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Physicochemical and Sensory Characteristics of Sudanese Low-Fat Cheese during Storage Period

Ibrahim Elkhidier Ahmed Elkhider[(1)] and Omer Ibrahim Ahmed Hamid[2]*
[1]*Department of Animal Production, Faculty of Agriculture and Natural Resources, Kassala University, Eastern Sudan, New Halfa, Sudan.*
[2]*Department of Dairy Science and Technology, College of Animal Production Science and Technology, University of Science, Sudan and Technology, Khartoum North, Sudan.*

Abstract*: This study was carried out in the milk processing units at College of Animal Production Science and Technology, Sudan University of Sciences during September 2014-January 2015. The chemical and sensory characteristics of Sudanese low-fat cheese were investigated as affected by different levels of gum Arabic and storage period. Three hundred and fifty liters (350) of standardized milk with (3%, 2.5% and 2%) of fat were prepared after purchase full cream milk from a private farm at Al Haj Yousif, Khartoum North. Seven treatments were carried out as follows: First treatment is the control in which cheese milk had no additive (3%) of fat. In the second and third with 3% of fat, fourth and fifth with 2.5% of fat and sixth and seventh with 2% of fat, 0.5 and 0.75% of gum Arabic were added respectively to cheese milk before pasteurization then low-fat cheese was made and stored at refrigerator (4°C) for 120 days. Physicochemical and sensory evaluation was done for the cheese samples at day zero, 30, 60, 90 and 120 days intervals. The cheese statistical analysis obtained that gum Arabic significantly (P< 0.05) affected the chemical composition of the cheese. The results also showed that crude protein fat, total solids, pH, volatile fatty acid and ash were significantly (P< 0.05) affected by both levels of gum Arabic and storage period. The results obtained there were significantly differences (P<0.05) between control cheese and the other with 0.5 and 0.75 gum Arabic respectively in all parameters.*

Keywords: *Sudanese low-fat cheese, Milk; chemical, storage, gum Arabic.*

I. Introduction

Various kinds of fresh soft cheese are the most popular cheese among consumers in Sudan. They are made on small holder's dairy farms from cow, sheep and goat milk and consumed after maturation or in fresh farm, white fresh cheese from many areas of Sudan are economically important for these areas. The traditional method of production involves renneting, curd formation, fermentation and final preparation for market [1] and [2].Cheese plays an important role in the Sudanese diet, and many people eat a certain amount of cheese with at least twice per week in one of their meals, most of the cheese is consumed either directly or with bread [3].

According to [4] cheese is highly concentration product which is rich in protein and minerals such as calcium and phosphorus, essential amino acids; therefore it is an important food in the diet. An excessive consumption of fat has been associated with an increased risk of health problems such as obesity, diabetes and cardiovascular diseases. Cheese is an excellent source of protein and mineral amino acids therefore it is an important food product for both young and old people. But low-fat cheese is usually characterized as having poor body and flavour. Therefore, it is crucial to find ways of improving the acceptability of the product. The aim of this research was to investigate the possibility of using gum Arabic powder in the production of low-fat cheese made from cow milk and to create organoleptic properties of a fat product in a low-fat product. Also objective this research was to develop a composition of a Sudanese low-fat cheese made from standardized milk and to determine the influence of gum Arabic on physicochemical, organoleptic properties of the product.

II. Materials and Methods

Seven treatments were carried out in this study and five level of storage period were used.

Materials

Gum Arabic powder from the pharmacy at local market. Cow's milk was purchased from the private farm. Power animal rennet was obtained from char-Hansen's Laboratories (Copenhagen, Denmark) table salt from the local market.

Methods

Low-fat cheese was processed using 350 pounds of standardized milk (3%, 2.5% and 2% of fat) according to the method of [1]. The milk was then divided into seven equal portions (50 liters each) gum Arabic powder was added at the levels of 0.5 and 0.75 to the milk respectively, while control sample with 3% of fat had no additive or left free without any additive of gum Arabic.

The cheese milk in all treatments was pasteurized at 72°C for one minute. The milk was then called to 42°C. Rennet powder (1 gram/50 liters) was added to the milk at 40°C. Milk was then stirred for 10 minutes and left until coagulation occurred. The curd was then cut into small cubes (5x5x5cm). After draining, salt at 7% (w/v) was mixed with the curd. The curd was poured into clean wooden molds lined with cheese cloth and pressed overnight. The manufactured cheese samples were stored into triplicate sterile poly the line pages (capacity 300 grams) and stored at refrigerator (4°C) for 120 days.

Physicochemical and sensory evaluations of cheese samples were carried out at zero day, 30, 60, 90 and 120 days intervals.

Chemical analysis

Total solids, fat, crude protein and ash were determined according to [5] and pH was determined according to[6]. Volatile fatty acids were determined according to [7].

Sensory evaluation

The sensory characteristics of the cheese samples were judge by 10 untrained panelists for colour, flavour, texture and saltiness by using sensory evaluation sheet according to [8].

Statistical analysis

Statistical analysis was done by using [9]. Factorial models were used to estimate the effect of storage period, gum Arabic powder and interaction between them on the chemical composition of the cow's milk low-fat cheese. Least significance differences (LSD) was used for mean separation between the treatments. The level of significance (a 0.05) was used in this study.

III. Results

Effect of different levels of gum Arabic on the physicochemical and sensory evaluation of Sudanese low-fat cheese

The effect of gum Arabic levels on the chemical composition of Sudanese low-fat cheese are presented in Table 1. As shown in the table crude protein of the cheese samples decreased significantly ($P< 0.05$) with increase in gum Arabic levels. The highest crude protein (26.09 ± 2.24%) was in the control cheese, while the lowest one (23.66 ± 3.22%) was recorded in the cheese sample with 0.75% of gum Arabic (Table 1). The result illustrated that the fat contents of the cheese sample were significantly ($P< 0.05$) different in all treatments, the highest fat (13.99 ± 1.27%) was in the cheese sample with 0.5% of gum Arabic, while the lowest one (13.61 ± 1.21%) was in the control cheese (Table 1). The total solids of the cheese samples increased significantly ($P< 0.05$) with the levels of gum Arabic. The highest total solids (66.85 ± 6.54%) were in the cheese sample with 0.5% of gum Arabic, while the lowest one (64.45 ± 6.11%) was recorded in the control cheese. The pH contents of the control cheese samples was significantly ($P< 0.05$) higher (5.41 ± 0.53%) in comparison with the cheese samples made from 0.75% of gum Arabic (5.21 ± 0.57%) Table (1).

The highest volatile fatty acid (2.62 ± 0.50 0.1N NaOH/100 gm cheese) was for the cheese samples with 0.5% of gum Arabic, while the lowest 2.31 ± 0.32 0.1N NaOH/100 gm cheese) was in the control cheese samples (Table 1). The results as observed that significant ($P< 0.05$) variation were found in the ash contents of the cheese samples in all treatments, the highest (ash 6.48 ± 0.72%) was recorded in the cheese sample with 0.75% of gum Arabic, while the lowest one (5.24 ± 0.75%) was found in the control cheese samples (Table 1).

Results in Table (2) illustrated the effect of gum Arabic levels on sensory characteristics of the low-fat cheese. Significant variation ($P< 0.05$) was found in the colour, flavour, texture and saltines of the cheese samples. However, significant differences ($P< 0.5$) were observed of colour of cheese samples. The highest colour scores were recorded for the control cheese samples, while the lowest one was in the cheese with 0.07% of gum Arabic. The cheese with no additive of gum Arabic recorded highest flavor, while the cheese sample with 0.05% of gum Arabic recorded the lowest one (Table 2). The control cheese samples recorded the highest texture scores, while the cheese samples with 0.5% of gum Arabic recorded the lowest one.

The lowest saltiness of the cheese samples was recorded in the cheese samples with 0.5% of gum Arabic while the highest one was recorded in the control cheese samples (Table 2).

Effect of storage period on the chemical composition and sensory characteristics of Sudanese low-fat cheese

Data in Table (3) illustrated the effect of storage period on the chemical composition of Sudanese low-fat cheese. The results revealed that the crude protein of the cheese samples significantly ($P< 0.05$) increased from (21.82 ± 3.49%) at day zero to the (25.47 ± 1.77%) at day 120 of the storage. The total solids contents of the cheese samples significantly ($P< 0.05$) affected by the storage period (Table 3) the highest total solid content (70.59 ± 5.86%) at day while the lowest one (59.29 ± 4.03%) at day zero. The pH significantly ($P< 0.05$) decreased from day zero (5.90 ± 0.06%) to 4.44 ± 0.14%) at day 120. Volatile fatty acids showed non-significant ($P< 0.05$) differences affected by storage period. It is decreased from day zero up to the day 120 (Table 3). The fat content in the cheese samples was significantly ($P< 0.05$) affected by the storage period

(Table 3) the highest fat content (14.39 ± 1.48%) was found at day 90, while the lowest one (13.11 ± 0.84%) was at day 60. The ash contents increased from (5.60 ±0.89%) at day zero up to (6.12 ± 0.40%) at day 120 (Table 3). Results in Table (4) illustrate sensory characteristics of the cheese samples as affected by the storage period. The results indicated that significant variations (P< 0.05) were observed in the colour, flavour, texture and saltiness. The best colour was for the cheese sample at day 60 and thereafter decreased in scores. The flavour and saltiness of the all cheese samples showed the same trend, while the texture decreased at day 60 and at day 90 then increased at day 120 Table (4).

IV. Discussion

Effect of gum Arabic levels on chemical composition and sensory properties of Sudanese low-fat cheese

The protein of the cheese samples was affected by gum Arabic levels Table (1). It was decreased with the levels of gum Arabic. The decreased of protein could be attributed to inhibition of proteolytic and lipolytic activities of microorganisms by low storage temperature or could be due to attributed to absorption of high level of moisture by curd. These results were in agreement with those reported by [10] who studied the effect of lime and grapefruit extract as coagulants on chemical composition of Sudanese white soft cheese during ripening. Our results were not in line with those of 11] who stated that protein contents increased with the levels of gum Arabic. fat content of the cheese samples increased with the levels of gum Arabic (Table 1). These results are in harmony with these reported by [12] our results were similar with those of [11]. The ash content showed the same trends as fat contents Table (1). The high ash contents of the cheese samples with gum Arabic levels could be due to the nutrient and minerals contents of gum Arabic. These results were in line with those reported by [13] and [14] and [15].

Total solids of the cheese sample was affected by gum Arabic levels (Table 1) the highest total solids with gum Arabic levels could be attributed to the high moisture content in the cheese made from different levels of gum Arabic these results were in agreement with those reported by[4] who stated that the total solids increase in cheese curds made from UFC led to an increase in moisture-binding capacity in comparison with cheese curds made from unconcentrated SM. Similar results were obtained by [16] who studied the effect of different levels of soybean milk on the chemical composition of the cheese made from buffalo milk. Moreover, [17] and [18]who reported that the same results, the volatile fatty acids as same trends of results. pH of the cheese samples decrease with the levels of gum Arabic. The decreased of the pH could be due to the increase of moisture content or increased of the acidity these results were harmony with those of [19]. Similar results were obtained by [4]. Data shown in Table (2) indicated that the cheese made from milk without gum Arabic recorded the highest values for colour, flavour, texture and saltiness. The best for all parameters were recorded by the cheese made without additive (gum Arabic) this could be due to the good sources of milk used in this study. Thesis results were in line with those reported by [20]; [16].

Effect of storage period on chemical composition and sensory properties of Sudanese low-fat cheese

Total solids, crude protein and ash increased during the storage period (Table 3). This increased in total solid contents could be attributed to decrease in the moisture content as the results of lactic acid developments which caused curd contraction [21]. Similar results were obtained by [22]; [23] increased in ash contents could be due to preservation effect of the gum Arabic on the cheese components. These results were in harmony with those of [21]. Who stated that the high ash content of the cheese samples with the cumin oil concentration could be due to preservation effect of the cumin oil on the cheese components. The storage period showed significantly (P< 0.05) variation in all the sensory parameters Table (4). The highest scores for all sensory characteristics were at day zero and in colour at day 60, 90 and at day 120, while in flavour, texture and saltiness the scores decline afterwards and these declines might be due to the lipolytic and proteolytic action of microorganisms.

Concluded

It could be concluded that the gum Arabic levels had significant effect on the total solids, protein, ash, fat, VFA and pH contents of Sudanese low-fat cheese and its improve the quality of low-fat cheese during the storage period.

Table1: Effect of different levels of gum Arabic on physicochemical characteristics of Sudanese low-fat cheese.

Gum arabic level	Physicochemical characteristics					
	Protein (%)	Fat (%)	Total solid (%)	pH (%)	VFA 0.lN NaOH/l00 g	Ash (%)
0	26.09±2.24 a	13.61±1.21 c	64.45±6.11 c	5.41±0.53 a	2.31±0.32 c	5.24±0.75 c
0.5	24.29±2.50 b	13.99±1.27 a	66.85±6.54 a	5.23±0.58 b	2.62±0.50 a	6.24±0.95a
0.75	23.66±3.22 c	13.89±1.60 b	66.77±6.02 b	5.21±0.57 c	2.41±0.32 b	6.48±0.72 a
LS	**	**	**	**	**	**

Mean Values bearing different superscripts within rows are significantly (P< 0.05).
L.S. = Levels of significance.

Table 2: Effect different levels of gum arabic on sensory characteristics of Sudanese low-fat cheese.

Gum arabic levels	Sensory characteristics			
	Colour (%)	Flavour (%)	Texture (%)	Saltines (%)
Zero	6.08±1.15 a	5.36±2.12 a	4.40±2.12 a	4.50±1.37 a
0.5	5.20±1.30 b	4.48±1.83 c	3.98±1.92 c	4.23±1.28c
0.75	5.15±1.41 c	4.49±1.95 b	4.16±2.03 b	4.27±1.27 b
LS	**	**	**	**

Mean Values bearing different superscripts within rows are significantly (P< 0.05).
L.S. = Levels of significance

Table 3: Effect of storage period on physicochemical characteristics of Sudanese low-fat cheese.

Storage period (days	Physicochemical characteristic					
	Protein (%)	Total (%)	pH (%)	VFA 0.lN NaOH/l00 g	Fat (%)	Ash (%)
Zero	21.82±3.49	59.29±4.03	5.90±0.06a	2.50±0.67 b	14.12±1.77	5.60±0.89cd
30	23.35±2.07	67.20±5.09	5.69±0.14b	2.49±0.38 c	13.81±1.25 d	5.82±0.88 d
60	25.26±2.99	69.28±4.61	5.36±0.17 c	2.64±0.21 a	13.11±0.84 cd	6.45±0.98 b
90	25.48±1.96	66.07±4.95	4.85±0.28 d	2.46±0.29 d	14.39±1.98 a	6.98±0.61 a
120	25.47±1.77	70.59±5.86	4.44±0.14 cd	2.34±0.34 cd	14.03±1.29 c	6.12±0.40 c
LS	**	**	**	**	**	**

Mean Values bearing different superscripts within rows are significantly (P< 0.05).
L.S. = Levels of significance

Table 4: Effect of storage period on sensory characteristics of Sudanese low-fat cheese.

Storage period (days)	Sensory characteristics			
	Colour (%)	Flavour (%)	Texture (%)	Saltines (%)
Zero	4.47±1.43 cd	6.47±1.43 a	6.54±1.40 a	5.51±1.32
30	4.93±1.45 d	5.31±1.66 b	4.05±1.25 c	4.09±0.99
60	5.97±1.00 a	4.61±1.33 c	2.83±1.30 d	4.27±1.13
90	5.81±0.98 b	3.89±1.02 d	2.56±1.27 cd	3.87±0.99
120	5.35±1.47 c	2.17±0.89 e	4.84±1.81 b	3.62±0.98
LS	**	**	**	**

Mean Values bearing different superscripts within rows are significantly (P< 0.05).
L.S. = Levels of significance

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