



# Effect of Chitosan and/or Nigella Sativa Oil on the Organoleptic Properties of Kareish Cheese

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## Abstract

**Background:** Kareish cheese is one of the most popular and traditional soft cheese consumed in Egypt. It is commonly made in the countryside, especially in small villages. The low-income people use Kareish cheese in their diet owing to its high protein content, low fat and reasonable price. Chitosan is a polysaccharide prepared commercially from chitin. Chitosan and its derivatives are extensively studied in medical and pharmaceutical fields due to their competitive biological properties. *Nigella sativa* is an annual medicinal plant has long been used as a natural medicine for the treatment of many disease conditions.

**Objective:** assessing the organoleptic properties of Kareish Cheese after addition of various concentrations of Chitosan and/or *Nigella sativa* oil to check the best concentration that can be added to the Kareish Cheese as natural preservatives and to get the beneficial biological effects of these additives.

**Materials and Methods:** Ten trained panelists were used to examine the organoleptic properties and to identify the differences among Kareish cheese samples treated with three different concentrations of Chitosan and/or *N. sativa* oil. Results: Addition of 1% Chitosan or 0.5% *N. Sativa* oil or a combination of them to Kareish cheese resulted in a non-significant decrease of the scores of its odor, taste, color and texture. Moreover, addition of higher concentrations resulted in a significant decrease of their scores. In all examined organoleptic characteristics, the control Kareish cheese samples showed higher scores than any sample supplemented with any concentration of Chitosan and/or *N. sativa* oil.

**Conclusion:** Addition of the low concentration of Chitosan (1%) and/or *N. sativa* oil (0.5%) to the Kareish cheese resulted in a non-significant decrease in its organoleptic score; moreover, the decrease was significant with the addition of higher concentrations.

**Keywords:** Kareish Cheese; Chitosan; *Nigella Sativa*; Organoleptic Properties

## Introduction

Kareish cheese is one of the most popular and traditional dairy products consumed in Egypt. It is a soft cheese commonly made in the countryside, especially in small villages. The low-income people use Kareish cheese in their diet owing to its high protein content, low fat and reasonable price [1]. A previous study reported that Kareish cheese has a protein content of  $19.99 \pm 1.32$  g/100g, a fat content of  $3.87 \pm 0.97$  g/100g, with a calcium and phosphorous content of  $641.1 \pm 49.21$  and  $431.18 \pm 37.21$  mg/100g; respectively

[2]. The high protein content of Kareish cheese and its high casein content make it a high satiety food, so it reduces hunger for a long time, so it is a beneficial food for weight loss. Calcium in Kareish cheese is important not only for building strong bones, but also for maintaining normal blood pressure. Kareish cheese is a promising food in the avoidance of health problems associated with fat, particularly for old people [3]. The microbiological quality of Kareish cheese indicates improper sanitation during its manufacture and handling. It is considered a rich medium for the

growth of various types of spoilage and pathogenic microorganisms, moreover, it is usually sold uncovered exposing it to various sources of contamination [4]. Chitosan is a polysaccharide prepared commercially by deacetylation of chitin. Chitin is polysaccharide abundant in nature and can be obtained as a byproduct of the seafood industry from the exoskeletons of crustaceans, mollusks, and insects [5]. The shells of crabs, shrimps, prawns, and lobsters coming from the peeling machines in canning factories are used for the industrial preparation of chitin [6]. Chitosan and its derivatives are extensively studied in medical and pharmaceutical fields due to their competitive biological properties including antimicrobial, antioxidant, analgesic, antitumor, hypercholesterolemia, anti-inflammatory properties, in addition to its biocompatibility, biodegradability and nontoxicity [7]. Chitosan is able to "soak up" or absorb from six to ten times its weight fat and oils and is able to significantly bind with fat molecules and convert them into a form which the human body does not absorb [8].

*Nigella sativa* is an annual medicinal plant commonly known as black cumin, and is native to the Middle East, North Africa, and Western Asia, but also cultivated in many countries worldwide. The seeds are used as a spice for food, especially bakery products and cheese, and in the preparation of traditional sweet dishes [9]. *Nigella sativa* seed extract has several beneficial biological effects including antimicrobial, antioxidant, antidiabetic, anticancer, immunomodulatory, analgesic, anti-inflammatory, spasmolytic, bronchodilator, hepatoprotective, antihypertensive, and renal protective [10]. Sensory properties such as odor and taste are among the most important factors in accepting a product from a consumer perspective. Therefore, it is important to examine these properties by taking into consideration the marketability of the product. Sensory analysis is the final guide to the acceptance of the product by the evaluators [11]. Abdel Rassoul [12] reported that Chitosan and *Nigella sativa* oil had antimicrobial effects regarding coliforms, fecal coliforms as well as mold and yeast when added to the Kareish cheese. Also, she found that feeding mice on cheese supplemented with Chitosan and/or *Nigella sativa* oil during the initiation and preinitiation stages of carcinogenesis, there were strong anti-inflammatory and antineoplastic effects in addition to inhibiting cancer colon and protecting against cancer development [12]. The aim of this study was to assess the organoleptic properties of Kareish Cheese after addition of various concentrations of Chitosan and/or *Nigella sativa* oil to check the best concentration that can be added to the Kareish Cheese as natural preservatives and to get beneficial biological effects of these additives.

## Material and Methods

Chitosan was prepared by extracting the Chitin from the Persian Gulf shrimp's shell according to Kaji et al. [13] and Kurita et al. [14] by washing of the shrimp's shell with water, drying and cutting into small pieces. Acetic acid was added then left for 2hrs. at room temperature followed by filtration, neutralization and washing. Deproteinization was performed using 2N sodium hydroxide solution at 60-65 °C, hydrochloric acid (10%) at room temperature for 3-5h was used for demineralization and acetone was added to remove natural pigments in the chitin. Deacetylation

was carried out by suspending one-gram chitin in 50 ml sodium hydroxide, at 90- 95°C under nitrogen purging for 3-5 hrs, then filtering, washing with water and drying at 85 °C. *Nigella sativa* oil was obtained from a pharmaceutical company in Egypt and was prepared by cold pressing.

## Kareish Cheese

A total of 7500g Kareish cheese was purchased from the local market, Alexandria, Egypt, placed into clean polyethylene bags and transported to the laboratory using a pre-chilled ice box with ice pack.

## Concentrations of Chitosan and /or *Nigella Sativa* Oil Added to the Kareish Cheese

- a) Chitosan with low, medium or high concentration of 1%, 2% and 4%; respectively
- b) *Nigella sativa* oil with low, medium or high concentration of 0.5%, 1.25% and 3% ; respectively
- c) Both Chitosan and *Nigella sativa* oil were added with the low, medium or high concentration of each additive previously mentioned above.
- d) Kareish cheese without any of the two additives was used as a control group.

## Organoleptic Examination

- a) The panel test method was conducted at zero time using ten trained panelists [15]. The panelists were drawn from personnel of the institution where the research was conducted. They were used to examine the organoleptic properties and to identify the differences among Kareish cheese samples treated with various concentrations of Chitosan and/or *Nigella sativa* oil.
- b) The panelists were trained to score the organoleptic properties of the samples from 1 to 10 according to their acceptance to the color, odor, taste and texture.

## Statistical Analysis

The panel data was statistically analyzed using SPSS program version 14.0. The cutoff point for statistical significance was P value <0.05 and all tests were two-sided. Post Hoc test was used to check the significant variation in the organoleptic properties among Kareish cheese parts treated with various concentrations of Chitosan and/or *Nigella sativa* oil [16].

## Results

The present study revealed that plain Kareish cheese showed the highest mean scores of odor, taste, color and texture ( $9.8 \pm 0.63$ ,  $9.1 \pm 1.2$ ,  $10.0 \pm 0.0$  and  $9.5 \pm 0.85$ , respectively). Supplementing Kareish cheese with 1% Chitosan, 0.5% *Nigella sativa* oil or a combination for both of them resulted in a non-significant decrease of the organoleptic score. However, supplementing Kareish cheese with higher levels resulted in significant decrease of the mean scores. Chitosan at a level of 4% resulted in the decrease of the

scores of odor, taste, color and texture of Kareish cheese to  $6.0 \pm 2.45$ ,  $4.8 \pm 2.35$ ,  $5.7 \pm 2.5$  and  $4.9 \pm 1.85$ , respectively. *Nigella sativa* oil at 3% resulted in the decrease of these scores to  $4.1 \pm 3.6$ ,  $4.8 \pm 2.94$ ,  $7.5 \pm 2.46$  and  $3.6 \pm 3.13$ , respectively. In the meantime, a

combination of both 4% Chitosan and 3% *Nigella sativa* oil resulted in greater decrease of these scores to  $4.1 \pm 3.5$ ,  $4.0 \pm 2.67$ ,  $4.7 \pm 3.06$  and  $2.8 \pm 2.82$ , respectively as shown in Tables 1 and 2.

**Table 1:** Scores of organoleptic examinations (Mean  $\pm$  SD) of Kareish cheese supplemented with different concentrations of Chitosan and/ or *Nigella sativa* oil.

Properties	Added Concentrations		Organoleptic Examination of Kareish Cheese with		
	Chitosan	<i>Nigella sativa</i> oil	Chitosan	<i>Nigella sativa</i> oil	Chitosan and <i>Nigella sativa</i> oil
Odor	Control		$9.80 \pm 0.63$	$9.80 \pm 0.63$	$9.80 \pm 0.63$
	1%	0.50%	$8.90 \pm 0.99$	$8.50 \pm 1.78$	$8.30 \pm 1.57$
	2%	1.25%	$7.30 \pm 1.64$	$6.40 \pm 2.55$	$5.60 \pm 2.12$
	4%	3%	$6.00 \pm 2.45$	$4.10 \pm 3.60$	$4.10 \pm 3.54$
Taste	Control		$9.10 \pm 1.20$	$9.10 \pm 1.20$	$9.10 \pm 1.20$
	1%	0.50%	$7.80 \pm 2.30$	$8.20 \pm 1.81$	$7.50 \pm 1.84$
	2%	1.25%	$6.50 \pm 1.72$	$6.50 \pm 2.17$	$5.30 \pm 2.50$
	4%	3%	$4.80 \pm 2.35$	$4.80 \pm 2.94$	$4.00 \pm 2.67$
Color	Control		$10.00 \pm 0.00$	$10.00 \pm 0.00$	$10.00 \pm 0.0$
	1%	0.50%	$8.70 \pm 1.25$	$9.20 \pm 1.03$	$7.60 \pm 1.265$
	2%	1.25%	$7.10 \pm 1.45$	$8.30 \pm 1.64$	$6.30 \pm 1.567$
	4%	3%	$5.70 \pm 2.50$	$7.50 \pm 2.46$	$4.70 \pm 3.06$
Texture	Control		$9.50 \pm 0.85$	$9.50 \pm 0.85$	$9.50 \pm 0.85$
	1%	0.50%	$8.40 \pm 0.70$	$7.70 \pm 1.64$	$7.10 \pm 1.29$
	2%	1.25%	$6.30 \pm 1.34$	$6.00 \pm 2.11$	$5.30 \pm 1.57$
	4%	3%	$4.90 \pm 1.85$	$3.60 \pm 3.13$	$2.80 \pm 2.82$

**Table 2:** Results of Post Hoc Test to check the variation in the organoleptic properties among Kareish cheese samples treated with various concentrations of Chitosan and/ or *Nigella sativa* oil.

Properties	Chitosan			<i>Nigella sativa</i> oil			Chitosan and <i>Nigella sativa</i> oil		
	(I) group	(J) group	Sig.	(I) group	(J) group	Sig.	(I) group	(J) group	Sig.
Odor	Control	2%	0.006	Control	1.25%	0.016	Control	2%+1.25%	0.001
		4%	0		3%	0		4%+3%	0
	1%	4%	0.001	0.50%	3%	0.001	1% + 0.5%	2%+1.25%	0.048
								4%+3%	0.001
Taste	Control	2%	0.025	Control	1.25%	0.045	Control	2%+1.25%	0.002
		4%	0		3%	0		4%+3%	0
	1%	4%	0.008	0.50%	3%	0.005	1% + 0.5%	4%+3%	0.004
Color	Control	2%	0.001	Control	3%	0.005	Control	1%+0.5%	0.028
		4%	0					2%+1.25%	0
	1%	4%	0.001					4%+3%	0
							1% + 0.5%	4%+3%	0.006
Texture	Control	2%	0	Control	1.25%	0.004	Control	2%+1.25%	0
		4%	0		3%	0		4%+3%	0
	1%	2%	0.004	0.50%	3%	0.001	1%+0.5%	Control	0.024
		4%	0					4%+3%	0
							2% + 1.25%	4% + 3%	0.018

## Discussion

Kareish cheese is an excellent source of protein, amino acids, calcium, phosphorus, vitamins and many micronutrients [17]. There is an increasing demand for this kind of cheese for its pleasant organoleptic properties. The microbial quality and safety of Kareish cheese is the major area of concern for producers and consumers. Also, there have been a number of serious well documented outbreaks of food borne diseases associated with consumption of cheeses [18]. Therefore, there is a need to develop improve the Kareish cheese quality, and increasing its shelf life [19]. Consumers are demanding food with least chemical preservatives and artificial additives, so scientists are putting increased efforts to discover and purify compounds to be used as safe alternatives to chemical preservatives [20]. So, Chitosan and *Nigella sativa* oil can be used as natural preservatives because of their antimicrobial effects as reported by Abdel Rassoul [12]. The present study revealed that, in all examined organoleptic properties, control Kareish cheese samples showed higher scores than any sample supplemented with any concentration of Chitosan and/or *Nigella sativa* oil, moreover, increasing the concentrations of these additives lowered the given scores. There were significant variations observed between control cheese samples and cheese samples supplemented with medium or higher concentrations of Chitosan and/or *Nigella sativa* oil. Kareish cheese supplemented with *Nigella sativa* oil showed lower odor and texture scores compared to Kareish cheese supplemented with Chitosan, although in case of taste and color, the reverse was observed where Kareish cheese supplemented with *Nigella sativa* oil showed higher scores. Another study revealed that addition of chitosan and anise essential oil "AEO" at 1.5% did not change the taste of chicken burger, but in AEO at 2%, the sensory score decreased [11]. Also, Ojagh et al. [21] found that addition of chitosan and cinnamon essential oil, decreased the sensory score of the stored trout fillet as compared to the control.

## Conclusion

Addition of the low concentration of Chitosan (1%) and/or *Nigella sativa* oil (0.5%) to the Kareish cheese resulted in a non-significant decrease in its organoleptic score; moreover, the decrease was significant with higher concentrations.

## Recommendations

More research should be carried out to neutralize the undesirable organoleptic properties resulting from using Chitosan and/or *Nigella sativa* oil as natural additives to increase the acceptability of Kareish cheese, improve its keeping quality and to get the biological benefits of these additives.

## Conflicts of Interest

The authors declare no conflict of interest.

## Author Contributions

All authors have made full contribution to data acquisition, interpretation of results, drafting and revising the final manuscript. All authors read and approved the final manuscript.

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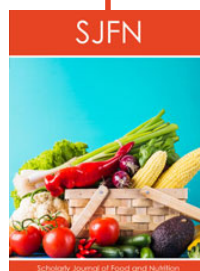
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