

# Effect of Cumin, Black cumin and Fennel seeds on pH of saliva - An Experimental Study.

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## ABSTRACT

**Background:** Dental caries is an infectious disease with a multifactorial aetiology in which the pH of saliva plays an important role. Low salivary pH creates an acidogenic environment that leads to enamel demineralisation and the development of dental caries.

**Objective:** To identify the effect of natural chewing products cumin, black cumin & fennel seeds on pH of saliva.

**Methods:** A total of 45 healthy participants aged 18–60 years were recruited and allocated into three groups of 15 each. Each group was assigned to chew one type of seed: cumin, black cumin, or fennel. Salivary pH was measured using standardized pH indicator strips placed beneath the tongue. Measurements were recorded at baseline (0 minutes) and subsequently at 5 and 10 minutes after chewing the assigned seeds.

**Results:** Intergroup comparison of salivary pH among the fennel, cumin, and black cumin groups at different time intervals was performed using one-way ANOVA. A statistically significant increase in pH was observed immediately after chewing in all three groups. Post hoc pairwise comparisons using the Bonferroni test showed a significant difference in pH immediately after chewing black cumin seeds ( $p = 0.006$ ).

**Conclusion:** Chewing the three seeds caused a significant rise in the salivary pH, making them suitable as anti-cariogenic agents.

**Keywords:** Fennel, Cumin, Black cumin, Salivary pH

## INTRODUCTION

Dental caries is one of the most common diseases affecting humans and has a complex, multifactorial etiology.

Saliva is a major element in the etiology of this multifactorial disease. Saliva is a biological fluid secreted by the major and minor salivary glands that consists of a mixture of secretory products. One of its functions is to maintain the pH of the mouth. A variety of ions are supersaturated in saliva. These ions serve as a buffer to keep the mouth's acidity between a range of around pH 6.2–7.4. Dental caries develop when saliva production is reduced. Dental enamel tends to dissolve its mineral contents if salivary pH falls below the threshold pH of 5.5 (critical pH of dental enamel). Hence, saliva protects against dental caries.<sup>1,2,3</sup>

Consumption of food causes significant changes in salivary pH, making it more acidic or basic. Alteration in pH can either lead to initiation and progression, or prevention of dental caries.<sup>4,5</sup>

The world is witnessing a paradigm shift, with people increasingly preferring natural /herbal substances over synthetic or chemical alternatives.

WHO states that 80% of the world's population relies on traditional/natural medicine today, and the majority of traditional therapies involve the use of plant extract or their active constituents.<sup>6</sup> In preventive dentistry, research on traditional

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herbal spices for their therapeutic purposes has yielded positive results.<sup>7</sup>

Fennel belongs to the Umbelliferae family. It is known as saunf in Hindi. It is used in traditional medicine against various disorders. It also has applications in various oral and dental care products for its antiseptic properties.<sup>8,9</sup>

Cumin seeds belong to the Apiaceae family. In India, these seeds are used as an ingredient in innumerable dishes and also have many applications in the traditional medicine.<sup>10</sup>

The Ranunculaceae family includes black cumin. Its therapeutic potential diuretic, antihypertensive, antidiabetic,

immune-modulatory, antimicrobial, anthelmintic, analgesic, anti-inflammatory spasmolytic, bronchodilator, gastroprotective, hepatoprotective, and renal protective qualities make it a major component of traditional medicine.<sup>10,11,12</sup>

To the best of our knowledge, no information is available regarding the impact of chewing cumin and black cumin seeds on salivary pH. There is limited research on examining the effect of chewing fennel seeds alone on the pH of saliva. Hence, we aimed to estimate the effect of fennel, cumin, and black cumin seeds on the salivary pH.

## MATERIAL AND METHODS

This study was carried out in the Department of Oral & Maxillofacial Pathology and Oral Microbiology of our institution. Before the commencement of the study, the procedure was explained to the study participants in their vernacular, and informed consent was obtained.

The total study sample included 45 participants, divided into three groups consisting of 15 subjects each.

Group I – Individuals who chewed fennel seeds

Group II – Individuals who chewed cumin seeds

Group III– Individuals who chewed black cumin seeds

This study included completely dentate male and female individuals who were above 18 years old. Subjects suffering from any systemic illness, undergoing chemotherapeutic procedures, topical fluoride therapy, or under any medication that affects the salivary function or salivary pH, and those who were allergic to these seeds were excluded from the study.

All the study participants were instructed to follow their regular diet and to avoid major diet variations before the study. The subjects were instructed to abstain from drinking or eating one hour before the study.

Unstimulated whole saliva was collected from all participants using the drooling method after ensuring a one-hour restriction on food, drink, and oral hygiene. Baseline salivary

pH (SP1) was recorded using commercially available pH strips (Qualigens Indikrom Paper Strips -Thermo Fisher Scientific India Pvt. Ltd) below the tongue. The colour changes were matched with the pH scale color chart within 15 seconds. Each participant then received 1.5 g of fennel seeds (Group I), cumin seeds (Group II), or black cumin seeds (Group III) and was instructed to chew the seeds for a fixed duration of one minute, which provided uniform gustatory and masticatory stimulation. Stimulated saliva was collected immediately after chewing (SP2), as well as at 5 minutes (SP3) and 10 minutes (SP4), and pH was recorded at each time point using the same strip-based method.

## Statistical Analysis:

Data were analyzed using SPSS software. Mean and standard deviation were calculated for all variables. Normality was assessed using the Shapiro–Wilk test and confirmed, following which parametric tests were applied. Intragroup comparisons (SP1–SP4) were analyzed using repeated-measures ANOVA, while intergroup differences were assessed using one-way ANOVA, with post hoc Bonferroni correction for multiple pairwise comparisons.

## RESULTS

In group I, the mean value of baseline salivary pH (SP1) was 6.56, and the mean value of immediate salivary pH (SP2) after chewing fennel seeds was 8.0. Similarly, the mean value of salivary pH after 5 & 10 minutes (SP3 & SP4) of chewing fennel seeds were 7.20 & 6.73 respectively.

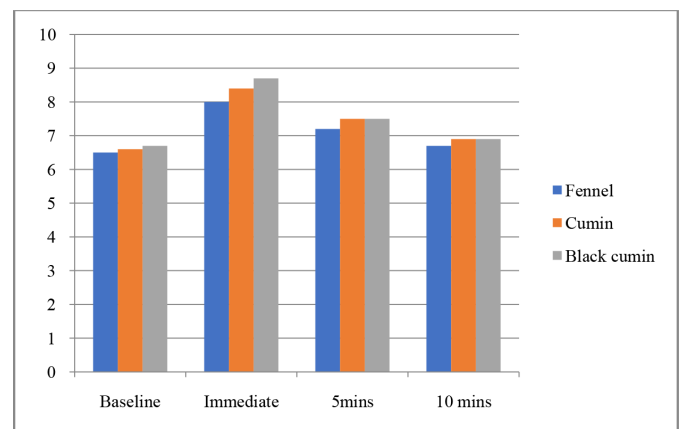
In group II, the mean value of baseline salivary pH (SP1) was 6.66, and the mean value of immediate salivary pH (SP2) after chewing Cumin seeds was 8.46. Similarly, the mean value of salivary pH after 5 & 10 minutes (SP3 & SP4) of chewing fennel seeds were 7.53 & 6.93 respectively.

In group III, the mean value of baseline salivary pH (SP1) was 6.70, and the mean value of immediate salivary pH (SP2) after chewing Black cumin was 8.76. Similarly, the mean value of salivary pH after 5 & 10 minutes (SP3 & SP4) of chewing fennel seeds were 7.56 & 6.93 respectively.

Intragroup comparison showed that all three seed types produced a significant rise in salivary pH from baseline (SP1) to the immediate post-chewing time point (SP2). Each group

**Table 1:** Descriptive statistics

Group	Time	Mean	Std. Deviation	Std. Error
Group I (Fennel)	Baseline (SP1)	6.567	.6510	.168
	Immediate (SP2)	8.000	.5345	.138
	5mins (SP3)	7.200	.5278	.136
	10mins (SP4)	6.733	.5936	.153
Group II (Cumin)	Baseline (SP1)	6.667	.9574	.247
	Immediate (SP2)	8.467	.4806	.124
	5mins (SP3)	7.533	.8338	.215
	10mins (SP4)	6.933	.7037	.182
Group III (Black cumin)	Baseline (SP1)	6.700	.8194	.212
	Immediate (SP2)	8.767	.8423	.217
	5mins (SP3)	7.567	1.1318	.292
	10mins (SP4)	6.933	1.0154	.262



**Fig. 1:** pH of Fennel, Cumin & Black cumin seeds

demonstrated a clear alkaline shift following the chewing intervention. [Figure-1] [Table -1]

An intergroup comparison of pH between fennel, cumin & black cumin seeds at various time intervals was done using ANOVA. Significance was noted in all three groups immediately after chewing the seeds (SP2) with the P value of 0.008, but not significant at baseline, 5 & 10 minutes after chewing the seeds (SP1, SP3 & SP4). [Table -2] Within each group, the salivary pH showed a statistically significant rise from baseline (SP1) to the immediate post-chewing value (SP2).

Table 3 describes the pairwise comparison of pH obtained immediately after chewing fennel, cumin, and black cumin seeds done by using the post hoc Bonferroni test, and statistical significance was noted in the black cumin seed group with the p-value of 0.006.

## DISCUSSION

Many traditional medicinal plants have been used as therapeutic agents to maintain human health. Since ancient times, many types of plants have been used as herbal remedies for the treatment of various diseases. In India, some spices and herbs were being utilized in food and medicine.<sup>13</sup> The practice of using herbal seeds is common in India, hence in our search for such traditionally practiced and effective preventive agents, we

found it interesting to assess the effect of chewing cumin, black cumin, and fennel seeds on the pH of saliva.

Fennel seeds, scientifically known as *Foeniculum vulgare*, in plant taxonomy it belongs to the Apiaceae (umbelliferae) family. This plant is a tall, stout, and aromatic annual herb. These seeds were commonly chewed after meals in India as a natural mouth freshener and digestive aid. They can be chewed by themselves or in combination with betel leaves and sugar. It is also available as sugar-coated sachets in stores.<sup>8,11</sup> Fennel seeds contain Anethol and Fenchone. Anethol causes an increase in acetylcholine secretion by stimulating the parasympathetic nervous system which leads to stimulation of serous acini cells resulting in an increased salivary flow rate. It also has anti-microbial, anti-inflammatory, anti-hirsutism, antioxidant, anti-thrombotic, anti-platelet, and antispasmodic properties.<sup>5,14</sup>

Cumin seeds are native to East Mediterranean which belongs to the family Apiaceae. Cumin seeds are oblong and yellow-grey. Since ancient times, they have been used in several cuisines of different food cultures, in both whole and ground forms. Cumin seeds have been used for thousands of years as a traditional ingredient of numerous dishes and as an ingredient of several spice blends in India. Apart from food use, in the Ayurvedic system of medicine in India, cumin seeds have enormous medicinal value, mainly for digestive disorders.<sup>10</sup>

**Table 2:** Intergroup comparison of pH between Fennel, Cumin and Black cumin seeds at various time intervals using Anova

Time	Group	Sample (n= 45)	Mean	Std. Deviation	Std. Error	F	p VALUE
Baseline(SP1)	Fennel	15	6.567	.6510	.1681	.108	.898
	Cumin	15	6.667	.9574	.2472		
	Black cumin	15	6.700	.8194	.2116		
Immediate(SP2)	Fennel	15	8.000	.5345	.1380	5.478	.008*
	Cumin	15	8.467	.4806	.1241		
	Black cumin	15	8.767	.8423	.2175		
5 min(SP3)	Fennel	15	7.200	.5278	.1363	.820	.447
	Cumin	15	7.533	.8338	.2153		
	Black cumin	15	7.567	1.1318	.2922		
10 min(SP4)	Fennel	15	6.733	.5936	.1533	.319	.728
	Cumin	15	6.933	.7037	.1817		
	Black cumin	15	6.933	1.0154	.2622		

**Table 3:** Post hoc bonferroni test

Dependent Variable	(I)group	(J) group	Mean Difference(I-J)	Std. Error	Sig.
0 min	Fennel	Cumin	-.4667	.2334	.156
		Blackcumin	-.7667*	.2334	.006
	Cumin	Fennel	.4667	.2334	.156
		Blackcumin	-.3000	.2334	.617
	Black cumin	Fennel	.7667*	.2334	.006
		Cumin	.3000	.2334	.617



Black seed also known as black cumin or *Nigella sativa* & belongs to the family Ranunculaceae and is an annual flowering plant. It is a native of Southern Europe, North Africa, and Southwest Asia. *Nigella sativa* seeds and their oil have a role in Indian and Arabian civilizations as food and medicine.<sup>11</sup> The seeds of *N. sativa* have a bitter taste and they are used as a spice in India and extensively in Middle Eastern cuisines.<sup>10</sup>

In our study, the mean value of baseline salivary pH in the group I was  $6.56 \pm 0.65$ . The study done by Manohar, et al in 2020 stated that the mean salivary pH at baseline was  $6.68 \pm 0.0614$ . Similarly, the study done by Ajithkrishnan, et al in 2014 and Shirahatti, et al in 2014 showed mean pH at baseline was  $6.88 \pm 0.55$  and  $6.8 \pm 0.65$  respectively.<sup>5,9</sup> These observations were in agreement with the findings of the present study.

In the present study, the mean value of immediate salivary pH after chewing fennel seeds was  $8.0 \pm 0.53$ . Similarly, the study done by Manohar, et al in 2020 and Ajithkrishnan, et al in 2014 showed the mean pH after chewing fennel seeds was  $7.94 \pm 0.05$  and  $7.45 \pm 0.30$  respectively.<sup>5,14</sup> Their study noted an increase in salivary pH from the baseline value immediately after chewing the fennel seeds. These observations were in agreement with the findings of the present study. But, in a study conducted by Shirahatti, et al, in 2014, the mean salivary pH decreased after chewing fennel seeds, which was  $6.61 \pm 0.24$  and it was contradictory to our study results.<sup>9</sup>

In the present study, the mean value of salivary pH after 5 minutes of chewing fennel seeds was  $7.20 \pm 0.52$  respectively. The study done by Manohar, et al in 2020, Ajithkrishnan et al in 2014, and Shirahatti, et al in 2014 showed the mean salivary pH after 5 minutes of chewing fennel seeds were  $7.64 \pm 0.06$ ,  $7.45 \pm 0.34$  and  $7.18 \pm 0.26$ .<sup>5,9,14</sup> These observations were in agreement with the findings of the present study.

In our study, the mean value of salivary pH after 10 minutes of chewing fennel seeds was  $6.73 \pm 0.59$  respectively. In a similar study done by Manohar et al, the mean salivary pH immediately after chewing fennel seeds at 10 min was  $7.50 \pm 0.05$  at 10 min which is in agreement with the findings of the present study.

In the present study, in group II, a significant rise in salivary pH was noted immediately after chewing the cumin seeds and there was a drop in pH level after 5 minutes and 10 minutes, but it didn't drop below baseline pH. In group III, a significant rise in salivary pH was noted immediately after chewing the black cumin seeds, but a subsequent drop was noted after 5 minutes and 10 minutes, but it didn't drop below baseline pH.

By using the keywords cumin, black cumin, and salivary pH in both Google and PubMed searches, we could not identify any previously published studies directly assessing the effect of these seeds on salivary pH. This lack of literature highlights a clear gap in current knowledge. While fennel has been relatively better studied for its oral benefits, cumin and black cumin remain largely under-explored with respect to their potential influence on salivary pH modulation. Consequently, the absence of comparable data limits our ability to contextualise or contrast the present findings with prior research, reinforcing the need for more targeted studies in this area.

In this present study, we observed an increase in pH from

the baseline to immediate salivary pH after chewing fennel, cumin & black cumin seeds throughout 5 to 10 minutes the salivary pH reduced, but it was not below the baseline or critical pH. When comparing fennel, cumin & black cumin seeds, black cumin seeds significantly increased the salivary pH.

The higher immediate salivary pH observed with black cumin may be attributed to its richer phytochemical profile—particularly thymoquinone and other volatile oils—which can enhance salivary stimulation and buffering capacity, leading to a stronger alkaline response. Additionally, the firmer texture and higher oil content of black cumin may require more vigorous chewing, promoting greater secretion of bicarbonate-rich stimulated saliva.

The limitation of this study includes limited sample size, hence larger sample size is needed to further validate the results of this present study findings.

## CONCLUSION

Chewing fennel, cumin & black cumin seeds caused a significant rise in the salivary pH after their consumption. All the seeds increased the pH following from the baseline, and after 5 minutes, it significantly reduced but not below the baseline or critical pH. A rise in the salivary pH prevents demineralisation and can have an anti-cariogenic effect. Hence, this study indicates that chewing these herbal seeds prevent the decline of salivary pH below the critical pH after consumption of a cariogenic diet.

The role of fennel, cumin, and black cumin seeds in modulating salivary pH remains an area that is relatively unexplored. The present study demonstrates that these seeds help maintain salivary pH within a favourable physiological range, supporting their potential anti-cariogenic effect. Within the study's limitations, the findings highlight their value as simple, natural adjuncts for short-term salivary pH stability. Additional longitudinal research is needed to validate and expand upon these observations.

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