

COMPARISON ON THE ACCEPTABILITY of MUDAFFARA CHEESE USING BLACK CUMIN and SESAME SEEDS DURING STORAGE

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Abstract

This study was conducted in order to compare the effect of adding black cumin and sesame seed on the acceptability of Mudaffara cheese that preserved with or without its whey. The cheese was prepared from fresh cow's milk using two types of flavors; black cumin and sesame seed. The cheese was divided into four portions (800 grams each) and treated as follows: two portions were stored in the whey (cheese with black cumin and cheese with sesame) and the other two portions were stored without whey for 4 - 8 months. All cheese samples were packed into plastic bags and stored at the refrigerator temperature (8°C) and were subjected to evaluation of the organoleptic quality every week during the storage to monitoring their acceptability. The cheese samples stored without whey showed a shorter shelf life compared to those stored in the whey and were deteriorated at week 4. On the other hand, the samples stored in the whey showed significantly ($P < 0.001$) longer shelf life that extended up to 7 weeks. The present study found that all Mudaffara cheeses showed changes in scores of appearance, flavor, taste, saltiness and texture during storage. Moreover all the cheese samples revealed high acceptability according to the panelists. Hence the present study concluded that sesame seeds can be used as additive for flavoring for Mudaffara cheese.

Keywords: Mudaffara cheese, black cumin, sesame seed, organoleptic characteristics, storage period.

Received: 11.07.2019

Reviewed: 09.10.2019

Accepted: 04.11.2019

1. INTRODUCTION

Cheese is the generic name for a group of fermented milk based food products, produced in a wide range of flavors and forms throughout the world (Fox, 1993). Fox (2000) reported that the precise nutritional composition of cheese is determined by multi-factorial parameters, including the type of milk used and the manufacturing and ripening procedures. Cheese is highly nutritious food with many diverse flavor and texture and it can be used as a snack or as a part of dish or prepackaged conveniences food (Guinee, 2004). Moreover cheese provides a useful service in extending the shelf-life of milk (Alalade and Adeneye, 2007).

Cheese processing in Sudan is concentrated mainly in producing white cheese employing traditional technology (El Owni and Osman, 2009; Idris and Alhassan, 2010; Elkhider *et al.*, 2012; Mohamed and El Zubeir, 2018). Also braided cheese locally known as Muddaffara is one of the most popular cheese types in Sudan

(Altahir *et al.*, 2015).

Ahmed (1995) reported that Mudaffara cheese is made from non-pasteurized raw whole milk, partially skimmed or a mixture of skim milk and whole cow's, sheep or goat's milk. The production of jibna mudaffara includes a high percentage of salt and rennet added to the milk to obtain a firm coagulum (Mohammed Salih *et al.*, 2011). Abdel-Razig *et al.* (2014) reported that storage period significantly ($P \leq 0.05$) affected its acceptability and the best acceptability score (4.26) was obtained at day 30 compared to 3.66 score that obtained at the end of the storage period (60 days).

Sesame (*Sesamum indicum* L.) seeds have been grown in tropical regions throughout the world since prehistoric times. Sesame seed is a rich source of protein and is one of the first crops that processed for oil production (Anilakumar *et al.*, 2010). Borchani *et al.* (2010) showed that the seed is an important source of oil (44-58%), protein (18-25%), carbohydrate (~13.5%) and ash (~5%). This study was done to investigate the effect of preservation method

(with or without whey) on the organoleptic characteristics during the storage of Mudaffara cheese using two different additives as flavor; black cumin (*Nigella Sativa*) and sesame seed (*Sesamum indicum*).

2. MATERIALS AND METHODS

2.1 Source of materials

The fresh cow's milk used for manufacturing of Mudaffara cheese was brought from a local farm in Khartoum North. Black cumin (*Nigella sativa*), sesame seed (*Sesamum inidcum*) and sodium chloride (NaCl) were obtained from the local market. The starter culture was obtained from Premier Food Product Dairy Factory, Khartoum North (Sudan). Rennet sticks (Christen Hansen's laboratories – Copenhagen, Denmark was used as 1 stick per 50 kg milk. This study was done during June– August 2013.

2.2 Manufacturing of Mudaffara cheese

The sesame seed was roasted first and left to cool down before it was added to the cheese.

The milk was first filtered from impurities and was divided into two parts; 13 liters each; one to be flavored with black cumin and to the other sesame seed was added as flavor. Then the milk was wormed down to 40°C and 1% of starter culture was added followed by addition of rennet powder (1%) that was dissolved into a glass of tap water and stirred (2–3 minutes) in order ensure uniform distribution of the rennet. The milk was then left undisturbed to settle and to coagulate to form a curd.

After about 40 minutes, the coagulation was complete and the whey was allowed to drain from the curd. The curd was then cut into slices in order to allow more draining of the whey. After that the curd was incubated at 40° C for 1.5 hours until the required elasticity and acidity for kneaing were reached (0.54–0.60% is the desired acisity). During this period, inflatable was measured; every half hour; by dipping a small piece of curd into hot water, then holding it (in hands), kneaing and pulling it to form a cord of about 2 meter long. If the curd breaks before reaching this length,

ripening is considered incomplete. When the curd became smooth paste with satisfactory stretching to a rope of more than 4 meters long and elastic, the ripening was complete. The then whole curd was then cut into strips, and each 4–5 pieces were taken together and put in the hot water (65–75°C) for 3–5 minutes; using wooden paddles; until the curd turned into smooth paste. Then each of the additives (Black cumin or roasted sesame seeds) was added to the hot paste before braiding. The curd was then hand worked and pulled to form a long rope which was then braided, washed by immersing it into cold water.

The two types of cheese were taken after the cooking process and put into stainless steel buckets to let the braided cheeses to be immersed into the sterilized whey to which salt is added (3%) for 12 hours. Two portions of the cheese were stored in the whey (cheese with black cumin and cheese with sesame), while the other two were stored without whey. Then all types of Mudaffara cheese were after packing into plastic bags and stored at the refrigerator temperature (8°C) for 4-8 months.

2.3 Sensory evaluation

Ten untrained panelists were asked to judge on the sensory quality of Mudaffara cheese that include appearance, flavor, taste, texture and overall acceptability using a seven-point scale (Ihekoronye and Ngoddy, 1985). The scores were evaluated as 7 excellent, 6 very good, 5 good, 4 average, 3 fair, 2 poor and 1 very poor.

2.4 Statistical analysis

The obtained data were analyzed using the SPSS (Statistical Package for Social Sciences) microcomputer programmer. Means were separated using LSD.

3. RESULTS AND DISCUSSION

The sensory evaluation scores for all types of Mudaffara cheese showed decreasing values during the storage period (Table 1). The higher score for appearance recorded significant ($P<0.001$) variations at the beginning of the storage period (days 0 and 7), then the score showing a decreasing trend until the end of the storage period.

Table 1: Effect of storage period on sensory evaluation of Mudaffara cheese

Storage period	Day 0	Day 7	Day 14	Day 21
Appearance	5.75±0.19 ^a	5.70±0.19 ^a	3.95±0.19 ^b	3.50±0.19 ^b
Flavor	5.80±0.11 ^a	5.20±0.11 ^b	4.90±0.11 ^b	4.75±0.11 ^b
Taste	5.15±0.22 ^a	4.65±0.22 ^{ab}	4.50±0.22 ^{bc}	4.00±0.22 ^c
Texture	5.90±0.18 ^a	5.75±0.18 ^a	4.85±0.18 ^b	5.20±0.18 ^b
Saltines	6.10±0.21 ^a	3.80±0.21 ^b	4.15±0.21 ^b	3.95±0.21 ^b
Overall acceptability	5.10±0.27 ^a	4.94±0.27 ^a	4.35±0.27 ^a	4.35±0.27 ^a

a,b,c,d,... means value within the same row with different superscripts letters are significantly different at P<0.001

This result disagreed with Abdel-Razig *et al.* (2014) who reported that the storage period significantly ($P \leq 0.05$) affected the appearance of the braided cheese; the lowest value (3.00) was obtained at the beginning of the storage period, while the best value (4.14) was found after a month of storing the cheese. The scores for appearance of Mudaffara cheese showed changes during the storage period (Table 2 and 3), these result are in agreement with the findings of El Owin and Hamid (2008).

According to the panelist, the best appearance was found in cheese stored without whey (Table 2). After 21 days of storage, the scores for appearance revealed that the cheese flavored with sesame was significantly ($P < 0.001$) better compared to that flavored with black cumin. However both cheeses stored without whey showed significantly ($P < 0.001$) better score for appearance compared to that kept in the whey. This might be because the addition of black cumin (2.5% and 3.5%)

rendered the cheese too dark and caused negative effect on appearance and color (Tarakci *et al.*, 2004; Abdel-Razig *et al.*, 2014). The data showed significant ($P < 0.001$) variations in flavor scores for Mudaffara cheese during the storage (Table 1, 2 and 3). This may be due to increasing level of acid taste, which could be due to fat content and higher acidity in sesame cheese (not shown data). Also Suliman *et al.* (2019) concluded that the level of fat content affected the Sudanese cheese acceptability and properties. Similarly Muir *et al.* (1997) and Nour El Diam and El Zubier (2007) reported that the differences in processed cheese flavors are due to fat content. Moreover Gbadamosi *et al.* (2017) that the oil absorption capacity of the sesame protein isolate was 131% and that the interaction of oil with proteins are very important in food systems because of the effects on the flavor of foods.

Table 2: Effect of preservation methods and type of additives on sensory evaluation of Mudaffara cheese during storage

Parameters / Treatments	C	Cw	S	Sw
Appearance	5.20±0.19 ^a	3.65±0.19 ^c	5.60±0.19 ^a	4.45±0.19 ^b
Flavor	5.20±0.11 ^a	5.60±0.11 ^a	5.60±0.11 ^a	4.25±0.11 ^b
Taste	4.85±0.22 ^b	4.15±0.22 ^c	5.90±0.22 ^a	3.40±0.22 ^d
Texture	5.55±0.18 ^a	5.55±0.18 ^a	4.95±0.18 ^b	5.65±0.18 ^a
Saltines	4.10±0.21 ^b	4.50±0.21 ^b	5.25±0.21 ^a	4.15±0.21 ^b
Overall acceptability	5.05±0.27 ^a	5.00±0.27 ^a	5.25±0.27 ^a	3.65±0.27 ^b

c= Mudaffara cheese flavored with black cumin kept without whey
 cw= Mudaffara cheese flavored with black cumin kept with whey
 s= Mudaffara cheese flavored with sesame seed kept without whey
 sw= Mudaffara cheese flavored with sesame seed kept with whey

Table 3: Effect of storage method and additive type on appearance and flavor of Mudaffara cheese during storage

Parameters Treatments storage	Appearance				Flavor			
	With whey		Without whey		With whey		Without whey	
	Cumin	Sesame	Cumin	Sesame	Cumin	Sesame	Cumin	Sesame
Day 0	5.80 ±0.38	4.60 ±0.38	6.00 ±0.38	4.40 ±0.38	5.60 ±0.40	5.00 ±0.40	5.60 ±0.40	4.60 ±0.40
Day 7	4.40 ±0.38	2.00 ±0.38	5.80 ±0.38	2.40 ±0.38	5.60 ±0.40	5.40 ±0.40	6.40 ±0.40	5.00 ±0.40
Day 14	6.20 ±0.38	5.00 ±0.38	5.00 ±0.38	6.20 ±0.38	6.00 ±0.40	5.40 ±0.40	6.40 ±0.40	4.60 ±0.40
Day 21	6.40 ±0.38	2.40 ±0.38	6.20 ±0.38	2.80 ±0.38	3.60 ±0.40	3.20 ±0.40	4.80 ±0.40	5.40 ±0.40
Day 28	2.20 ±0.44	4.20 ±0.44	D	D	4.40 ±0.50	4.60 ±0.50	D	D
Day 35	4.0 ±0.44	4.20 ±0.44	D	D	5.20 ±0.50	3.0 ±0.50	D	D
Day 42	1.8 ±0.44	3.0 ±0.44	D	D	2.60 ±0.50	2.80 ±0.50	D	D
Level of significant	***							

a,b,c,d,... means value within the same columns and rows with different superscripts letters are significantly different at P<0.001

D: cheese deteriorated

Table 4: Effect of storage method and additive type on taste and texture of Mudaffara cheese during storage

Parameters Treatments storage	Taste				Texture			
	With whey		Without whey		With whey		Without whey	
	Cumin	Sesame	Cumin	Sesame	Cumin	Sesame	Cumin	Sesame
Day 0	4.40 ±0.44	3.80 ±0.44	5.00 ±0.44	6.20 ±0.44	5.80 ±0.37	4.40 ±0.37	6.60 ±0.37	5.40 ±0.37
Day 7	4.60 ±0.44	2.60 ±0.44	6.20 ±0.44	3.20 ±0.44	6.60 ±0.37	6.20 ±0.37	6.60 ±0.37	2.80 ±0.37
Day 14	5.40 ±0.44	6.40 ±0.44	6.20 ±0.44	5.60 ±0.44	4.60 ±0.37	4.20 ±0.37	5.60 ±0.37	5.40 ±0.37
Day 21	4.20 ±0.44	3.20 ±0.44	3.20 ±0.44	3.00 ±0.44	6.00 ±0.37	6.00 ±0.37	4.80 ±0.37	5.80 ±0.37
Day 28	4.60 ±0.47	5.00 ±0.47	D	D	3.80 ±0.34	4.60 ±0.34	D	D
Day 35	5.20 ±0.47	4.80 ±0.47	D	D	2.80 ±0.34	2.40 ±0.34	D	D
Day 42	2.80 ±0.47	2.80 ±0.47	D	D	2.20 ±0.34	2.20 ±0.34	D	D
Level of significant	***							

a,b,c,d,... means value within the same columns and rows with different superscripts letters are significantly different at P<0.001

D: cheese deteriorated

Storage period significantly ($P \leq 0.05$) affected the flavor score of the braided cheese. The lowest score (3.00) was obtained at the beginning of the storage, while the highest score (4.14) was recorded after a month of storing the cheese (Abdel-Razig *et al.*, 2014). It was clear that the cheese flavored with sesame and kept in the whey revealed significantly ($P < 0.001$) lower score flavor (Table 2 and 3), which might be due to the high content of fat in sesame (Anilakumar *et al.*, 2010; Gbadosi *et al.*, 2017). This result agreed with that obtained by Singh and Kanawjia (1989) who reported that the sensory characteristic of flavor and texture of the processed cheese were reduced during the storage of the cheese. However the present result disagreed with Tarakci and Kucukoner (2006) and Nour El Diam and El Zubier (2007) who reported increasing scores

for both flavor and overall acceptability during ripening, which could be attributed to the variation of the cheese types and their processing conditions.

The taste scores of the Mudaffara cheese showed high significant ($P < 0.01$) differences during day 0, 28 and 35 of the storage, with slight decrease during storage period (Table 1). Mudaffara cheese flavored with sesame kept without whey showed a significant ($P < 0.001$) higher score for taste compared to other cheeses (Table 2), which could be due to the higher content of fat and acidity in sesame seed. Anilakumar *et al.* (2010) reported that sesame seeds add a nutty taste and a delicate, almost invisible crunch to many Asian dishes. After 21 days of storage, the average scores for taste revealed that there were no significant variations between both cheeses kept with oe

without their whey (Table 2 and 4). The sesame seed had a preservation characteristic so it can be used in products like baked goods, confectionery products and for preservation of the sweets (Namiki, 1995). Also black cumin has significant effect as preservative (El Zubeir *et al.*, 2005; Abdel-Gadir *et al.*, 2013). Moreover black cumin (*Nigella sativa L.*) contains several bioactive molecules and functional ingredients that are present in its fixed and essential oil (Sultan, 2009). Evidence is also available supporting the utilization of *Nigella sativa* and its bioactive components in a daily diet for health improvement (Butt, 2010). Black cumin played a remarkable inhibitory effect on the growth of *Staph aureus*. Moreover, the presence of phytosterols in amounts of 0.33 to 0.36% further strengthens its hypoglycemic and hypcholesterolemic perspectives (Cheikh-Rouhoua, 2008).

The texture scores changed during storage period with a decreasing trend during the storage period (Table 1, 2 and 4). The higher score of texture was found at the beginning of the storage (day 0, 7 and 28), then decrease significantly ($P < 0.001$) towards the end of storage period. Similarly Nour El Diam and El Zubier (2007) found that the processed cheese made from Sudanese white cheese after 15 days of ripening was more stable and acceptable compared to that made after 30 days of ripening. Fox *et al.* (2000) reported that cheese texture is a composite of sensory attributes resulting from a combination of physical properties perceived by the sense of sight and touch. However Abdel-Razig *et al.* (2014) reported that the lowest value (3.32) of the texture score of braided cheese was obtained at the beginning of the storage, while the highest (4.48) was recorded at the end of 30 days of the storage period. The lower score was obtained for Mudaffara cheese flavored with sesame and kept without whey, while other cheeses showed high texture score. Wium *et al.* (2003) reported that both compositional and process parameters are known to influence texture of cheese.

After 21 days, the average score for texture revealed that there was non significant ($P > 0.05$) variations between cheese flavored with sesame and that flavored with black cumin (Table 2 and 4). Van heggen *et al.* (2004) found that cheese texture changed significantly ($P < 0.05$) during the first 4–8 weeks of storage. However Schar and Bosset (2000) reported that structure and flavor of processed cheese during storage at room temperature were slowly changed. The lowest score (3.65 ± 0.27) was reported for Mudaffara cheese flavored with sesame seed and kept in the whey. This suggested that when sesame seed are used as flavor for Mudaffara cheese, the cheese has to be removed from the whey immediately after ripening.

4. CONCLUSION

It was concluded that the panelist showed a high affinity for Mudaffara cheese made from sesame. Moreover, sesame is available in Sudan and it has good flavor and good properties for keeping the quality of the product. This result recommended that processing and consumption of braided (Mudaffara) cheese flavored with sesame seed have to be promoted.

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