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(RESEARCH ARTICLE)

Attempting to produce Egyptian Tallaga cheese with International Specifications

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Abstract

This study is designed to make adjustments to the traditional Tallaga cheese manufacturing method to reach cheese with international soft cheese specifications with good economic feasibility by changing the traditional method of salting, which depends on adding salt to milk directly to salting in a brine solution after manufacturing and after reaching the best rate of salting and best time in a brine solution, animal rennet, which is a source of pathogenic microbial contamination, is replaced with microbial rennet, and accordingly the best percentage of microbial rennet is reached, and the next stage comes, which is to reach the best proportion, then in the end, adjust the proportions of cow's milk to buffalo to reach the best percentage that gives good economic feasibility between the modified Tallaga sample with the traditional sample. With each of these parts, we determined the chemical composition (pH values, moisture%, Fat%, Protein%, Salt%), Microbiological analysis (Total bacteria count cfu X 10^6, lactic acid bacterial count cfu X 10^4, Total Mold and Yeast count cfu X 10^2 and coliform group) and Organoleptic evaluation (Points).

Keywords: Tallaga cheese Chemical composition; TBC, LAB; Organoleptic properties

1. Introduction

Tallaga cheese is Egyptian unripened soft cheese, usually made from heated milk with adding low concentration of salt and stored in the refrigerator until consumption within two weeks. Egyptian consumers demand for Tallaga cheese increases mainly because it is low salt content and mild taste. Tallaga cheese is made from skimmed cow or buffalo milk, or their mixtures cut into suitable pieces to be directly consumed as fresh cheese. One of the recent trends in cheese manufacture is the production of cheese with natural flavor and high nutritional value and good microbiological quality to the consumer in a short time. The shelf-life of refrigerated non-sterile dairy products, including cheese is generally limited 1-3 weeks depending upon the quality of the raw materials, processing conditions, and post processing conditions, and post processing handing [1]. Tallaga means in Arabic refrigerator, so this cheese should be ripened in low temperature storage rooms. Only 6% salt was added to the cheese milk [2]. The manufacturing process of the Egyptian dairy products was originated since the Pharaonic period from 3200 to 332 BC and was developed through the Greco-Roman period from 332 to 641 AD, and then in the Arab Islamic period 641 AD until now. The manufacturing process of the Egyptian dairy products was very well developed, and modern automation took place in the large cities in both lower and upper Egyptian governorates. The manufacturing process of the traditional dairy products in the frontier governorates must be intensively and carefully investigated because it has not been previously studied [3]. The percentage of salt differs according to the season of the manufacture and the ripening temperature of the cheese. For refrigerator stored cheese, known locally as 'Tallaga cheese', salt is added to the milk at a level of 5-6% in winter, 6-7% in spring and autumn, and 7-8% in summer [3]. Ghada et al. (2002) reported that the fresh Tallaga cheese contained moisture content ranged between 58.17% to 66.02%, protein 10.80% - 15.60%, fat 11.90% -16.95%. Rennet is an enzyme mixture of chymosin types A, B and C as well as pepsin from stomach of claves and other ruminant mammals. The most highly active enzyme in animal rennet is chymosin. It causes the coagulation of milk by cleaving the Phe105-Met106 bond of k-casein. The coagulation of the milk is traditionally made by calf rennet in White cheese manufacturing.

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Animal rennet is traditionally manufactured by extracting the abomasum, the fourth stomach of young ruminants, mainly of calves [5]. Coagulation of milk is a basic step in the manufacture of most cheeses and can be achieved by several proteolytic enzymes from various sources, such as different animal rennet, microbial proteinases and proteinases extracted from fruits and plants [6]. Traditional cheeses also obtain their flavor intensity also from the non-starter lactic acid bacteria (NSLAB), which are not part of the normal starter flora but develop in the product, particularly during maturation, as a secondary flora. The isolation and optimization of wild-type strains from traditional products, to be used as starter cultures in cheese processing, is indeed a highly active field of research in food science today [7]. Starter application in cheese making is a very good tool to produce healthy distinguished cheese, application of starter demand pasteurized or heat-treated cheese milk. Some lactic acid bacteria are regarded as probiotics had the ability to produce functional foods. Developed countries recently applied such microorganisms to produce various functional healthy foods. The very common members of probiotic are Bifidobacteria and Lactobacillus [8]. Reducing the amount of sodium chloride in cheese is particularly challenging for the industry because salt has very specific functions in cheese production that affect flavour, body, texture, and extended shelf life [9]. Salt has several functions in cheese. Rind formation for brine-salted cheeses, inhibition of growth of microorganisms, ripening, texture, water binding, aroma and taste are modulated by salt. It is an important contributing factor for food safety and for the suppression of spoilage bacteria or variety specific undesired bacteria in cheese. For brine-salted, smear ripened, the loaf size, water and fat content, temperature, pH, flow of the brine and salt addition in the smear water [10]. The aim of study is to produce Tallaga cheese with good specifications commensurate with the international specifications of soft cheese by changing the type of rennet, replacing the traditional method of salting, which relies on adding salt to milk directly to soaking in a brine solution, adding a starter of different ratios, adjusting the proportions of cow's milk to buffalo, and finally the economic feasibility study of what it has reached.

2. Material and methods

2.1. Materials

Milk: Fresh whole cows' and buffaloes' milk used in this study was obtained from a local farm, Damietta, Egypt. Rennet: Using two types of rennet was used during this study: The first type is local Calf animal rennet brought from local market; 1 ml of rennet was applied for 1 L of salty milk for making traditional Tallaga cheese, and the second type is microbial rennet powder purified from protease rhizomucor miehei obtained from DANISCO FRANCE for making modified Tallaga cheese. Commercial clean cooking salt (Sodium Chloride) obtained from the local market. Fine calcium chloride "Food grade" was obtained from Caso Co., Italy. The starter culture being used in this study were freeze-dried culture DVS of mesophilic bacteria called commercially "Dairy 40" obtained from (Ch. Hansen's Lab A/S Copenhagen, Denmark) and kept under suitable conditions until use.

2.2. Media

Nutrient agar medium: This medium was used for total bacterial count [11]. De Man Rogosa Sharpe Agar (MRS Agar): This medium was used for Cultivation of Lactobacillus species [12]. MacConkey broth: This medium was used for the selective isolation and cultivation of coliforms according to [11]. Potato Dextrose Agar (PDA): This medium was used for Cultivation of fungi and yeast [11].

2.3. Methods

Traditional Tallaga cheese making (Control): The treatment of traditional Tallaga cheese without whey were manufactured according to the method adopted by [13] with some modifications.

Steps of modified Tallaga cheese making: Modification of traditional Tallaga cheese has gone through many stages to reach the perfection manufacture which achieve the highest improvement of Egyptian Tallaga cheese. In the following parts we will make the same steps of traditional Tallaga cheese and change one factor one in manufacture and when we choose the optimal sample, it will be ready to new step with new change.

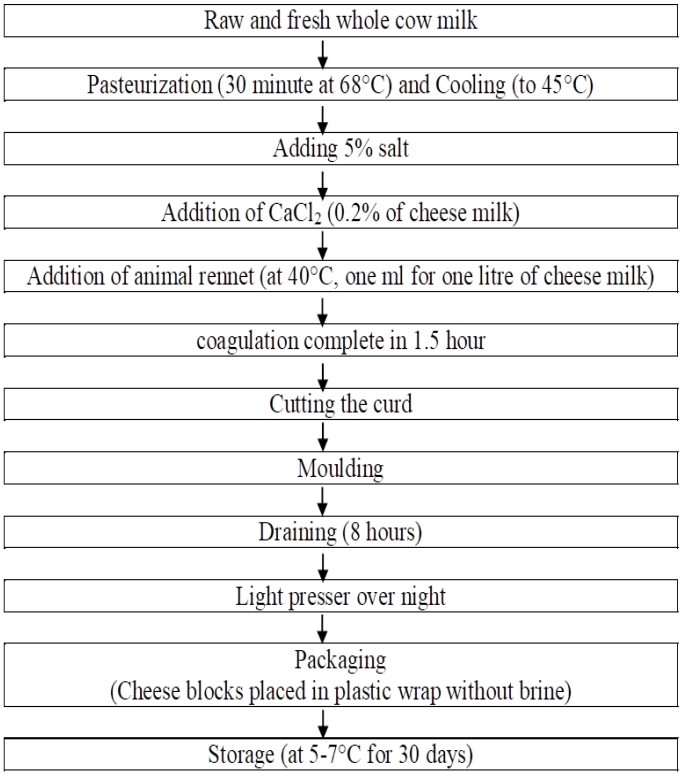

Figure 1 Tallaga cheese making (Control)

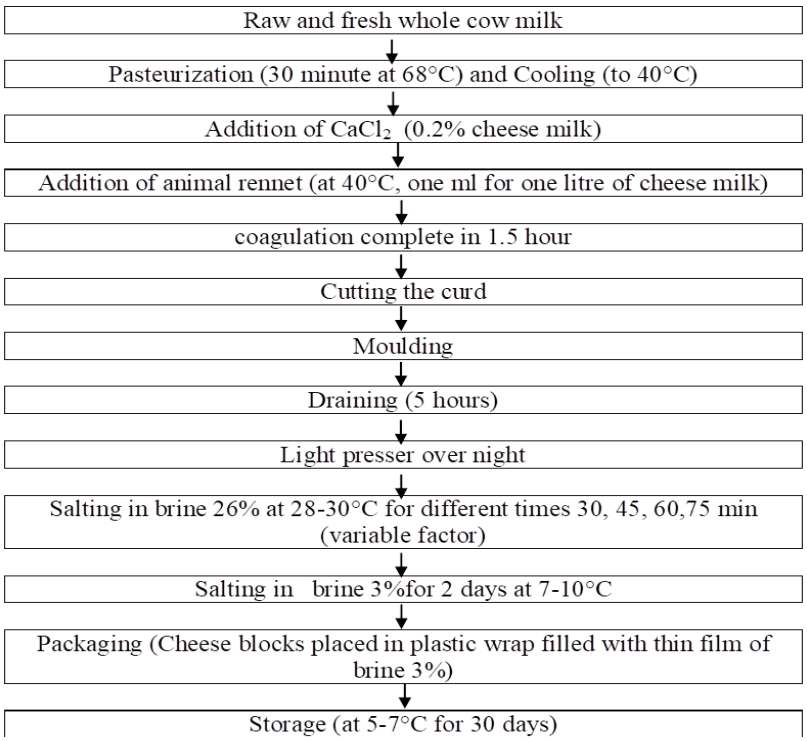

Figure 2 Modified Tallaga cheese making step one

Salting in brine instead of milk salting is considered the unique step is changed at first to improve the manufacture of traditional Tallaga cheese. As international dairy federation recommendations for brine-salted cheeses, brining time and brine concentration are important factors affecting on processing, so the main variable factor in this chapter is the time in saturated brine (26%), treatment (B) stay 30 min, treatment (C) stay 45 min, treatment (D) stay (60) min, treatment (E) stay 75 min, after that (3%) brine that receives cheese until the salting is complete, which takes about two days, In the third day cheese pieces are placed in a thin film of the same brine (3%), that`s zero time which we begin analyzes and continue every 7 days. In this chapter will comparative traditional Tallaga cheese (A) which made from salted milk with modified Tallaga cheese which salted in brine, (B, C, D, and E), The optimal treatment is (C) which stay 45 minutes in 26 % brine, and it will be ready to the second modification of manufacture.

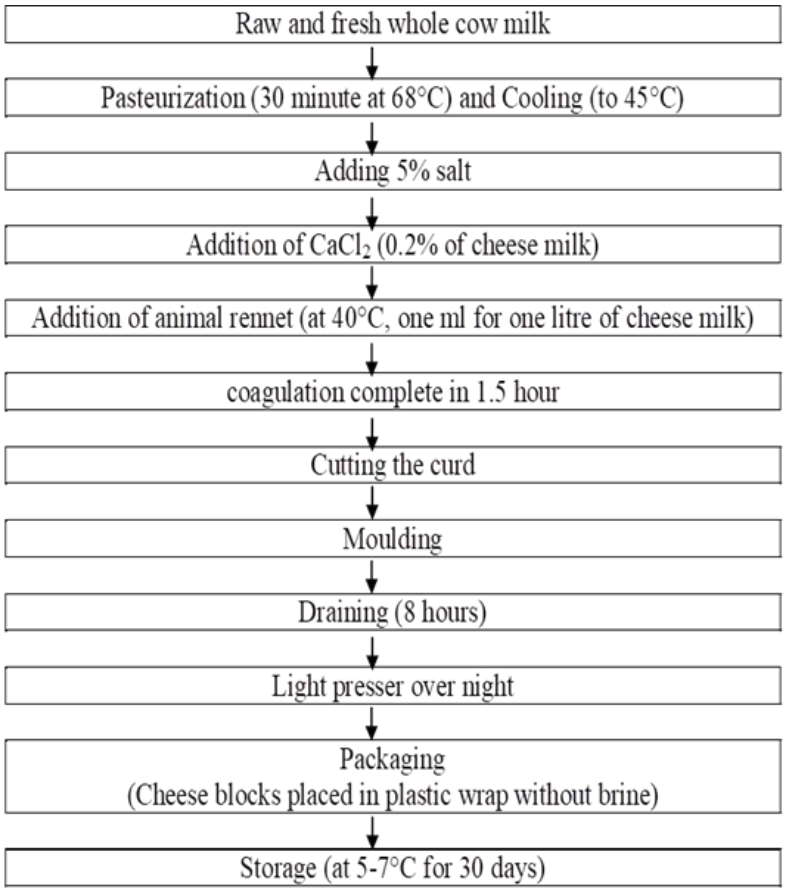

Figure 3 Modified Tallaga cheese making step two

Using of microbial rennet instead of animal rennet is considered the unique step is changed at first to improve the manufacture of traditional Tallaga cheese. In this part we will take the optimal treatment from part one (C) With installing manufacture steps described previously except for using animal rennet and replacing it with microbial as a variable factor. There are three percentage of microbial rennet using for coagulating milk 0.2%, 0.3%, and 0.4% respectively which called R1, R2 and R3 which take 35, 75, 105 minutes respectively to complete coagulation. The optimal treatment is 0.3% microbial rennet (R2) which 75 minutes to complete coagulation and it will be ready to the third modification of manufacture.

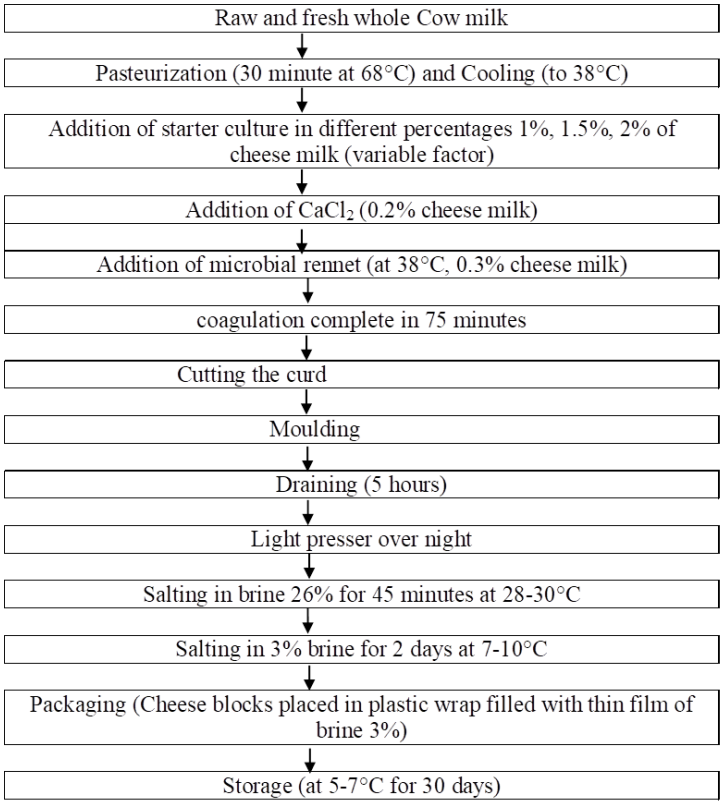

Figure 4 Modified Tallaga cheese making step three

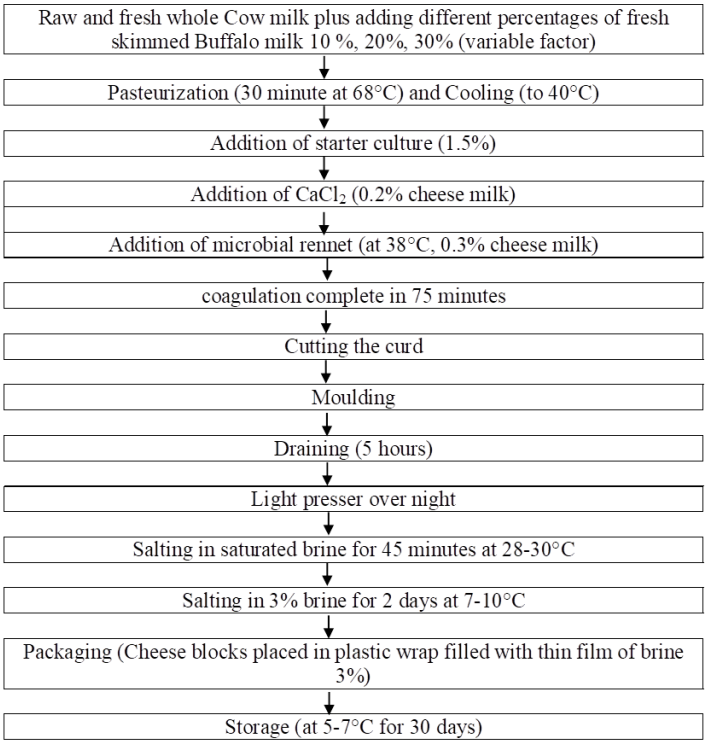

Figure 5 Modified Tallaga cheese making step four

Pasteurization of fresh milk will reduce most of microorganisms including the natural microflora which responsible for cheese ripening and improving characterized flavors and texture, so should be add lactic acid bacteria starter to do this

task perfectly. In this part we will take the optimal treatment from part two (R2) with Installing manufacture steps described previously with addition of three percentage lactic acid bacteria as a variable factor 1%, 1.5%, 2% which called S1, S2, and S3, respectively. The optimal treatment is 1.5% (S2) LAB, and it will be ready to the fourth modification of manufacture.

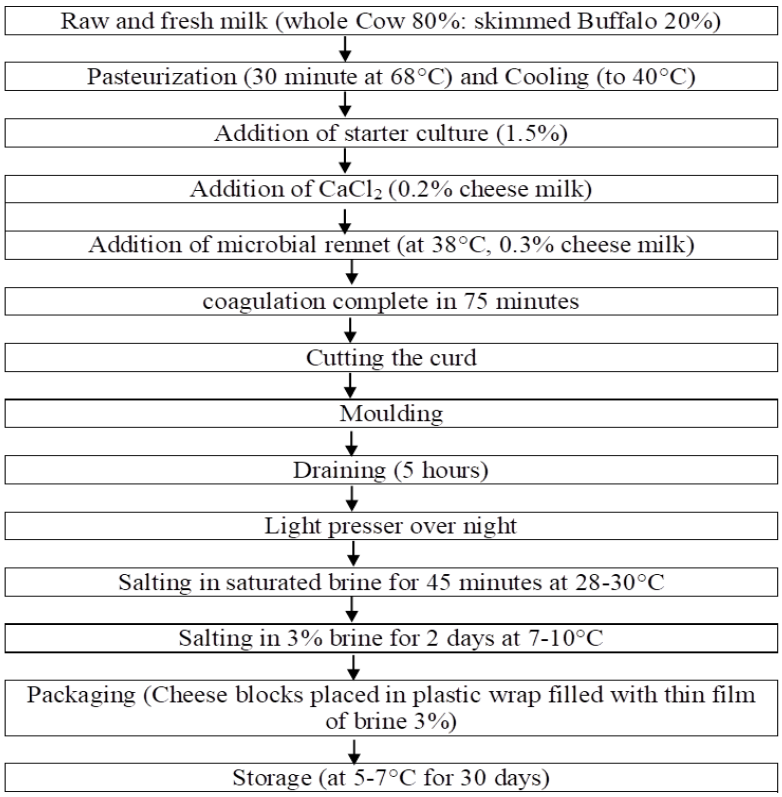

Figure 6 Modified Tallaga cheese making

Using of fresh skimmed Buffalo milk the final modulation of manufacture to support protein. In this part we will take the optimal treatment from part three (S2) With Installing manufacture steps described previously with addition of three percentage of skimmed buffalo milk F1, F2, F3 which refer to 10%, 20%, and 30%, respectively. The optimal treatment is F2 in the final of modulation of manufacture is achieving the total improvement Egyptian Tallaga cheese.

2.4. Some rheological properties of milk

Rennet clotting time (RCT): The stability of milk protein to rennet was determined by measuring the time required for clotting to appear in a 10-ml milk sample to which a small value (0.1 ml) of dilute rennet solution 0.005 N had been added. The temperature of the sample was mentioned as 30ºC during the test. The coagulation time taken as a measure of the milk rennet stability which was deserved the visual method by [14 - 15]. The renneting time of each milk sample in seconds was determined. Curd tension: It was determined by using the method of [16] the results were expressed as weight in grams required to get a knife out the curd. Thus, the required weight could be directly proportional to the strength of the curd. Syneresis of the resultant curd measured as the volume of drained whey, and calculated as the percent of the volume of whey as described by the method of [17].

2.5. Microbiological Analysis

Total bacterial count (TBC): TBC was done from suitable dilution (10^4 -10^5) in duplicates using Nutrient agar medium [18]. Using pouring plat method [19]. Coliform bacteria test: One ml of each dilution was transferred to test tubes containing Durham tubes in three replicates; added 6.00-8.00ml of MacConkey Broth medium was and then placed Test tubes incubated at 37°C for 24 h. the tubes which have yellow color and gas production is considered positive results. Lactobacillus count: Viability of starter cultures were assessed during production and during refrigeration storage at 7°C for 30 days. Lactobacillus bacterial counts was determined using MRS agar medium according to [12]. All plates were anaerobically incubated at 37°C for 48h. Molds and Yeasts Count: Molds and Yeasts were counted by using potato dextrose agar medium, the plates were incubated at 22˚C for 5 days.

Physiochemical analysis: The Moisture content was determined as described by [20]. The Fat content was determined by using the conventional Gerber's method as described by [20]. Salt content was estimated as described by [21]. pH value of samples which gives an indicator for lactic acid was measured by using laboratory pH meter was determined according [20]. Total nitrogen content was determined by the semi-micro kjeldahl method as described by [20].

Organoleptic evaluation: The organoleptic properties of Tallaga cheese samples were assessed according to [22] by a regular taste panel of the staff members of the Diary Science Department, Faculty of Agriculture, Damietta University. Samples were evaluated for flavor (50 points), color & appearance (15 points) and body & texture (35 points) to be 100 points for the total scores.

3. Results and discussion

3.1. Salting of Tallaga cheese in brine instead of salting in milk

3.1.1. Physio-chemical composition

The following data shows pH values, moisture content, fat content, protein content and salt content of cheese during 30 days of storage in Table (1). For all Treatments, as the storage period advanced, pH decreases because acidity development increased. Although there is no starter at this stage and the good pasteurization of the milk used, there are some types of coliform bacteria found in the animal rennet which used prevail over few lactic acid bacteria and ferment lactose instead of them therefore it is called pseudolactic acid bacteria. Generally, in zero-time pH ranged between (6.2-6.4) and it gradually decreases until reaching to 30 days which ranged between (5.1-5.4). Control cheese (A) which salting by adding salt direct in milk as a traditional way agree with [23] which reported that as the storage period advanced, acidity development also increased for Tallaga which made from 8% salt in milk.

In control cheese (A), moisture is significantly increase at first then it decreases gradually over the period of storage, this is the result of the direct salting of milk, which in turn leads to casein micelles holds the largest amount of moisture, so moisture at zero time was (63.7%) and it gradually decreases until reaching to 30 days which (60.53%), while, the modified Tallaga cheese under refrigerator conditions osmatic pressure was an important factor between the brine and the modified Tallaga cheese which affected on moisture all over storage time. On the other hand, in treatments (B, C, D, and E) the moisture percentage decreases slightly over the period of storage so it were 67.76%, 66.83%, 65.2% and 63.7% at zero time, respectively, and 65.29%, 66.35%, 67.71% and 67.16% at 30 days, respectively. In general moisture percentage ranged between (63.7% - 67.83%) so total solids ranged between (36.3%-32.17%) which get very close with the findings of several investigators [2, 4]. They reported that the total solids content of Tallaga cheese was ranged between (33.98%-36.78%), respectively.

Values of fat for A, B, C, D, and E samples as affected by salting cheese in brine found in Table (1). Treatment (A), as the storage period progressed, the fat content gradually increased to reach the highest fat content by the end of storage. This apparent increase of fat is due to the increase of total solids, this result matching with [23]. In Treatment (B, C, D and E) the fat content increases slightly over the period of storage so it were (12.44%, 12.56%, 12.77% and 12.81%) at zero time and it were (13.62%, 12.56%, 11.55% and 11.56%) at 30 days, respectively. Generally, in modified Tallaga cheese fat content ranged between (11.49 -13.62) and these obtained data are in the range of the findings of several investigators [24, 25]. They reported that the Fat content of Soft white cheese was ranged between 11.2 % and 14.4%.

Values of protein for A, B, C, D, and E samples as affected by salting cheese in brine found in Table (1). In treatment (A), as the storage period progressed, the protein content gradually increased to reach the highest protein content by the end of storage. This apparent increase of fat is due to the increase of total solids, this result matching with [23]. The protein content increases slightly over the period of storage so it were 11.03%, 10.79%, 10.65% and 10.66% at zero time while were 11.28%, 10.15%, 9.92% and 10.08% at 30 days storage. Generally, in modified Tallaga cheese protein content ranged between (9.92%-11.78%) and that results are in the average acceptance with those obtained by [23] who found that the protein content ranged between 9.93 and 11.84% for fresh soft white cheese.

Values of salt for A, B, C, D, and E samples as affected by salting cheese in brine found in Table (1). In control cheese (A), as the storage period progressed, the salt content gradually increased to reach the highest protein content by the end of storage. This apparent increase of fat is due to the increase of TS, this result matching with [23]. In Treatments (B, C, D and E), the salt content increases slightly over the period of storage so it were (2.52%, 3.17%, 3.65% and 4.36%) at zero time and (2.86%, 3.12%, 3.74% and 4.06%) at 30 days, respectively. Generally, in modified Tallaga cheese salt content depends on how long the cheese remains in the 26% brine so values of salt for B, C, D and E samples were an average 2.5, 3, 3.5 and 4, respectively.

3.1.2. Microbial analysis

Data in Table (1) showed that total bacterial counts (TBC), mold and yeasts count (M&Y), Total LAB count and the coliform bacteria content through 30 days of storage. TBC showed different trend of increase until the middle of the storage period and then it goes down although treatment had no starter, also [23] said that. The higher the salt percentage, the less bacterial content will be over the storage period, meaning that the treatment (B) with the lower salt percentage is higher in the bacterial content than the treatment (E) with the higher salt percentage. TBC values were (568, 563, 530, 465 and 458 cfu X 10^6 for treatments A, B, C, D and E in zero time, respectively, while the numbers of TBC were 420, 275, 220, 150 and 120 cfu X 10^6 after 30 days storage, respectively. It`s clear that the osmotic pressure present as a result of salting in brine affects positively due to the intolerance of harmful bacteria to the presence and activity under its influence, so that its effect is considered a suitable preservation method for cheese throughout the storage period without looking to add preservatives and taken into consideration the change of the type of rennet in the next part, which is considered to be the source of contamination in the samples. Such data are in the same trend with those reported by [26 - 27]. They reported that the total microbial count increases rapidly to a maximum amount after a week of storage and then declines in Domiati cheese, stored at room temperature. Table (1) deals with viable colonies grown on MRS medium. As a result of the absence of a starter in this part, some types of lactic acid bacteria were present in a small form because of good pasteurization, this presence increases slightly in the beginning and then decreases after 15 days due to the increase in the activity of harmful bacteria that take control in growth and raise the acidity to a degree that is not suitable for lactic acid bacteria.

The percentage of mold and yeasts (M&Y) increases over the storage time, in control cheese (A), the Total molds and yeasts was little increase, on the other hand samples which salted in brine had more increase due to the ability of some types of yeast to grow well in brine solutions. As a result of the absence of a starter in this part, some types of lactic acid bacteria were present in a small form because of good pasteurization, this presence increases slightly in the beginning and then decreases after 15 days due to the increase in the activity of harmful bacteria that take control in growth and raise the acidity to a degree that is not suitable for lactic acid bacteria. This result matching with [28] when said For Tallaga cheese, found the higher the incidence of coliform, but with similar incidence and counts of *E. coli* and *E. coli* O157H7, *Salmonella* spp and the other gram-negative enteric *bacilli* as *Proteus* spp, *Pseudomonas* spp and Citrobacter spp. Also, they reported nearly similar percent of samples do not meet the ES due to coliform count and E. coli presence. Salt contributes to food safety and quality of cheese. Salt on its own is not a sufficient hurdle against the growth of pathogenic microorganisms, but in association with other factors inhibits the growth of pathogenic bacteria. This is especially important in raw milk cheeses. Shiga-toxin producing E. coli O157:H7 grow up to a salt-in-moisture concentration of 8.5%, they are moderately salt tolerant. At low salt concentrations, this serotype can even recover from stress more quickly thanks to salt [10].

Table 1 Physicochemical, Microbiological, and organoleptic properties for Tallaga cheese after 30 days storage.

Parameters	**Treatments**					***P*-value**
	A	**B**	**C**	**D**	**E**	
pH	5.23	5.23	5.40	5.20	5.10	0.1322
Moisture%	60.53^{d}	65.29^{c}	66.35^{bc}	67.71^{ab}	67.16^{a}	0.0001
Fat%	13.00^{b}	13.62^{a}	12.56^{c}	11.55^{d}	11.56^{d}	0.0001
Protein%	11.55^{a}	11.28^{a}	10.15^{b}	9.92^{b}	10.08^{b}	0.0001
Salt%	3.16^{c}	2.86^{d}	3.12^{c}	3.74^{b}	4.06^{a}	0.0001
TBC (cfu X 10^6)	420.00^{a}	275.00^{b}	220.00^{c}	150.00^{d}	120.00^{e}	0.0001
Total M&Y count (cfu X 10^2)	66.00^{c}	41.00^{d}	64.00^{c}	79.00^{b}	89.00^{a}	0.0001
Total LAB count (cfu X 10^4)	7.00^{a}	4.00^{b}	3.00^{b}	1.00^{c}	-	0.0002
Organoleptic evaluation (Points)	57	70	86	73	72	-

A: Traditional Tallaga cheese; **B:** Tallaga cheese with salting in saturated brine (26%) for 30 min; **C:** Tallaga cheese with salting in saturated brine (26%) for 45 min; **D:** Tallaga cheese with salting in saturated brine (26%) for 60 min; **E:** Tallaga cheese with salting in saturated brine (26%) for 75 min.

TBC: Total bacterial count; Total M&Y count: Total mould and yeast count; Total LAB count: Total lactic acid bacterial count.

3.1.3. Organoleptic Evaluation

The results show that the optimal Treatment is (C) which stays 45 min in saturated brine. As for the traditional sample (A) did not receive any acceptance from consumers. The main disadvantages of optimal treatment (C) after brine salting are the high content of molds, yeasts and coliform bacteria that sure affecting on flavor so it isn`t widely acceptable for

the consumer. The second the low of LAB content which leads to weakness in the level of the sensory characteristics such as smoothness of texture and tenderness of the body. All these disadvantages will be improved in the coming chapters; also, modifications will be made to be suitable with new way of salting Tallaga cheese. Salt is important for its direct taste. It also plays the role of a flavour enhancer and influences aroma and trigeminal sensations. Cheeses that are low in salt are bland and prone to flavour defects such as bitterness or impure flavour. Especially in fat reduced cheeses, salt influences aroma release. Through the modulation of desired and undesired microorganisms and enzymes, salt modulates the development of cheese flavour Table (1).

3.2. Using microbial rennet instead of animal rennet in manufacture of Tallaga cheese

3.2.1. Physio-chemical composition

The following data shows pH values, Moisture%, Fat%, Protein% and salt% of treatments cheese during 30 days of storage in Table (2). For all Treatments, as the storage period advanced, pH values decreases slightly because acidity development increased also slightly. There is no factor that effect on the level of acidity, so it is in the normal range for the length of the storage period, there is no source of contamination that results in the presence of pathogenic bacteria from animal rennet and there is no added starter yet in addition to that the pasteurization was done well and the manufacturing conditions were also done in a clean and sterile atmosphere. The only influencing factor is the presence of some very few types of lactic acid bacteria in milk after pasteurization, which affects a slight increase in acidity and therefore a decrease in the pH level at the same rate. Generally, in zero-time pH values were 6.5, 6.4 and 6.7 for treatments R1, R2 and R3, respectively, and it gradually decreases until reaching to 30 days which were 5.7, 5.6 and 6.1 for treatments R1, R2 and R3, respectively.

The percentage of rennet effects on the duration of coagulation and moisture, while percentage of rennet decreases, the duration of coagulation increase and the percentage of moisture also increase so the rates of increasing in moisture values were (71.05%) for treatment (R3) in zero time and (74.81%) in 30 days, while, in treatment (R2) the moisture percentage in relative stability so it was (70.53%, and 71.22%) at zero time, and 30 days, respectively, while, the treatment (R1) the moisture percentage decreases more so it was (69.28%) at zero time and (71.51%) at 30 days, respectively.

In treatment (R1) the fat content was the highest over the period of storage because the high of TS, so it was (13.81%) at zero time and (12.64%) at 30 days, while, in treatment (R2) the fat content was moderate, so it was (13.53%) at zero time and (13.07%) at 30 days, and the end, the treatment (R3) the fat content was the lowest, so it was (13.47%) at zero time and (12.65%) at 30 days. Generally fat content in this part by using microbial rennet higher than previous part by using animal rennet which lose more total solids during curd syneresis, in comparison, at zero time it was an average (12.66%) by using animal rennet, but it was (13.6%) by using microbial rennet.

In treatment (R1) the protein content was the highest relatively over the period of storage because the high of TS, so it was (13.84%) at zero time and (13.06%) at 30 days, while, in treatment (R2) the protein content was moderate, so it was (13.39%) at zero time and (13.19%) at 30 days, and the end, the treatment (R3) the protein content was the lowest relatively, so it was (13.14%) at zero time and (13.01%) at 30 days. Generally, protein content in this part by using microbial rennet higher than previous part by using animal rennet which lose more total solids during curd syneresis, in comparison, at zero time it was an average (10.64%) by using animal rennet, but it was (13.45%) by using microbial rennet.

In treatment (R1) the salt content was the highest relatively over the period of storage because the high of TS, so it was (3.44%) at zero time and (3.18%) at 30 days, while, in treatment (R2) the salt content was moderate, so it was (3.31%) at zero time and (3.13%) at 30 days, and the end, the treatment (R3) the salt content was the lowest relatively, so it was (3.13%) at zero time and (2.96%) at 30 days. Generally, the change of salt content is simple because of salting in brine does not milk salting, so the salt content average 3% and that is the average of salt content also in the previous part.

3.2.2. Microbial analysis

Data in Table (2) showed TBC, LAB counts through 30 days of storage. In general, the microbial content is less than the previous part because there is no starter yet and no source of harmful bacteria because of using microbial rennet which high quality of hygiene, the influencing factor is some types of non-pathogenic microbes remaining after pasteurization, it increases significantly at the beginning and middle of storage, and then begins to decrease again until the end of storage. In treatment (R1) the rates of increasing in TBC values were 137, 304 and 345 cfu X 10^6 in zero time, 7 days and 15 days, respectively, then decreases to be 178 cfu X 10^6 in 30 days, also in treatment (R2) the rates of increasing in total bacterial counts values were 152, 391 and 354 cfu X 10^6 in zero time, 7 days and 15 days, respectively, then

decreases to be 202 cfu X 10^6 in 30 days, and the end, the treatment (R3) the rates of increasing in total bacterial counts values were 150, 346 and 304 cfu X 10^6 in zero time, 7 days and 15 days, respectively, then decreases to be 220 cfu X 10^6 in 30 days. As a result of the absence of a starter also in this part, some types of lactic acid bacteria were present in a small form as a result of good pasteurization, this presence increases slightly in the beginning, but the different in this part is there is no harmful bacteria from animal rennet which take control in growth and raise the acidity to a degree that is not suitable for lactic acid bacteria, so few LAB can grow relatively. The results were negative for Yeasts and Molds, Coliform in all these tests for all treatments during the storage period (30 days). This is due to of the hygienic condition during experimental procedure of soft white cheese for all treatments; these results agree with [23].

3.2.3. Organoleptic evaluation

The results show that the optimal treatment is (R2) were gained (95, 95 and 93) in zero time, 15 and 30 days, respectively, which had 0.3% of microbial rennet, on the other hand, the treatment (R1) and (R3) did not receive any acceptance from consumers (Tables 2). The main disadvantages of optimal treatment (R2) were lack smooth texture and great taste which can be achieve by using starter in the following part.

Table 2 Physicochemical, Microbiological, and organoleptic properties for Tallaga cheese treatments after 30 days storage.

Parameters	Treatments			SEM	*P*-value
	R1	R2	R3		
pH	5.70^{b}	5.63^{b}	6.06^{a}	0.079	0.0171
Moisture%	71.54^{b}	71.22^{b}	74.81^{a}	0.231	0.0001
Fat%	12.64^{b}	13.07^{a}	12.65^{b}	0.034	0.0002
Protein%	13.0^{6}	13.19	13.07	0.123	0.7232
Salt%	3.18^{a}	3.13^{b}	2.96^{c}	0.012	0.0001
TBC (cfu X 10^6)	178.00^{c}	202.00^{b}	220.00^{a}	2.886	0.0002
Total LAB count (cfu X 10^4)	7.00^{b}	9.00^{b}	17.00^{a}	1.527	0.0081
Organoleptic evaluation (Points)	77	93	80	-	-

R1: Tallaga cheese with salting in saturated brine (26%) for 45 min with 0.2% microbial rennet; R2: Tallaga cheese with salting in saturated brine (26%) for 45 min with 0.3% microbial rennet; R3: Tallaga cheese with salting in saturated brine (26%) for 45 min with 0.4% microbial rennet.
TBC: Total bacterial count; Total LAB count: Total lactic acid bacterial count.

3.3. Using different ratio of starter in Tallaga cheese making

3.3.1. Physio-chemical composition

The following data shows pH, Moisture%, Fat%, Protein% and Salt% of cheese treatments by using different percentages of starter during 30 days of storage in Table (3). For all treatments, as the storage period advanced, pH decreases because of acidity development increased, but there is a difference in the starter percentage between samples which was 1%, 1.5% and 2% for treatments S1, S2 and S3, respectively. It is noticeable that cheese with low amount of starter (S1) was the lowest in acidity and the highest in pH so it was 5.66, and 5.24 at zero time, and 30 days, respectively, while in treatment (S2) with moderate percentage of starter so it was 5.48, and 5.12 at zero time, and 30 days, respectively, and the end, the treatment (S3) was the highest in acidity and the lowest in pH so it was 5.26, and 5.01 at zero time, and 30 days, respectively. Reported by [28] that the development of acidity during the refrigeration period is a direct response for converting the residual lactose in cheese into lactic acid by the available micro-flora. Effat et al., 2012, mentioned that, the changes in acidity of probiotic soft cheese were significantly higher; especially at the end of refrigeration period. For all treatments, as the percentage of starter increased, the moisture decreased because the TS increased. It is noticeable that cheese with low amount of starter (S1) was the highest in moisture, so it was 69.53%, and 69.81% at zero time, and 30 days, respectively, while in treatment (S2) with moderate percentage of moisture so it was 68.56%, and 68.35% at zero time, and 30 days, respectively, and the end, the treatment (S3) was the lowest in moisture, so it was 65.41%, and 67.63% at zero time, and 30 days, respectively. (Al Esawy, 2017) reported that brined Tallaga cheese with different types of starter, as the percentage of starter increased, the TS also increased, and the moisture decreased.

In treatment (S1) the fat content was 13.25%, and 13.21% at zero time, and 30 days, respectively, while in treatment (S2) it was 13.35%, and 13.28% at zero time, and 30 days, respectively, and the end, the treatment (S3) it was 13.43%, and 13.61% at zero time, and 30 days, respectively. The marked observation, the fat content relatively stable as the storage period progressed also the difference between samples is very simple. In general, it is relatively the same percentage of fat as the previous part, that matching with [23] which reported that type or percentage of starter had no direct effect on fat content of cheese, the effect is mainly on the TS of the cheese.

Protein in all treatments were increased slightly by increasing starter percentage, although there was stability of protein content all over storage period. In treatment (S1) the protein content was 13.13% and 13.01% at zero time, and 30 days, respectively, while in treatment (S2) it was 13.50%, and 13.64% at zero time, and 30 days, respectively, and the end, the treatment (S3) it was 13.85%, and 13.97% at zero time, and 30 days, respectively. On the other side, the salt content in treatment (S1) was 3.25%, and 3.21% at zero time, and 30 days, respectively, while in treatment (S2) it was 3.35%, and 3.27% at zero time, and 30 days, respectively, and the end, the treatment (S3) it was 3.59%, and 3.76% at zero time, and 30 days, respectively.

3.3.2. Microbial analysis

Total bacterial count (cfu X 10^6): Data in Table (3) showed that total bacterial count of Tallaga cheese as affected by using different percentages of starter through 30 days of storage. Generally, as a higher percentage of starter as a greater total microbial content and it increases gradually over the period of storage due to the availability of all appropriate conditions for starter work. In treatment (S1) the total bacterial count was 183, and 850 cfu X 10^6 at zero time, and 30 days respectively, while in treatment (S2) it was 230, and 920 cfu X 10^6 at zero time, and 30 days, respectively, and the end, the treatment (S3) it was 366, and 990 cfu X 10^6 at zero time, and 30 days, respectively.

Total LAB count (cfu X 10^4): Table (3) deals with viable colonies grown on MRS medium of Tallaga cheese as affected by using different percentages of starter through 30 days of storage. In general, the higher starter percentage, the greater total lactic acid bacteria, and it increased gradually over the period of storage to provide all appropriate conditions for the starter work. In treatment (S1) it was 131, and 490 cfu X 10^4 at zero time, and 30 days, respectively, while in treatment (S2) it was 241, and 584 cfu X 10^4 at zero time, and 30 days, respectively, and the end, the treatment (S3) it was 300, and 625 cfu X 10^4 at zero time, and 30 days, respectively. The results were negative in all these tests for all treatments during the storage period (30 days). This is due to of the hygienic condition during experimental procedure of Tallaga cheese for all treatments.

3.3.3. Organoleptic evaluation

The results in (Tables 3) shows that the optimal treatment is (S2) which had 1.5% of starter on the other hand treatment (S1) and (S3) did not receive any acceptance from consumers. The main disadvantages of optimal treatment (S2) were weak body and texture which can be achieve by using little percentage of skim buffalo milk in the following part.

Table 3 Physicochemical, Microbiological, and organoleptic properties for Tallaga cheese treatments after 30 days storage.

Parameters	Treatments			SEM	P-value
	S1	S2	S3		
pH	5.24^a	5.12^b	5.01^c	0.011	0.0001
Moisture%	69.81^a	68.35^b	67.63^c	0.141	0.0001
Fat%	13.21^b	13.28^b	13.61^a	0.087	0.0372
Protein%	13.01^c	13.64^b	13.97^a	0.014	0.0001
Salt%	3.21^b	3.27^b	3.76^a	0.057	0.0009
TBC (cfu X 10^4)	850.00^c	920.00^b	990.00^a	5.773	0.0001
Total LAB count (cfu X 10^4)	490.00^c	584.00^b	625.00^a	2.886	0.0001
Organoleptic evaluation (Points)	81	91	82	-	-

S1: Tallaga cheese with salting in saturated brine (26%) for 45 min with 0.3% microbial rennet and 1% lactic acid bacteria starter; S2: Tallaga cheese with salting in saturated brine (26%) for 45 min with 0.3% microbial rennet and 2% lactic acid bacteria starter; S3: Tallaga cheese with salting in saturated brine (26%) for 45 min with 0.3% microbial rennet and 3% lactic acid bacteria starter. TBC: Total bacterial count; Total LAB count: Total lactic acid bacterial count.

3.4. Adding ratios from skim buffalo milk to cow milk

3.4.1. Physio-chemical composition

Three treatments in this chapter F1, F2, F3 which refer to the amount of buffalo milk is 10%, 20%, and 30%, respectively. The following data shows pH, Moisture%, Fat%, Protein% and Salt% of cheese treatments by using different percentages of skim buffalo milk during 30 days of storage in Table (4). For all Treatments, as the storage period advanced, pH decreases because of acidity development increased because of using 1.5% starter. In treatment (F1) pH value was 5.50 and 5.12 in zero time, and 30 day respectively, while in treatment (F2) pH value was 5.48, and 5.16 in zero time, and 30 day respectively, in the end, in treatment (F3) pH value was 5.44, and 5.18 in zero time, and 30 day, respectively. Generally, as the percentage of skim buffalo milk increased, the moisture decreased because the TS increased, and it is noticeable that there is a relative stability in moisture over the period of storage. In treatment (F1) moisture content was 67.14%, and 69.31% in zero time, and 30 day respectively, while in treatment (F2) moisture content was 65.24%, and 66.45% in zero time, and 30 day, respectively, in the end, in treatment (F3) moisture content was 63.44%, and 65.16% in zero time, and 30 day, respectively. Moisture percentage ranged between (65.27%-66.94%) so TS ranged between (36.3%-34.73%) which get very close with [23] who reported that total solids for Tallaga cheese was (37.19, 36.65, and 36.83) and [2] mention it was 36.78%.

Values of fat for F1, F2 and F3 samples as affected by using different percentages of skim buffalo milk during 30 days of storage. The marked observation, there is relative stability in fat content as the storage period progressed. In general, the average percentage of fat as the same as the previous part, because of using skim buffalo milk not full fat which did not affect significantly. Al-Esawy (2017) reported that the higher fat content of Tallaga cheese ranged between (12.15-14.15%) for fresh cheese, this due to the cheese milk from admixing of (Buffalo+Cow 1:1) milk 5.7% fat.

The protein content of modified Tallaga cheese affected by using different percentages of skim buffalo milk through 30 days of storage. Generally, the higher percentage of buffalo milk, in turn, the higher the protein content, and thus the percentage of TS increased significantly. In treatment (F1) protein content was 14.75%, and 14.58% in zero time, and 30 day, respectively, while in treatment (F2) it was 14.95%, and 14.77% in zero time, and 30 day, respectively, in the end, in treatment (F3) it was 15.21%, and 15.08% in zero time, and 30 day, respectively. The present results are close to those obtained by [23] who found that the protein content ranged between 9.93 and 11.84% for fresh soft white cheese. Salt content in treatment (F1) was 3.54%, and 3.86% in zero time, and 30 day, respectively, while in treatment (F2) salt content was 3.33%, 3.23% in zero time, and 30 day, respectively, in the end, in treatment (F3) salt content was 3.12%, and 3.14% in zero time, and 30 day, respectively.

3.4.2. Microbial analysis

Data in Table (4) showed that TBC of modified Tallaga cheese as affected by using different percentages of skim buffalo milk through 30 days of storage. Generally, the results showed different trend of increase gradually by the same rate in all samples. In treatment (F1) the TBC was 215, and 894 cfu X 10^6 at zero time, and 30 days, respectively, while in treatment (F2) it was 228, and 924 cfu X 10^6 at zero time, and 30 days, respectively, and the end, the treatment (F3) it was 233, and 934 cfu X 10^6 at zero time, and 30 days, respectively. In Tallaga cheese which made by [23] for brined cheese, TC is lower than those found of unbrined cheese under the same levels. Table (4) deals with viable colonies grown on MRS medium of modified Tallaga cheese as affected by using different percentages of skim buffalo milk through 30 days of storage, in general the results matching with the pervious part because of using the same percentage of starter 1.5%. In treatment (F1) it was 241, and 555 cfu X 10^4 at zero time, and 30 days respectively, while in treatment (F2) it was 238, and 593 cfu X 10^4 at zero time, and 30 days respectively, and the end, the treatment (F3) it was 230, and 573 cfu X 10^4 at zero time, and 30 days, respectively. The results were negative in all these tests for all treatments during the storage period (30 days). This is due to of the hygienic condition during experimental procedure of Tallaga cheese for all treatments.

3.4.3. Organoleptic evaluation

The results given in Table (4) shows that the optimal treatment is (F2) which had 10% of skim buffalo milk on the other hand treatment (F1) and (F3) did not receive any acceptance from consumers. With this we have reached the final perfect treatment which receives more acceptances from consumers.

Table 4 Physicochemical, Microbiological, and organoleptic properties for Tallaga cheese treatments after 30 days storage.

Parameters	Treatments			SEM	*P*-value
	F1	F2	F3		
pH	5.12^{c}	5.16^{b}	5.18^{a}	0.005	0.0009
Moisture%	69.31^{a}	67.17^{b}	65.16^{c}	0.043	0.0001
Fat%	13.27^{c}	13.59^{b}	13.87^{a}	0.046	0.0003
Protein%	14.58^{c}	14.77^{b}	15.08^{a}	0.019	0.0001
Salt%	3.86^{a}	3.23^{b}	3.14^{c}	0.012	0.0001
TBC (cfu X 10^{6})	894.00^{c}	924.00^{b}	934.00^{a}	2.309	0.0001
Total LAB count (cfu X 10^{4})	555.00^{c}	593.00^{b}	573.00^{a}	2.185	0.0001
Organoleptic evaluation (Points)	82	100	85	-	-

F1: Tallaga cheese with salting in saturated brine (26%) for 45 min with 0.3% microbial rennet, 2% lactic acid bacteria starter, 10% skimmed buffalo milk and 90% cow milk; F2: Tallaga cheese with salting in saturated brine (26%) for 45 min with 0.3% microbial rennet, 2% lactic acid bacteria starter, 20% skimmed buffalo milk and 80% cow milk; F3: Tallaga cheese with salting in saturated brine (26%) for 45 min with 0.3% microbial rennet, 2% lactic acid bacteria starter, 30% skimmed buffalo milk and 70% cow milk.
TBC: Total bacterial count; Total LAB count: Total lactic acid bacterial count.

3.5. Economical study of Tallaga cheese Treatments

Data in Tables (5 a and b) and Figure (7) showed that the cost of the components used in the tested ingredients and the total price and the net profit for Tallaga cheese samples manufactured by the traditional method and the modified Tallaga sample. From the results, we find that the cost of mixtures for Traditional Tallaga cheese (A) and Modified Tallaga cheese (F2) were 3563 and 3619.5 pounds in fresh cheese, respectively for every 100 liters of milk cheese, and from it the cost of traditional cheese was less than the cost of modified cheese, while we find that after 30 days of storage the cost were for the same two samples. They were 4097.45 and 4162.425, respectively, after adding 5% manufacturing costs and 10% storage costs, and here the most important economic benefits appear. This is due to the fact that the treatments carried out on the modified sample led to a reduction in moisture loss and the cheese retaining its properties without deterioration in its organoleptic properties as a result of controlling the pH of the sample and the absence of contamination.

Table 5a Economic Evaluation of Fresh Tallaga Cheese Samples.

Ingredients	Price (L.E.)	Quantities used in manufacturing		Salt of brine		Treatments	
		Traditional Tallaga cheese (A)	Modified Tallaga cheese (F_2)	Traditional Tallaga cheese (A)	Modified Tallaga cheese (F_2)	Traditional Tallaga cheese (A)	Modified Tallaga cheese (F_2)
						Total price (L.E.) for 100 Kg cheese.	
Cow milk (L)	7	500 L	400 L	--	--	3500	2800
Skim buffalo milk (L)	7	--	100 L	--	--	---	700
Animal rennet (L)	20	0.5 L	--	--	--	10	---
Microbial rennet (500g)	300	--	15 g	--	--	---	9
Calcium chloride (kg)	30	100 g	100 g	--	--	3	3
Sodium chloride (kg)	2	25	25	--	25	50	100
Starter	100	--	7.5	--	--	--	7.5
Total						3563	3619.5

Table 5b Economic Evaluation of Fresh Tallaga Cheese Samples.

Treatment	**Costs**					**Yield**		**The price is the cost of a Kg cheese**		**The selling price of Kg of cheese to the consumer**	**Gain for Kg cheese**		**Gain % for Kg cheese**	
	Ingredients	Processing 5%	Storage cost 10%	Total for Fresh	Total after storage	Fresh	After 30 Days	Fresh	After 30 Days		Fresh	After 30 Days	Fresh	After 30 Days
Traditional Tallaga cheese (A)	3563	178.15	356.3	3741.15	4097.45	104	83.33	35.97	49.17	50	14.03	0.83	28.06	1.66
Modified Tallaga cheese (F_2)	3619.5	180.975	361.95	3800.475	4162.425	100	100	38	41.62	50	12	8.38	24	16.76

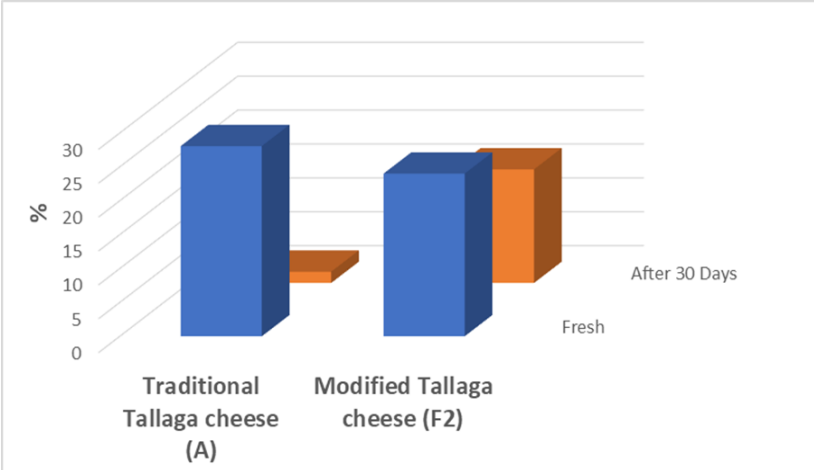

Figure 7 Gain Profit of Tallaga cheese made by different methods.

4. Conclusion

The study concluded with modifications to the traditional method of Tallaga cheese and producing cheese with good specifications as follows:

- Salting in brine for cheese is better than salting in milk. The optimal treatment is (C) which stay 45 minutes in 26% brine.
- Microbial rennet is better than animal rennet, as animal rennet was a source of contamination with pathogenic bacteria. The optimal treatment is 0.3% microbial rennet (R2) which 75 minutes to complete coagulation.
- Addition of starter has modified the qualities of the cheese. The optimal treatment is 1.5% (S2) LAB.
- The optimal treatment is F2 (80% cow milk and 20% skimmed buffalo milk) in the final of modulation of manufacture is achieving the total improvement Egyptian Tallaga cheese.
- The economic feasibility of the modified cheese with traditional cheese, the viability of the traditional cheese on the first day was better than the modified Tallaga cheese, but after 30 days, the improved cheese was better.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version. Additionally, there are no conflicts of interest in connection with this paper, and the material described is not under publication or consideration for publication elsewhere.

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