Original Article

The Effect of Chamomile and Fenugreek on Smear Layer When Used as RCI: Scanning Electron Microscope

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Abstract

In this in vitro study, our aims to determine the effect of Matricaria chamomilla Fam. Astraceae and the Trigonella foenum graecum L. Fam. Leguminosae (Chamomile and Fenugreek) on smear layer when used as root canal irrigants. This study was in vitro in Saudi Arabia. The least possible sample size to achieve an accuracy of 5% marginal error with a 95% confidence level. Five specimens from each group. Each specimen was sputter-coated with gold and examined under a scanning electron microscope. The root canal of each specimen was examined by using 2000X magnification. The photographs were qualitatively evaluated for the degree of cleansing and the presence or absence of the smear layer using image analysis software SPSS 27 used for data entry and data analysis. The Quantitative evaluation of the smear layer present on the root canal walls showed the following: on comparison between the two herbs the mean smear layer % present, it was found that: At the apical segment, there was no statistically significant difference between Fenugreek (98±2.6) and Chamomile (93.1±5.6). In the middle segment, Fenugreek (41.5±10.4) showed statistically significantly higher mean smear layer % than Chamomile (5.2±0.8). At the coronal segment, there was no statistically significant difference between Fenugreek (12.7±4.1) and Chamomile (6.2±0.4). Our study concluded the Matricaria chamomilla fraction of 2% could be used instead of sodium hypochlorite as a natural irrigant in the root canal due to its effect on the smear layer removal as it showed a higher effect than the sodium hypochlorite.

Keywords: Chamomile, Fenugreek, Root canal irrigants, Smear layer.

Introduction

Complete debridement of the root canal system is the main goal of endodontic therapy to accomplish we use chemo-mechanical debridement of the root canal this is achieved through 3D shaping, cleaning, and efficient obturation with sufficient sealing [1]. Because the root canal system is so complicated and diverse, we haven't been able to consistently clean and disinfect it. Nearly all root canal shaping is done with the use of manual and rotary instrumentation techniques [2]. Both organic and inorganic components can be found in the smear layer. It has been advised to remove the smear layer since it can include a combination of germs and their by-products [3]. Additionally, it may inhibit the tight adaptation and adhesion of sealer cement onto canal walls as well as the entry of irrigants and intracanal medications into the dentinal tubules [4]. Sodium-Hypochlorite (NaOCl), chlorhexidine, ethylene-diaminete-traacetic-acid (EDTA), and a combination of tetracycline, an acid, and a detergent (MTAD) are all examples of commonly used irritants [5]. These chemical irrigants may lead to many harmful accidents during treatment such as damage to clothing, damage to the eye, allergy, hematoma, ecchymosis, swelling, and nerve damage. Recently, herbal medicine referred to as Herbalism or Botanical Medicine has developed. Depends on the use of herbal extracts in dental and medical practice due to their high antimicrobial activity, biocompatibility, and anti-inflammatory and antioxidant properties [5, 6]. Every living organism generates a wide variety of chemical compounds known as natural products. Carbohydrates, proteins, and lipids are examples of primary metabolites, which are organic compounds that are present in all living things [7]. Thus, many of the chemical components of primary metabolites may be found in all plants that are used

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as medicine (e.g. amino acids, common sugars such as glucose and fatty acids) [8]. Plants also create additional chemicals with a more limited distribution in addition to primary metabolites; these are collectively referred to as secondary metabolites [9]. Whatever their functions within plants, several of them have pharmacological effects that have been used to create pharmaceuticals. Alkaloids, which contain a secondary or tertiary amine function within a heterocyclic ring, Glycosides, which are composed of an aglycone (non-sugar part) and a sugar part, Phenols, in which many of the aromatic components of plants contain hydroxyl substituents that are phenolic, Terpenes, Flavonoids, and Tannins, are among the most common secondary metabolites [10]. Fenugreek, which has a long history of medical applications in Chinese medicine and has been used for a variety of medical purposes, is an example of a medicinal plant that is employed [11]. Fenugreek is useful as an antibacterial and anti-inflammatory agent. Mucilage, which is renowned for calming and relaxing inflamed tissues, is present in fenugreek. As mucosal fluids are produced more readily as a result of fenugreek, allergens and poisons are more easily removed from the respiratory system [12]. The German chamomile, often known as camomile, is another herb that is employed. It is an annual plant in the Asteraceae family [13]. This plant is well known for its capacity to be processed into tea, which is frequently served with either honey or lemon and is typically used as a sedative. The primary chemical components of German chamomile are coumarins, flavonoids, and volatile oils. It is used medicinally to treat irritable bowel syndrome, painful stomach, and other conditions. It also has moderate laxative, anti-inflammatory, and antibacterial properties. In vitro tests have shown that chamomile possesses antibacterial, antioxidant, and perhaps anti-cancer effects [14]. In 2006, a study was done by [15] aimed to compare the cleaning effectiveness of chamomile hydroalcoholic extract and tea tree oil to 2.5% sodium hypochlorite (NaOCl) solution as an intracanal irrigant for the removal of the smear layer. Results showed that the most effective removal of smear layer occurred with the use of NaOCl with a final rinse of 17% EDTA (negative control) followed by the use of a chamomile extract. Chamomile extract was found to be significantly more effective than distilled water and tea tree oil ($P < 0.008$). The use of a 2.5% NaOCl solution alone, without EDTA and that of tea tree oil, was found to have only minor effects. There was no statistical differen between distilled water, 2.5% NaOCl and tea tree oil. It was concluded that the efficacy of chamomile to remove smear layer was superior to NaOCl alone but less than NaOCl combined with EDTA. In this study, our objective is to determine their effect of Matricaria chamomilla Fam. Astraceae and the Trigonella foenum-graecum L. Fam. Leguminosae (Chamomile and Fenugreek) on smear layer when used as root canal irrigants.

Materials and Methods

Plant Material

The seeds of (Trigonella foenum-graecum L.) Fam. Leguminosae was purchased from herbalist Haraz and flower heads of (Matricaria chamomilla L.) Fam. Asteraceae were collected from the Experimental Station of Medicinal and Aromatic Plants, Faculty of Pharmacy, King Abdulaziz University, Jeddah, KSA. The taxonomical features of the plants were kindly confirmed by the Faculty of Pharmacy.

Material for Biological Study

Plant Extracts

- Total extract of (Trigonella foenum-graecum L.) seeds and flower heads of (Matricaria chamomilla L.) were prepared by crushing 500g of each separately in an electric mill, then percolated in ethanol (70%) till exhaustion. Ethanol (70%) extracts were evaporated under reduced pressure to give 100, and 110-gram residues of (Trigonella foenum-graecum L.) and (Matricaria chamomilla L.) respectively. Five grams of Ethanol (70%) extracts of each plant were suspended in bi-distilled water containing Tween 80 for the anti-inflammatory activity and others containing DMF for the antimicrobial test then refrigerated for biological study.
- Ninety grams and one hundred grams of (Trigonella foenum-graecum L.) seeds and flower heads of (Matricaria chamomilla L.) were separately suspended respectively in double distilled water. The suspensions were separately partitioned successively between petroleum ether (5x400 ml), chloroform (5x400 ml), ethyl acetate (5x400 ml), and butanol (5x400 ml). Each fraction was concentrated to dryness under reduced pressure using a rotary evaporator to give petroleum ether (18%), chloroform (10%), ethyl acetate (30%), butanol (10%), and the remaining aqueous fractions (32%) for fenugreek and petroleum ether (20%), chloroform (5%), ethyl acetate (40%), butanol (5%) and the remaining aqueous fractions (30%) for chamomile. These fractions were refrigerated for biological study and endodontic irrigation Percentage of yield extract of each plant:

Trigonella Foenum-Graecum L

Weight of dried plant parts**:** 500mg
Weight of total yield extract: **20%**

Matricaria Chamomilla L.

Weight of dried plant parts**:** 500mg
Weight of total yield extract: **22%**

Methods

Teeth Selection

Eighty freshly-extracted, single-canalled, human teeth with straight, completely- formed roots were selected for this study. The collected teeth had no visible cracks or caries. The teeth were soaked in 5.25% NaOCl solution for ten minutes before the removal of soft tissue remnants on the root surface, then washed with tap water to remove any soft tissue tags followed by proper scaling to remove any calculus deposits or bone. Teeth were then stored in normal saline at room temperature to avoid dehydration.

Specimens' Preparation

For standardization decoronation of the specimens 2 mm coronal to the cervical line, was done using a diamond disc to obtain specimens of 17 mm. Size# 15 K-type file* was inserted into the canal until the tip was just visible at the apical foramen. The length of the file was measured and 1 mm was subtracted from this length to establish the working length. *(Dentsply Maillefer, Ballaigues, Switzerland)

Irrigants Preparation

1. For Chamomile and Fenugreek, we put 2g of each plant extract on 100ml of distilled water containing a few drops of DMF to obtain irrigant with a concentration of 2% and 1g of each plant extract to obtain irrigant with a concentration of 1%.
2. For chlorhexidine 1% it was prepared by dilution of 100ml of chlorhexidine 2% with 100ml of distilled water.
3. For sodium hypochlorite 1% it was prepared by dilution of 19.04ml of 5.25% of NaOCl with 80.96 ml of distilled water.

Classification of the Samples

The eighty samples were randomly divided into eight main groups with ten teeth per group.
Group 1: irrigated with chamomile 2%
Group 2: irrigated with fenugreek 2%
Group 3: irrigated with sodium hypochlorite 2% Group 4: irrigated with chlorhexidine 2%
Group 5: irrigated with chamomile 1% + chlorhexidine 1%
Group 6: irrigated with chamomile 1% + sodium hypochlorite 1% Group 7: irrigated with fenugreek 1% + chlorhexidine 1%
Group 8: irrigated with fenugreek 1% + sodium hypochlorite 1%.

Instrumentation of Root Canals

All the samples were instrumented using "Crown-Down pressure less preparation" or "step-down technique" which was introduced by Marshall [16].

The preparation was carried out in two steps:

- #### Coronal and Middle Thirds Preparation

The coronal and middle thirds of the canal were first flared using progressively smaller Gates Glidden drills* (#3 and #2) accompanied by 2ml irrigation of tested irrigant solution according to each group followed by final flushing with 20 ml of distilled water using 30- gauge irrigation needle.

- #### Apical Preparation

Starting with size #35 K-file and working down the canal to size #15 K-file, the files were used in a watch-winding motion (back-and-forth oscillation movement of the file i.e. 30 to 60 degrees as the file was pushed forward into the canal) until the working length was reached.

When resistance was met to further penetration, the next smaller size was used to properly enlarge the apical third; a reverse order of the files was then used. Successively larger files were used until the #35 K-file reached the full working depth. Final smoothening of the walls and perfection of the flaring shape was accomplished with size #35-K file. Stainless-Steel K-file size from (15 to 35) and Gates-Glidden drills size (#2 and #3) were used in this study up to five times each.

Moreover, for the apical third irrigation was done with 2 ml of the tested irrigating solution at each change of instrument followed by final flushing with 20 ml of distilled water. A little amount of sticky wax was placed on the apex of each root to prevent the loss of solution through the apical foramen during irrigation.

Two longitudinal grooves were made on the facial and lingual surfaces of the roots using a fine diamond disc mounted on a low-speed handpiece with water spray coolant to facilitate their future splitting. To avoid creating artificial debris, the disc was not allowed to penetrate the canal space.

Methods of Evaluation

Scanning Electron Microscopic Evaluation

Five specimens from each group were examined and photographed under the scanning electron microscope (SEM)*. Each specimen was sputter-coated with gold and examined under a scanning electron microscope at 30 kV. The root canal of each specimen was examined at the coronal, middle, and apical levels using 2000X magnification. The photographs were qualitatively evaluated for the degree of cleansing and the presence or absence of the smear layer using image analysis software (Image-J 1.43U National Institute of Health, USA).

Statistical Analysis

All values of biological screening were expressed as the mean standard error of the mean (SEM) for control and experimental animals. Each mean represented 7 animals. The statistical significance of values between groups was analyzed using one-way ANOVA (Analysis of Variance) followed by the Tukey-Kramer multiple comparison test. Data were presented as mean and standard deviation (SD) values. Student's t-test was used for comparisons between the two groups. One-way ANOVA was used for comparisons between more than two groups. Tukey's post-hoc test was used for pair-wise comparison between the groups when the ANOVA test is significant. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with PASW Statistics 18.0® (Predictive Analytics Software) for

Windows. Repeated measures ANOVA was used to study the changes by time in mean edema thickness.

Results and Discussion

The total extract fraction of Matricaria chamomilla L. (most potent fractions) was chosen to be used as a natural irrigant which was used for the smear layer test during the endodontic treatment in teeth and the following are the SEM results:

1-Quantitative evaluation of the smear layer present on the root canal walls showed the following:

- *Comparison between the two herbs* **(Table 1)**

On comparing the mean smear layer % present it was found that:

- At the apical segment, there was no statistically significant difference between Fenugreek (98±2.6) and Chamomile (93.1±5.6).
- In the middle segment, Fenugreek (41.5±10.4) showed statistically significantly higher mean smear layer % than Chamomile (5.2±0.8).
- At the coronal segment, there was no statistically significant difference between Fenugreek (12.7±4.1) and Chamomile (6.2±0.4).

Table 1. The mean, standard deviation (SD) values, and results of comparison between smear layer % after using the two herbs.

Herb / Segment	Chamomile		Fenugreek		P-value
	Mean	SD	Mean	SD	
Apical	93.1	5.6	98	2.6	0.846
Middle	5.2	0.8	41.5	10.4	<0.001*
Coronal	6.2	0.4	12.7	4.1	0.070

*: Significant at $P \leq 0.05$

- *Comparison between the Two Irrigants*

When using the two irrigants (NaOCl, CHX) without any herbal irrigants:

- At the apical segment, there was no statistically significant difference between NaOCl (94.7±4) and CHX (99.9±0.1).
- At the middle segment, CHX (91.1±0) showed statistically significantly higher mean smear layer % than NaOCl (8.1±2.5)
- At the coronal segment, there was no statistically significant difference between NaOCl (7.6±2.4) and CHX (18.1±4.5).

- *Comparison between (Chamomile +NaOCl) and (Chamomile+CHX)*

When using two irrigants (NaOCl, CHX) with Chamomile:

4. At the apical segment, there was no statistically significant difference between Chamomile +NaOCl (94.6±6.1) and Chamomile +CHX (95.7±3.3).
5. In the middle segment, Chamomile+ CHX (24.3±9.7) showed statistically significantly higher mean smear layer % than Chamomile +NaOCl (6.9±1.3).
6. At the coronal segment, there was no statistically significant difference between Chamomile +NaOCl (6.1±0.5) and Chamomile +CHX (9.2±1.7).

- *Comparison between (Fenugreek +NaOCL) and (Fenugreek+CHX)*

When using two irrigants (NaOCl, CHX) with Fenugreek:

- At the apical segment, there was no statistically significant difference between Fenugreek+ NaOCl (96.9±0.9) and Fenugreek +CHX (98.9±0.7).
- In the middle segment, Fenugreek+ CHX (72.6±17.1) showed statistically significantly higher mean smear layer % than Fenugreek+ NaOCl (33.4±8.8).
- At the coronal segment, there was no statistically significant difference between Fenugreek+ NaOCl (12.3±2.1) and Fenugreek+ CHX (15.8±6.5).

Comparison between all groups

- **Apical segment**: **Table 2**

In the apical segment, there was no statistically significant difference between all groups.

Table 2. The mean, standard deviation (SD) values, and results of comparison between smear layer % in all groups at the apical segment.

Group	Mean	SD	*P*-value
CHX + Chamomile	95.7	3.3	0.319
NaOCl + Chamomile	94.6	6.1	
Total extract of Chamomile	93.1	5.6	
CHX	99.9	0.1	
CHX + Fenugreek	98.9	0.7	
NaOCl + Fenugreek	96.9	0.9	
Ethyl acetate of Fenugreek	98	2.6	
NaOCl	94.7	4	

*: Significant at $P \leq 0.05$

- **Middle segment: Table 3** In the middle segment, CHX showed the statistically significantly highest mean smear layer % (91.1±0).

This was followed by CHX +Fenugreek (72.6±17.1).

There was no statistically significant difference between NaOCL+Fenugreek (33.4±8.8) and Fenugreek (41.5±10.4).

This was followed by CHX+ Chamomile (24.3±9.7).

There was no statistically significant difference between NaOCl (8.1±2.5), NaOCl +Chamomile (6.9±1.3), and

Chamomile (5.2±0.8); all showed the statistically significantly lowest mean smear layer % values.

Table 3. The mean, standard deviation (SD) values, and results of comparison between smear layer % in all groups at the middle segment.

Group	Mean	SD	Rank	P-value
CHX + Chamomile	24.3	9.7	D	0.003*
NaOCl + Chamomile	6.9	1.3	E	
Total extract of Chamomile	5.2	0.8	E	
CHX	91.1	0	A	
CHX + Fenugreek	72.6	17.1	B	
NaOCl + Fenugreek	33.4	8.8	C	
Ethyl acetate of Fenugreek	41.5	10.4	C	
NaOCl	8.1	2.5	E	

*: Significant at P ≤ 0.05, which Means with different letters are statistically significantly different according to Tukey's test.

- **Coronal segment: Table 4** and **Figure 1**

In the coronal segment, there was no statistically significant difference between all groups.

Table 4. The mean, standard deviation (SD) values and results of comparison between smear layer % in all groups at the coronal segment.

Group	Mean	SD	P-value
CHX + Chamomile	9.2	1.7	0.391
NaOCl + Chamomile	6.1	0.5	
Total extract of Chamomile	6.2	0.4	
CHX	18.1	4.5	
CHX + Fenugreek	15.8	6.5	
NaOCl + Fenugreek	12.3	2.1	
Ethyl acetate of Fenugreek	12.7	4.1	
NaOCl	7.6	2.4	

*: Significant at P ≤ 0.05

Qualitative Evaluation of the Smear Layer Present on the Root Canal Walls Showed the Following

All figures are showing heavy smear layers and debris covering the dentinal tubule walls with almost no opened dentinal tubules.

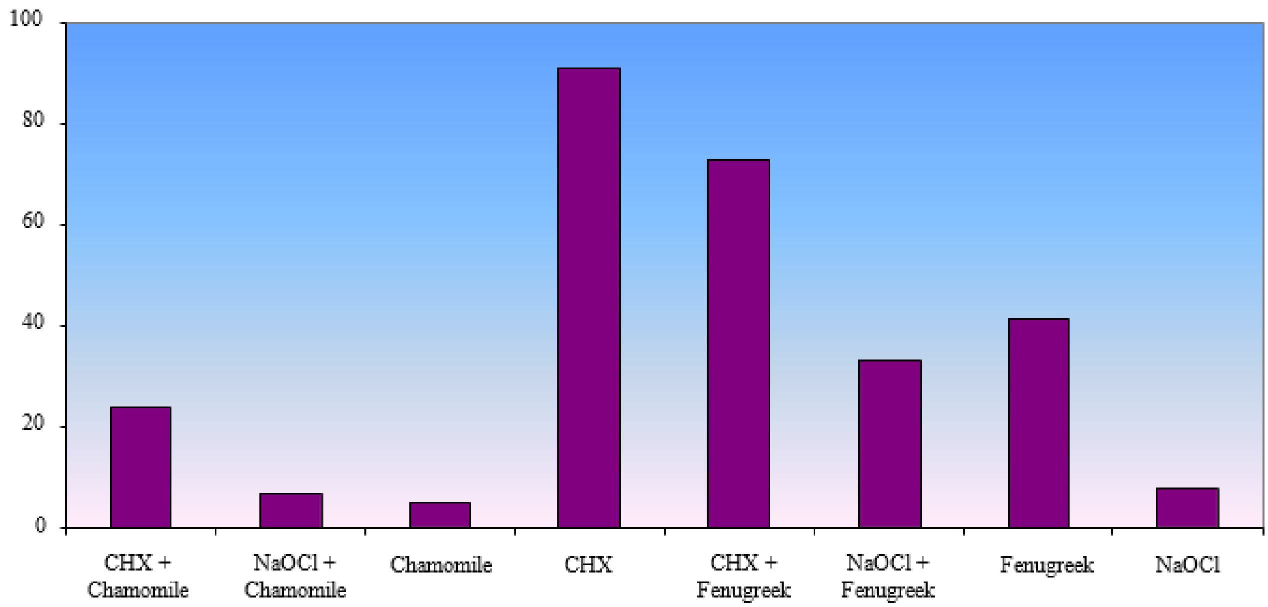

Figure 1. Scanning electronic microscopy images illustrating the cleaning of the root canal dentin walls in the apical third after biomechanical preparation with different irrigants. a) Chamomile +CHX liquid. b) Fenugreek + CHX liquid. c) Fenugreek + Sodium hypochlorite liquid. d) Chamomile + Sodium hypochlorite liquid.

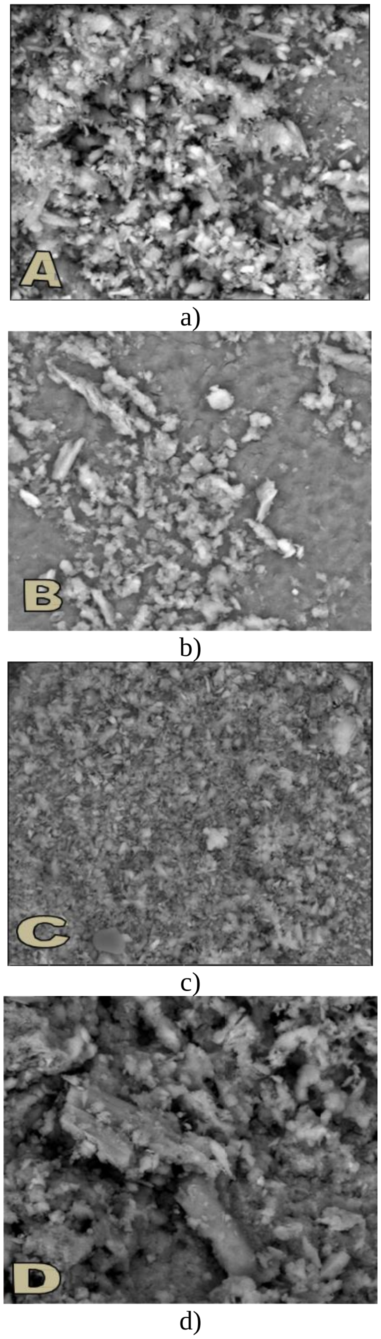

Figure 2. Scanning electronic microscopy images illustrating the cleaning of the root canal dentin walls in the apical third after biomechanical preparation with different irrigants a) Chamomile +CHX liquid. b) Fenugreek + CHX liquid. c) Fenugreek + Sodium hypochlorite liquid. d) Chamomile + Sodium hypochlorite liquid.

All figures are showing heavy smear layers and debris covering the dentinal tubule walls with almost no opened dentinal tubules.

Figures (a) and (d) are showing a moderate number of dentinal tubules covered by a mild smear layer and a mild amount of debris. Figure (b) is showing a little number of dentinal tubules covered by a large smear layer and heavy debris. Figure (c) is showing little dentinal tubules covered by a moderate smear layer and debris.

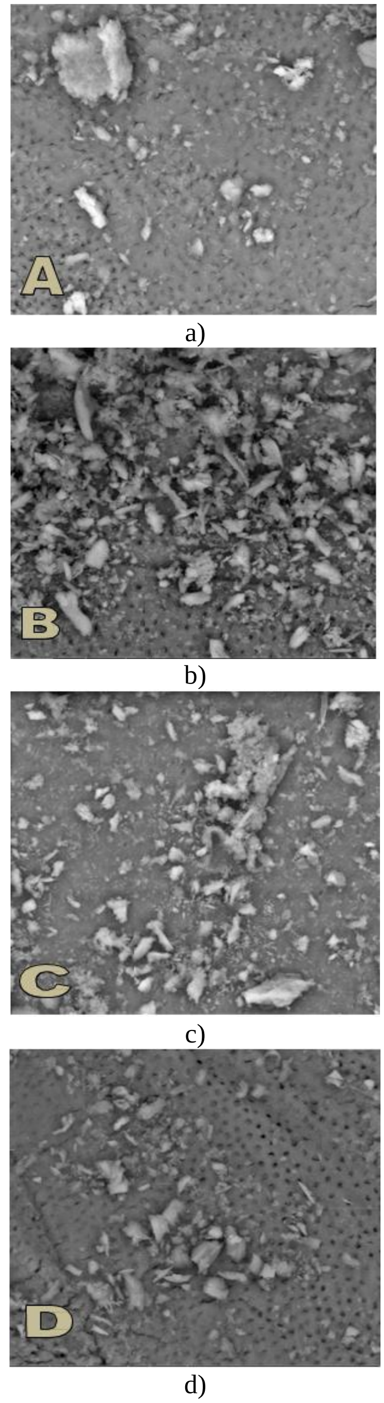

Figure 3. Scanning electronic microscopy images illustrating the cleaning of the root canal dentin walls in the middle third after biomechanical preparation with different irrigants a) Chamomile liquid. b) Chlorhexidine liquid. c) Fenugreek liquid. d) Sodium hypochlorite liquid.

Figure (a) is showing little dentinal tubules covered by a large smear layer and debris, Figure (b) is showing a moderate number of dentinal tubules covered by a mild smear layer and debris, Figure (c) is showing a moderate number of dentinal tubules number covered by a large smear layer and debris, Figure (d) is showing heavy smear layer and debris covering dentinal tubules with tubules.

Endodontic therapy involves cleaning, shaping, and decontamination of the hollows with tiny files and irrigating solutions then obturation with a filling. The most frequently used irrigants are sodium hypochlorite, ethylenediaminetetraacetic acid (EDTA), Hydrogen peroxide, Chlorhexidine, and others which are considered chemical irritants however they have harmful effects (swelling, ecchymosis, burning sensation, paralysis of muscles [17]. Therefore, we chose to study alternative substances derived from plant origin (Trigonella foenum-graecum L. and Matricaria recutita L.) to reduce the harmful effects of the chemical irrigants as possible. The smear layer has been described as being formed during instrumentation and composed mostly of inorganic particles and some organic materials [18]. There is still a controversy about the influence of the smear layer on the outcome of endodontic treatment. Some authors believe that the presence of the smear layer may reduce the permeability of dentin and prevent bacterial penetration into the underlying dentinal tubules [19]. Others consider that the smear layer can prevent the penetration of irrigants and medications from gaining access to the infected dentinal tubules, and may also present an obstacle to the complete sealing of the root canal [20]. In addition, an infected smear layer, containing bacteria and necrotic tissue, may act as a substrate for bacteria, letting them penetrate deeper into the dentinal tubules [21]. Generally, it is still considered to be desirable to remove the smear layer, because of its potential deleterious effects. In this study, matched pairs of single-canalled teeth were used to eliminate as many variations as possible in root canal size, shape, or length between the studied groups [22]. Decoronation of the specimens 2 mm coronal to the level of the cervical line was also done to minimize access cavity variations that may occur during root canal instrumentation [23]. Longitudinal sectioning was used in this study to exclude the possibility of the occurrence of artificial debris and/or loss of original debris that could occur during cross-sectioning. For the same reason, the disc was not allowed to penetrate the canal space during longitudinal grooving [23, 24]. Apical foramina were sealed with sticky wax to simulate the clinical conditions of the periapical tissue as well as to prevent the escape of irrigating solutions during irrigation [25]. In this study, preparation was done 1 mm shorter than the W.L. to decrease the amount of extruded debris and irrigant in agreement with [26]. The 30-gauge irrigation needle was employed to coincide with the apical preparation size 35 file which has been claimed to be the minimum instrumentation size needed for the penetration of irrigants into the apical part of the root canal [27].

In the current study, we prepared the canal up to size 35. It has been reported that a gauge irrigation needle thinner than the diameter of the prepared canal was more effective than a larger gauge for deeper penetration and consequently removing more debris from the apical part [28]. Equal amounts volumes of 2 ml of irrigating solutions were used followed by flushing with 20 ml of distilled water to stop any further solvent action. The duration of exposure to irrigating solutions was selected based on studies that were done by other investigators [29]. In this study, an Environmental Scanning electron microscope was used to evaluate the cleanliness (Debris and smear layer removal) of the coronal, middle, and apical thirds. The SEM was used for a detailed view and the assessment of smear layer removal. 2000X magnification was used because it offered a wider view and detailed image of the canal wall surfaces. It allowed for the identification of debris and smear layers as well as tubule orifices [30].

Image J software was adopted in the present study to quantify and analyze the percentages of debris in each canal. It seemed to provide a less subjective and more accurate method for evaluation, which in turn resulted in a more reliable comparison of the investigated irrigation systems [31, 32]. In this present study, we used either the plant material extract or the chemical irrigant alone and we mixed them in a concentration of 2% to take the benefits of both materials and check their efficiency in smear layer removal.

Regarding the results of the present study, the results of this study showed that all irrigants used for smear layer removal did not promote an adequate cleaning of the root canal with a variant degree of smear layer remaining adhered to the dentin walls. The cleaning effect of all irrigants was more pronounced in the coronal, middle thirds than in the apical parts of the root canals. This finding concurs with other studies [33]. The smaller diameter of the root canal and the consequent decrease in the flow of the irrigant is the most possible explanation. Chamomile showed the best effect in smear layer removal in this study; this may be attributed to the presence of acidic components in chamomile extract [15]. While NaOCL plus Chamomile was found to be less effective in smear layer removal and this may be due to the ineffectiveness of sodium hypochlorite in achieving thorough removal of debris. which corroborates with earlier studies by [33]. This also may be attributed to the possible interaction between both substances. An acid-base reaction could have occurred when chamomile extract and NaOCl were mixed, as chamomile extract contains some acidic components and NaOCl is alkaline. This is maybe similar to what occurs between NaOCl and chlorhexidine when mixed to form a neutral and insoluble precipitate [34]. Mahfouz *et al*. 2010, showed that when using chamomile + EDTA as a chelating agent in irrigation for dentin and smear layer removal, it showed better results which may be attributed to the use of EDTA which can dissolve inorganic dentin particles. while there was no statistically significant difference found between using chamomile +EDTA and Sodium hypochlorite + EDTA in removing the smear layer. The smear layer is composed of 70% inorganic particles produced during instrumentation [35]. EDTA acts upon the inorganic components of the smear layer in dentin and organic material in pulp and likely also in dentin. It dissolves more than 70% of the dentin and more than 51% of the pulp, while NaOCl is acting as an organic solvent having the capability of dissolving virtually the entire organic component of dentin causing its demineralization and removal [36]. Fenugreek showed better results than Chlorhexidine but less than Chamomile and sodium hypochlorite when each was used separately in removing the smear layer. However, this is maybe attributed to its chemical composition consisting of alkaloids and saponins [37]. Which may decrease the effect of flavonoids which are considered weak acids [38]. Chlorhexidine was found to be the worst irrigant to remove the smear layer among all the used irrigants scanning electron microscope pictures of Chlorhexidine showed the presence of a heavy smear layer, this is in accordance with [39]. Chlorhexidine as an irrigant has been shown to lower the number of postirrigant positive bacterial cultures, as well as the number of colony-forming units remaining in positive cultures [40]. Because of its cationic properties, chlorhexidine can bind to surfaces covered with acidic proteins, such as the hydroxyapatite component of dentin, and be released at therapeutic levels, a phenomenon known as substantivity [41]. However, in spite of being used as a long-lasting antimicrobial agent it lacks the tissue-dissolving property and has no ability to dissolve organic tissue [42]. This may give a possible explanation of the results of smear layer removal of samples irrigated with chlorhexidine in our study.

Conclusion

The purpose of this study was to determine the effect of Matricaria chamomilla Fam. Astraceae and the Trigonella foenum-graecum L. Fam. Leguminosae (Chamomile and Fenugreek) on smear layer when used as root canal irrigants. The total extract fraction of Matricaria chamomilla L. (most potent fractions) was chosen to be used as natural irrigants which were used for the smear layer test during the endodontic treatment in teeth. In comparison between all groups, there was no statistically significantly different between mean smear layer scores at the apical segment. At the middle segment, CHX showed the statistically significantly highest mean smear layer. This was followed by CHX +Fenugreek. There was no statistically significant difference between NaOCL+ Fenugreek and Fenugreek. This was followed by CHX+ Chamomile. There was no statistically significant difference between NaOCl, NaOCl +Chamomile, and Chamomile; all showed the statistically significantly lowest mean smear layer % values. In the coronal segment, there was no statistically significant difference between all groups. Under the limitations of this investigation, the following conclusions could be drawn: The Matricaria chamomilla fraction 2% could be used instead of sodium hypochlorite as a natural irrigant in the root canal due to its effect on the smear layer removal as it showed a higher effect than the sodium hypochlorite.

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