine-containing products began to gain popularity between 2006-2009, and currently, there are estimated to be over 40 million users of these devices [1]. They have been promoted as a safer alternative to conventional tobacco cigarettes. Excluding the harmful chemicals present in tobacco smoke, there is a debate as to whether electronic cigarettes are indeed a safer alternative as presumed for a smoker,

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although the long-term effects are not fully understood [2]. The involvement of smoking in the progression of periodontal diseases [3] and its effects on oral health are well-known, but e-cigarette manufacturers claim that these products can improve oral health by providing alternatives to smoking [4]. However, the impact of electronic cigarettes on oral health is not fully understood and is still debated among scientists and clinicians [5].

It is essential and of utmost importance to determine whether exposure to aerosols produced by electronic cigarettes contributes to the progression of periodontal diseases and how they affect the periodontal ligament and gingival cells, which are believed to be the primary targets [6].

Internationally, different countries have adopted various policies, including the prohibition of electronic cigarettes [7]. These regulations help populations as these devices have become extremely popular, especially among middle and high school students [8]. The purpose of this study is to highlight the harmful effects of electronic cigarettes in the daily lives of the population. As more and more people, especially young individuals, are encouraged to choose this vice as less harmful than conventional cigarettes and are attracted by various flavours or strengths to choose it, dentists are compelled to sound the alarm about potential oral cavity conditions, as well as the entire body [9] [10].

Conventional cigarette smoke harms nearly every organ in the body and is one of the leading causes of mortality worldwide [11] [12]. For several decades, it has been demonstrated that most of the damage caused by excessive tobacco consumption stems from the burning process and the complex mixture of ingredients resulting from it, rather than from nicotine, the primary psychoactive substance and addictive component in cigarette smoke [13][14][15]. It is now widely accepted that nicotine is not responsible for this [16][17][18].

The development of alternative nicotine delivery methods is not a new topic, with a wide range of nicotine replacement therapies having been used for tobacco cessation in a medical context for over 30 years [19]. In 2015, the World Health Organization estimated that 19.9% of the world's population aged 15 and older were tobacco users, with numerous clinical investigations linking its consumption to over 25 diseases, including lung, heart, and oral diseases such as oral cancer or periodontal disease [20].

MATERIAL AND METHODS

In this experimental study, the analysis of multiple salivary components of subjects is intended, divided into three categories based on the type of cigarette they use. The three categories in which the subjects will be classified are: non-smokers, conventional cigarette smokers, and electronic cigarette smokers; saliva samples, both stimulated and resting, will be collected from each. Following the saliva samples, we will be able to determine salivary flow, viscosity, and consistency of unstimulated saliva, resting saliva pH, stimulated saliva quantity, and buffering capacity of stimulated saliva. The results of the analysis will be compared to demonstrate which type of cigarette has a more pronounced impact on oral health. Additionally, the conventional cigarette smoker and electronic cigarette smoker groups will be proposed the use of electronic cigarettes, whose liquid will contain an essential oil of Cannabidiol (CBD). This is the active ingredient derived from the hemp plant and is extracted from the flowers, leaves, and stems of the plant, being recognized for its impressive medicinal and antioxidant properties. These types of liquids, containing cannabidiol, are also encouraged by manufacturers for smokers of any type because they do not contain nicotine, offering a similar sensation but less harmful. These subjects will be provided with a questionnaire consisting of 14 questions, aiming to provide feedback on their experience using the liquid. The questions will refer to the state created, level of satisfaction, flavor, time and period of usage, the latter being whether subjects would abandon the inhaled smoke type in favor of the new solution. Saliva from the two groups will be collected one week after

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starting the use of the new liquid. The experimental study consists of a total of 21 male and female subjects distributed as follows: non-smokers- 7 subjects, conventional cigarette smokers- 7 subjects, electronic cigarette smokers - 7 subjects.
Inclusion criteria for subjects:
ages between 18-60 years, clinically healthy.
Exclusion criteria for subjects: age under 18 or over 60 years, pregnant women, respiratory conditions, gastrointestinal conditions, salivary gland disorders, oral mucosa disorders, xerostomia.
Saliva collection is done using the GC Saliva-Check Buffer kit [Figure 1]. The kit includes: 20 in vitro pH test strips (range 5.0-8.0), 20 saliva collection cups, 20 pieces of wax for stimulating salivary flow, 20 pipettes for saliva manipulation, 20 strips for buffering capacity evaluation.

Figure 1. GC Saliva-Check Buffer saliva testing kit

Using the Saliva-Check Buffer kit, we determine:
Salivary flow, viscosity, and consistency of unstimulated saliva to gather information about the patient's lifestyle, resting saliva pH, alerting if acidity levels are high, stimulated saliva quantity to identify potential salivary gland issues, buffering capacity of stimulated saliva, establishing its effectiveness in neutralizing acids in the oral cavity. Subjects receive containers with liquid for electronic cigarettes, each containing equal quantities of each component to avoid potential errors. The liquids are manufactured in an authorized facility, specialized and staffed by professionals qualified in the field. Each container has a volume of 30 ml and is graduated.

For a volume of 30 ml, a nicotine concentration of 7 mg/ml, and a 10% flavour percentage, we composed the liquid as follows:
- 16.50 ml base consisting of 50% vegetable glycerine (VG) and 50% propylene glycol (PG)
- 10.50 ml nicotine
- 3.00 ml mint flavour

The liquid containing cannabidiol is also 30 ml and is composed of a base consisting of 50% vegetable glycerine (VG) and 50% propylene glycol (PG) to which 0.1 ml of cannabidiol solution has been added, equivalent to 2 drops.

Sample collection
To obtain saliva pH, we collect a saliva sample from the subject into a cup; we then insert a test strip from the kit for 10 seconds, and the resulting color will be compared with the chart provided by the manufacturer. Saliva with high acidity levels will appear red within the range of 5.0-5.8. Moderate acidity levels will turn yellow and fall within the range of 6.0-6.6. Normal saliva pH will appear green and has a value between 6.8-7.8.
The stimulated saliva quantity is obtained by the subject chewing on a piece of wax for 5 minutes, thereby stimulating salivary flow. The wax piece is tasteless precisely to mechanically stimulate salivary flow. At regular intervals, when the patient feels the need, they will deposit saliva into a cup. The saliva quantity will be measured using the graduations on the cup, values expressed in millilitres. If the measurement is below 3.5 ml, the stimulated saliva quantity is very low. The range between 3.5-5.0 ml indicates a low level, while values above 5 ml represent a normal level.
Saliva buffering capacity is measured using a strip with three red spaces placed on a pad, and saliva samples are dropped onto each of the three spaces using a pipette. Excess saliva will be removed by lifting the strip at a 90-degree angle. The spaces on the strip will change colour, and after 2 minutes, the results can be observed. The colours obtained will be compared with another table provided in the kit. If the saliva buffering capacity is low, the

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space will remain red. Spaces will appear blue for moderate buffering capacity, and in the case of normal buffering capacity, all spaces will turn green. The result will be calculated using an image available in the table, based on the colours present in the spaces.

For the next test, conventional cigarette smokers are provided with electronic devices, their liquid containing cannabidiol [Figure 2]. Following the usage instructions, each subject will replace conventional cigarettes with electronic cigarettes containing cannabidiol for one week, analysing the effects of nicotine replacement. Electronic cigarette smokers receive the same instructions. After one week, saliva tests are repeated for both categories, and the obtained data is compared, both among themselves and with previous data. Each subject receives a questionnaire, in which they will respond positively or negatively to questions about their status in the last week, satisfaction level, flavour, time and period of electronic cigarette usage, as well as the presence of potential mucosal lesions.

Figure 2. CBD-containing electronic cigarette

RESULTS AND DISCUSSIONS

In the first stage of this study, we collected samples from all patients, non-smokers, conventional cigarette smokers, and electronic cigarette smokers. Saliva samples were collected from the subjects for the evaluation of the following tests:

- Salivary pH measurement
- Stimulated saliva quantity
- Saliva buffering capacity

For the salivary pH measurement test, we obtained the following results:

Non-smokers had a pH ranging from 6.4 to 7.0 [Table 1]. This indicates a salivary pH within normal limits, with healthy saliva [Figure 3].

Figure 3. Saliva sample from a non-smoker (Ș.G) with normal pH, with a result of 6.6

Conventional cigarette smokers had a pH ranging from 6.0 to 7.8 [Table 2]. Saliva exhibits a moderately acidic character, slightly elevated [Figure 4].

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Figure 4. Saliva sample from a conventional cigarette smoker (D.C), with a moderately acidic pH of 6.4

Electronic cigarette smokers had a pH ranging from 5.8 to 7.4 [Table 3]. This demonstrates the moderately elevated to moderate acidic character of salivary pH [Figure 5].

Figure 5. Saliva sample from an electronic cigarette smoker (B.P), with a moderately elevated acidic pH of 5.8

The stimulated saliva quantity was the next test conducted. Each participant was given a piece of wax (paraffin) to chew on for 5 minutes. During the 5-minute period, the saliva of each subject was collected in a graduated cup [Figure 6]. The results show that the stimulated saliva quantity was within normal limits for each category of subjects, with results between 6-12 ml [Table 1, 2, 3].

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Figure 6. Stimulated saliva quantity from all groups of subjects, in the following order: non-smoker (T.A), conventional cigarette smoker (S.B), electronic cigarette smoker (P.H)

The last thing that was studied was the saliva buffering capacity. For this test, we collected saliva from each subject using a pipette. Saliva samples were dripped onto the strip in the kit, which had 3 spaces. Depending on the color resulting from the sample dripping on the strips, we assigned scores:

- Green- 4 points
- Green/blue- 3 points
- Blue- 2 points
- Red/blue- 1 point
- Red- 0 points

The results were as follows:

For non-smoker subjects, the samples showed that the buffering capacity is within normal limits after summing up the scores. The range of results is 7-11 [Table 1], resulting in values within normal limits [Figure 7].

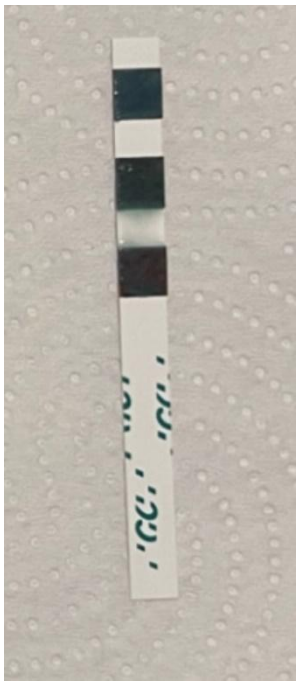

Figure 7. Green-colored strip in two of the boxes, the last one turning green/blue, with a final score of 11 (T.A).

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Conventional cigarette smokers obtained scores ranging from 4-11 [Table 2], indicating a low or very low saliva buffering capacity [Figure 8].

Figure 8. Green/blue, blue, and blue/red colored strip, with a score of 6 (P.H).

Electronic cigarette smokers obtained scores similar to those of conventional cigarette smokers, with some values being lower. The results were within the range of 2-11 [Table 3], indicating a low or very low saliva buffering capacity [Figure 9].

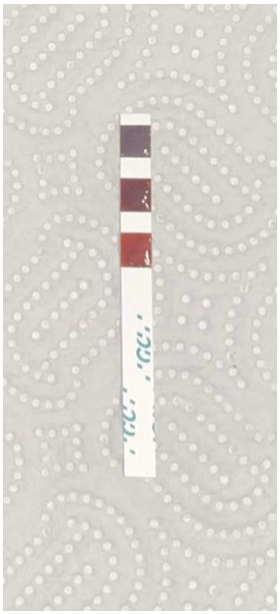

Figure 9. Blue/red and red colored strip, with a score of 2 (P.B).

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After the first week of using CBD-containing electronic cigarettes, in the case of electronic cigarette smokers, the following observations were made [Table 5]:

The salivary pH of the first two subjects decreased by approximately 0.2 [Figure 10].

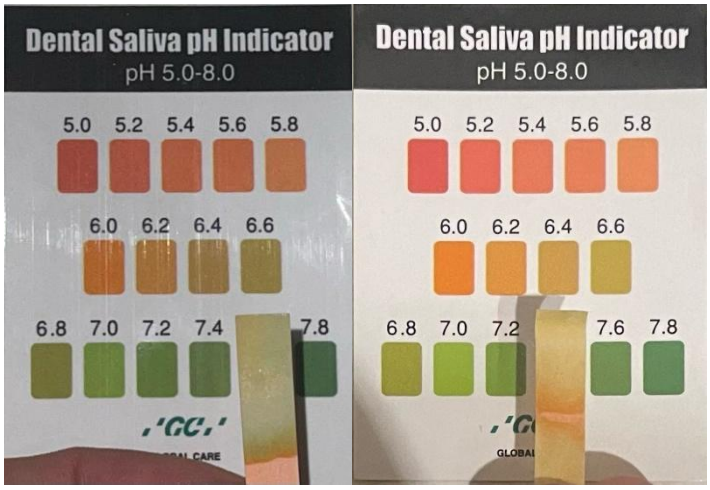

Figure 10. pH strips modified one week after using CBD electronic cigarettes (P.H).

For the stimulated saliva quantity in the first two patients, the results show minor changes of up to 0.1 ml of saliva produced.

The buffering capacity of saliva changed by approximately 1 unit for both subjects, at the last box level, simultaneously with the overall score increase [Figure 11].

Figure 11. Changing the last box from blue/green to green one week after using CBD electronic cigarettes (U.S).

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Patient Name	Salivary pH Value	Stimulated Saliva Quantity	Buffering Capacity of Stimulated Saliva
P.L	6.6	6.5 mL	8
T.A	6.8	8 mL	7
S.G	6.6	7 mL	10
M.V	7.0	10 mL	10
V.T	6.4	7 mL	7
P.S	6.6	9 mL	9
T.D	6.8	7 mL	8

Table 1. Results of non-smoker patients

Patient Name	Salivary pH Value	Stimulated Saliva Quantity	Buffering Capacity of Stimulated Saliva
P.H	6.8	8 mL	11
P.B	6.0	7 mL	4
D.C	7.8	6 mL	9
T.R	6.2	10 mL	9
P.V	6.8	9 mL	7
S.A	7.4	12 mL	11
P.D	7.0	12 mL	10

Table 2. Results of patients smoking conventional cigarettes

Patient Name	Salivary pH Value	Stimulated Saliva Quantity	Buffering Capacity of Stimulated Saliva
B.F	7.4	9 mL	10
A.W	7.2	8 Ml	9
P.H	6.6	10 mL	6
U.S	7.4	8 mL	11
P.I	5.8	6 mL	2
P.C	7.0	9 mL	11
M.F	6.8	10 mL	10

Table 3. Results of electronic cigarette smoker patients

Patient Name	Salivary pH Value	Stimulated Saliva Quantity	Buffering Capacity of Stimulated Saliva
P.H	6.4	8 mL	9
P.B	5.8	6 mL	6
D.C	7.6	7 mL	8
T.R	6.8	10 mL	8
P.V	7.2	10 mL	7
S.A	7.4	11 mL	10
P.D	7.2	12 mL	9

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Table 4. Results of conventional cigarette smoker patients after CBD

Patient Name	Salivary pH Value	Stimulated Saliva Quantity	Buffering Capacity of Stimulated Saliva
B.F	6.6	9 mL	9
A.W	7.0	8 mL	8
P.H	6.4	8 mL	5
U.S	7.8	7 mL	12
P.I	6.4	7 ml	4
P.C	6.8	10 mL	9
M.F	6.8	10 mL	10

Table 5. Results of electronic cigarette smoker patients after CBD

For statistical processing of the results obtained in the experiment, we used IBM SPSS Statistics software for Windows, Version 26.0. Armonk, NY: IBM Corp. Continuous variables were presented as mean value and standard deviation. Categorical variables were expressed as absolute frequency and percentage. Comparison of means between paired samples was possible using the Wilcoxon test, as the variables were not normally distributed and had a very small sample size. We used cross-tabulation and the $\chi 2$ (chi-square) test for analysing associations between categorical variables. Fisher's exact test was also used for those results of the chi-square test that were significantly altered, thus making a proper analysis impossible. Comparison of parameters between groups was done using the Kruskal-Wallis H test. A significance level of $p<0.05$ was considered statistically significant.

Among the descriptive statistics characteristics, we can acknowledge that:

- The mean is the number resulting from dividing the sum of several quantities by their number;
- The standard deviation is the most well-known and commonly used measure of data variability;

The salivary pH values

The salivary pH values are observed to have an average of 6.68 for non-smokers, an average of 6.85 for conventional cigarette smokers, and an average of 6.88 for electronic cigarette smokers. The salivary pH values deviate from the average by plus or minus 0.19 within the non-smoker group, by 0.62 in the case of conventional cigarette smokers, and by 0.56 among electronic cigarette smokers [Table 6]. We began comparing the mean salivary pH values among the three groups using the Kruskal-Wallis test. The results indicated the absence of significant differences in the mean salivary pH values among the three groups (p=0.726) [Table 7].

Salivary pH Value	N	The average	Standard deviation
Non-smokers	7	6.686	.1952
Conventional cigarette smokers	7	6.857	.6294
Electronic cigarette smokers	7	6.886	.5640
Total	21	6.810	.4836

Table 6. Salivary pH Value

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Results of the Kruskal-Wallis test

	Salivary pH Value
Kruskal-Wallis H	1,634
df	2
p	,442

Table 7. Results of the Kruskal-Wallis test for salivary pH value

Stimulated Saliva Quantity (ml)

Analysing the sample based on the volume of stimulated saliva, it is observed that the mean value was 7.78 ml for non-smokers, 9.14 ml for conventional cigarette smokers, and 8.57 ml for electronic cigarette smokers [Table 8]. No significant differences were found between the mean values of stimulated saliva volume among the groups.

Stimulated Saliva Volume (ml)	N	The average	Standard deviation
Non-smokers	7	7.786	1.2864
Conventional cigarette smokers	7	9.143	2.3401
Electronic cigarette smokers	7	8.571	1.3973
Total	21	8.500	1.7464

Table 8. Stimulated Saliva Volume (ml)

Results of the Kruskal-Wallis Test

	Stimulated Saliva Volume (ml)
Kruskal-Wallis H	1,722
df	2
p	,423

Table 9. Results of the Kruskal-Wallis test for the amount of stimulated saliva (ml)

Buffering Capacity of Stimulated Saliva

The average level of buffer capacity of stimulated saliva was 8.42 among smokers, 8.71 among conventional cigarette smokers, and 8.42 among electronic cigarette smokers [Table 10]. Since the significance threshold value is greater than 0.05, it indicates that there are no significant differences between groups regarding the buffer capacity of stimulated saliva.

The buffer capacity of stimulated saliva	N	The average	Standard deviation
Non-smokers	7	8.429	1.2724
Conventional cigarette smokers	7	8.714	2.4976
Electronic cigarette smokers	7	8.429	3.3094
Total	21	8.524	2.3795

Table 10. Buffer Capacity of Stimulated Saliva

Results of the Kruskal-Wallis Test

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	Buffering capacity of stimulated saliva
Kruskal-Wallis H	,763
df	2
p	,683

Table 11. Kruskal-Wallis Test Results for Stimulated Saliva Buffering Capacity

The salivary pH value after CBD

It is observed that the salivary pH values after CBD are at an average of 6.68 for non-smokers, 6.91 for conventional cigarette smokers, and 6.82 for e-cigarette smokers [Table 12]. The salivary pH values after CBD deviate from the average by plus or minus 0.19 within the non-smokers group, by 0.63 in the case of conventional cigarette smokers, and by 0.48 among e-cigarette smokers. We began comparing the average pH values of salivary pH among the 3 groups using the Kruskal-Wallis test. The results indicated no significant differences in the average salivary pH values after CBD among the 3 groups (p=0.545) [Table 13].

The salivary pH value after CBD	N	The average	Standard deviation
Non-smokers	7	6.686	.1952
Conventional cigarette smokers	7	6.914	.6309
Electronic cigarette smokers	7	6.829	.4821
Total	21	6.810	.4582

Table 12. Salivary pH Value after CBD

Kruskal-Wallis Test Results

	Buffering Capacity of Stimulated Saliva
Kruskal-Wallis H	,763
df	2
p	,683

Table 13. Kruskal-Wallis Test Results for Salivary pH Value after CBD

Stimulated Saliva Quantity after CBD

Analysing the sample in terms of stimulated saliva quantity after CBD, it is observed that the average value was 7.78 ml for non-smokers, 9.14 ml for conventional cigarette smokers, and 8.42 ml for electronic cigarette smokers [Table 14]. No significant differences were found in the average values of stimulated saliva quantity after CBD between groups.

Stimulated Saliva Quantity after CBD	N	The average	Standard deviation
Non-smokers	7	7.786	1.2864
Conventional cigarette smokers	7	9.143	2.1931
Electronic cigarette smokers	7	8.429	1.2724
Total	21	8.452	1.6576

Table 14. Stimulated Saliva Quantity after CBD

Kruskal-Wallis Test Results

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	Buffering Capacity of Stimulated Saliva
Kruskal-Wallis H	2,084
df	2
p	,353

Table 15. Kruskal-Wallis Test Results for Stimulated Saliva Quantity after CBD

Buffering capacity of stimulated saliva after CBD

The average buffering capacity of stimulated saliva after CBD was 8.42 for smokers, 8.14 for conventional cigarette smokers, and 8.14 for conventional cigarette smokers [Table 16]. Since the significance threshold value is greater than 0.05, it follows that there are no significant differences between groups regarding the buffering capacity of stimulated saliva after CBD.

Buffering capacity of stimulated saliva after CBD	N	The average	Standard deviation
Non-smokers	7	8.429	1.2724
Conventional cigarette smokers	7	8.143	1.3452
Electronic cigarette smokers	7	8.143	2.7946
Total	21	8.238	1.8413

Table 16. Buffering Capacity of Stimulated Saliva after CBD

Kruskal-Wallis Test Results

	Buffering Capacity of Stimulated Saliva after CBD
Kruskal-Wallis H	,117
df	2
p	,943

Table 17. Kruskal-Wallis Test Results for Buffering Capacity of Stimulated Saliva after CBD

Comparative Salivary pH Value between Initial and Post-Use of CBD Electronic Cigarettes

At the initial assessment, the average salivary pH value for conventional cigarette smokers was 6.85, which increased to 6.91 post-use of CBD cigarettes [Table 18]. For electronic cigarette smokers, the initial average salivary pH value was 6.88, which decreased to 6.82 post-use of CBD cigarettes. To determine if there was a significant change in salivary pH after using CBD cigarettes, we used the Wilcoxon test. The results indicate that the evolution of salivary pH was not statistically significant for any of the groups [Table 19].

Statistics for Paired Samples

Group			The average	N	Standard deviation	Mean standard error
smokers of conventional cigarettes	Pair 1	Salivary pH value	6.857	7	.6294	.2379
		Salivary pH value after CBD	6.914	7	.6309	.2385
Electronic cigarette smokers	Pair 1	Salivary pH value	6.886	7	.5640	.2132
		Salivary pH value after CBD	6.829	7	.4821	.1822

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Table 18. Statistics for paired samples

Wilcoxon test results

Group		The salivary pH value after CBD - The salivary pH value
smokers of conventional cigarettes	Z	-,425
	p	,671
electronic cigarette smokers	Z	-,318
	p	,750

Table 19. Wilcoxon test results for salivary pH value after CBD - Salivary pH value

The stimulated saliva quantity (ml) compared between the initial moment and after using CBD-containing electronic cigarettes.

The stimulated saliva quantity, in the case of conventional cigarette smokers, remained constant at the two measurement moments, initially and after using CBD cigarettes [Table 20]. For electronic cigarette smokers, the stimulated saliva quantity changed from 8.57 ml initially to 8.43 ml after using CBD cigarettes [Table 20]. As observed, there were no statistically significant differences between the two moments for either group.

Statistics for Paired Samples

Group			The average	N	Standard deviation	Mean standard error
smokers of conventional cigarettes	Pair 1	Stimulated saliva quantity (ml)	9.143	7	2.3401	.8845
		Stimulated saliva quantity after CBD	9.143	7	2.1931	.8289
Electronic cigarette smokers	Pair 1	Stimulated saliva quantity (ml)	8.571	7	1.3973	.5281
		Stimulated saliva quantity after CBD	8.429	7	1.2724	.4809

Table 20. Statistics for paired samples

Wilcoxon test results

Group		Stimulated saliva quantity after CBD - Stimulated saliva quantity (ml)
smokers of conventional cigarettes	Z	,000
	p	1,000
electronic cigarette smokers	Z	-,378
	p	,705

Table 21. Wilcoxon test results for stimulated saliva quantity after CBD - Stimulated saliva quantity (ml)

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Buffering capacity of stimulated saliva compared between initial and after use of CBD-containing electronic cigarettes

The mean buffering capacity of stimulated saliva at the initial assessment was 8.71 for conventional cigarette smokers and 8.43 for electronic cigarette smokers. After using cannabidiol cigarettes, the mean value reached 8.14 for both conventional cigarette smokers and electronic cigarette smokers [Table 22]. The differences are not statistically significant.

Statistics for paired samples

Group			The average	N	Standard deviation	Mean standard error
smokers of conventional cigarettes	Pair 1	Buffering capacity of stimulated saliva	8.714	7	2.4976	.9440
		Buffering capacity of stimulated saliva after CBD	8.143	7	1.3452	.5084
Electronic cigarette smokers	Pair 1	Buffering capacity of stimulated saliva	8.429	7	3.3094	1.2509
		Buffering capacity of stimulated saliva after CBD	8.143	7	2.7946	1.0562

Table 22. Statistics for paired samples

Wilcoxon test results

Gorup		Buffering capacity of stimulated saliva after CBD - Buffering capacity of stimulated saliva
smokers of conventional cigarettes	Z	-1,081
	p	,279
Electronic cigarette smokers	Z	-,541
	p	,589

Table 23. Wilcoxon test results for buffering capacity of stimulated saliva after CBD - Buffering capacity of stimulated saliva

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In achieving the research objectives, we utilized data from a total of 21 subjects: 7 non-smokers, 7 conventional cigarette smokers, and 7 electronic cigarette smokers. The statistical tools used in data processing included descriptive statistical analysis, the Wilcoxon test, the Kruskal-Wallis test, and the $\chi 2$ (chi-square) test.

The results obtained helped us conclude the following:

There are no significant differences observed in terms of salivary pH among the three subject categories (non-smokers, conventional cigarette smokers, and electronic cigarette smokers), contrary to studies demonstrating a more acidic pH in smokers compared to non-smokers [21] [22]. Similarly, no significant differences were found between the mean values of stimulated saliva quantity among groups, consistent with the results of other studies [23].

There are no significant differences between groups regarding the buffering capacity of stimulated saliva. According to other research, smokers have lower buffering capacity of stimulated saliva compared to non-smokers, with a correlation observed between this value and pH [21] [23].

The results indicated the absence of significant differences in the mean salivary pH values after CBD among the three groups. In literature, it has been found that CBD is present in very low concentrations, thus it cannot constitute a major alteration in analyses [24].

There were no significant differences found in the mean values of stimulated saliva quantity after CBD between groups. Studies demonstrate [25]. There are no significant differences between groups regarding the buffering capacity of stimulated saliva after CBD, confirming the limited implication of CBD in saliva [25]. The evolution of salivary pH after using CBD cigarettes was not statistically significant for any of the groups, as also demonstrated in other studies [25]. The differences were not statistically significant between the two time points for any of the groups in terms of the quantity of stimulated saliva. It has been demonstrated that CBD does not interfere with the quantity of stimulated saliva [25];

The average buffering capacity of stimulated saliva at the initial assessment was 8.71 for conventional cigarette smokers and 8.43 for electronic cigarette smokers. After using CBD cigarettes, the average value reached 8.14 for both conventional cigarette smokers and electronic cigarette smokers. The differences are not statistically significant, a fact also confirmed in other research [25]; All conventional cigarette smokers consider smoking to calm them in stressful situations, and among electronic cigarette smokers, 85.7% share the same view. Numerous studies have demonstrated a correlation between smoking and stress [26] [27]. A higher percentage of electronic cigarette smokers (71.4%) want to quit smoking, while only 42.9% of conventional cigarette smokers stated they want to quit smoking. The percentage is similar to other statistics from specialized studies [28] [29].

The proportion of those who chose to use electronic cigarettes to help quit smoking is identical in both groups of smokers (57.1) and this subject has been extensively studied in other specialized studies [30].

A lot of conventional cigarette smokers prefer electronic cigarettes containing nicotine, while among electronic cigarette smokers, 85.7% prefer those containing nicotine. In the literature, electronic cigarette users have been classified into several types based on their preference for nicotine-based or non-nicotine-based products [31].

The difference between the two groups regarding the opinion that electronic

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cigarettes are a less harmful alternative is statistically significant. These results corroborate data obtained in other studies investigating the population's perception regarding electronic cigarette use and awareness of their harmful effects [32] [33].

Among conventional cigarette smokers, 28.6% state that using CBD-containing electronic cigarettes has helped them relax, while among electronic cigarette smokers, 57.1% share the same opinion. The obtained results are consistent with those of a thoroughly studied research. Some individuals claim the utility of CBD in anxiety, insomnia, stress, etc. [34].

None of the surveyed subjects reported observing mucosal lesions after using CBD-containing electronic cigarettes. Some studies have reported cases of lung lesions (pneumothorax) and oral cavity lesions following the use of CBD-containing electronic cigarettes [35] [36].

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