

## Impact of Chewing Cardamom and Fennel Seeds on Salivary Ph: A Hospital-Based Comparative Analysis

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### Abstract

**Objective:** To compare the changes in salivary pH by chewing fennel and cardamom seeds.

**Methods:** A factorial randomized controlled trial was conducted in the Department of Oral Diagnosis, Altamash Institute of Dental Medicine, Karachi during February-April 2022. Following trial registration with the clinical trial. gov. (NCT05245019) and IRB approval, 75 subjects attending the Altamash Institute of Dental medicine after informed consent were enrolled and randomized into three groups. Group X as controls, Group A for chewing fennel and Group B for cardamom seeds. Salivary samples from controls once and the other two groups at baseline and immediately after 5 minutes of seed chewing, were determined using calibrated pH meter. Required statistical tests were applied to evaluate the results using SPSS 26.

**Results:** The mean salivary pH at baseline, and after 5 minutes of chewing seeds were statistically different in groups A (before vs after, p-value<0.01) and B (before vs after, P<0.01 respectively). When we compared the pH for the three groups together (group X control, group A and group B both after seed chewing) the results were statistically significant (p<0.01). Further, after the use of seeds in group A vs group B, the increase in pH was statistically significant; (p< 0.001).

**Conclusion:** Cardamom and fennel seeds significantly rise the salivary pH when compared to controls. However, cardamom seeds have proven to increase more salivary pH than fennel.

**Keywords:** seeds, foeniculum, elettaria, saliva, hydrogen ion concentration, oral health.

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### Introduction

Dental cavities with caries are the most common infectious disease related to the oral cavity.<sup>1</sup> Although significant advances have been made on a global front to prevent caries, still studies show its incidence is on the rise making it one of the major chronic oral diseases affecting all age groups.<sup>2</sup> It largely affects

children and the lower socioeconomic groups hence demanding feasible and inexpensive ways to counter this growing ailment.

Dental caries is a multifactorial disease involving the interaction of the host, agent, and environment.<sup>3</sup> The primary etiologic agent implicated in dental caries is the streptococcus mutans and non-streptococcus species like Lactobacillus, Actinomyces, and Veillonella species.<sup>4</sup> These oral microbes break down carbohydrates content in the diet, producing acids as by-products. Cavities or dental caries are ultimately made worse by acid production because they cause demineralization of enamel and dentine, and lower the pH of plaque and saliva.<sup>5</sup>

The responsibility of saliva in maintaining oral health has been studied extensively over time. Saliva not only competes for a very important role in lubrication by flushing the oral cavity of food remains, and fighting

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off the invading microorganisms but also plays a major task in neutralizing the acids yielded by oral microorganisms.<sup>6</sup> The buffering capacity of saliva prevents the teeth from demineralization by maintaining the pH of the oral cavity thereby declining the possibility of dental caries.<sup>7,8</sup> Since ancient times, medicinal plants and herbs have been used for maintaining oral health. Recent studies have shown fennel seeds and cardamom to play a meaningful role in regulating the pH of saliva and plaque, and ultimately preventing dental caries.<sup>9</sup>

Cardamom (*Elettaria cardamomum*) is historically identified as the queen of spices. It is used as a flavouring agent in foods as well as for treating various cardiovascular, gastrointestinal, and neural problems. Fennel (*Foeniculum vulgare*) is a dry seed used in treating many ailments. Known for its anti-inflammatory, anti-spasmodic, and analgesic properties, it is also widely used for treating gastroenteritis and indigestion. It has been used as a breath freshener on its own and in several oral treatments for its antibacterial qualities over antiquity.<sup>10</sup>

Fennel and Cardamom are commonly used economical household ingredients that can affect oral pH, hence having an impact on oral pathogens. The present study was designed and conducted to evaluate the variations in salivary pH at baseline and after 5 minutes of chewing fennel and cardamom seeds. Secondly, to compare the pH changes after chewing fennel and cardamom seeds between both the groups. To the best of our knowledge this work with detailed comparison of two seed in respect to salivary pH has not been reported yet in any study with such prospective.

## Material and Method

A factorial randomized controlled trial with an allocation ratio of 1:1 was conducted in the Department of Oral Diagnosis, Altamash Institute of Dental Medicine, Karachi during February–April 2022. With the ethical approval for the study from the Ethical review committee, Altamash Institute of Dental Medicine (ERB/AIDM\_1, Dated: 12-01-2022) the trial was further registered with the clinical trial. gov. (NCT05245019). The sample size was calculated for a two-sample mean Satterthwaite's t-test using a reference article.<sup>14</sup> The estimated sample size evaluated was 22 with 11 patients in one group and was raised to 50 total with 25 patients per group. For control group X, an equal number of saliva samples were collected to evaluate the better comparison of the trial between the groups.

After voluntary informed consent, sampling was done in the dental clinic and individuals  $\geq 18$  years of any gender with complete dentate were included in the study. Subjects undergoing topical fluoride therapy, other chemotherapeutic procedures, antibiotics or drugs, also those suffering from any systemic diseases,<sup>14</sup> and individuals who were allergic or not willing to participate, were excluded from the study.

Following pilot testing on 5 samples, the main trial was carried out on 50 subjects who were selected based on eligibility criteria. All subjects were evaluated for diet patterns, chewing habits, and medical history. The study participants were randomly divided into two groups, chewing fennel seeds (group A) or cardamom seeds (group B). Each group comprised 25 subjects and the baseline salivary pH before chewing seeds was recorded by placing calibrated pH meter in the sterilized container of optimal size for saliva, which further was matched with the pH scale collared chart. The subjects in Group A were asked to chew a known standardized quantity (1.3 grams) of fennel seeds and in Group B, one pod of cardamom, both for 5 min. Patients were requested to sit comfortably on the dental chair and to spat into the sterilized test tube and almost 1 ml of saliva was collected as a sample. (CONSORT diagram. figure 1)

A calibrated pH meter Digital pH Meter (Mini Digital Pen Type ROHS pH-009) was used for the scrutiny of the salivary samples. Standard solutions of pH 7.0 and 4.0 were used for the calibration of the system, and standard tests of the system were conducted randomly in between the salivary pH readings. The electrode of the pH meter was cleaned with a stream of distilled water in between each reading and was placed in a standard solution of pH 7.0. This was done to ensure a stable reading on the pH meter to prevent drift and constant checks.

For comparison between the groups (control group X, group A after fennel seed chewing and group B after cardamom chewing) results were analyzed by ANOVA, (Group A before and after seed chewing, Group B before and after seed chewing) paired T test and Students T test was applied (Group A Vs Group B) for obtaining statistical significance between the groups.

## Result

In the present clinical study, all the groups were statistically non-significant for age ( $p=0.14$ ) and gender ( $p=0.85$ ) (**Table 1**).

For group A Vs group B at baseline, the mean salivary

pH was non significant ( $p=0.42$ ). When we compared the results for groups, it was observed that for the baseline values were statistically non-significant, again making these two groups similar before intervention ( $p=0.42$ ). Whereas after the use of fennel seed in groups A and cardamom seed in group B, the rise in pH was statistically significant ( $p<0.001$ ) with more ascent in group B (**Table:2**)

When we compared the results for the three groups (group X control, group A and group B) the results were statistically significant ( $p<0.01$ ). Further, the means were estimated for statistical difference between the groups (group X vs Group A,  $p<0.01$ ; group X vs group B,  $p<0.01$ ; group A vs group B,  $p<0.001$ ) (**Table:3A, figure 2**)

**Table 1:** Socio-Demographic Characteristics, Group A VS B (N=50)

S.no	Charac-teristics	Group X (n=25)	Group A (n=25)	Group B (n=25)	Sig
1	Age	44.0± 13.6	38.1 ± 12	37.4 ± 12.7	0.14
2	Gender				
	Male	12(48%)	11 (44%).	10 (40%).	0.85
	female	13(52%)	14(56%)	15(60%)	

\*Statistically significant (ANOVA and chi square test applied)

**Table 2:** Comparison of Before and After Intervention between Group A and Group B (Group A VS B) (N=50)

S. no	Characteristics	Group A (n=25)	Group B (n=25)	Sig
1	pH before product chewing	6.87± 0.404	6.97 ± 0.45	0.42
2	pH after product chewing	7.56± 0.308	7.85± 0.29	<0.001*

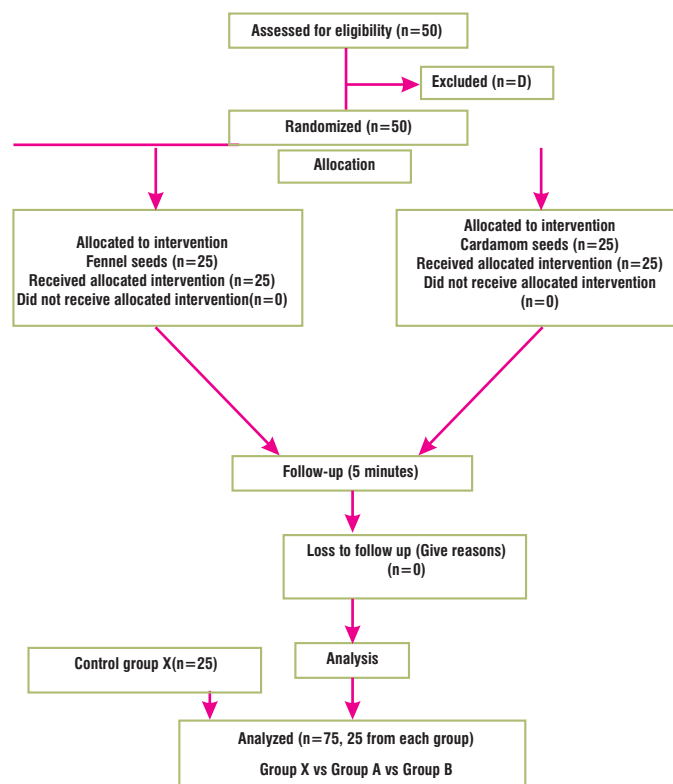
Group X: Control group  
 Group A: Fennel group: pH after seed chewing  
 Group B: Cardamom group: pH after seed chewing  
 \*Statistically significant (Students T test applied)

**Table 3A:** Comparison of salivary pH between the Groups (Group X, A and B) (N=75)

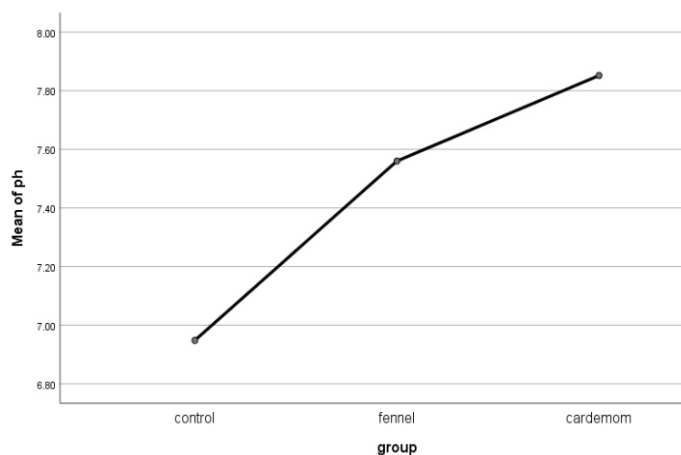
Group	n	mean	SD	Group X & A&B	Group X v A	Group X vsB	Group A vs B
Group X	25	6.94	0.09				
Group A	25	7.56	0.05				
Group B	25	7.85	0.06				
p-value				<0.01*	<0.01*	<0.01*	<0.001*

Group X: Control group  
 Group A: Fennel group: PH after seed chewing  
 Group B: Cardamom group: PH after seed chewing  
 \*statistically significant (ANOVA and students T test applied)

After chewing fennel seeds, a rise in pH was observed with a statistically significant difference between before and after consumption of fennel in group A ( $p<0.01$ ). Similarly, change in salivary pH scores before and after chewing cardamom seeds showed statistically significant results in group B ( $p<0.01$ ). (Table:3B)



**Fig-1:** Allocation of study participants according to CONSORT 2010



**Fig-2:** Comparison of mean salivary pH between the Groups for control (Group X) and after seed chewing (Group A and B)

**Table 3B:** Comparison of salivary pH within the Groups before and after seed chewing (N=50)

S. no	Characteristics	Group A (n=25)	Group B (n=25)	Sig
1	pH before fennel chewing	6.87±0.404		<0.01*
2	pH after fennel chewing	7.56±0.308		
3	pH before cardamom chewing		6.97±0.45	<0.01*
4	pH after cardamom chewing		7.85±0.29	

Group A: Fennel group  
Group B: Cardamom group  
\*statistically significant (paired T-test applied)

## Discussion

In South Asia, fennel and Cardamom seeds are regularly chewed after suppers to help with assimilation while going about as a herbal mouth revitalization.<sup>11</sup> These are beneficial with therapeutic properties especially related to gut. Additionally possess hostile properties against microorganisms. Cardamom seeds are loaded with health benefits and rich in calcium, iron, phosphorous, volatile oils holds strong inhibitory effects, flavonoids, and ether extracts.<sup>12,13,14</sup>

Previous studies on spices and seeds have shown multiple effects of salivary pH immediately after chewing herbs.<sup>15</sup> A microbiological study on cardamom extract has shown antimicrobial activity against dental caries.<sup>16</sup> Studies have found that these traditional seeds not only inhibit the activity of oral flora but also alter salivary pH hence depicting the anti-cariogenic activity. According to Kang and Ajithkrishnan,

*S. mutans*, a very important oral floral microorganism, would not produce virulence factors with extracts of fennel seeds.<sup>17,18</sup> While Ravi documented that chewing fennel seeds caused a relatively brief drop in salivary pH.<sup>19</sup> Only a few researchers examined the alteration in salivary pH and antibacterial effects of fennel essential oil.<sup>18,19,20</sup> and further no clinical dental hospital-based study was reported from our population.

Even in our part of South Asia where these seeds are consumed very commonly, there hasn't been much research that specifically appraises the effects of chewing cardamom and fennel seeds on salivary pH. According to our findings, there was a statistically significant rise in salivary pH after consuming fennel and cardamom seeds even after 5 minutes of chewing. The results are similar to one study conducted by Ramesh Nagarajappa A, in which changes in salivary pH were noticed 30

min after chewing the fennel and cardamom seeds.<sup>20</sup> Thus our study predicts a significant early rise in the salivary pH just after 5 minutes in comparison to other studies. Even in that study the difference between the two groups was missing which was the main objective of our research. Results can further be clarified by the fact that chewing home-grown seeds animates salivation which builds the saliva bicarbonate fixation and subsequently increments salivary pH.

The results of mean salivary pH at baseline were comparable with investigations conducted by Ajithkrishnan<sup>(18)</sup> and Shirahatti.<sup>21</sup> The mean salivary pH significant rise after chewing fennel seeds was similar to the study conducted by Ajithkrishnan.<sup>14</sup> But, in another study conducted by Shirahatti only on fennel seed, documented the mean salivary pH decreased after chewing fennel seeds and is contradictory to our study results.<sup>21</sup> The reason could be other confounding factors as it was an Indian-based study where consumption of alcohol, betel nut and pan chewing are much more common and popular than in our country.

In our study, before chewing cardamom seeds the mean salivary pH at the baseline was contradictory to the results in an investigation conducted by Swathi.<sup>13</sup> However, our results were comparable further in the next half as the mean salivary pH augmented after chewing cardamom seeds in both studies. To the best of our knowledge, our study depicts significant results not only between the three groups (control, fennel and cardamom) but also revealed a statistical difference between cardamom and fennel groups, making cardamom better for salivary pH as showed significantly more values when compared to fennel.

Azrak conducted research with 12 boys and 13 girls with fennel tea, to see if there would be any differences in the pH of their saliva. Results were contradictory as the mean salivary pH dropped to 0.35 and 0.33 after 5 minutes and 10 minutes after the intake of enhanced fennel tea.<sup>22</sup>

Our study evaluated the a subsequent increase in pH for fennel and cardamom seeds and that further would prevent the fall of pH below the critical pH for enamel demineralization. This indicates that after consumption of a cariogenic diet the chances of salivary pH decline below critical pH reduces by chewing fennel and cardamom seeds, concluding the protective effect of these seeds against dental caries.

Further multi-centred studies can be conducted with a large sample size, to evaluate changes in salivary pH

at longer intervals, also to emphasise the impact of these seeds on antibacterial activity against many carcinogenic bacteria. Further additional prospective researches should be carried out to evaluate their effects on salivary parameters such as salivary flow rate, viscosity, and buffering capacity.

## Conclusion

According to the results, there was an elevation in salivary pH after chewing cardamom and fennel seeds at intervals of five minutes. Compared to fennel seeds, cardamom seeds are more effective at lowering salivary pH. Henceforth, can be used as an efficient way to buffer the pH of the saliva after consuming a diet high in sugars and cancer causing agents in the diet. Both fennel and cardamom seeds can be cost-effective if advocated as dentifrice when mixed with other components to improve their efficacy and as a herbal alternative for keeping caries-free oral cavities.

## Conflict of Interest

*None*

## Funding Source

*None*

## References

1. Pitts N, Twetman S, Fisher J et al. Understanding dental caries as a non-communicable disease. *Br Dent J*. 2021; 231:749–753. DOI: <https://doi.org/10.1038/s41415-021-3775-4>
2. Kianoush N, Adler CJ, Nguyen KA, Browne GV, Simonian M, Hunter N. 2014. Bacterial profile of dentine caries and the impact of pH on bacterial population diversity. *PLoS One* 9:e92940.
3. Lee Y. Diagnosis and Prevention Strategies for Dental Caries. *J Lifestyle Med*. 2013;3(2):107–109.
4. Miller W. The presence of bacterial plaques on the surface of teeth and their significance. *Dent Cosmos* 1902; 44: 425-446
5. Straetemans M, Van Loveren C, De Soet J, De Graff J and CATE T J. Colonization with mutans streptococci and lactobacilli and the caries experience of children after the age of five. *Journal of dental research* 1998; 77: 1851-1855.
6. Stookey GK, The effect of saliva on dental caries. *J Am Dent Assoc*. 2008;139 :11S-17S
7. Mandel ID. The functions of saliva. *J Dent Res* 1987; 66:623–627.
8. Tenovuo J. Salivary parameters of relevance for assessing caries activity in individuals and populations. *Community Dent Oral Epidemiol* 1997;25:82–86.
9. Larsen MJ, Jensen AF, Madsen DM, Pearce EI. Individual variations of pH, buffer capacity, and concentrations of calcium and phosphate in unstimulated whole saliva. *Arch Oral Biol* 1999;44:111–117.
10. Singhal PK, Gautam GK, Kumar R, Kumar G. A Review on Amomum subulatum and Elettaria Cardamomum with their Pharmacological Activity. *Recent Trends in Pharmaceutical Sciences and Research*. 2022; 4 (1):1-6
11. Ağaoğlu S, Dostbil N, Alemdar S. Antimicrobial effect of seed extract of cardamom (*Elettaria cardamom* Maton). *YÜ Vet Fak Derg*. 2006;16(2):99-101
12. Manohar R, Ganesh A, Abbyramy N, Abinaya R, Balaji S K, Priya S B. The effect of fennel seeds on pH of saliva – A clinical study. *Indian J Dent Res* 2020;31:921-3 DOI: 10.4103/ijdr.IJDR\_185\_19
13. Swathi V, Rekha R, Abhishek J, Radha G, Pallavi SK, Gadde P. Effect of chewing fennel and cardamom seeds on dental plaque and salivary pH-a randomized controlled trial. *International Journal of Pharmaceutical Sciences and Research (IJPSR)*. 2016;7(1):406-12. DOI: [http://dx.doi.org/10.13040/IJPSR.0975-8232.7\(1\).406-12](http://dx.doi.org/10.13040/IJPSR.0975-8232.7(1).406-12)
14. Ramesh Nagarajappa A, Madhusudan S: Estimation of salivary and tongue coating pH on chewing household herbal leaves: A randomized controlled trial. *Anc Sci Life*. 2012; 32(2): 69–75. DOI: 10.4103/0257-7941.118531
15. Arora DS, Kaur GJ. Antibacterial activity of some Indian medicinal plants. *Journal of natural medicines*. 2007; 61(3):313-7. <https://doi.org/10.1007/s11418-007-0137-8>
16. Aneja KR, Joshi R. Antimicrobial activity of Amomum subulatum and Elettaria cardamomum against dental caries causing microorganisms. *Ethnobotanical Leaflets* 2009; 13: 840-9.
17. Kang S, B. Park. Fennel essential oil inhibits the virulence of Streptococcus Mutans. *International Association of Dental Research*. 2012; 9: 32-33.
18. Ajithkrishnan CG., Thanveer K., Singh RP. An in-vivo evaluation of the effect of fennel seeds chewing on salivary pH. *J Oral Health Community Dent* 2014; 8(2): 79-81.
19. Lee SS, Zhang W, Li Y. The antimicrobial potential of 14 natural herbal dentifrices: Results of an in vitro diffusion method study. *J Am Dent Assoc*. 2004; 135(8): 1133-1141. DOI: <https://doi.org/10.14219/jada.archive.2004.0372>.

20. Anwar F, Ali M, Hussain AI, Shahid M. Antioxidant and antimicrobial activities of essential oil and extracts of fennel (*Foeniculum vulgare* Mill.) seeds from Pakistan. *Flavour and Fragrance Journal*. 2009; 24(4):170-6. DOI 10.1002/ffj.1929
21. Shirahatti RV, Ankola AV, Nagesh L. Effect of fennel seeds on dental plaque and salivary pH-A clinical study. *J Oral Health Comm Dent* 2010;4:38-41
22. Azrak B, Willershausen B, Meyer N, et.al. Course of changes in salivary pH-values after intake of different beverages in young children. *Oral Health Prev Dent* 2008;6(2):159-64.

### **Authors Contribution**

**TFB:** Conceptualization of Project  
**MU, EA:** Data Collection  
**RA:** Literature Search  
**RA:** Statistical Analysis  
**ZK:** Drafting, Revision  
**ZK, TFB:** Writing of Manuscript