



## Development of al-khawada a traditional Saudi food by adding olive oil or black seed

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### ABSTRACT

**Background:** The success of food products is significantly influenced by their development, aimed at achieving a new product characterized by excellent flavor, distinctive color, desirable texture, and widespread consumer acceptance. In line with these objectives, the product "al-Khawada" has been innovatively developed. This popular food item is crafted from millet flour and ghee to meet consumer preferences and expectations.

**Objective:** The objective of our study was to enhance al-khawada by refining its flavor, color, and texture, ultimately improving overall liking degree. Acceptance is evaluated through hedonic tests to assess the overall liking and degree of liking for individual sensory attributes. This was achieved by incorporating either olive oil or *Nigella sativa* into the formulation.

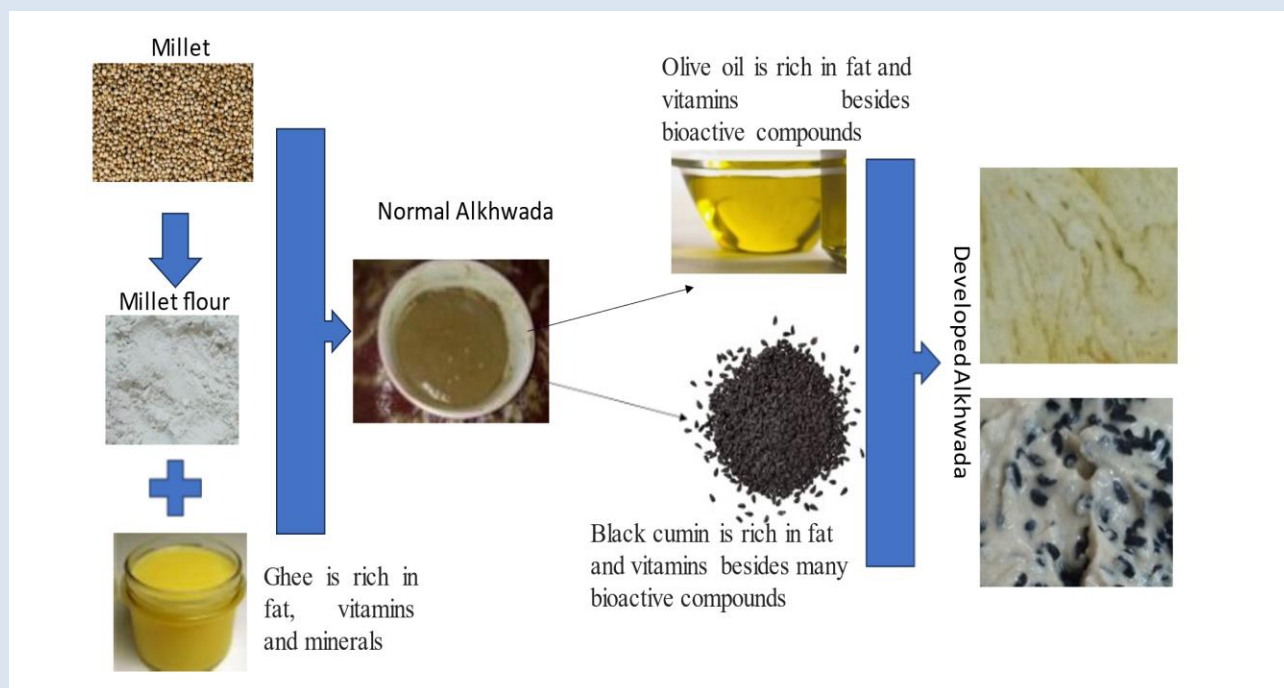
**Methods:** In this study, al-khawada was formulated with the addition of 1% and 2% olive oil, known for its richness in fat and vitamins. This variation is recognized for its ease of digestion. Additionally, black seed was incorporated at 1% and 2%, contributing seeds with high antioxidant content and numerous essential vitamins. The standard al-khawada was utilized as the control group in this comparative analysis.

**Results:** The results of the panelists were analyzed using the SAS program and showed that the addition of olive oil by 1% and 2% in the manufacturing of al-khawada received the satisfaction of the panelists in terms of flavor, color,

texture, and overall acceptance while the addition of black seed by 1% and 2% did not have the satisfaction of the panelists in terms of flavor, color, texture, and overall acceptance.

**Conclusion:** The study recommended the need to develop an al-khawada product by adding olive oil at concentration of around 1% and 2% because of its good flavor, distinctive color, desirable texture, and good overall liking. Other studies are needed to increase the ratios of acceptance of al-khawada product to give good flavor, distinctive color, and desired texture.

**Keywords:** Al-khawada, Millet, Ghee, Olive oil, Black cumin seed



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## INTRODUCTION

Millet belongs to the grass family, which is in the form of small spherical grains. Millet has different colors such as white, gray, yellow, and even red. Several varieties of millet are available worldwide in China, India, Nigeria, Sudan, and Greece. Millet contains about 15% protein and is rich in fiber, it is a rich source of B, B vitamins - niacin, thiamine, and riboflavin, and E, in addition, millet also contains essential amino acids such as methionine, lysine and minerals such as iron, magnesium, phosphorus, potassium [1]. Humans feed on millet

seeds which are a prominent food in the dry areas of Africa, where grains are cooked like rice or milled like wheat. The seeds are used in feeding poultry and animals and the vegetative total of the plant is used as animal feed. The presence of flavonoids in millet seeds indicates the effectiveness of chemoprevention because they are inversely associated with the prevention of coronary heart disease and the occurrence of heart attacks in millet consumers [2].

Al-khawada is a popular Saudi food known to the Bedouin, known as Bedouin chocolate, consisting of

millet flour mixed with ghee. Al-khwada was confined to the rural areas, so interest in it was increased in the cities. Al-khawada is a popular Saudi food containing millet flour and ghee.

The finest millet in Saudi Arabia is grown in the region of Badhan, it is widely grown in Jazan, and wadis are prepared in several ways. The people of Al-Hijaz are famous for the consumption of al-khwadah. Al-khawada is the oldest food in the Bedouin of Hijazi when it moves from one place to another or when it graze its sheep from early morning until sunset [3]. Nowadays, the product of al-khawada is famous and is demanded in all regions of Saudi Arabia and even some Gulf countries. In recent years the demand for al-khawada products has become greater than ever before. Because it contains ghee, it makes its stability low, adding both olive oil and black seed improves its stability. Hence the researcher has developed the idea to enhance the al-khawada products [3].

Ghee is extracted from sheep, cow, or goat milk using traditional methods and is used in the preparation of many foods. It is considered a laxative and reduces constipation. Ghee is also used to protect nerves from the effects of acids and thus from diseases of the nerves such as Alzheimer's sclerosis and diabetes. Ghee contains important vitamins for the body such as vitamin A, vitamin E, vitamin B1, and vitamin B2. It contains important minerals to build bones such as calcium, magnesium, and phosphorus, and helps in the elimination of osteoporosis [4]. Olive oil is an oil produced by squeezing or pressing olive fruits, used in cooking and many other uses. It is widely used as a healthy food, rich in useful fats and essential vitamins needed by the human body. Contemporary science has discovered tremendous benefits of olive oil which is also referred to in the Holy Quran as a blessing deposited by God in this marvelous oil [5]. Olive oil is frequently used

to treat allergies and digestive problems. Olive oil can also treat swollen lymph nodes, debility, swelling of the joints and pain, lack of appetite, swollen sinuses, and respiratory problems, especially asthma. It can be useful in the treatment of viral diseases such as hepatitis and contains a large amount of vitamin D necessary for humans. Olive oil contains oleic and palmitic acids with antioxidants such as flavonoids, vitamin E, and carotene, compounds that regulate blood sugar [6]. The fatty part, namely ghee, of al-khwada is subjected to significant deterioration during storage, with an increase in unwanted oxidants, which can act as catalysts for further oxidative reactions, reducing the shelf life of the product. Therefore, the use of olive oil and black cumin seeds in al-khwada improves its sensory properties and preference by the consumer.

Black cumin seeds contain more than 15 types of amino acids necessary for the body, as well as proteins, starches, and good fats such as omega 6 and omega 3. This ingredient also contains dietary fiber and minerals such as calcium, iron, sodium, and potassium [7]. Black seeds are also used in foods as a flavoring additive such as in breads and pickles because it has a very low level of toxicity. The compounds are also effective in helping regulate breathing and widening the trachea [6].

Distinctive food products are well known among consumers, but luck has played a significant role in their success and often new ideas are unknown. Recognizing new ideas has a major role to play in developing food products that meet or exceed the expectations of consumers. Food products were developed by developing new products or improving existing ones. The process of research and development represents the spirit of renewal and continuity of food products and reflects positively on the food products themselves in their goal to meet the needs and desires of consumers [8]. Sensory evaluation of the food product

plays an important role in achieving consumer satisfaction, by knowing the customer's requirements, degrees of preference, and taste, based on conducting market studies through marketing management, which depends either on the procedures of taste studies directly or on imitating or taking advantage of the sensory characteristics of products popular in the market [9]. Since its development, the 9-point hedonic scale has been the most used scale for testing consumer preference and acceptability of foods [10]. The 9-point hedonic scale has been used routinely in food science, the same way for 60 years. With advances in technology, data from the scale is being used for more and more complex programs for statistical analysis and modeling. There are alternatives to the generally used serial monadic protocol, which can be more suitable. Traditionally, the 'words' on the 9-point hedonic scale are reassigned as 'numbers', while other '9-point hedonic scales' are purely numerical; the two are not interchangeable [11]. The 9-point hedonic scale is a balanced bipolar scale with a neutral value at the center with four positive and four negative categories on each side. The categories are labeled with phrases representing various degrees of the effect of consumer and those labels are arranged successively to suggest a single continuum of likes and dislikes [10]. New ideas have a significant role to play in the development of food products, both current and new ones. Accordingly, the research problem will focus mainly on the addition of olive oil or *Nigella sativa* seeds to al-khwada products. One reason that leads to the successful development of the product is the logical response to the surrounding environmental conditions to ensure the continuity of food products [12]. In this regard, the development of the al-khwada product was considered by adding olive oil or black seed to a certain percentage to obtain a new product that meets the needs of consumers. This

research aims to develop al-khwada products by improving the flavor, color, and texture by adding olive oil or *Nigella sativa*.

## MATERIALS AND METHODS

Millet flour, ghee, black cumin seeds, and olive oil were obtained from Alkamil City, KSA. Alkhwada was prepared by heating the ghee in a pan I, then millet flour was added (1:5 ghee to millet flour) after gentle mixing, one of the following components were added to the mix: 1 and 2% of olive oil or 1 and 2% of black cumin seed.

### Sensory and organoleptic evaluation of prepared al-khwada:

Al-khawada was prepared in the Food Laboratory of Department of Biology, University of Jeddah, Alkamil, KSA. The four developed al-khwada products were first standardized at different levels. Each of the developed al-khwada was compared with conventional al-khwada (control) by 70 panelists (students and faculty members at the University of Jeddah, Alkamil) using the 9-point hedonic scale for different parameters such as appearance, color, texture, aroma, taste, and overall acceptability [13]. The samples were then given to the panelists with an evaluation form. They were asked to taste one sample at a time and record their responses allowing time between samples so that the tasters can record their opinion.

**Statistical analysis:** The data generated from the results of sensory scores were statistically analyzed for the nutritional attributes using SAS program. All experiments were performed in duplicate. The values are expressed as Mean  $\pm$  SD (Standard deviation). The mean values for the descriptive terms and sensory acceptability of al-khwada samples scored using the nine-point hedonic scale were compared using the variance analysis.

## RESULTS

### Sensory evaluation results of developed al-khwada in

**terms of flavor:** It is clear from Table 1 that the addition of 1.0% olive oil to standard al-khwada received the acceptance of 88.4% of the panelists. This can be further broken down to 3.7% in the like very much category 32.8% in the like moderately category and 11.43% in the like slightly, category. This is followed by the addition of 2.0% olive oil which, was accepted by 88.57% of the panelists with 31.43% in the like very much category, 28% in the like moderately category and 21.43% of the panelists in the like slightly category. When compared al-khwada developed with 1.0% and 2.0% olive oil with

that of black seed it was clear that panelist preferred the addition of olive oil.

### Sensory evaluation results of developed alkhwada in

**terms of color:** It is clear from Table 2 that the addition of olive oil to al-khwada by 2% received the acceptance of 87.14% of the panelists with a degree of like extremely at 20% followed by the category of like very much at 15.71%, like moderately at 22.86% and like slightly at 28.57%. The addition of olive oil by 1.0% which received the acceptance of 85% of the panelists with the categories broken down as: like very much 18.86%, like moderately 24.43% and like slightly 27.14%.

**Table 1.** Sensory score (% of acceptance) (9-point Hedonic Scale) for the results of developed al-khwada in terms of flavor.

Grade	Al-khwada with 2% black seed	Al-khwada with 1% black seed	Al-khwada with 2% olive oil	Al-khwada with 1% olive oil	Standard Al-khwada
Like Extremely	0.0	0.0	7.14	8.57	0.0
Like Very Much	0.0	0.0	31.43	35.71	0.0
Like Moderately	3.33	4.29	28.57	32.86	2.86
Like Slightly	5.00	7.14	21.43	11.43	31.43
Neither Like nor Dislike	0.0	0.0	0.0	0.0	0.0
Dislike Slightly	25.00	24.29	2.86	7.14	28.58
Dislike Moderately	33.33	30.00	5.71	4.29	25.71
Dislike Very Much	11.67	14.29	2.86	0.0	11.43
Dislike Extremely	21.67	20	0.0	0.0	0.0

**Table 2.** Sensory score (9-point Hedonic Scale) for the results of developed al-khwada in terms of color.

Grade	Al-khwada with 2% black seed	Al-khwada with 1% black seed	Al-khwada with 2% olive oil	Al-khwada with 1% olive oil	Standard Al-khwada
Like Extremely	3.71	4.29	20.0	14.29	2.86
Like Very Much	4.86	4.29	15.71	18.86	2.86
Like Moderately	2.86	2.86	22.86	24.43	13.29
Like Slightly	12.86	15.71	28.57	27.14	15.71
Neither Like nor Dislike	0.0	0.0	0.0	0.0	0.0
Dislike Slightly	24.29	40.29	10.0	21.29	34.29
Dislike Moderately	15.71	11.43	5.71	10.14	8.57
Dislike Very Much	10	14.29	2.86	7.14	21.42
Dislike Extremely	25.71	24.29	0.0	0.0	0.0

**Table 3.** Sensory score (9-point Hedonic Scale) for the results of developed al-khwada in terms of texture.

Grade	Al-khwada with 2% black seed	Al-khwada with 1% black seed	Al-khwada with 2% olive oil	Al-khwada with 1% olive oil	Standard Al-khwada
Like Extremely	4.29	7.14	7.14	10.00	5.71
Like Very Much	8.57	10.00	20.00	24.29	8.57
Like Moderately	10.00	11.43	18.57	21.43	8.57
Like Slightly	12.86	12.86	12.86	22.86	28.57
Neither Like nor Dislike	0.0	0.0	0.0	0.0	0.0
Dislike Slightly	20.00	18.57	10.00	8.57	17.14
Dislike Moderately	18.57	17.14	11.43	4.29	7.14
Dislike Very Much	12.86	14.29	7.14	8.57	15.71
Dislike Extremely	12.86	8.57	12.86	0.0	0.0

**Sensory evaluation results of developed al-khwada in**

**terms of texture:** As shown in Table 3, the addition of olive oil to Al-khawada at the rate of 1% received the acceptance of 78% of the panelists with the following breakdowns: 24.29% in the category like very much, 21.43% in the like moderately category and 22.86% in the like slightly category. Followed by the addition of olive oil by 2%, which created the acceptance of 57% of the panelists in the categories as follows: like very much 20.00% and like moderately 18.57% and like slightly 12.86%.

As shown in Table 4, the addition of olive oil to al-khawada by 1.0% received the acceptance of 87.15% of the panelists with a degree of like extremely 14.29% ,like very much at 17.14%, like moderately at 32.86%, and like slightly at 22.86% followed by the addition of olive oil by 2% which required to the acceptance of 82.86% of the panelists with a degree of like extremely at 12.86%,like very much at 15.71%,like moderately at 32.86% and like slightly 21.43%.

**Table 4.** Sensory score (9-point Hedonic Scale) for the results of developed alkhwada in terms of whole acceptability.

Grade	Khwada with 2% black seed	Khwada with 1% black seed	Khwada with 2% olive oil	Khwada with 1% olive oil	Standard al-khwada
Like Extremely	0.0	0.0	12.86	14.29	12.86
Like Very Much	0.0	5.71	15.71	17.14	17.57
Like Moderately	2.86	5.71	32.86	32.86	11.43
Like Slightly	8.57	7.14	21.43	22.86	10
Neither Like nor Dislike	0.0	0.0	0.0	0.0	0.0
Dislike Slightly	18.57	28.57	5.71	12.86	18.57
Dislike Moderately	28.57	21.43	7.14	0.0	15.71
Dislike Very Much	24.29	0.0	4.29	0.0	12.86
Dislike Extremely	17.14	15.71	0.0	0.0	0.0

**DISCUSSION**

Table 1 which shows the results of the sensory evaluation by the panelists in terms of flavor. During this evaluation, it was found that, the addition of olive oil by 1% and 2% to al-khwada received a high acceptance from the panelists which can be explained as olive oil containing volatile compounds such as hydrocarbons

and aromatic alcohols and aliphatic and aldehydes esters which gave this distinctive flavor to the developed al-khwada. This is in agreement with the study of Dinnella et al. which reported that, the addition of olive oil strongly influenced the sensory properties (good taste and flavor) of tomato and bean samples [14]. Also, Matsakidou, et al. confirmed the addition of

extra virgin olive oil produced a wide range of volatile compounds, were originated either from extra virgin olive oil or were produced during the baking process [15]. The results of the sensory evaluation by the panelists in terms of color (Table 2), showed that the addition of olive oil by 1% and 2% obtained a high proportion of the panelists acceptance, because the olive oil contains chlorophyll pigment which gives a distinctive color for the developed al-khwada. This is similar to the study of Matsakidou, et al. which reported that the use of olive oil with cake gives a distinctive color because it contains distinctive pigments [15]. Table 3 shows the results of the sensory evaluation carried out by the panelists in terms of texture, it reported that the addition of olive oil by 1% and 2% obtained a high percentage of the panelists acceptance as it contains thick texture and liquidity. This result is like the information in an internet article titled "The distinguished chemist Tariq Ismail Kakhia" which reported that the liquid texture of olive oil is one of the reasons for the successful acceptance of olive oil in food [16]. The replacement of margarine with extra virgin olive oil significantly affected the hardness and the cohesiveness of the Madeira cakes [17].

Table 4 shows the results of the sensory evaluation in terms of panelists acceptability that the addition of olive oil by 1.0% and 2.0% obtained a high acceptability which can be explained by the good flavor and distinctive color and desirable texture of olive oil and therefore give a good acceptance which is in good agreement to the study of Tarancón et al. which reported that the use of olive oil in biscuits gave good general acceptance and more healthier product [17]. It was found in tables (1-4) that the addition of the black cumin seed did not have the satisfaction of the panelists in terms of flavor, color, textures, and general acceptance and that the addition of the black seed did

not add flavor, color, texture, and good acceptance of the developed al-khwada. This result is contrary to the study by Ramadan, which proved that the addition of black seed to the grain gives a distinctive flavor [18]. This is similar to the study by Osman et al., which reported that the addition of black seed to the bread gives a good taste flavor and good overall acceptability [19]. Olive oil has many benefits, including enhancing heart health, reducing the risk of stroke, improving brain function, and stimulating memory [20]. Millet is a rich source of magnesium, which is an important mineral for reducing high blood pressure and the risk of a heart attack or stroke [21]. Therefore, diets that combine millet and olive oil as in the case of al-khwada, it is not surprising that they serve as functional foods that will improve brain functions and activate memory. Research indicates that millet is considered a functional food because it contains health-promoting phytochemicals. For example, millet contains polyphenols and phytates with high antioxidant properties, which make it a regulator of the aging process [22]. It also contains fiber, non-starch sugars, and non-digestible carbohydrates that help lower blood sugar levels [23]. Millet is considered a safe food for people with gluten sensitivity and celiac disease. Millet is also considered a functional food that can treat malnutrition. Some research recommends eating a mixture of millet and dairy products, such as natural ghee, as in the case of al-khwada improved with olive oil or whole black seed [24].

## CONCLUSION

In conclusion, conventional al-khwada can be developed by adding olive oil by 1% and 2% because olive oil contributes good flavor, distinctive color, desired texture, and strong acceptance of the product. More studies are needed to investigate the addition of black

cumin seeds to al-khwada products to improve the good flavor distinctive color and desired texture and good acceptance of al-Khwada.

**Competing interests:** The authors declare that they have no competing interests.

**Authors' contributions:** AAM and AM discussed the idea of developing al-khwada. ANA participates in the study and doing the experimental and lab work, participated in the study design, data collection and analysis of the results. AAM and AM edited and finalized the manuscript for submission, participated in the study.

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