Characterization of Small Ruminant's Raw Milk And The Good Parameters to Obtain High Quality Dairy Products

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Dedication

This thesis is dedicated to my father, my mother, my lovely sisters and brothers, my supervisors, my colleagues in Alquds University, to all my friends, and to the farmers who interested in development the animal resource in Palestine.

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Wesam M. H. Sammar

1. Chemical Analysis

1.1. Protein determination

1.1.1. Scope

Standard method used for protein determination in end products was kjeldahl method. In which protein determined in this method three steps. Digestion step, distillation step, and titration step. In this method we obtained N%
Then protein = N% * 6.25

1.1.2. Materials and Reagents:

Kjeldahl's apparatus (digestion and combustion unit)
2- Sulphuric acid
3- Potassium sulphate
4- Copper sulphate
5- Sodium hydroxide
6- Hydrochloric acid
7- Cylinders with different volumes
8- Pipettes with different volumes

1.1.3. Procedure:

Digestion is accomplished by:

1. Weighing out approximately 1 gm of the sample containing protein, making a note of the weight, and placing the sample into a digestion flask, along with 12-15 ml of concentrated sulfuric acid (H_2SO_4).
2. Adding seven grams of potassium sulfate and a catalyst, usually copper.

3. Bringing the digestion tube/flask and mixture to a "rolling boil" (about 370^{o}C to 400^{o}C) using a heating a block.
4. Heating the mixture in the tube/flask until white fumes can be seen, and then continuing the heating for about 60-90 mins.
5. Cooling the tube/flask and cautiously adding 250 mls of water.

Distillation

The purpose of the next step, distillation, is to separate the ammonia (that is, the nitrogen) from the digestion mixture. This is done by,

1. Raising the pH of the mixture using sodium hydroxide (45% NaOH solution). This has the effect of changing the ammonium (NH_4^+) ions (which are dissolved in the liquid) to ammonia (NH_3), which is a gas.
2. Separating the nitrogen away from the digestion mixture by distilling the ammonia (converting it to a volatile gas, by raising the temperature to boiling point) and then trapping the distilled vapors in a special trapping solution of about 15 ml HCl (hydrochloric acid) in 70 ml of water.
3. Removing the trapping flask and rinsing the condenser with water so as to make sure that all the ammonia has been dissolved.

Titration

1. Adding an indicator dye to the acid/ammonia trapping solution. This dye should turn a strong color, indicating that a significant amount of the original trapping acid is still present.
2. Putting a standard solution of NaOH (sodium hydroxide) into the burette (a long tube with a tap at the end), and slowly, slowly adding small amounts of the sodium hydroxide solution to the acid solution with the dye.
3. Watching for the point at which the dye turns orange, indicating that the "endpoint" has been reached and that now all the acid has been neutralized by the base.
4. Recording the volume of the neutralizing base (sodium hydroxide solution) that was necessary to reach the endpoint.

5. Performing a calculation to find the amount of ammonia, and thus nitrogen that came from the original sample.

1.1.4. Calculation:

Moles of acid = molarity of acid x volume used in flask
(moles A = M x V)

Moles of base = molarity of base x volume added from burette
(moles B = M x V)

gms nitrogen = moles nitrogen x atomic mass
(g N = moles N x 14.0067)

%nitrogen = (gms nitrogen / gms sample) x 100
%N = (gN / gS) x 100

Protein % = %N x 6.25

1.2. Fat Determination.

1.2.1. Scope

The standard method used in fat determination for end products was Babcock method.

1.2.2. Reagent:

1. Babcock centrifuge.
2. Water bath at 55°C.
3. Torsion balance, 9 and 18 g weights.
4. Babcock shaker.
5. Glassware: 50% cheese bottles, 50% Paley bottles, 17.5 ml cylinders, 17.6 ml pipette.

6. Reagents: - Babcock sulphuric acid (Sp. Gr. 1.82-1.83)

1.2.3. Procedure:

1. Temper cream sample to 20°C and mix. Grind cheese to small particles.
2. Weigh 9 g of cream into 50% cream bottle and add 9 ml of distilled water at 20^0C. Weigh 9 g of cheese into a 50% Paley bottle and add 10 ml of distilled water at 60C.
3. Add 17.5 ml sulphuric acid in at least three increments. Mix until color is uniform chocolate brown and all cheese particles are dissolved.
4. Centrifuge 5 min.
5. Add distilled water at 60C to bring contents to within one-quarter inch of base of neck. Do not mix.
6. Centrifuge 2 min.
7. Add water at 60C to float fat into neck of bottle. Do not mix.
8. Centrifuge 1 min.
9. Temper bottles in water bat at 55C, for 5 min.
10. Measure the length of the fat column from the demarcation between fat and the bottom of the lower meniscus.

1.3. Ash Determination.

1.3.1. Scope

The standard method used for ash determination in end products was dry ashing method.

1.3.2. Materials and Reagents:

1- Crucible
2- Glass rod
3- Muffle furnace
4- Bunsen burner
5- Analytical balance

1.3.3. Procedure:

1- Take a clean and dry crucible, and then weigh it (crucible w1)

3- Add approximately 10g of milk and record the weight to be used in calculation (crucible + sample w2).

4- According to the high moisture content in milk, milk must dry to prevent spattering and crust formation during combustion.

5- Dry ashing procedures use a high temperature muffle furnace capable of maintaining temperatures of between 500 and 600^{o}C for 12hrs.

6- Water and other volatile materials are vaporized and organic substances are burned in the presence of the oxygen in air to CO_2, H_2O and N_2. Most minerals are converted to oxides, sulfates, phosphates, chlorides or silicates.

7- Transfer the crucible into the desiccators to remove the moisture from desiccators and so on do not affect on the result.

8- Weight the sample after combustion (crucible + ash w3)

Ash content = (w3 – w1) / (w2 – w1)* 100%

1.4. Total Solid Determination.

1.4.1. Scope

The standard method used to determine total solid for end product was Oven drying method. In which water evaporated from the sample and the remain portion was total solid in sample.

1.4.2. Reagents:

1- Analytical balance with readability of 0.1mg
2- Dessicator
3- Drying oven
4- Water bath
5- Pipette

1.4.3. Procedure

a) Oven temperature should be 103ºC ± 2ºC.
b) A flat-bottomed dish and glass rod are put in the oven (for 15 minutes).
c) Cool in a dessicator and weight them.
d) Add 10ml of milk, mix them well by using the glass rod.

Heat it on a water bath for 30 minutes and mix well so as to break the protein layer that forms on the surface and prevent the vapor from going out

e) Put them in the oven for 3 hours at 103ºC.
f) Leave the samples to cool in the dessicator then weight them 3 times at 0 times, 30min, until weight is constant.

1.4.4. Calculation

$$\text{Total solids} = \frac{\text{final mass of milk} * 100}{\text{Initial mass of milk}}$$

2. Microbial Analysis

2.1. Total Coliform

2.1.1. Purposes

This procedure describes the method of detection of total coliforms in a products, from raw materials to finished products as well as to ensure that finished products are with in Microbiological specifications.

2.1.2. Materials

1. Petri dishes, glass or plastic
2. Pipettes with pipette aids, 1, 5, and 10 ml, graduated in 0.1 ml units
3. Pipette and petri dish containers, adequate for protection
4. Water bath, for tempering agar, thermostatically controlled to 45 ± 1°C
5. Incubator
6. Colony counter
7. Refrigerator, to cool and maintain samples at 0-5°C; milk, 0-4.4°C
8. Freezer, to maintain frozen samples from -15 to -20°C
9. Stomacher
10. Violet Red Bile Agar
11. Stomacher bags
12. Peptone water
13. Autoclave
14. Vortex

2.1.3. Procedure:-

1- Prepare the sample for examination by weighting 10g from sample and then completed to 100g with peptone water, then stomaching it with the diluent for specific time producing the fist decimal dilution (10-1).

2- Prepare three different dilutions or further if necessary by transferring 1.0ml of the working solution of the tested material to a tube containing 9.0ml of Peptone water (10-2).

3- Transfer 1.0 ml of this tube to another tube containing 9 ml of the same diluent to obtain (10-3) dilution. The fluid so that 1.0 ml will be expected to yield between 30 and 300 colonies.

4- Pipette 1 ml of each dilution on to tow sterile Petri dishes.

5- Promptly add to each dish 15 to 25 ml of violet red bile agar medium that previously has been method and cooled to approximately 45°C, cover the plate and mix the samples with agar by tilting or rotating the dishes.

6- Allow the agar to solidify at room temperature.

7- Invert Petri dishes and incubate for 24-48 hours at 37°C.

8- Interpretation of result:

At the end of incubation period, Count dark red colonies with reddish zone of precipitated bile, size of colony 0.5 – 2 mm in diameter.

2.1.4. Calculation:

average counts of 2 plates *X* dilution factor = Coliform counts /g or ml of food sample.

2.2. Yeasts & Molds

2.2.1. Purposes

This procedure aimed to enumerate yeasts and molds cause various degrees of deterioration and decomposition of foods.

2.2.2. Materials

1. Petri dishes, glass or plastic
2. Pipettes with pipette aids, 1, 5, and 10 ml, graduated in 0.1 ml units
3. Pipette and petri dish containers, adequate for protection
4. Water bath, for tempering agar, thermostatically controlled to 45 ± 1°C
5. Incubator
6. Colony counter
7. Refrigerator, to cool and maintain samples at 0-5°C; milk, 0-4.4°C
8. Freezer, to maintain frozen samples from -15 to -20°C
9. Stomacher
10. Malt Extract Agar
11. Stomacher bags
12. Peptone water
13. Autoclave
14. Vortex

2.2.3. Procedure:-

1- Prepare the sample for examination by weighting 10g from food product and then completed to 100g with peptone water, then stomaching it with the diluent for specific time producing the fist decimal dilution (10-1).

2- Prepare three different dilutions or further if necessary by transferring 1.0ml of the working solution of the tested material to a tube containing 9.0ml of Peptone water (10-2).

3- Transfer 1.0 ml of this tube to another tube containing 9 ml of the same diluent to obtain (10-3) dilution. The fluid so that 1.0 ml will be expected to yield between 30 and 300 colonies.

4- Pipette 1 ml of each dilution on to tow sterile Petri dishes.

5- Promptly add to each dish 15 to 25 ml of Malt Extract agar medium that previously has been method and cooled to approximately 45°C, cover the plate and mix the samples with agar by tilting or rotating the dishes.

6- Allow the agar to solidify at room temperature.

7- Invert Petri dishes and incubate for 72-120hours at 22-25°C.

8- Interpretation of result:

At the end of incubation period, count the total colony forming units (CFU) on each plate. Calculate the average and compute the CFU per gram of food sample by multiplying the number of colonies by the dilution factor as follow:

Count = number computed X 1/ dilution factor

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Chapter One Introduction

1. Introductions

One of the most important groups of food which is essential for human life is milk and dairy products which provide human mainly with protein for muscle building and calcium for bone and teeth health.

Milk is the basic product in the farms, and is considered the main income for the farmers. Milk comes from different sources such as cows, goats, sheep, and buffalo. Currently in the world it is estimated that over 100 million sheep are used for milk production (Haenlein et al., 2002). France and Spain produce the largest quantities. Europe is by far the largest producer of sheep milk, cheese and yogurt. Table 1.1 shows the world milk production for the forth main important source of milk.

Table 1.1 World milk productions

Species	Million liters	Percent of total
Cow	494.6	84.6
Buffalo	69.1	11.8
Goat	**12.5**	**2.1**
Sheep	**7.8**	**1.3**
Other	1.3	0.2
Total	585.3	100

Source: FAO of United Nations, 2005

The total number of sheep in the Palestinian Territory during the agricultural year 2007/2008 reached 689 thousand heads distributed as follows: 639 thousand heads in the West Bank and 49,740 in the Gaza strip, in which 27.6% of sheep is in Hebron, then Jenin, Nablus and Bethlehem. There are 322 thousand heads of goats in the Palestinian Territory, in which 3.5% in the Gaza strip and 96.5% in the West Bank mainly in Hebron, Jenin, and Bethlehem respectively (Palestinian Central Bureau of Statistics, 2008).

The Awassi is the most numerous and widespread breed of sheep in south-west Asia. It is the dominant type in Iraq, the most important sheep in the Syrian Arab Republic and the only indigenous breed of sheep in Lebanon, Jordan and palestine.

Milk and dairy products contain many nutrients and provide a quick and easy way of supplying the diet with relatively few calories. Milk, cheese and yogurt all provide the following beneficial nutrients in varying quantities.

- Calcium: for healthy bones and teeth
- Phosphorous: for energy release
- Magnesium: for muscle function
- Protein: for growth and repair
- Vitamin B12: for production of healthy cells
- Vitamin A: for good eyesight and immune function
- Zinc: for immune function
- Riboflavin: for healthy skin
- Folate: for production of healthy cells
- Vitamin C: for formation of healthy connective tissues.
- Iodine: for regulation of the body's rate metabolism

Factors affecting the characteristics of milk directed to dairy processing:

1. Role of breed
2. Role of animal feeding method
3. Role of raw milk treatments
4. Role of milk processing techniques (heat treatment, milk mixing)
5. Role of feed types and composition (protein percentage, mineral content,etc)
6. Role of milking season

Sheep milk has higher total solids content than goat or cow milk. As a result, more cheese can be produced from sheep milk than goat or cow milk. Sheep milk yields 18 to 25 percent cheese, whereas goat and cow milk only yield 10 to 15 percent (Simos et al., 1996)

Among the 25 recognized dairy sheep breeds, which are mostly found in the Mediterranean region, great genetic variation exists in milk composition, in lactation period, in lactation yield and seasonality of milk production. Using artificially controlled photoperiods of daylight can change milk production by 25-38% with concomitant changes in fat and total solids contents (Bocquier et al., 1997). Even normal sheep milk composition may differ between 6 and 9% for fat, 4 and 7% for protein, 17 and 21% for total solids, 4 and 6% for lactose (Dario et al., 1995; Margetin, 1996; Simos et al., 1996).

Milk composition during the lactation period follows typical curves. Therefore tables of average milk composition of any species do not tell the whole story, since fat, protein and ash contents increase considerably towards the end of lactation, while lactose contents decrease (Casoli et al., 1989; Fenyvessy et al., 1991; Dario et al., 1995; IDF, 1996; Ploumi et al., 1996). This influences the taste of milk, as it may be more salty at the end of lactation, and also affects cheese making characteristics (Piredda et al., 1996; Perea et al., 2000).

1.2 Factors Affecting Small Ruminants Milk Composition

Lactation curves, yield and milk composition, are mainly conditioned by several factors including breed, stage of lactation, milking system and feeding in sheep (Bocquier and Caja, 1993), as well as in other dairy ruminants. Moreover, milk yield and milk composition (fat, protein, casein and serum proteins, but not lactose) are negatively correlated in sheep milk (Fuertes et al., 1998).

1.2.1 Effect of Milking Time

Between morning and evening milking on the same day the gross composition of milk may change (Simos et al., 1991), in which the intervals between morning and evening effect on milk composition, as with equal intervals of milking of 12 hours milk fat and total solids proportion were higher in the evening milk than in the morning (Fadil et al., 2010 and Adebosi et al., 2010), but in some cases morning milk has higher milk composition than evening milk (Haenlein et al., 2002).

Several daily milking also has affect milk chemical composition and yield, one daily milking lead to reduction of milk yield but milk has higher composition than twice milking per day (Salama et al., 2003).

1.2.2 Effect of Lactation Stage

Sheep and goat milk composition has different behavior during lactation period. For sheep milk, fat, protein, solids not fat and total solids increase during the lactation period (Gonzalo et al., 1992).For goat milk, protein, fat, and total solids decreased at the end of first period and then increased to reach the initial values or more (Lancu et al., 2010)

1.2.3 Effect of breed and species

Milk composition varied among breed (goats and sheep), sheep contains protein, fat, total solids and total solids not fat more than goat milk (Jandal et al., 1996, Pork et al., 2007).

Average genetic composition differences among species, ewe versus goat versus cow, and compared to human milk are considerable (Posati et al., 1976) in absolute and relative terms. Ewe milk is generally much higher in solids contents than goat, cows or human milks, but composition categories and contents of individual minerals, fatty acids and amino acids vary in different directions between the species, and without relation to higher or lower solids contents (Park et al., 2007)

Genetic differences in milk composition within species have a wide range of variations. For ewe milk, fat varies from 4.6 percent to 12.6 percent (Casoli et al., 1989) with an average of 7.1 percent (Anifantakis. 1986); as for ewe milk protein varies from 4.8 to 7.2 percent with an average of 5.7 percent, according to the breed.

1.2.4 Effect of Season and Diets

There are also clear seasonal differences in milk composition of major and minor components of ruminant's milk (Renner, 1982), but they are confounded with climate and diet effects.

Winter climate can affect milk yields and composition, and both are negatively correlated. Winter feeding is providing usually different proportions and qualities of grazing, hays, silage and supplements, which influence milk composition considerably.

Feeding of animals play an important role in changing milk composition, the type and component of feed introduced to the animal affect the percentage of the chemical in milk (Al-Dobaib et al., 2009)

1.3 Factors Affecting Cheese qualities

The Quality of cheese obtained after processing depend on parameters and conditions used during processing. There are different factors affecting cheese such as heat treatment, addition of starter culture, addition of calcium chloride, and addition of natural additives (carob).

1.3.1 Effect of Heat Treatment

Heat treatment of milk before cheese processing has an advantage and disadvantage at the same time, the advantage is related to heat treatment which are important to inactivate lipolytic and proteolytic enzymes and kill microorganism present in milk, because of their effect on cheese composition (Kanka et al., 1989). The disadvantage is related to clotting time and firmness of cheese (Brown et al., 1984).

1.3.2 Effect of Starter Culture

Dairy starters cultures are harmless, active bacteria, grown in milk or whey, which imparts certain characteristics and qualities to various milk products. The culture may be one strain of a microorganism species, called a single strength culture, or a number of strains and/or species called a multi strain culture.

Addition of starter culture to milk during cheese processing play an important role of enhancing the sensorial properties (flavor) in final cheese products (Dervisiglu et al., 2010).

Also during cheese storage, low pH and salt are two factors contributing to the inactivation of bacterial pathogens during a 60-day curing period for cheese (Sung et al., 2000), and prevent lipolytic and proteolytic microorganisms activity (Belgrade et al., 2005).

1.3.3 Effect of Calcium Chloride

Calcium chloride is a chemical compound added to milk after pasteurization to substitute the loss of minerals during heat treatment (Brown et al., 1984). On the other hand, calcium is very important in increasing the amount of ash present in cheese, also decreasing clotting time and increase cheese yield, due to the role of calcium in casein micelles formation during cheese clotting.

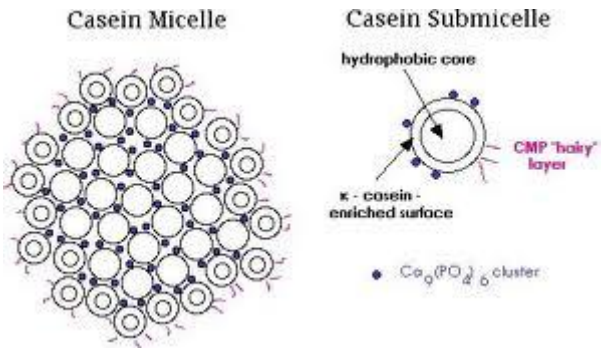

Fig 1.1 Casein micelles structure in cheese.

1.4 Factors Affecting Yogurt processing

Also as cheese, yogurt quality is affected by different factors during processing and conditions used during processing**.** The main factors which affect yogurt are storage condition of milk before processing and heat treatment used during yogurt manufacturing.

1.4.1 Effect of Milk Storage on Yogurt Quality

Milk storage in cooling or freezing condition for specific time before processing is a very important subject to be studied and discussed.

1.4.2 Effect of Heat treatment

Heat treatment is very important in yogurt manufacturing (increasing heat treatment to high temperature is required to increase availability of protein, because of its affect on casein structure and cause whey denaturation (Lee et al., 1988) and (Doan et al., 1942), this denaturation of whey protein is very important to enhance texture of yogurt and to prevent synerisis during yogurt storage.

Also heat treatment before processing led to killing of all coliforms and yeasts and molds present in milk (Alakali et al., 2008)

1.5 Justification for The Project

1- There are deficiencies of Palestinian standard about dairy processing and raw milk characteristics for goats and sheep milk, allowing each dairy plant to use special parameters during cheese and dairy production. This result in the presence of products with different quality in the market.

2- Absence of precautions and guidelines to be used during milking leading to poor handling procedure of raw milk in farms resulting in milk with low quality, either in sensorial or microbial quality.

3- There is a lacks of interests in small ruminant's raw milk for processing and in industry leading to limited products in the market from sheep and goat milk.

1.6 Objectives of The Study

Good quality raw milk is required to make good-quality dairy products. Once raw milk is defective, it cannot be improved during processing, and defects often become more pronounced. Therefore, it is important that raw milk is produced and handled from farm to plant under conditions that do not reduce its quality or, consequently, the quality of the product. Many factors can influence the quality of raw milk (Mubarack et al., 2010).

Milk as secreted from the udder of a healthy cow is very low in bacterial numbers. Bacteria can increase in raw milk due to poor milking methods, inadequate cleaning of milk equipment, poor cooling, and, in some cases, as a result of mastitis (Barabas 1995). Good production and herd management practices help ensure low bacteria counts and reduce the risk of the presence of pathogens in the raw milk (Fuhrmann 2002)

Objectives of this study will enable us to:

1- enrich the dairy processing industry with a database on ewe and caprine milk, and will provide the data required to practice and produce typical dairy products.

2- To define the different factors affecting quality and yield of milk.

3- To recommend different practices of processing methods for different ewe and caprine milk products.

1.7 Literature Review

1.7.1 Introduction

All the studies carried out on the same subject were reviewed and reported in this chapter.

All the literature studying the factors affecting milk composition (protein, fat, lactose, and total solids) were reported and compared with the finding obtained from this research study, In addition, all factors affecting cheese and yogurt quality either chemical composition (Fat, protein, ash, and total solids) or Microbial analysis (*Coliform* and Yeasts & Molds) were observed.

1.7.2 Factors Affecting Raw Milk Composition and Quantity.

1.7.2.1 Effect of Milking Time Morning and Evening

(Fadil et al., 2010) studied the milk composition variation between morning and evening milk in Awassi sheep, the obtained results showed that with equal intervals of milking of 12 hours, milk fat and total solids proportions were higher in the evening milk than in the morning milk. In addition it was shown that, there is no difference in the quantity of milk between morning and evening.

Similar results were reported by (Fadel et al., 1989) where milk composition in Awassi sheep was determined in relation to time of milking, stage of lactation, and age of ewe, The results showed that there are no effect of ewe age on milk composition, but the total solids and fat proportion were higher in evening than morning, and there was no difference between morning and evening in the quantity of milk.

(Simos et al., 1996) studied the factors affecting milk composition using 352 ewes of the Epirus mountain breed, and found that during double-milking periods the evening milk was richer in fat than the morning milk. While there are no effects on the other components.

These findings were highlighted by (Adebosin et al., 2010) who studied the difference between evening and morning milk in composition, and found that all components of milk (fat, protein, total solids, and total solids not fat) are higher in evening than morning milk.

On the other hand, studies showed that there are no effect of lactation period on milk composition, (Kasetelic et al., 2006) who studied the difference in milk quantity and milk composition between morning and evening milking time. Showed that the percentage of fat, protein, lactose, dry matter and dry matter without fat did not differ between morning and evening, and the quantity of milk was higher at evening time.

(Gilbert et al., 1973) found the same results for cow's milk, who studied the factors affecting daily milk yield of cows, in which 51 Holstein cow's sampled every 12 hours for 15 days, and analyzed for protein and fat percentage. The study found that milk yield was higher in morning milk than evening milk, also protein percentage and fat percentage were higher in evening than in morning.

Earlier studies reported same results (Gilmore et al., 1963) for different breeds of cows. It was found that all components were lower in morning than evening. Milk fat was lower 0.73% in morning than evening, and protein lower 0.03% in morning.

This result disagreed with the findings obtained by (Haenlein et al., 2002) who studied the nutritional value of sheep and goat milk and the factors affecting the chemical composition of milk, the result found that protein, fat, and total solids were higher in morning than evening time.

Milk composition changes also studied during 24 hours by (Castillo et al., 2008), in which twenty-four lactating ewes were used to assess the short-term effects of different machine milking intervals (4, 8, 12, 16, 20, and 24 h) on milk yield, milk composition. In was shown that fat% decreased during the 24 hours, but no differences were observed in protein content. The other constituents were increased during the 24 hours.

(Salama et al., 2003) studied the effect of the number of daily milking on milk quantity and milk composition by comparing between milking once or twice a day. The results showed that the milk yield were reduced 18% for milking once a day and the composition of milk were higher (TS% 13.6 vs 12.6), fat (5.10 vs 4.62) and casein (2.57 vs 2.35) in case of milking once a day compared to milking twice a day.

(Pomies et al., 2008) studied the difference between once daily milking and twice daily milking, and found that once daily milking results in a reduction in milk yield (from -15 to -46% according to species and context) and an increase in protein and lipid content of milk compared to twice daily milking.

The quantity of milk affected widely the milk composition, during lactation period. The milk quantity decreased leading to an increase in the amount of chemical composition. (Casoli et al., 1989) studies the effects of parity and length of lactation on physicochemical characteristics of sheep milk from the first to the sixth lactation of 100 Massese sheep in Italy. The results showed that milk quantity decreased during the milking period.

1.7.2.2 Effect of Lactation Stage

(Gonzalo et al., 1992) studied of the effect of milking period on milk composition especially protein and fat by daily sampling of milk from January to July from 3200 different sheep. The results obtained showed that protein and fat quantity increased during milking period.

More evident results were obtained (Fuertes et al., 1997) who studied the daily milk yield and milk composition for 155 churra ewes, daily sample were collected from ewes and analyzed for protein, fat, casein, lactose, and total solid, the results showed that lactation curve and lactose percentage were inversely related to protein, fat, casein and total solids percentage. At week 3 lactose percentages reached its peak, and protein, fat, casein and total solids reached their lowest point.

For goat milk, (Lancu et al., 2010) studied the variation of chemical composition in goat milk during lactation stage, the results obtained showed that fat decreased in second stage and then increased in the last period (5.27, 4.21 and 5.49), protein also decreased in second stage and then slightly increased in the last stage (4.9, 3.66 and 4.2), lactose also decreased in second stage and then increased in the last stage (9.46, 9.12 and 9.72).

(Simos et al., 1991) collected goat milk sample from 164 animals in their second and third stage of milking after weaning until dry off, the results showed that there were considerable variations in the concentrations of main constituents during lactation. Fat content decreased progressively with advancing lactation. Protein and casein contents were fairly constant over the lactation. Lactose content increased during the first 2 months after weaning and then decreased until the end of lactation.

1.7.2.3 Effect of Breed and Species Type

Milk composition varies between goats and sheep, and also varies between the same breed.

Comparison experiment was done between goat and sheep milk in chemical composition by (Jandal. 1996). In which TS% were found to be 12-18 for goat milk and 15- 20% for sheep milk, 3-4.5% protein for goat milk and 5-6% for sheep milk.

Same findings were obtained by (Park et al., 2007), in which different physicochemical property were studied for goat and sheep. The results showed a difference in total solid with higher levels in sheep milk than goat milk.

These two results were in accordance with (Talpur et al., 2008) who studied the effect of breed on milk composition. It was found out that fat% and fat component in milk differ from one breeds to another although the same feed was used.

(Vafopoulou et al., 2008) studied the effect of sheep species on milk composition. Samples were taken from two types of ewe breeds which were Karagouniki and Serron, the results obtained were 11.54% TNF, 6.43 % fat, 5.97 % protein, and 4.95 lactose for Karagouniki breed, and 11.51 % TNF, 6.65% fat, 5.64% protein, and 4.94% lactose for Serron breed. During lactation stage some variations of component were noticed, fat and protein changed in both breed, lactose changed only in Karagouniki breed and protein only in Serron.

(Sawaya et al., 1984) studied the chemical composition of goat milk in two different species in Saudi Arabia which were Masri and Ardi, the results showed that chemical composition differ from one species to another although the same diet introduced.

1.7.2.4 Effect of Animal Feeding

(Al-Dohaib et al., 2008) studied the effect of feeding on milk composition, and on physical and chemical characteristics of milk, in which two types of diets were used, one of them is a

control diet (35% alfafa and 65% cereals), and the other one was substituted with 30% dates, the result showed that no significant difference in acidity and milk yield between the two types of diet. Protein, casein and total solid not fat are higher in dates diet than control.

(Mushtaq et al., 2009) studied the effect of physiological states and management on milk composition, reported that the type of feed affect milk yield, where crop maize and wheat bran increase milk yield and also increased fat and lactose percentage in milk. Also it was found out that the aged and young animals showed milk yield lower than mature animals.

1.7.3 Factors Affecting Cheese Quality

Cheese composition and quality are affected with different factors according to the parameters and processing conditions used during cheese manufacturing, such as heat treatment, addition of starter culture, addition of calcium chloride, and addition of natural additives.

1.7.3.1 Effect of Heat Treatment

(Brown et al., 1984) studied the effect of heat treatment on clotting time during cheese manufacturing, where milk sample divide into different subgroup and heated at different temperature for different holding time, it was found out that the temperature of pasteurization increased clotting time and pH decreased with increasing cheese firmness. Pasteurization at high temperature for long time (75ºC for 30 minutes) cheese did not clot.

Some studies showed that heat treatment affect the chemical composition of cheese. (Kanka et al., 1989) who studied the effect of heat treatment on cheese chemical composition, found that cheese from pasteurized milk have higher a moisture content than that from raw milk, and also found that the moisture content decrease in all cheese types throughout the storage period. The fat % was slightly lower in pasteurized milk than in raw milk cheese.

This result is in accordance with (Kanka et al., 1989) who also studied the effect of heat treatment on some physicochemical properties of cheese, in which the results showed that, raw

cheese milk had higher percentage of chemical composition (fat and protein) than pasteurized goats milk.

As heat treatment affect the chemical composition and it also affect on microbial load which may present in cheese after processing, (Litopoulou et al., 1992). A comparison study were done between a cheese produced from raw milk and a cheese produced from a pasteurized milk, the result showed that the later contain less total aerobic count than the other, also the load of proteolytic and lipolytic organisms in cheese from raw milk were higher than the pasteurized one.

At the same time (Kroll et al., 1995) studied the effect of using raw milk without pasteurization on cheese quality, The results showed that there is a relationship between the high proteolytic count and the low yield of the cheese, and also found that cheese from pasteurized milk had significant decrease in total proteolytic count than that from raw milk.

The same findings were reported with (Hamid et al., 2008) who studied the microbial quality of traditional lighvan cheese produced in Tabriz Iran from mixed milk. In which the hygienic condition of processing and chemical characteristics of lighvan cheese were determined, the result reported that the microbial growth for cheese from raw milk was higher than pasteurized cheese milk.

Some times using of heat treatment with other factors during cheese manufacturing lead to enhanced quality of cheese. (Psoni et al., 2005) studied the quality of Batzos cheese made from raw, pasteurized and/ or pasteurized standardized goat milk and a native culture. The use of pasteurized milk with addition of starter culture decreased the rate of lipolysis compared to raw milk without addition of starter culture.

1.7.3.2 Effect of Starter Culture

(Najaf et al., 2008) studied the effect of starter culture addition to cheese on salt concentration. The result reported that the concentration of salt increased when pH decreased because the

starter culture led to a decrease in pH and enhanced the attraction of minerals to casein micelles.

Other benefits of the decrease pH on goat cheese were shown by (Psoni et al., 2003) who found that decreasing cheese pH lead to the decline of microorganisms during cheese ripening.

The effects of starter culture on Turkish white cheese composition were reported by (Dagdemir et al., 2008). The results showed that the starter culture increased the acidity of cheese and decreased the lipolytic and proteolytic activity of cheese.

The same results were obtained by (Belgrade et al., 2005) who studied the effect of starter culture on cheese quality. The result reported was that the starter culture added to the cheese affected the lipolytic and proteolytic characteristics of the cheese.

(Goncu et al., 2005) studies sensorial and chemical properties of white pickled cheese produced using kefir, yogurt or a commercial cheese as starter culture. It was reported that starter culture type affected the sensory and chemical properties of white pickled cheeses and had a significant impact on acidity, pH, salt, and fat levels in cheese, as well as fat level, appearance, and odor properties.

On the other hand (Sert et al., 2007) studied the effects of starter culture on chemical composition, microbiological and sensory characteristics of Turkish Kasar cheese during ripening. Kasar cheeses were produced from raw milk and starter culture was added to pasteurized milk. Chemical, microbiological and organoleptic properties of Kasar cheeses were analyzed at certain times during the ripening periods (1, 7, 15, 60, 90 days). Generally, physicochemical parameters were not affected by starter culture addition. But Kasar cheese with starter culture contained low levels of total aerobic mesophilic bacteria, moulds and yeasts, and *Coliforms* and had a good flavor.

More evident result, were reported by (Olarte et al., 2001) who studied the effect of starter culture on the chemical composition, microbial quality and organoleptic properties of goat cheese. The addition of starter culture didn’t affect the chemical composition of cheese while

its caused a decrease in microbial growth. Organoleptic quality and the raw milk gave cheese better aroma, color, and texture than pasteurized cheese.

On the other hand other studies showed that there is no effect of some starter culture on the properties and chemical composition of Turkish white cheese (Dagdemi et al., 2003)

During cheese storage different changes occur due to the conditions used during cheese processing and condition of storage, some changes were discussed by (Khosrowshahi et al., 2006) who studied chemical and textural changes during ripening of Iranian White cheese made with different concentrations of starter culture. As ripening progressed, moisture and protein content continuously decreased, whereas their total ash, salt, and salt in moisture contents increased. Fat content and pH of cheeses remained stable during ripening.

The combination between heat treatment and addition of starter culture to cheese lead to good results, (Dervisiglu et al., 2010) studied the effect of heat treatment and starter culture on color intensity and sensory properties of Kulek cheese. The results showed that the heat treatment affect cheese color, and starter culture affected cheese flavor.

1.7.3.3 Effect of Calcium Chloride

(Elzubeir et al., 2008) studied the effect of calcium chloride on fresh cheese from camel milk. The result found that the addition of calcium chloride into milk before renneting will decrease the time of coagulation, increase cheese yield, and increase the percentage of ash.

Also (McMahon et al., 2005) studied the influence of Calcium chloride, pH, and moisture on protein matrix structure and functionality in direct acidified nonfat mozzarella cheese. The result reported was that the addition of calcium chloride during cheese manufacturing caused hardness of cheese.

The same result was found by (Wolfschoon et al., 1998) who studied the influence of calcium chloride addition to milk on the cheese yield. The result showed that the addition of calcium chloride at 0.01% to milk before renneting increased the yield of cheese.

(Ustunol et al., 1990) studied the effect of Calcium chloride addition on the yield of cheese manufactured with *Endothia parasitica* Protease. Addition of calcium chloride to cheese milk clotted with *E. parasitica* protease increased cheese yield. Calcium needed to be higher than 0.02% to produce maximum yields when cheese was manufactured with *Endothia parasitica* protease.

1.7.3.4 Effect of Natural Addition

Sometimes, natural additives added to cheese has negative effect as shown in (Nouanth. 2009) who studied the effect of addition of extracts derived from artichoke flowers and from the fig tree latex in light of their use in the manufacture of traditional camel cheeses. The result reported that the addition of natural additive to milk during cheese manufacturing increased proteolytic activity.

1.7.4 Yogurt

1.7.4.1 Effect of Storage Before Processing

(Ravins et al., 2000) studied the effect of storage milk for 14 days at 4°C and pasteurized on days 1, 3, 4, 7, 9 and 14. Precautions were taken to eliminate post-pasteurization contamination. The pasteurized milks were stored at 4°C and analyzed at weekly intervals for standard plate counts (SPC)). The initial raw milk quality was very good and the keeping quality of all the pasteurized milks tested was greater than 22 d. In some cases, the milk still had acceptable SPC after 42 days storage, which showed the keeping quality that can be achieved when the process is well controlled.

(Psoni et al., 2005) studied the effect of refrigeration storage of milk before using heat treatment, the result reported that the storage of milk lead to increase the activity of lipolytic and decrease amount of protein.

1.7.4.2 Effect of Heat Treatment

(Lee et al., 1988) and (Doan et al., 1942) who studied the effect of heat treatment on yogurt quality, in which the result showed that increasing heat treatment to high temperature is required to increase availability of protein, because of its affect casein structure and cause whey denaturation

(Kanka et al., 1989) who studied the effect of heat treatment on chemical properties, and microbial quality of yogurt produced from sheep milk. The result showed that heat treatment increased the amount of protein in cheese, also decreased the microbial loads in cheese, and also ash decreased during pasteurization.

The same finding were shown (Alakali et al., 2008) who studied the effect of heat treatment on microbial quality of yogurt, the result found that yogurt pasteurized at high heat treatment shows no fungal and coliform growth after yogurt production.

Effects of ultra-high temperature and vat processing temperatures on rheological properties of yogurt were investigated by (Labropoulos et al., 1983). Cultured yogurt processed by the ultra-high temperature system showed much lower gel firmness and apparent viscosity than yogurt processed by the vat systems

Chapter Two Materials & Methods

2.1 Introduction

To indicate the quality of raw milk and dairy products under this investigation, a number of analytical methods were used including chemical analysis and microbial analysis.

To obtain high quality products, raw materials must be within high quality, so that all materials used in this investigation are discussed in this chapter.

2.2 Materials

Different materials were used in this study, most of them which will be discussed there are milk, Starter Culture, Calcium Chloride, Carob, and Rennet.

2.2.1 Milk

Raw milk from sheep and goats, were collected from 5 farms distributed in different areas (Hebron, Bane na'em, Bethlehem, Abu dies, and Rafat), the samples were collected through lactation period and transported into food processing laboratory in cooled and insulated containers.

2.2.2 Starter Culture:

Its origin is from mother culture (thermophilic starter culture from yogurt product produced later). It was added to milk at 2% it contains *L. Bulgaricus, S. Thermophilus* (50%:50%).

2.2.3 Calcium Chloride:

White chemical compound present in food technology laboratory (Di hydrated) and used in cheese production at 0.1% ratio and approved from FDA. It dissolved in deionized water and then added to milk before coagulation step. Its purity around 90%. From Merck Company.

2.2.4 Rennet Enzyme:

It's a powder of rennet enzyme (Type II) was added to milk for coagulation and curd formation at 0.05% ratio, enzyme were extracted from special mold which is *Mucor Mohei* and it consist of two enzyme chymosin and pepsin. Take from Sigma Company.

2.2.5 Carob Fruits:

Carob used to enhance texture of cheese and to reduce time of coagulation. Fresh Fruits were cutted and soaked in water for several hours and then squeezed to take the solution. Used in cheese at 1% concentration.

2.2.6 Salt:

Calcium chloride salt used to prepare the brine solution at 15% ratio, to be used for cheese preservation.

2.3 Methods

All Method used and practical work were carried out in Food Technology Lab/ Food Technology Department/ Al-Quds University.

2.3.1 Method Used for Raw Milk Analysis

Samples after being received at the laboratory were analyzed for chemical composition using manual methods (standard methods) and mechanical method (using milk analyzer).

Analysis of milk by lactoscan equipment which give an idea and information about the quality of milk before processing by measuring the following:

- Protein percent.
- Surface tension.
- Fat percent.
- Freezing point.
- Added water percent.
- Lactose percent.
- Solid Not Fat percent (SNF).
- Density.
- Temperature of milk.

2.3.1.1 Apparatus Description:

- Supplied from Milkotronic Ltd Company/ Bulgaria
- Ultrasonic portable milk analyzer
- 1 sample measurement time: 90 minutes.
- LCD display – 4 lines x 16 characters

2.3.1.2 Accuracy of Lactoscan

Fat …..……..…….…...± 0.10%
SNF …….. ……...…….…...± 0.15%
Density ……...……..± 0.3 kg/m3
Proteins …….…...± 0.15%
Lactose ……..……...± 0.20%
Water content ……..……± 3.0%
Temperature of milk ……± 1oC
Freezing point…….. ……± 0.001oC
Salts ……... ...……...± 0.05%
PH ……. ...……±0.05%
Conductivity ……..……...±0.05
Total solids ……...……± 0.17%

2.3.2 Methods Used for Dairy Products Analysis

All methods used in cheese and yogurt analysis were done according to AOAC (2007).

2.3.2.1 Chemical Analysis:

2.3.2.1.1 Protein Determination

Standard method used for protein determination in end products was kjeldahl method. Protein was determined in this method by three steps. Digestion step, distillation step, and titration step (Appendix 1.1). In this method we obtained Nitrogen percent.
Then protein were calculated using the following equation
Protein = N% * 6.25

2.3.2.1.2 Fat Determination.

The standard method used in fat determination for end products was Babcock method. (Appendix 1.2). This method depends on using strong acid as sulphuric acid to dissolve fat.

2.3.2.1.3 Ash Determination.

The standard method used for ash determination in end products was dry ashing method (Appendix 1.3).

2.3.2.1.4 Total Solid Determination.

The standard method used to determine total solid for end product was oven drying method (Appendix 1.4). In which water evaporated from the sample and the remaining portion was total solid in sample.

2.3.2.2 Microbial Test:

The two major type of microbial analysis (Total *Coliform* and Yeasts & Molds) were used in this investigation to determine the quality of dairy products. Samples tested according to ICMSF (1996).

2.3.2.2.1 Total Coliform

This procedure describes the method of detection of total *Coliforms* in products, from raw materials to finished products as well as to ensure that the finished products are with the Microbiological specifications. (Appendix 2.1). The method used depends on using violet red bile agar media and incubation temp-time was 30 ºC for 1 day.

2.3.2.2.2 Yeasts and Molds

This procedure describes the method of detection of Yeast & Molds in products, from raw materials to finished products as well as to ensure that finished products are with in Microbiological specifications. (Appendix 2.2). The method used depends on using malt extract agar media and incubation temp-time was 25 ºC for 5 days.

2.3.2.3 Sensorial Evaluation

Organoleptic properties of cheese and yogurt (Flavor, texture, aroma, and color) were determined by a group of people (10 trained students from food technology department), and the sensorial properties of the products were evaluated according to the hedonic scales.

Table 2.1 Hedonic scale used to evaluate sensorial properties of cheese

Hedonic Scorecard used in evaluation:	**Score**
like extremely	9
like very much	8
like moderately	7
like slightly	6
neither like nor dislike	5
dislike slightly	4
dislike moderately	3
dislike very much	2
dislike extremely	1

2.3.3 Experimental Design

The experimental work was done according to the following sequence:

2.3.3.1 Farms Selection

Five farms were selected according to different parameters as follows:

a- Farm situation

All farms selected were away from buildings, also all farms selected to be easily provided with electricity and water source.

b- Farms hygiene: the most hygiene condition

c- Rancher personality

d- Farms appropriate according to types and number of cattle
Which were included at least 100 cattle (30 head at the same lactation period)

e- Appropriate of farms management

Five farms were selected in different area as:

- 2 Farms in Hebron, one of them in Hebron city and the second in bane na'em.
- 2 Farms in Alquds, both in mekhmas.
- 1 Farm in Bethlehem, in Fredes village.

Sample taken from the farms (all the amount of milk obtained from the farm were taken directly to the lab), transferred to the lab under controlled condition. Milk was collected in poly ethylene plastic cases and preserved in cooled insulated containers until reaching to the laboratory.

The required test and experiments (processing and analysis) were performed.

- Milk components analyzed in milk analyzer.
- Milk collected and different groups of cheese were manufactured as shown in Table 2.2 and different groups of yogurt were also manufactured as shown in Table 2.3. Method of production showed in Fig 2.1, 2.2, and 2.3.
- Cheese and Yogurt samples were stored for the expected shelf life (2 months for cheese and 2 weeks for yoghurt) and then all sample quality evaluated by chemical component analysis, sensorial evaluation, and microbiological analysis.

Table 2.2 Different cheese group produced from small ruminant's milk.

Group	W/o Past.	65ºC for 30 mints	80ºC for 30 secs	S.C	$CaCl_2$	Rennet	Carob
1			X	X	X	X	X
2			X	X		X	X
3			X	X	X	X	
4			X	X		X	
5			X		X	X	X
6			X			X	X
7			X		X	X	
8			X			X	
9		X		X	X	X	X
10		X		X		X	X
11		X		X	X	X	
12		X		X		X	
13		X			X	X	X
14		X				X	X
15		X			X	X	
16		X				X	
17	X			X	X	X	X
18	X			X		X	X
19	X			X	X	X	
20	X			X		X	
21	X				X	X	X
22	X					X	X
23	X				X	X	
24	X					X	

Table 2.3 Different groups of yogurt produced from small ruminant's milk.

Group	w/o storage	Refrigeration (24 hrs)	Freezing (24 hrs)	Past. (80ºC for 15 mints)	Past. (90ºC for 10 secs	Boiling	S.C
1	X			X			X
2	X				X		X
3	X					X	X
4		X		X			X
5		X			X		X
6		X				X	X
7			X	X			X
8			X		X		X
9			X			X	X

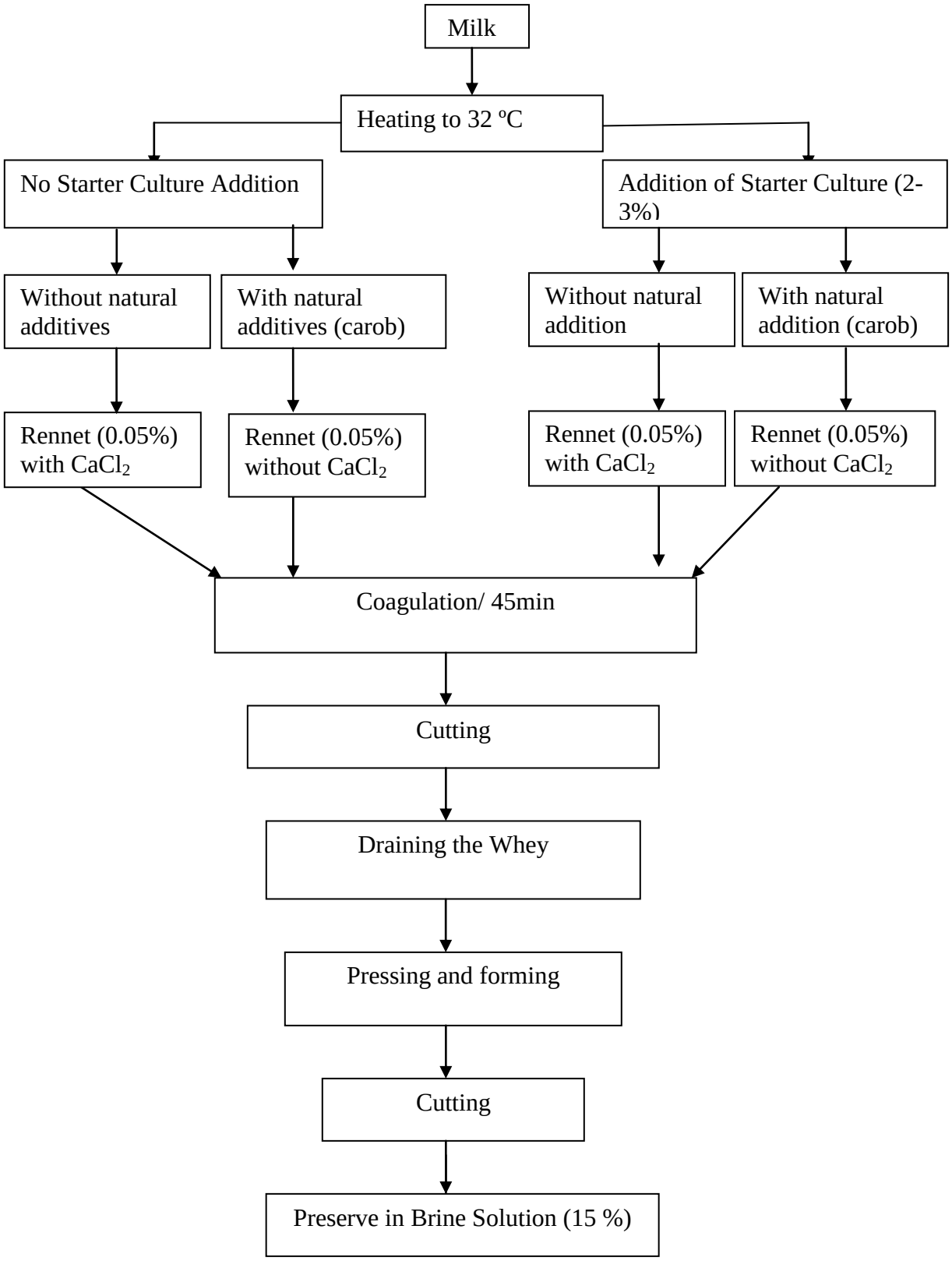

Fig 2.1 flow chart for cheese production from unpasteurized milk

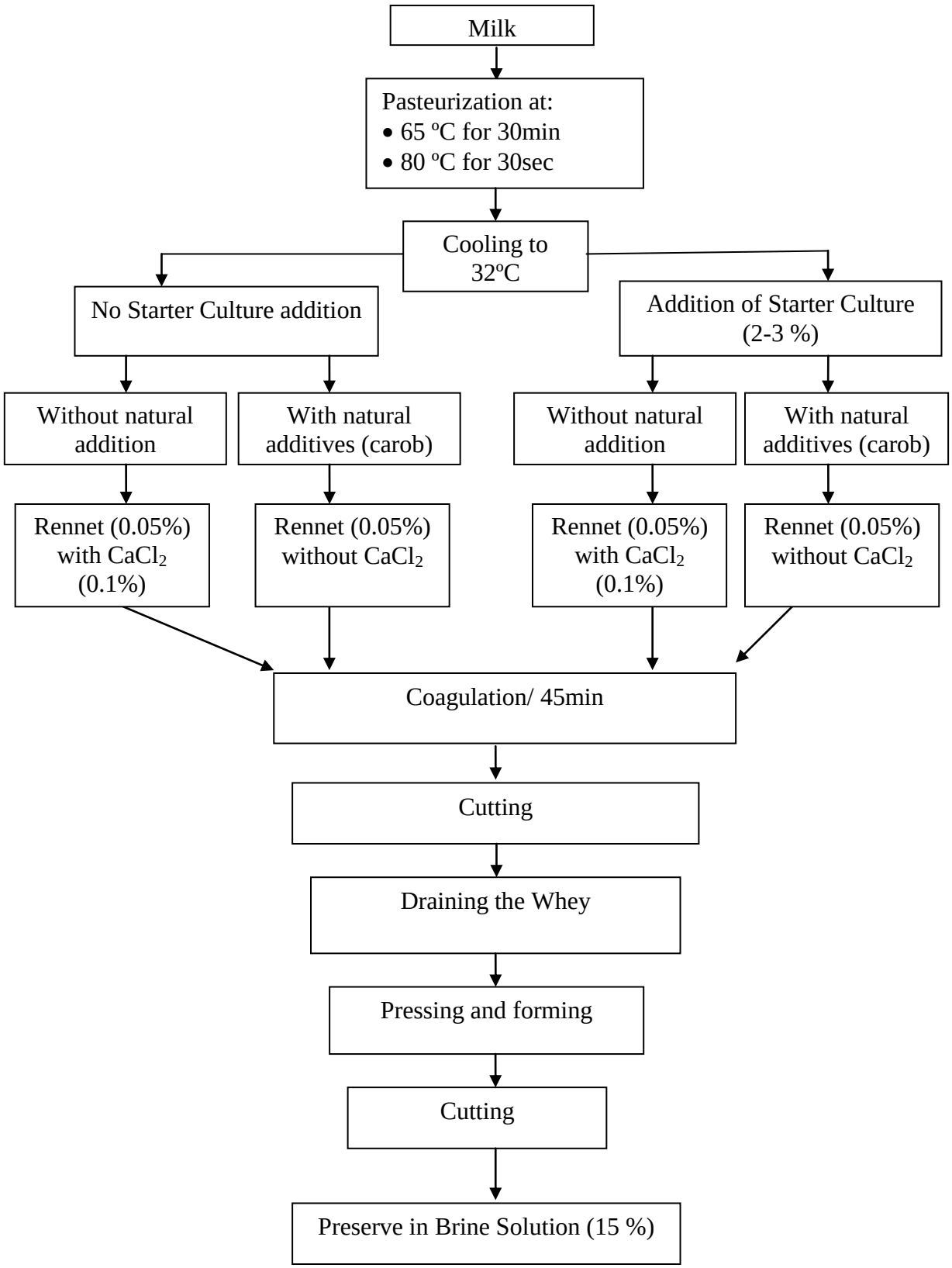

Fig 2.2 Flow chart for cheese production from pasteurized milk

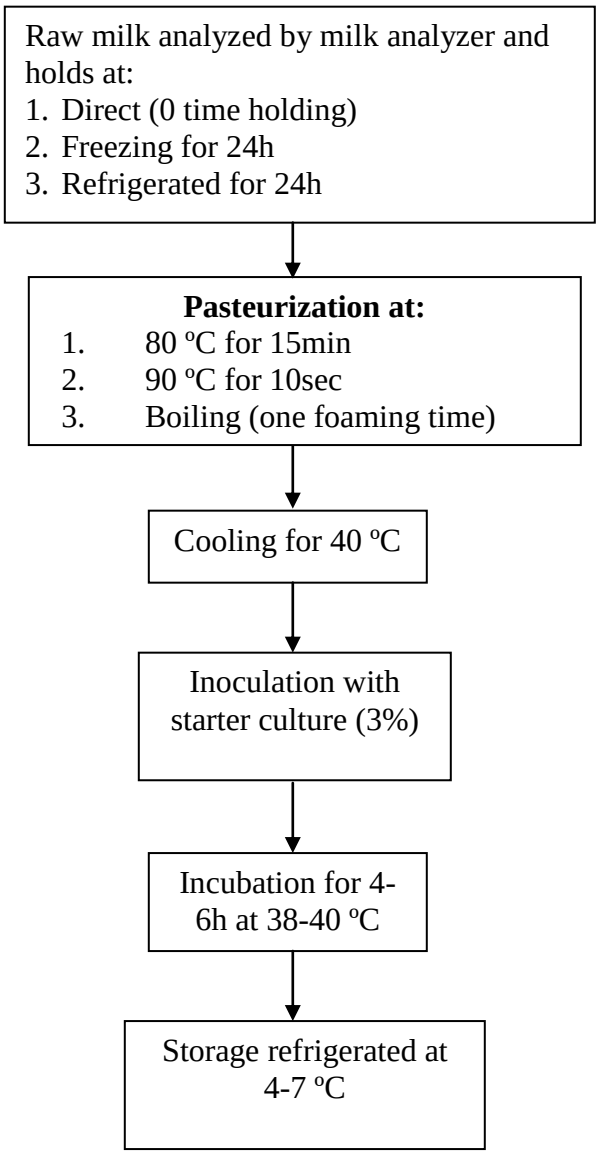

Fig 2.3 Flow chart for Yogurt production with different parameters

There are different parameters to be studied in this research:

1- Effect of heat treatment (pasteurization) on products quality.

2- Effect of storage (cooling, freezing) before processing in yogurt quality.

3- Effect of Rennet on cheese quality.

4- Effect of Starter culture cheese quality.

5- Effect of natural additives on cheese quality.

6- Factors affecting milk composition

Chapter Three Result and Discussion: Sheep Milk

3.1 Introduction

This chapter includes two parts of result, the first one related to the characterization of sheep milk and discuss the main changes for milk components during lactation period. The second part shows the result of dairy products and discuss the factors affecting the products quality.

3.2 Factors Affecting Raw Milk

Raw milk composition changes were studied during lactation stage (which represent 3 months). The major components of milk which were studied were protein, fat, total solid, and lactose.

3.2.1 Factors Affecting Protein Content

3.2.1.1 Lactation Stage in Spring Season

3.2.1.1.1 Morning Milking Time

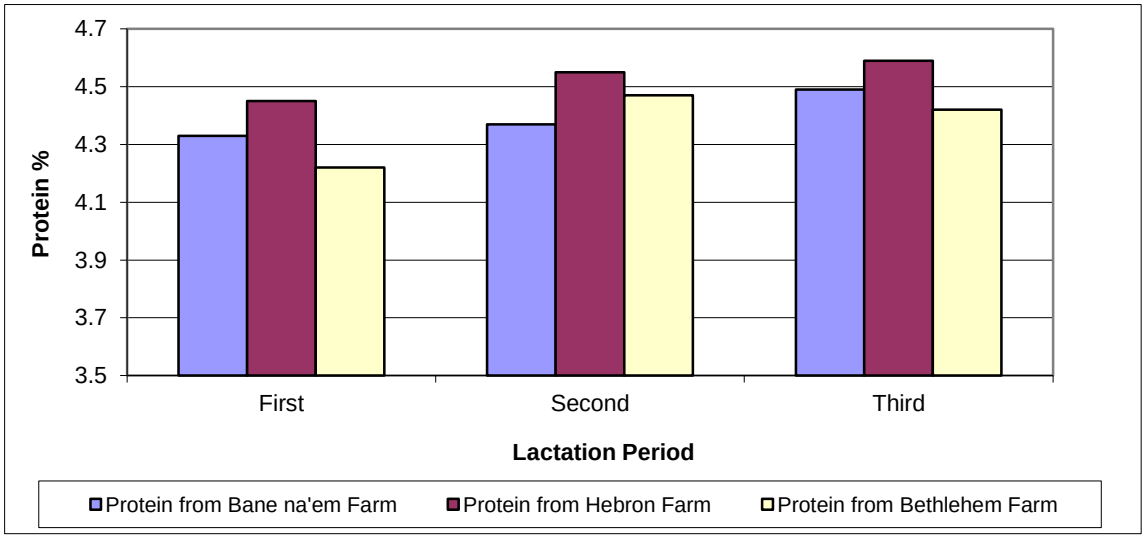

Fig. 3.1 Protein quantity in Bane na'em, Hebron, and Bethlehem farms during the three time period of milking at morning time in spring. Each period consist of one month.

From Fig 3.1 The protein quantity in all spring farms significantly increased as time of the season developed, this increment was due to the decrease in the amount of milk during milking, which lead to an increase in the amount of protein concentration. These finding were in agreement with (Haenlein et al., 2002) who found that milk composition concentration increased as the quantity of milk decreased. (Fuerttez et al., 1997) also found that milk composition concentration were related inversely to the milk yield.

The milk quantity obtained during the three stages of lactation from spring farms at the two time milking (morning and evening) are shown in Table 3.1.

Table 3.1 Milk yield obtained during the three periods of lactation from spring farms at the two time of milking (morning and evening)

Farm	Milk quantity(Kg)/ day					
	First period		Second period		Third period	
	Morning	Evening	Morning	Evening	Morning	Evening
Bane na'em (30 head of sheep)	19,208	17,399	13,370	12,116	8,330	7,400
Hebron (30 head of sheep)	24,567	23,320	19,693	17,834	10,000	8,745
Bethlehem (20 head of sheep)	12,374	11,050	10,490	8,600	7,451	6,100

3.2.1.1.2 Evening Milking Time

At evening time, 30 milk samples from each farms, namely Hebron, Bane na'em, while 20 milk samples from Bethlehem farm were taken and the results of protein percentage were given in Fig 3.2.

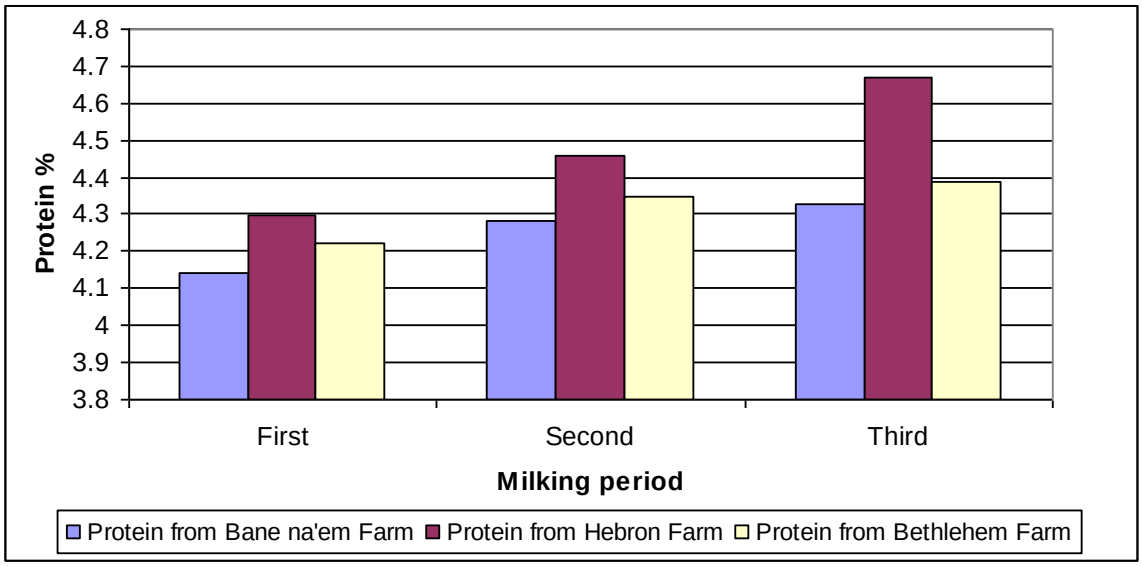

Fig. 3.2 Protein quantity in Bane Na'em, Hebron, and Bethlehem farms during the three periods of milking at evening time in spring. Each period consist of one month.

Also in evening milk, the two results from Bane na'em and Bethlehem had the same result as in the morning milk. In which the quantity of protein increased as milk quantity decreased, and the milk quantity decreased with the progress of lactation period.

3.2.1.1.3 Correlation Between Morning and Evening for Spring Farms.

The result in Fig 3.3 showed that evening's milk contain higher amount of protein than mornings milk. These finding are in agreement with the result of (Fadel et al., 2011) and (Gilmore et al., 1963), whom found that the evening milk for Awassi sheep had higher amount of protein than morning milk. Also (adebosin et al., 2010) found that all component of milk increase in evening than morning.

On the other hand (Kastelic et al., 2006) found that there were no differences between morning and evening milk in composition.

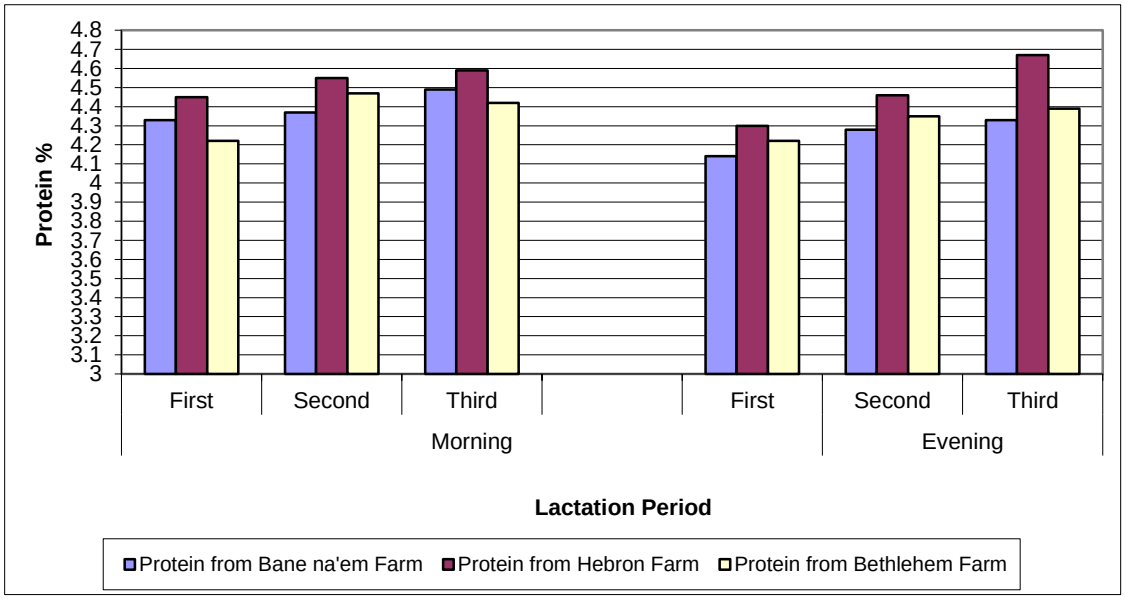

Fig 3.3 Comparison between morning and evening milk of protein content for spring farms at morning time.

3.2.1.2 Milking Period in Summer Season

Two farms were appointed to collect samples from them in summer period which were Abu dies and Rafat farms. Samples collected in spring period during three intervals time (first, second and third period of milking). On each interval, samples are collected twice time daily morning and evening).

3.2.1.2.1 Morning Milking Time.

At morning time, 20 milk samples were taken from each of the 2 farms; Abu dies and Rafat, the result of protein obtained are plotted in Fig 3.4.

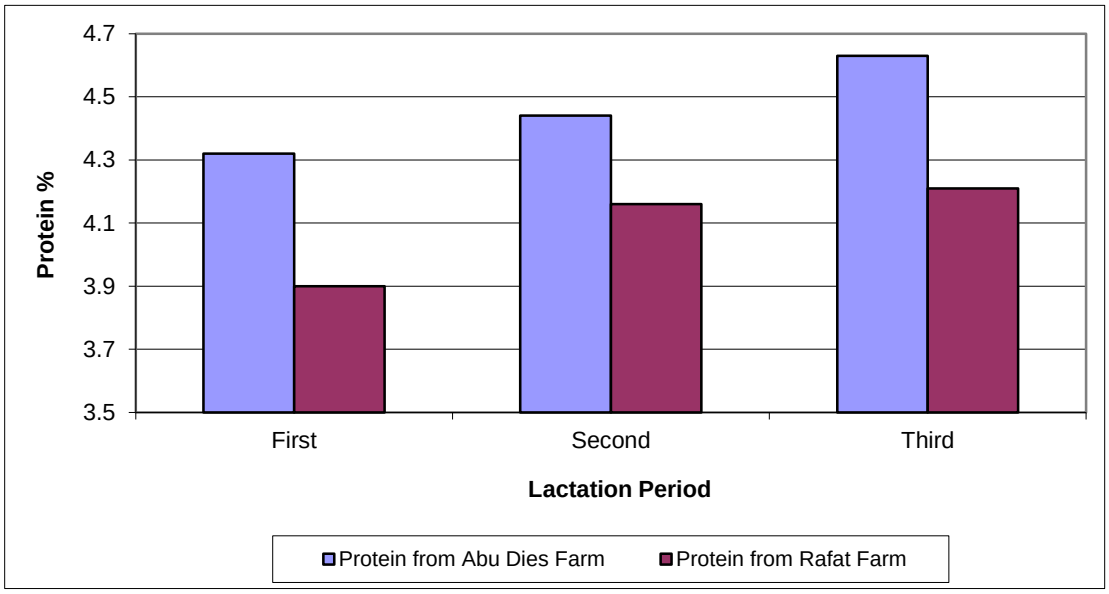

Fig. 3.4 Protein quantity in morning milk from Abu dies and Rafat farms during the three times period of milking in summer. As each period consist of one month.

The result showed as well that protein quantity in summer farms increased during the period of milking, because quantity of milk decrease as shown in table 3.2.

Table 3.2 Quantity of milk obtained during the three periods of milking from summer farms at the two time of milking (morning and evening)

Farm	**Milk quantity(Kg)/ day**					
	First period		**Second period**		**Third period**	
	Morning	Evening	Morning	Evening	Morning	Evening
Abu dies (20 head of sheep)	11,085	9,700	9,766	8,462	5,440	5,400
Rafat (20 head of sheep)	12,500	12,330	10,721	7,983	6,211	4,290

3.2.1.2.2 Evening Milking Time

At evening time, 20 milk samples were taken from each of the 2 farms; Abu dies and Rafat, the result of protein content were obtained and shown in Fig 3.5

Fig. 3.5 Protein quantity in Abu dies and Rafat farms during the three time period of milking at evening time in summer. Each period consist of one month.

3.2.1.2.3 Correlation Between Morning and Evening for Summer Farms.

Fig. 3.6 showed that evening milk had more protein quantity than morning milk this is because the quantity of milk in evening is less than morning. These findings are confirmed with the results of (Adebosin et al., 2010) who found that protein proportion were higher in evening milk than morning milk, also (Fuertes et al., 1997) found that protein quantity in milk related inversely to the quantity of milk.

However some result showed that there is no difference in protein quantity between morning and evening (Kastelic et al., 2006), also (Castillo et al., 2008) found that there was no effect of milking intervals on protein composition in milk during 24 hours of the day.

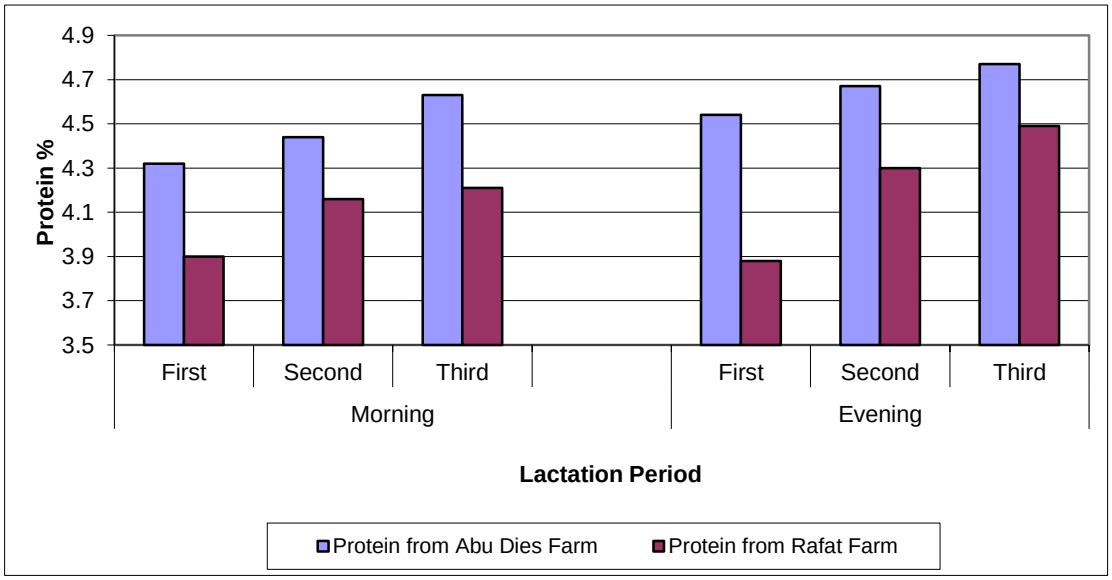

Fig. 3.6 Comparison between morning and evening milk in protein quantity for summer farms (Abu dies and Rafat farms).

3.2.2 Factors Affecting Fat Content

Fat percent changes in milk were studied twice related to spring and summer time. In which three farms were studied in spring (Hebron, Bane na'em, and Bethlehem), in addition, two farms studied during summer semester (Abu dies, and Rafat).

3.2.2.1 Milking Period in Spring Season

Samples are collected from the three farms that are appointed (Bane na'em, Hebron, and Bethlehem) at three intervals time (first, second and third period of milking). In each individual interval, samples are collected twice daily (morning and evening).

3.2.2.1.1 Morning Milking Time

At morning time, 30 milk samples from each Hebron, Bane na'em farms, and 20 milk samples from Bethlehem farm were taken and the results of fat were shown in Fig 3.7.

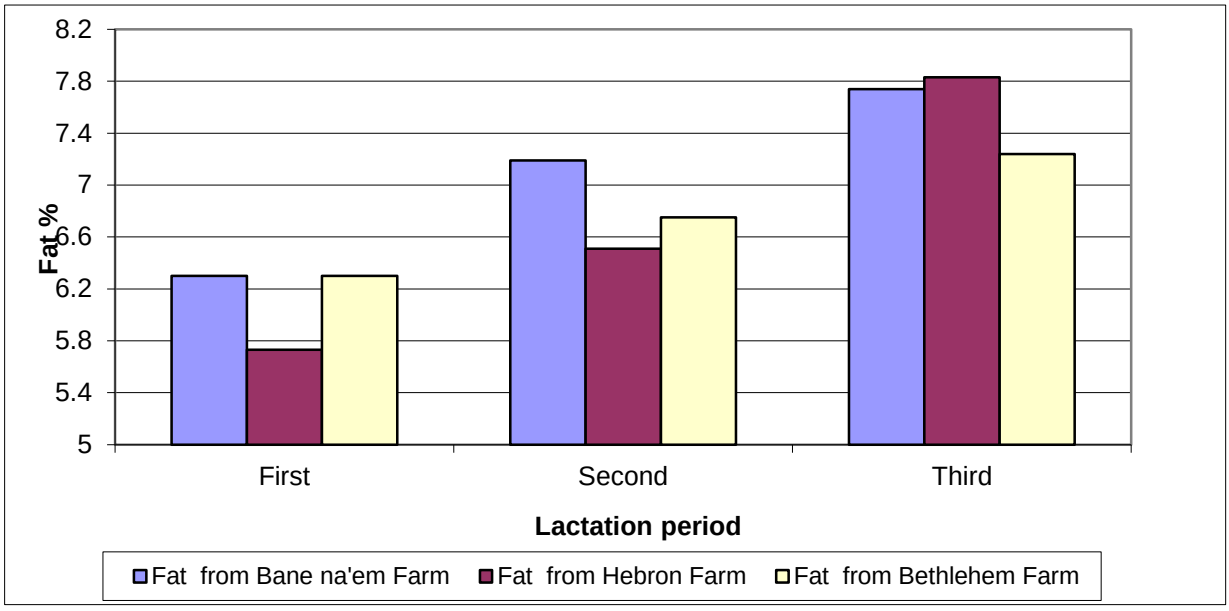

Fig. 3.7 Fat quantity in Bane na'em, Hebron, and Bethlehem farms during the three time period of milking at morning time in spring. Each period consist of one month.

In general, all the results of fat in morning milk during the three period of milking showed that fat increases as stage of milking advance. These increases of fat proportion are due to the decrease of milk quantity during the third stage of milking (Fuertes et al., 1997). Fat quantity in milk are positively correlated to protein proportion, in other means as protein increase in milk during stage of milking also fat increases (Bencini et al., 1990).

3.2.2.1.2 Evening Milking Time

At evening time, 30 milk samples from each Hebron, Bane na'em farms, and 20 milk samples from Bethlehem farm were taken and the results are shown in Fig 3.8.

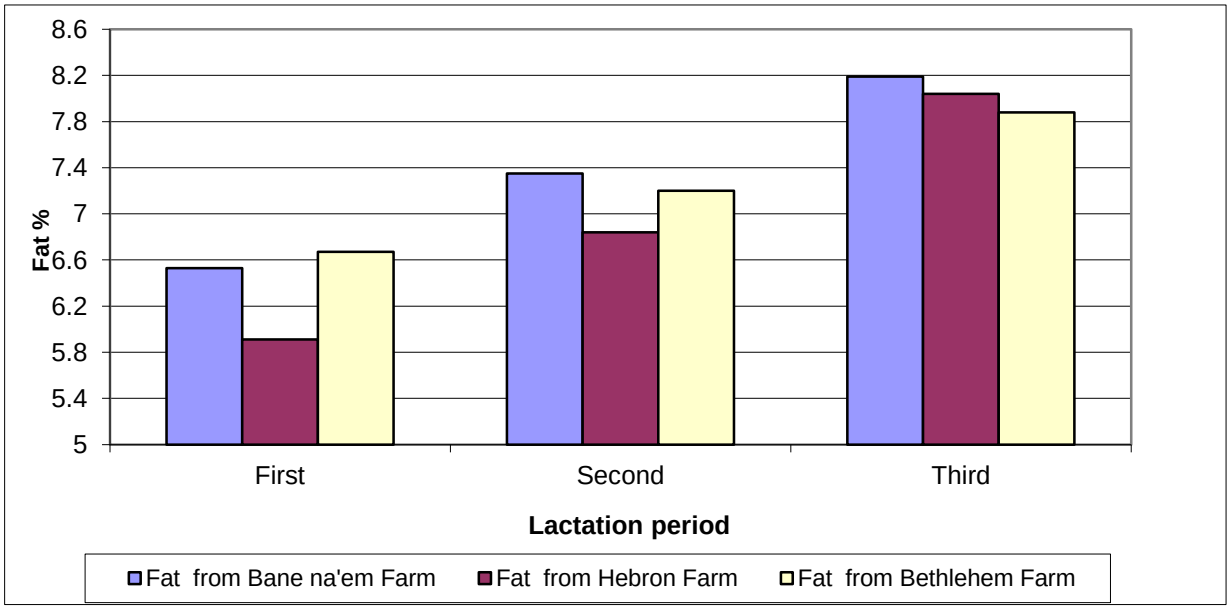

Fig. 3.8 Fat quantity in Bane na'em, Hebron, and Bethlehem farms during the three time period of milking at evening time in spring. Each period consist of one month.

All evening results for fat showed the same results as in morning milk, in which fat quantity increased during the stage of milking, so that there is no difference between morning and evening in fat during the third stage of lactation.

3.2.2.1.3 Fat Correlation Between Morning and Evening for Spring Farms

The Comparison study between morning and evening milk in fat quantity showed that fat proportion is higher in evening than morning, which return to the same result of increasing fat during milking period, with decreasing amount of milk. Increase in the amount of fat in evening than morning time is in the accordance with (Fadel et al., 2011), (Adebosin et al., 2010), and (Simos et al., 1996) who found that fat proportion were higher in evening milk than morning milk, in addition the first author found there were no differences between morning and evening in the quantity of milk. On the other hand (Kastelic et al., 2006) found that there were no differences between morning and evening milk in fat quantity. (Castillo et al., 2008) found opposite results, in which fat proportion decreased during period of milking.

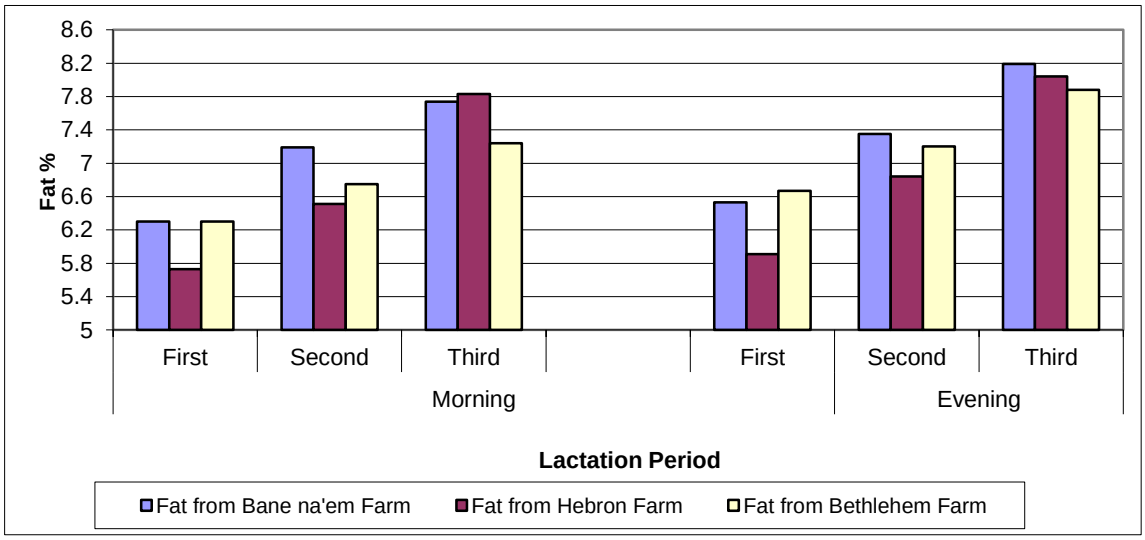

Fig. 3.9 Comparison between morning and evening milk in fat quantity for the three spring farms (bane na'em, Hebron, and Bethlehem).

3.2.2.2 Milking Period in Summer Season.

Two farms were appointed to collect milk samples from them in summer period which were Abu dies and Rafat farms. Samples were collected in spring period during three intervals time (first, second and third period of lactation). On each one interval samples collected twice time daily in morning and evening).

3.2.2.2.1 Morning Milking Time

At morning time, 20 milk samples were taken from each of the 2 farms; Abu dies and Rafat, the result of fat were obtained showed in Fig 3.10.

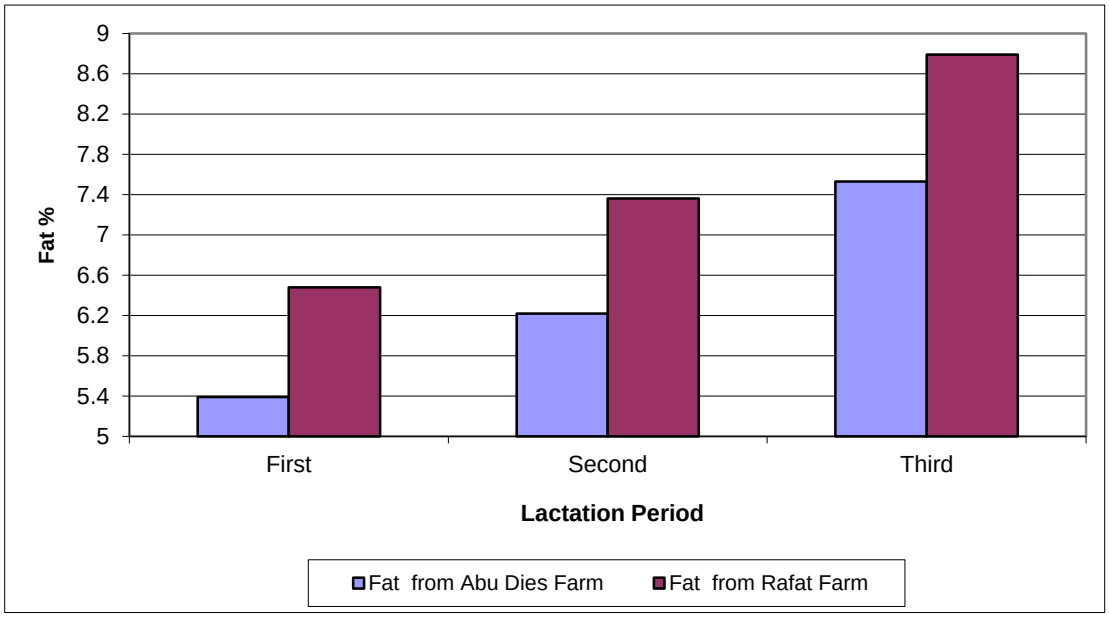

Fig. 3.10 Fat quantity in Abu dies and Rafat farms during the three time period of milking at morning time in summer. Each period consist of one month.

Also as in spring farms, all the results of fat quantity in Abu dies and Rafat farms obtained from morning milking time showed that fat quantity increased during the stage of milking.

3.2.2.2.2 Evening Milking Time

At evening time, 20 milk samples were taken from each of the 2 farms; Abu dies and Rafat, the result of fat were obtained showed in Fig 3.10.

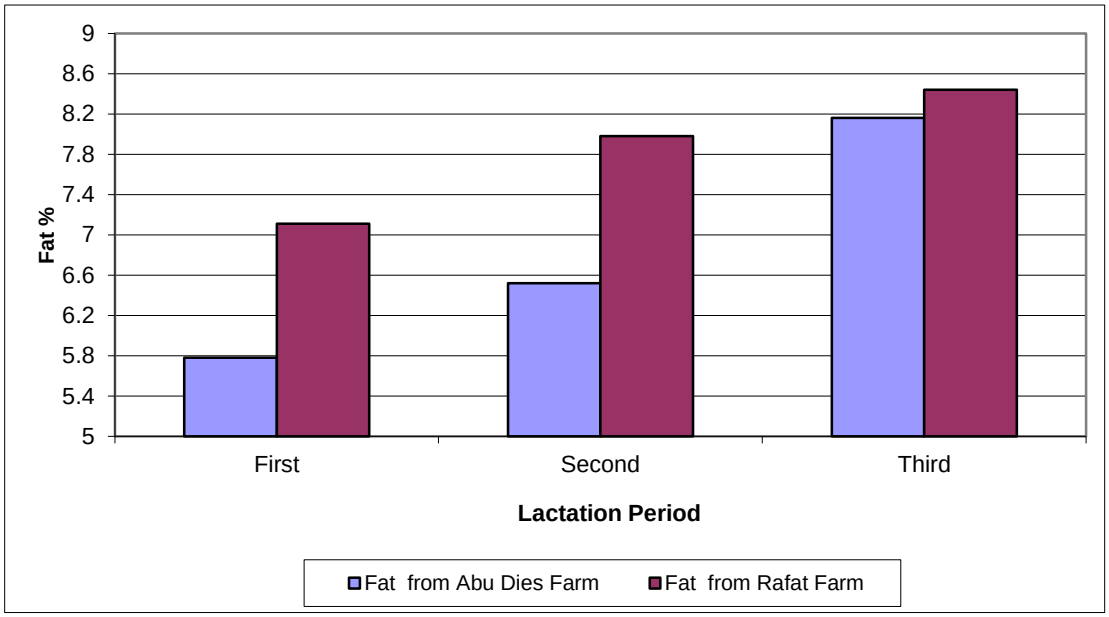

Fig. 3.11 Fat quantity in (Abu dies and Rafat) farm during the three time period of milking at evening time in summer. Each period consist of one month.

3.1.2.2.3 Fat Correlation Between Morning and Evening for Summer Farms

The comparison study between morning and evening milk for fat content showed that, fat in evening milk is higher than morning milk.

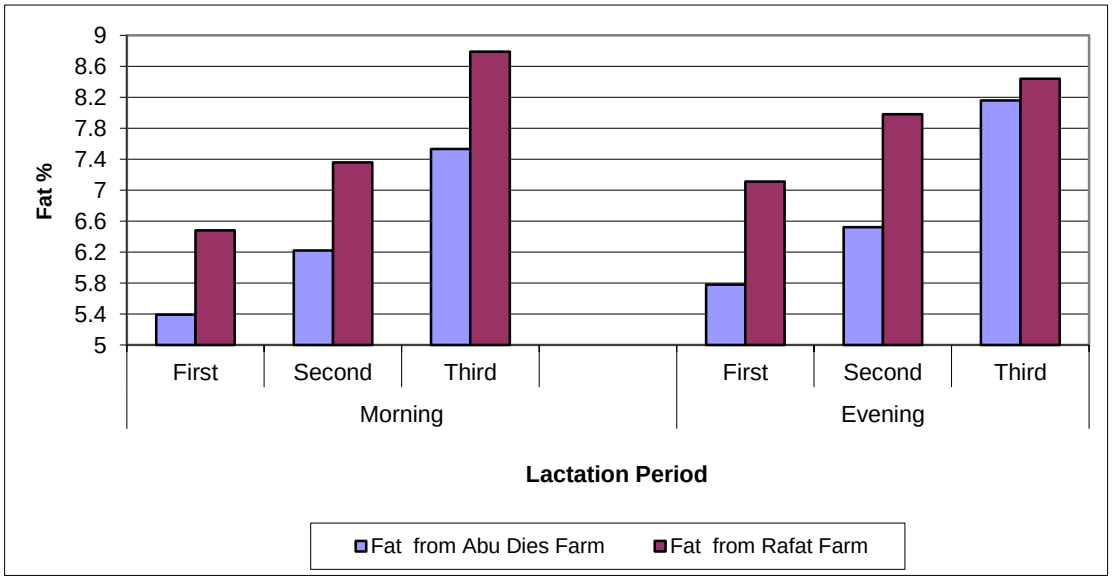

Fig. 3.12 Comparison between morning and evening milk in Fat quantity for summer farms (Abu dies and Rafat).

3.2.3 Factors Affecting Total Solids Content

Protein percent changes in sheep milk were studied during spring and summer seasons. In which three farms were studied in spring (Hebron, Bane na'em, and Bethlehem), in addition to two farms in summer (Abu dies, and Rafat).

3.2.3.1 Milking Period in Spring Season

Three farms were appointed to collect samples from them in spring period which were Bane na'em, Hebron, and Bethlehem farms. Samples collected in spring period during three intervals time (first, second and third period of milking). On each one interval samples collected twice daily in morning and evening).

3.2.3.1.1 Morning Milking Time

At morning time, 30 samples from each Hebron, Bane na'em farms, and 20 samples from Bethlehem farm were taken and the results of total solid were given as the following.

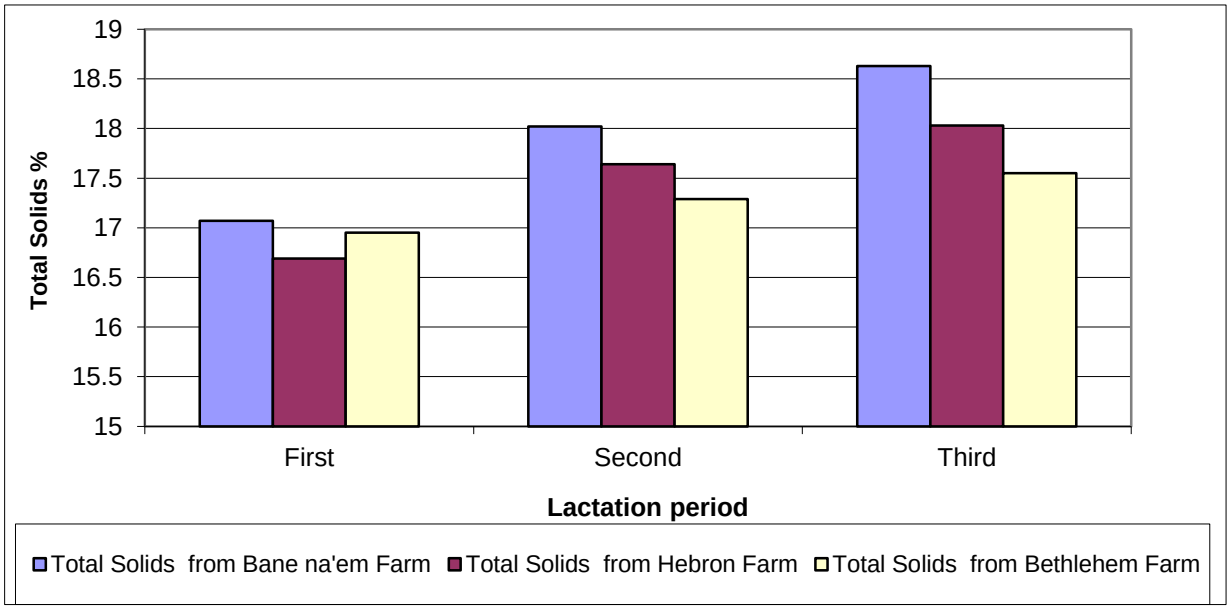

Fig. 3.13 Total solids quantity in Bane na'em, Hebron, and Bethlehem farms during the three time period of milking at morning time in spring. Each period consist of one month.

Fig 3.13 showed that total solid percentage in milk increased during the third period of milking, due to the increased amount of protein, fat and minerals. These results are in accordance with (Fuertes et al., 1997). Who found that total solid, protein; casein and fat were relatively to the milk yield. Since the amount of milk decrease during milking period, so the amount of total solid decreased. Also (Haenlein et al., 2002) found that minerals increased during the period of milking. (Pavic et al., 2002) found that total solid percent in the first period of lactation about 19.11, and the percentage increased in second and third period of milking.

3.2.3.1.2 Evening Milking Time

At evening time, 30 samples from each Hebron, Bane na'em farms, and 20 samples from Bethlehem farm were taken and the results of total solid were given as the following.

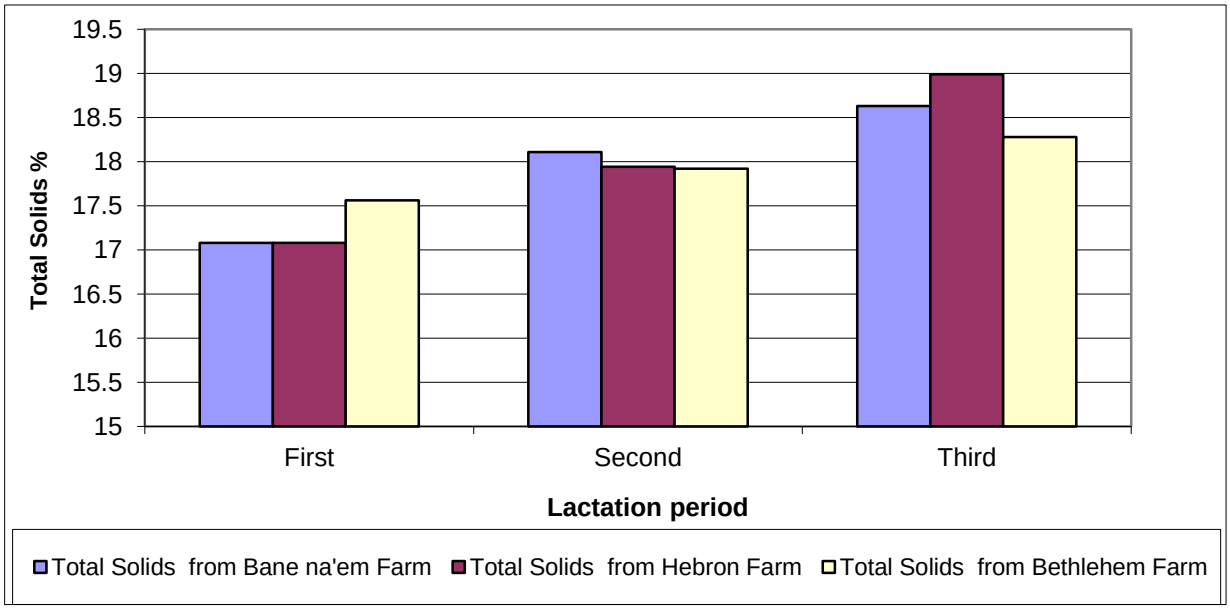

Fig. 3.14 Total solids quantity in Bane na'em, Hebron, and Bethlehem farms during the three time period of milking at evening time in spring. Each period consist of one month.

Total solid percentage in evening milk do not differ from morning milk, which also have the same result of increasing amount of total solid during milking period.

3.2.3.1.3 Total solid Correlation Between Morning and Evening Milk for Spring Farms

Fig 3.15 shows that the percentage of total solid in evening milk higher than in morning milk, due to the increase of both protein and fat amounts in evening milk than morning milk. These results are in agreement with (Castillo et al., 2008), (Adebosin et al., 2010) and (Fadel et al., 2011) who found that total solid percent in evening milk higher than morning milk. However (Kastelic et al., 2006) found that there was no difference between morning and evening milk in total solid quantity.

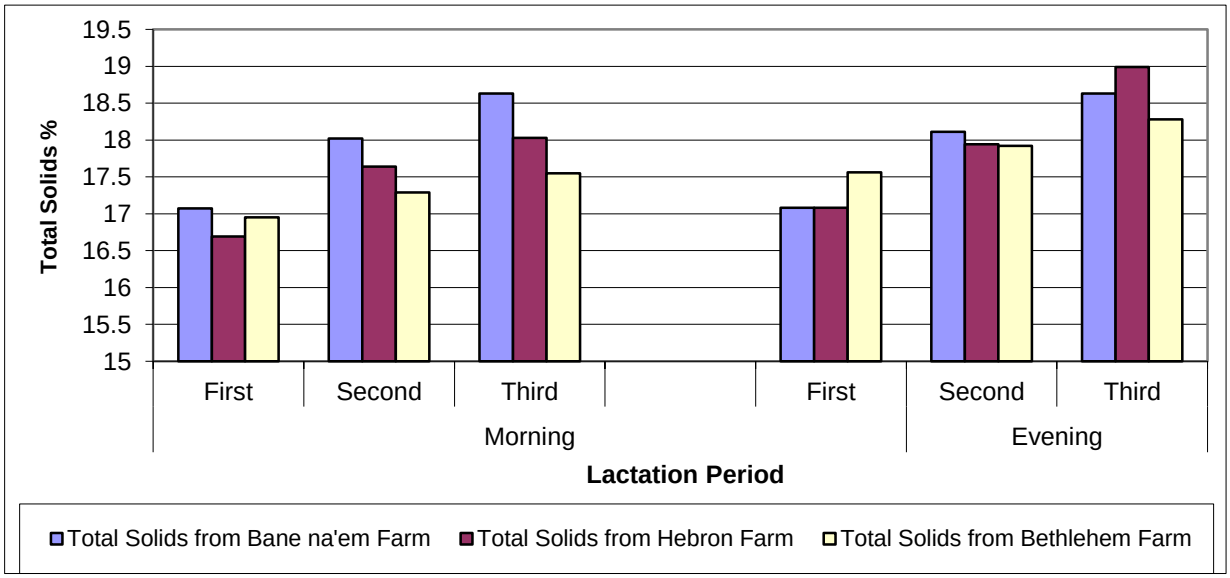

Fig. 3.15 Comparison between morning and evening milk in Total solid quantity for the three spring farms (Bane na'em, Hebron, and Bethlehem).

3.2.3.2 Milking Period in Summer Season

Two farms were appointed to collect samples from them in summer period which were Abu dies and Rafat farms. Samples are collected in spring period during three intervals time (first, second and third period of milking). On each interval samples collected twice daily in morning and evening).

3.2.3.2.1 Morning Milking Time

At morning time, 20 milk samples were taken from each of the 2 farms; Abu dies and Rafat, the results of total solid were obtained as the following:

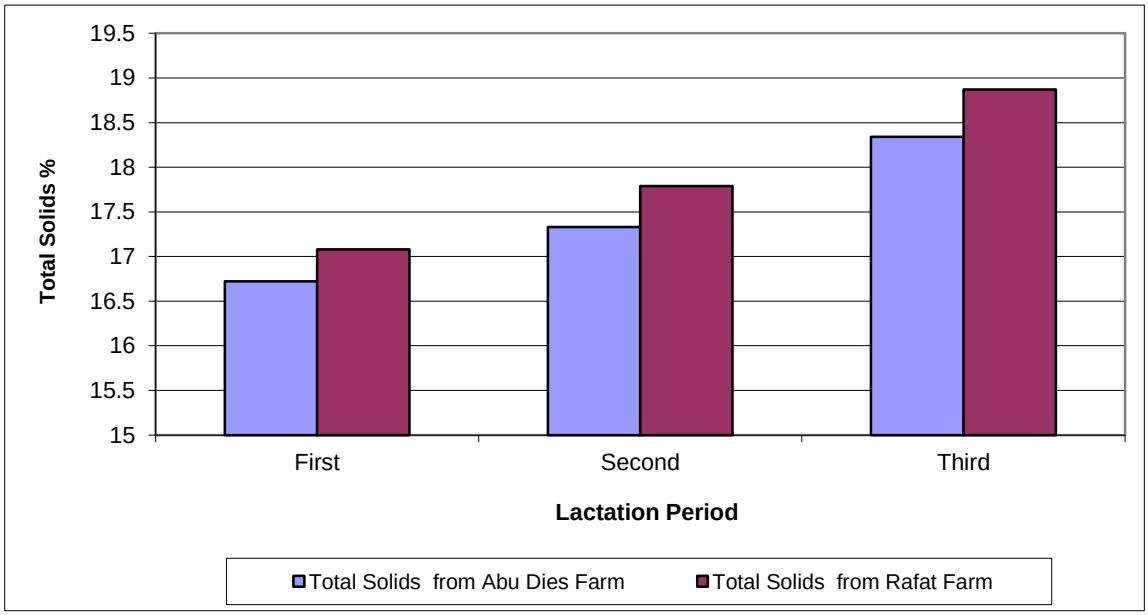

Fig. 3.16 Total solids quantity in Abu dies and Rafat farms during the three time period of milking at evening time in summer. Each period consist of one month.

3.2.3.2.2 Evening Milking Time

At evening time, 20 milk samples were taken from each of the 2 farms; Abu dies and Rafat, the result of total solid were obtained are reported in Fig 3.17.

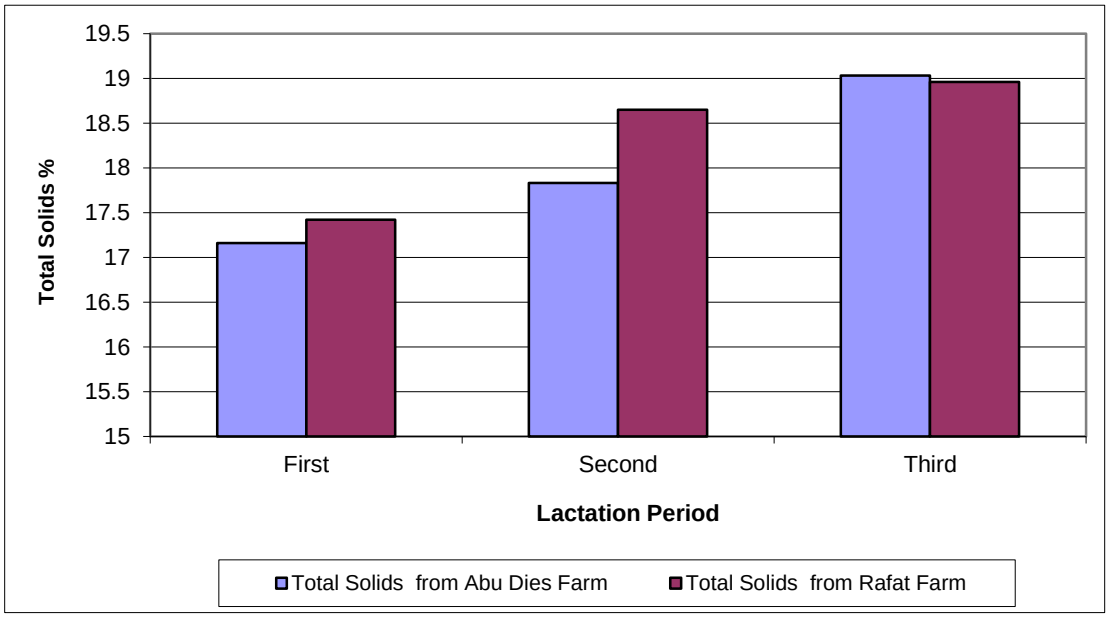

Fig. 3.17 Total solids quantity in Abu dies and Rafat farms during the three time period of milking at evening time in summer. Each period consist of one month.

3.2.3.2.3 Total solid Correlation Between Morning and Evening for Summer Farms

Fig 3.18 results showed that total solid percent in evening milk were higher than that in morning milk for summer farms (Abu dies and Rafat). The result confirmed with that result obtained in spring farms.

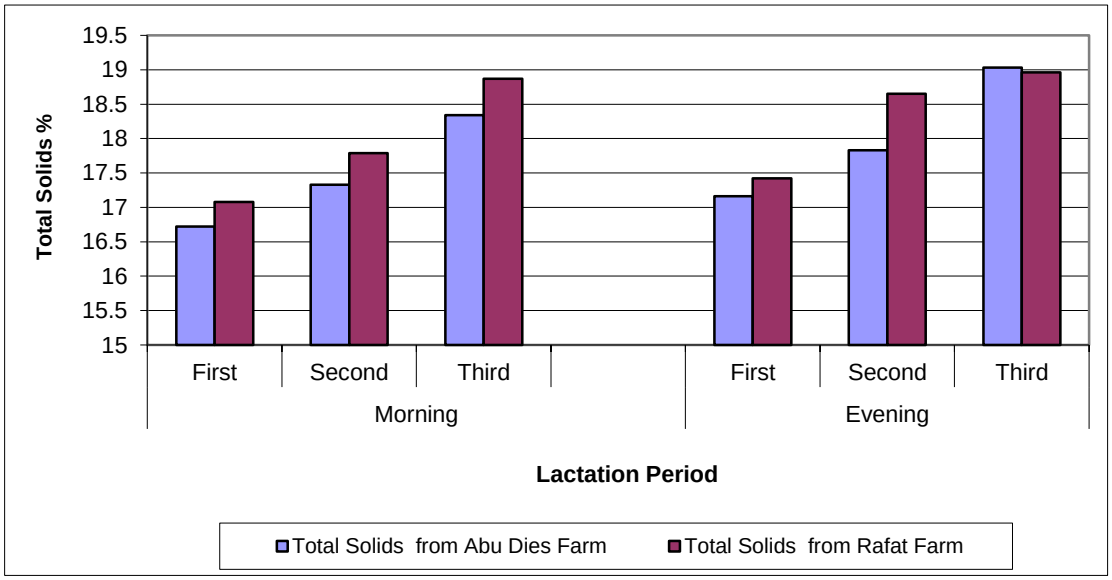

Fig. 3.18 Comparison between morning and evening milk in Total solid quantity for summer farms (Abu dies and Rafat farms).

3.2.4 Factors Affecting Lactose Content

Protein percent changes in milk were studied twice in spring and summer. Three farms are studied in spring time (Hebron, Bane na'em, and Bethlehem), in addition to two farms in summer time (Abu dies, and Rafat).

3.2.4.1 Milking Period in Spring Season

Three farms were appointed to collect samples from them in spring period which were Bane na'em, Hebron, and Bethlehem farms. Samples collected in spring period during three intervals time (first, second and third period of milking). On each interval, samples are collected twice daily in morning and evening).

3.2.4.1.1 Morning Milking Time

At morning time, 30 samples from each Hebron, Bane na'em farms, and 20 samples from Bethlehem farm were taken and the results of lactose were given in Fig 3.19.

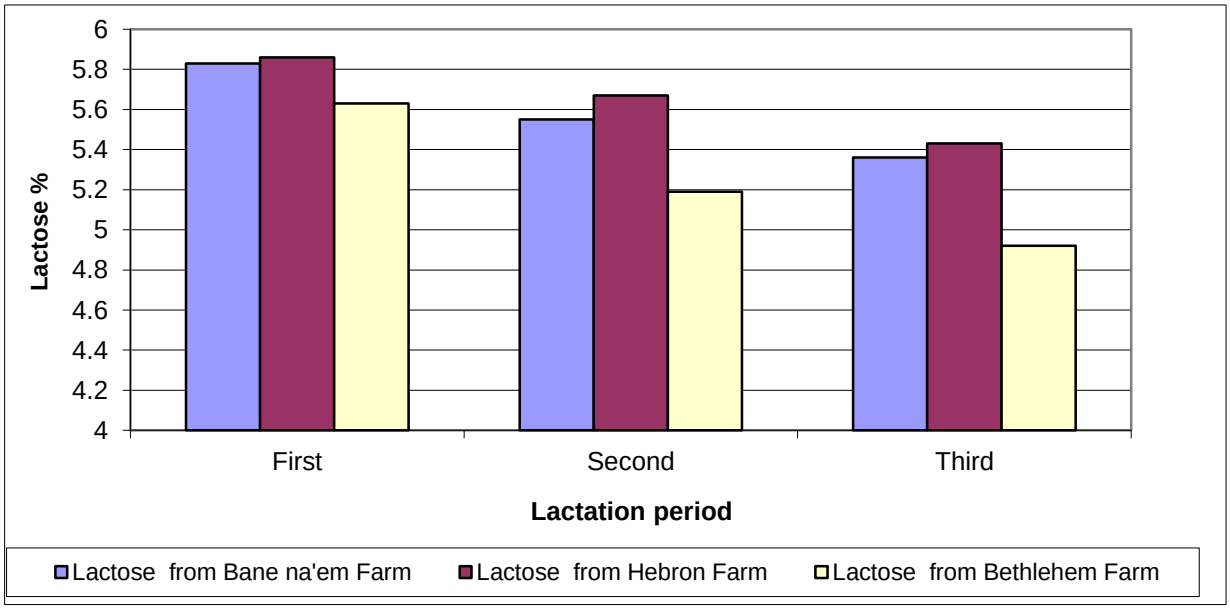

Fig. 3.19 Lactose quantity in Bane na'em, Hebron, and Bethlehem farms during the three time period of milking at morning time in spring. Each period consist of one month.

Fig 3.19 showed that lactose content in sheep milk for all farms, decreased during the three period of milking, this is due to the negative relation between lactose and the other component present in milk, (Fat, Protein, Total solids). This results are also found in the study of (Fuertes et al., 1997) who found that lactation curves and lactose content are inversely related to protein, fat, casein, and total solids.

Other finding obtained by (Fuertes et al., 1997), was that lactose reach its peak at third week then decreased at the all period.

3.2.4.1.2 Evening Milking Time

At evening time, 30 samples from each Hebron, Bane na'em farms, and 20 samples from Bethlehem farm were taken and the results of lactose were given in Fig 3.20.

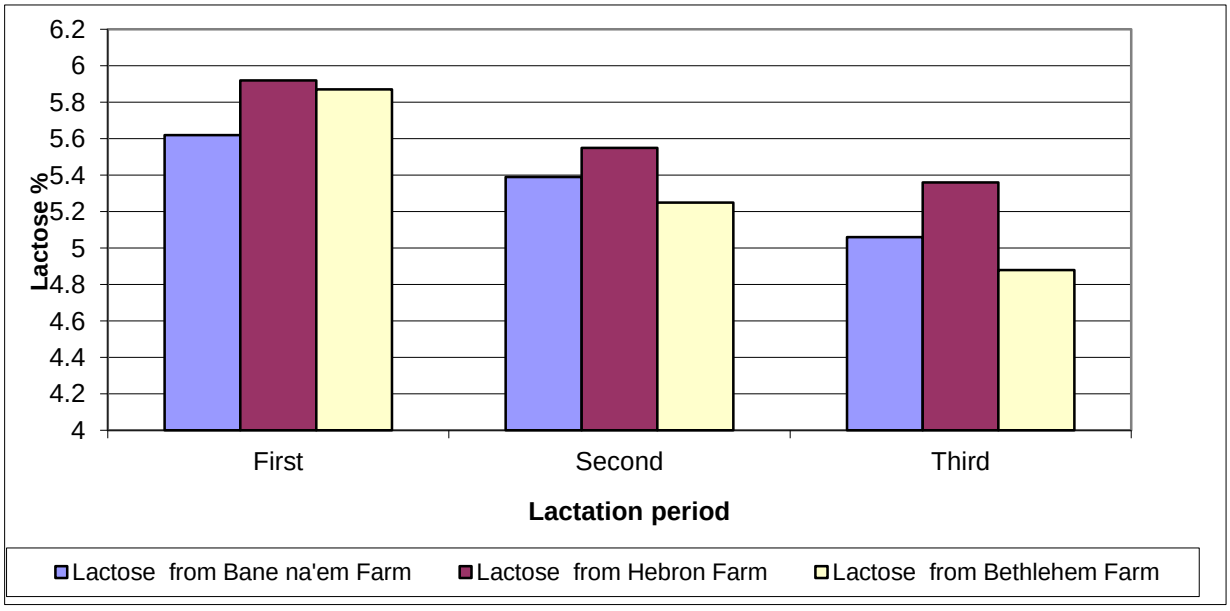

Fig. 3.20 Lactose quantity in Bane na'em, Hebron, and Bethlehem farms during the three time period of milking at evening time in spring. Each period consist of one month.

3.2.4.1.3 Lactose Correlation Between Morning and Evening for Spring Farms

The comparison between morning and evening in lactose content are shown in Fig 3.21. Lactose in morning milk are higher than evening milk. This is due to the negative correlation between lactose on one side and protein and fat on the other side. Lactose has a positive correlation with milk quality. This finding is in accordance with (Haenlein et al., 2002).

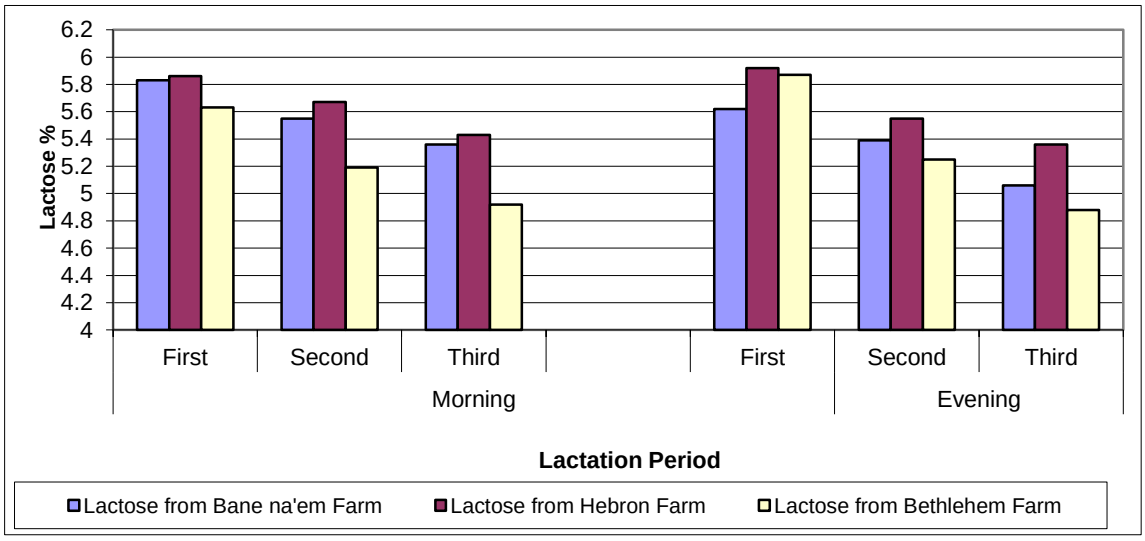

Fig. 3.21 Comparison between morning and evening milk in lactose quantity for the three spring farms (Bane na'em, Hebron, and Bethlehem).

3.2.4.2 Milking Period in Summer Season

Two farms were appointed to collect samples from them in summer period which were Abu dies and Rafat farms. Samples collected in spring period during three intervals time (first, second and third period of milking). On each interval samples were collected twice daily in morning and evening.

3.2.4.2.1 Morning Milking Time

At morning time, 20 milk samples were taken from each of the 2 farms; Abu dies and Rafat, the result of lactose were obtained were showed in Fig 3.22.

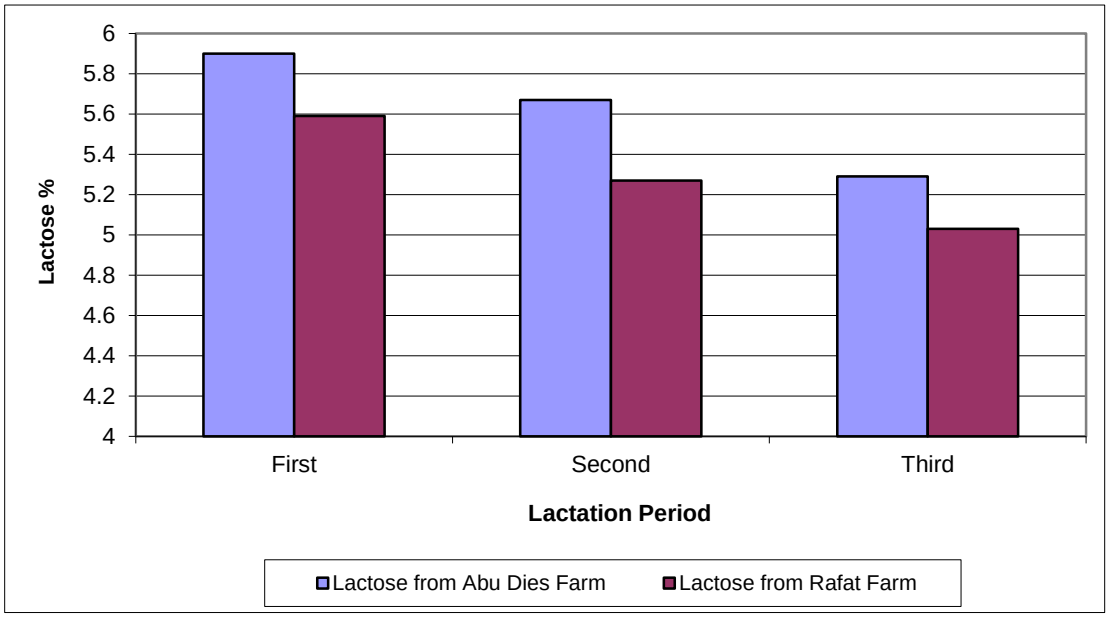

Fig. 3.22 Lactose quantity in Abu dies and Rafat farms during the three time period of milking at morning time in summer. Each period consist of one month.

3.2.4.2.2 Evening Milking Time

At evening time, 20 milk samples were taken from each of the 2 farms; Abu dies and Rafat, the result of lactose obtained are shown in Fig 3.23.

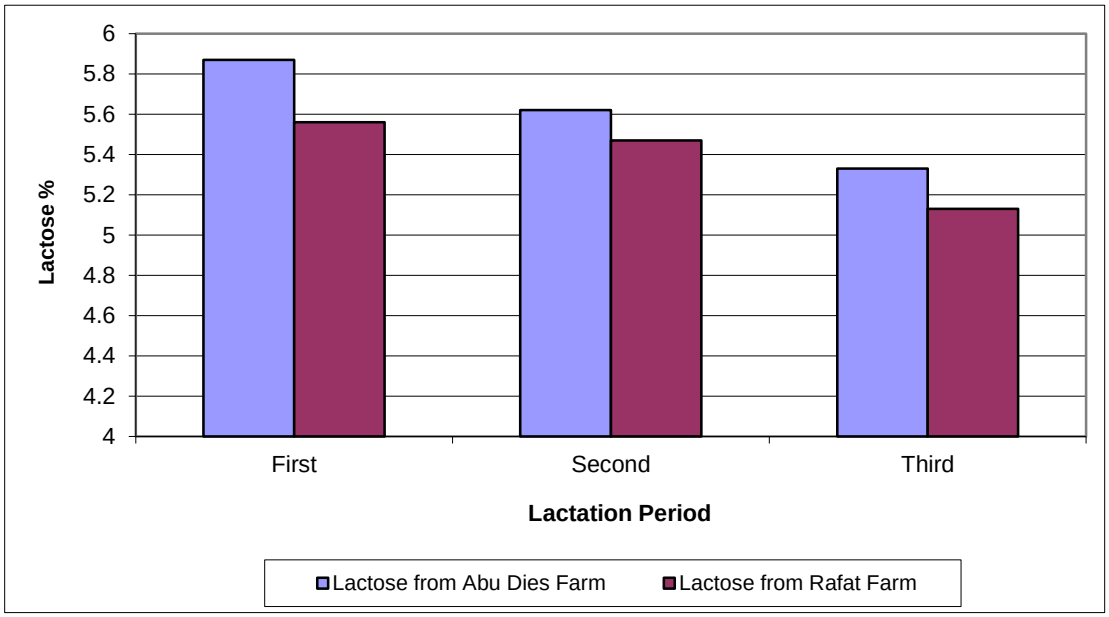

Fig. 3.23 Lactose quantity in Bane na'em, Hebron, and Bethlehem farms during the three time period of milking at evening time in summer. Each period consist of one month.

3.2.4.2.3 Lactose Correlation Between Morning and Evening for Summer Farms.

Fig 3.24 showed that morning milk had higher lactose content than evening milk due to the same reasons discussed in 3.2.4.1.3.

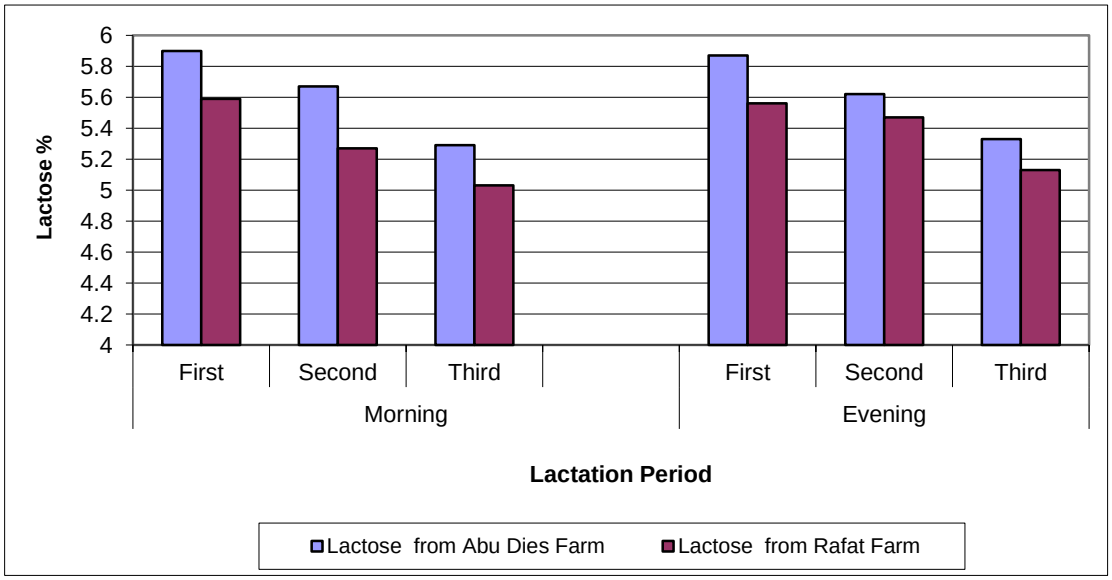

Fig. 3.24 Comparison between morning and evening milk in lactose quantity for summer farms (Abu dies and Rafat farms).

3.3 Factor Affecting Cheese Product

Milk obtained from the all farms are invested into different analysis, these analyses are divided into different categories such as yield %, chemical analysis, microbial analysis and sensorial evaluation.

3.3.1 Spring Cheese

All milk taken from the spring farms (Bane na'em, Hebron, and Bethlehem farms) were collected together twice per day, morning and evening separately and converted into cheese with different conditions and parameters.

3.3.1.1 Morning Cheese

24 types of cheese produced from spring milk at morning time with different parameters are shown in Table 2.2. All of them invested into different analysis at the time of production, and after 2 months.

3.3.1.1.1 Cheese Yield

The yield for all cheese groups were calculated to evaluate the best parameters and conditions to obtain the highest yield in cheese production.

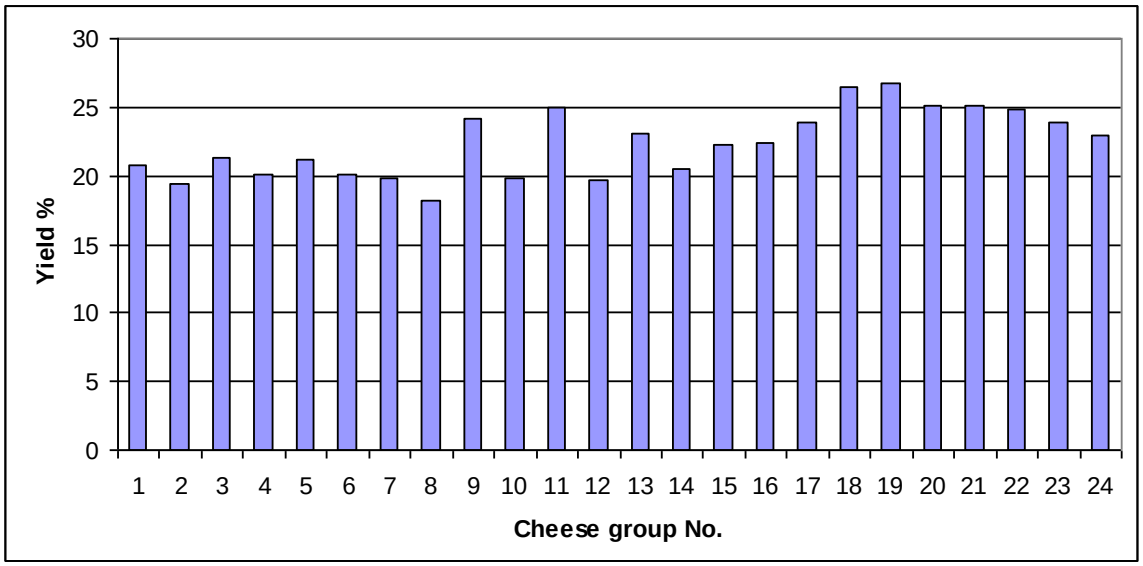

Fig 3.25 yield % for the 24 groups of cheese produced in spring at morning time

Fig 3.25 shows that group 19 of cheese has the highest yield, because this cheese type produced from raw milk without any heat treatment. Also the figure shows that group 8 of cheese produced from milk after pasteurization at 80°C for 30sec have the lowest yield.

This is a normal result because heat treatment has a negative effect on cheese yield. As heat treatment increases, protein, fat, and total solid will be decreased. These results are in agreement with (Singh et al., 2001) who found that heat treatment cause denaturation of whey protein and make a complex interaction between whey protein, fat globules, minerals and casein resulting in long coagulation time and weak curd.

3.3.1.1.2 Factors Affecting Chemical Composition

Protein, fat, total solids and ash were determined for all cheeses produced in spring farms at the evening time and are showed in Fig 3.26-3.29.

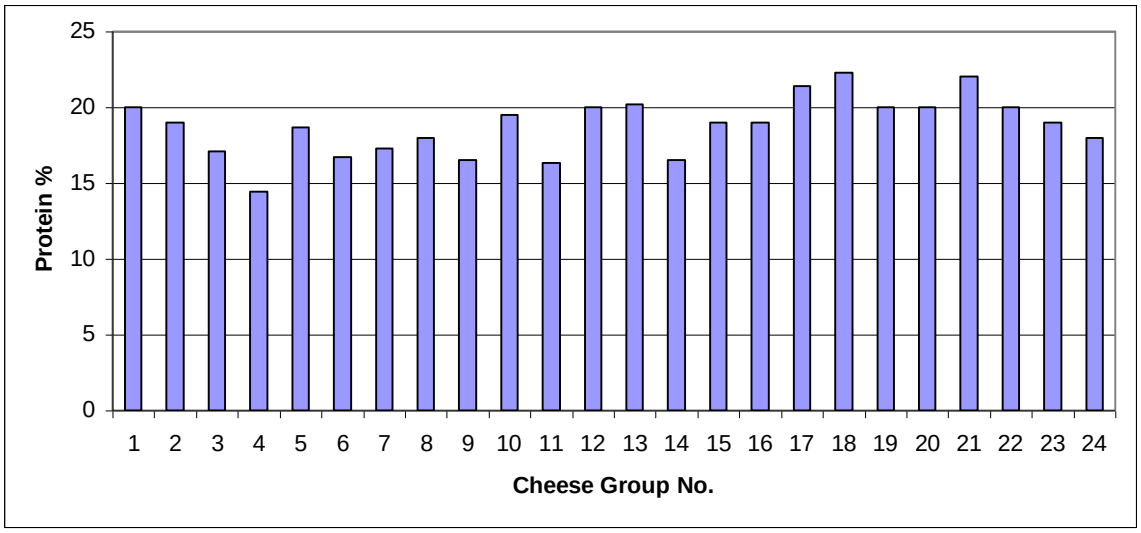

Fig 3.26 Protein % for the 24 groups of cheese produced in spring season at morning time.

During the studying of protein content, Fig 3.26 showed that the highest protein value was found in group number 18 (which was produced from milk without heat treatment, addition of starter culture, rennet and calcium chloride); protein value was 23%. At the same time the lowest protein content was found in group number 4 (which produced from milk past. At 80°C/30 sec, with addition of rennet and starter culture); protein content was 14%.

Variation of protein content in cheese group refers to the parameters used during cheese manufacturing, heat treatment have a negative effect on protein content in cheese, this result was reported with (Awad et al., 2006) who found that pasteurization decrease the protein content in cheese, because heat make protein denaturation. Also the same result was reported with (Yun et al., 1993 and Fox et al., 1993) who found that cheese produced from fresh milk have more protein content than cheese produced from pasteurized milk.

Protein percentage in cheese was reported by (Sulieman et al., 2007) who found that protein content in cheese was between 15.40-20.60, the same finding was reported with (Najaf et al., 2008) who found that protein content in cheese between 16.5-21.9%.

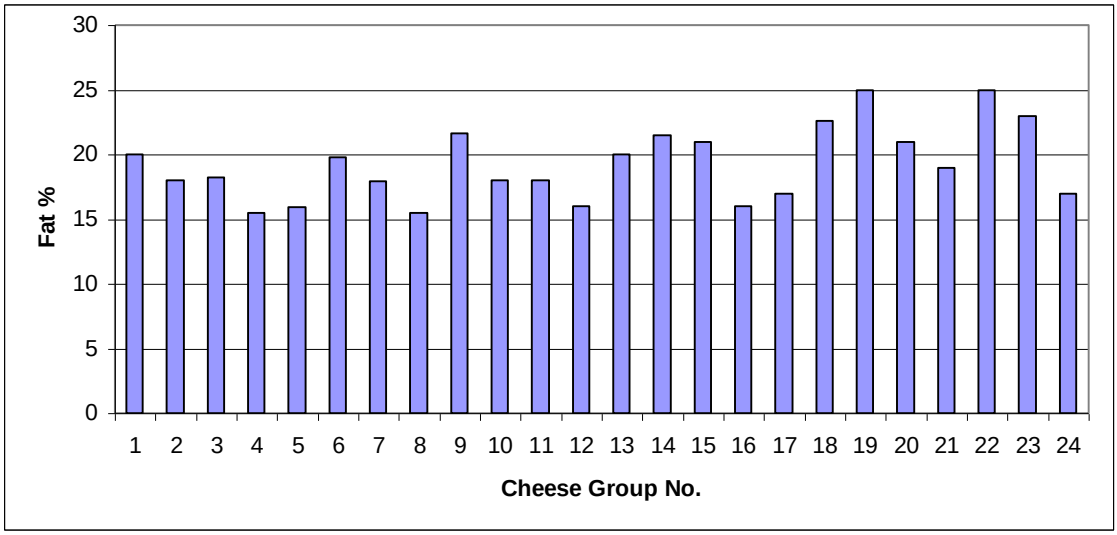

Fig 3.27 Fat % for the 24 groups of cheese produced in spring season at morning time.

In addition the highest fat content, as shown in Fig 3.27, was in cheese number 19 (which produced from unpasteurized milk, with CaCl2, starter culture and rennet) and cheese number 22 (which produced from unpasteurized milk and rennet); fat value was 25 %. At the same time the lowest fat content was found in group number 8 (which produced from past. Milk at 80°C for 30 sec, and rennet); fat value was 13.5%.

These variations in fat content between cheese groups refer to the parameters and conditions used during cheese manufacturing. (Najaf et al., 2008) found that starter culture decrease pH in cheese which leads to increase the abundance of fat in cheese. Also heat treatment affect fat content in cheese, (Kanka et al., 1989) and (Awad et al., 2006) found that cheese from pasteurized milk have higher moisture content and lower fat content than pasteurized one.

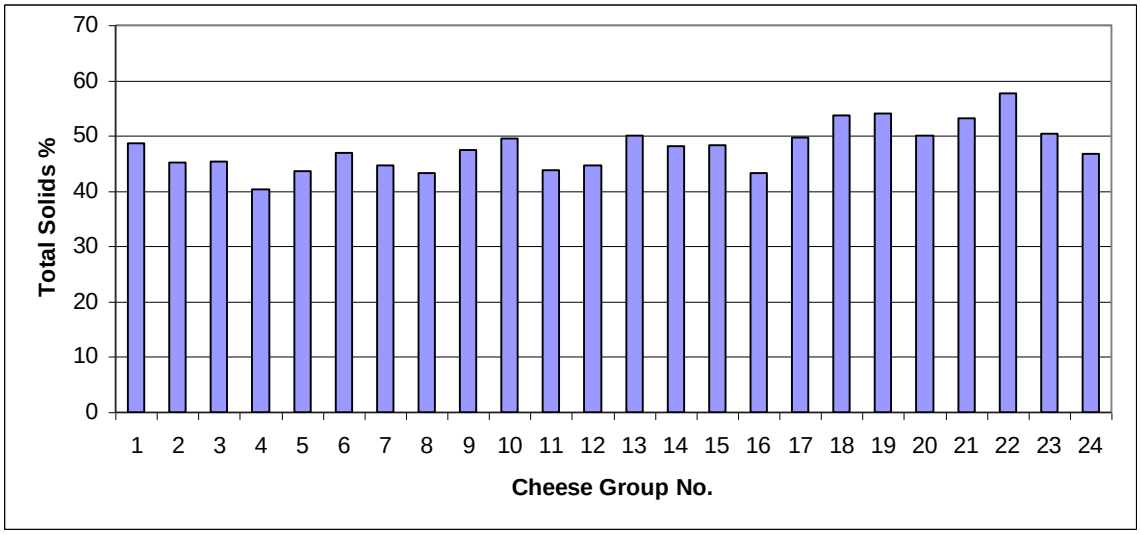

Fig 3.28 Total solid % for the 24 groups of cheese produced in spring season at morning time.

As shown in Fig 3.28, the lowest total solid percent found was in cheese number 22 (which was produced from unpasteurized milk, with rennet, and carob): it was 56.7%. At the same time the lowest total solid percent found in cheese number 4 (which produced from past. milk at 80°C for 30 sec, with starter culture, and rennet); it was 40.1%.

Different findings were reported for the total solid percent in cheese, (Al zubeir et al., 2004), (Suleiman et al., 2007), and (Suleiman et al., 2005) found that the total solid content in cheese varies between 48. 46-56.50%.

These variations in total solid between cheese groups refer to the different parameters and conditions used during cheese manufacturing, heat treatment effect on total solid percent as reported by (Kanka et al., 1989) who found that cheese made from pasteurized milk have higher moisture content than that produced from raw milk.

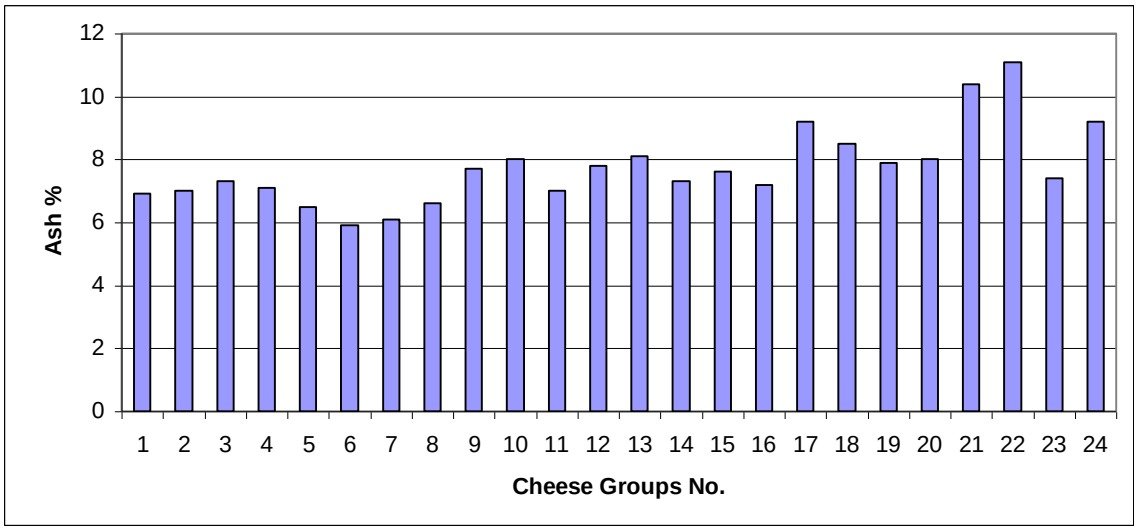

Fig 3.29 Ash % for the 24 groups of cheese produced in spring season at morning time.

As shown in Fig 3.29, the highest ash content was in cheese number 22 (which was produced from unpasteurized milk, with rennet, and carob); it was 11 %, followed by cheese number 21 (which was produced from unpasteurized milk, CaCl2, starter culture, and rennet); it was 10.5%. At the same time the lowest ash content found in cheese number 6 (which was produced from past. milk at 80 ºC for 30 sec, rennet, and carob); it was 5.5 %.

These variations of ash content between cheese groups refer to the different parameters and conditions used during cheese manufacturing, heat treatment cause solubilization of ash and then decrease of ash content. These finding was reported by (Kanka et al., 1989) who found that cheese from pasteurized milk has lower ash than cheese produced from fresh one. (Suleiman et al., 2007) reported that ash percentage in white cheese was between 8.5-12%.

After two month of storage chemical composition measured again in all types of cheese and are reported in Table 3.3

Table 3.3 Chemical analysis results (after two months of storage) for cheese produced in spring farms at morning time.

Cheese group	Protein	Fat	TS%	Ash
1	19.5	19.7	48	7
2	19	17.9	44.5	7
3	16.3	18	43.6	7.3
4	13.9	15.4	38	7.1
5	17.9	15.5	41.7	6.5
6	16	18.7	42	5.9
7	17	17.1	42.4	6
8	17.5	13	39.9	7
9	15.4	20.4	45	7.9
10	18	16.9	45	8.6
11	15.6	16.7	41	8
12	19	15	42.4	7.9
13	19.3	20	49	9.1
14	14	20.7	45	7.8
15	17.4	20	46	8
16	18	15.5	41.7	7.4
17	20	15.5	46.3	9.5
18	20	21.1	51	8.5
19	19.3	24	52.7	8.4
20	18.7	18.6	47	8
21	19.4	16.5	48	11
22	18	23	53.6	11
23	17.5	21	48.9	8.4
24	17	16	44	9.5

From table 3.3 the result shows that the chemical composition for some types of cheese change significantly after two month of storage. This significant changes occur in chemical composition differ from one group of cheese to another due to the different condition used in cheese processing. Cheese which pasteurized at high temperature (80 ºC) with addition of starter culture shows the lowest decrease in protein and fat % during storage, because lipolytic and proteolytic enzyme inactivated by high temperature and with the action of starter culture as found in cheese group (1-8).

Cheese number 21 shows that the most decrease value of protein and fat, in which protein decreased from 22 to 19.4 and fat decreased from 19 to 16.5. In the other hand ash content increase during storage period because chemical component found in cheese decomposed in such cheese groups.

This result in agreement with (Osman et al., 2009) Who found that fat, protein, and total solids content decreased with the advancement of storage periods while ash content and titrable acidity increase. The same result were found by (Litopoulou et al., 1992) who found that the rate of proteolytic and lipolytic enzyme and organisms in cheese from raw milk were higher than in pasteurized one.

Other studies also found the same results as the result found by (Belgrad et al., 2005) who reported that the starter culture which were added to the cheese affected on lipolytic and proteolytic characteristics of the cheese.

3.3.1.1.3 Microbial Analysis

All cheese produced in spring season at morning time was invested into different microbial analysis, which were yeast and mold, and total *Coliform*. The results obtained from analysis are recorded in Table 3.7.

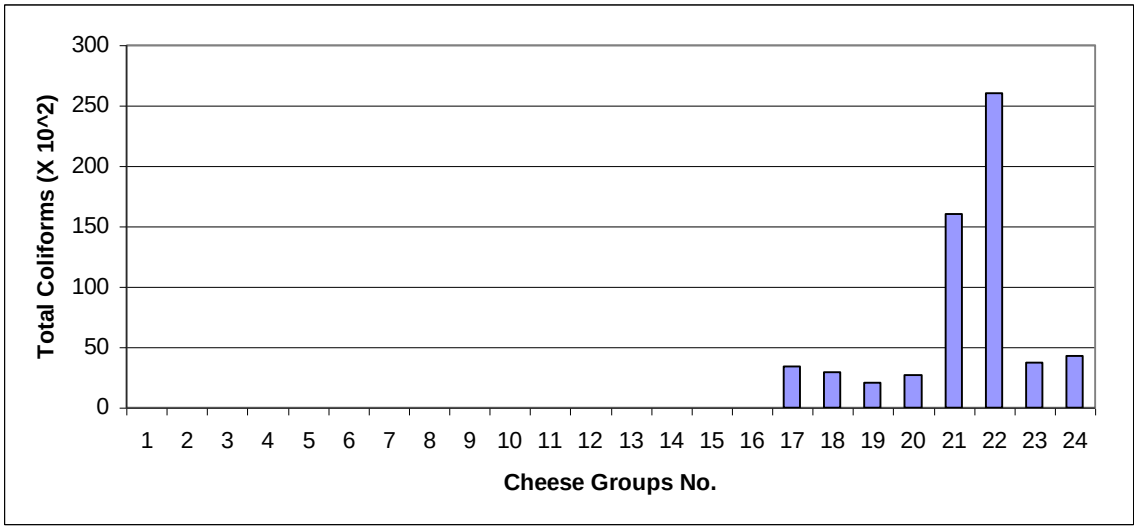

Fig 3.30 Total Coliform (at 0 time) for cheese produced in spring season at morning time.

From Fig 3.30 the result showed that all group of cheese produced from pasteurized milk are found without coliforms, because heat treatment destroy and decrease microbial load in raw milk.

This result is in agreement with (Kameni et al., 2006) who found that heat treatment destroys all the coliform organisms and probably other undesirable microorganisms of raw milk, and also found that it improves the microbiological quality of cheese.

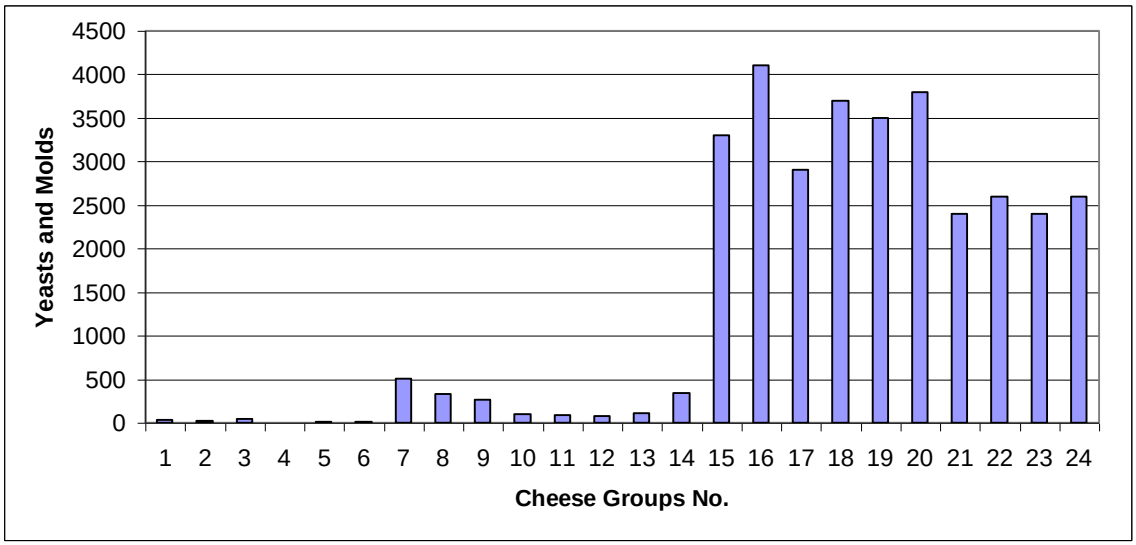

Fig 3.31 Yeasts and Molds (at 0 time) for cheese produced in spring season at morning time.

From Fig. 3.31 shows that cheese groups (17 to 24), which are produced from unpasteurized milk have the highest value of yeasts and molds. Cheese group (9 to16) which pasteurized at (65ºC for 30 minutes) show that yeast and mold value less than the previous groups. The last cheese groups (from 1 to 8) which produced from pasteurized milk at (85 ºC) have the lowest value of yeasts and molds, because heat treatment decrease microbial load present in raw milk.

This result is in agreement with (Hamid et al., 2008) who reported that the microbial growth for cheese from raw milk is higher than pasteurized cheese milk. Low pH and salt are two factors contributing to the inactivation of bacterial pathogens during storage period of cheese (Sung et al., 2000)

After 2 months the same microbial analysis were measured in all cheese groups to indicate the quality of products during storage.

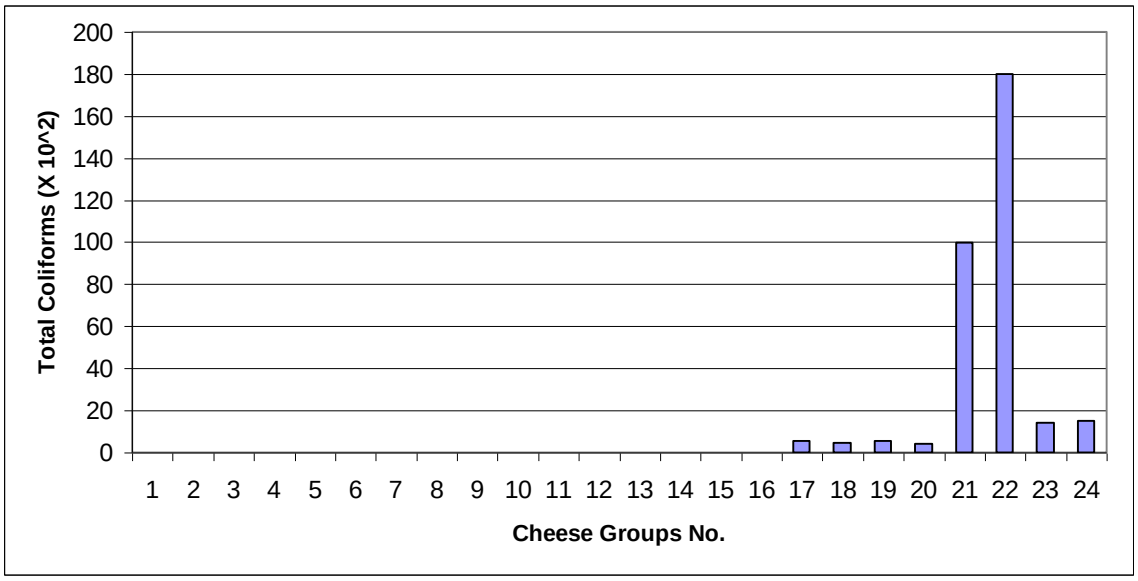

Fig 3.32 Yeasts and Molds results (after 2 months storage) for cheese produced in spring season at morning time.

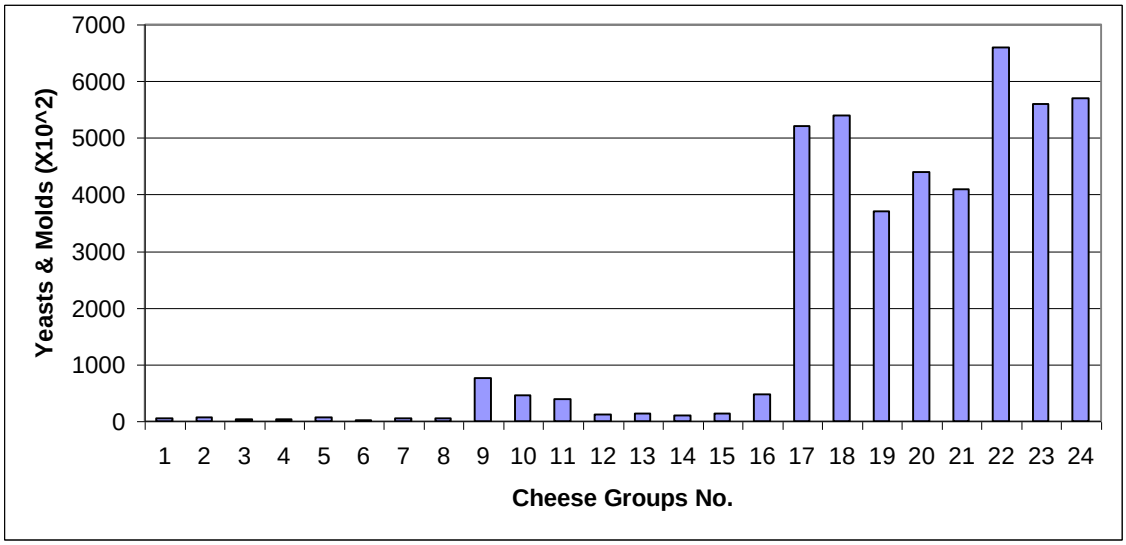

Fig 3.33 Total *Coliforms* results (after 2 months storage) for cheese produced in spring season at morning time.

Fig 3.32 and 3.33 showed that total coliforms value in cheese groups decreased during storage period, because are coliforms affected with the acidic condition found in cheese. On the other hand, yeasts and Molds increased during storage period due to their ability to resist acidic condition in cheese. These results were in agreement with (Amran et al., 20011) and (Osman

et al., 2008) who found that coliform decreased in cheese during storage period, while yeasts and molds increased.

3.3.1.1.4 Sensorial Evaluation

The sensory evaluation was reported by a panel, in which Organoleptic properties of cheese (Flavor, texture, aroma, and color) were determined according to the hedonic scales in Table 2.1.

Result obtained from sensorial analysis were reported in Table 3.4

Table 3.4 Sensory Evaluation of cheese produced in spring semester at morning time.

Cheese Group Number	Color	Texture	Flavor	Aroma	General Acceptance
Group 1	6	7	5	6	6
Group 2	4	6	5	7	5.5
Group 3	7	6	6	6	6.25
Group 4	6	6	6	6	6
Group 5	5	6	5	5	5.25
Group 6	5	6	6	5	5.5
Group 7	7	6	6	6	6.25
Group 8	7	6	7	6	6.5
Group 9	7	8	6	7	7
Group 10	5	7	6	8	6.5
Group 11	8	7	7	7	7.25
Group 12	7	7	7	7	7
Group 13	6	7	6	7	6.5
Group 14	6	7	7	7	6.75
Group 15	8	7	7	8	7.5
Group 16	8	7	8	7	7.5
Group 17	**7**	**9**	**8**	**9**	**8.25**
Group 18	6	8	8	8	7.5
Group 19	8	9	7	8	8
Group 20	**8**	**8**	**8**	**9**	**8.25**
Group 21	7	8	8	8	7.75
Group 22	7	8	7	8	7.5
Group 23	8	8	7	7	7.5
Group 24	8	9	7	8	8

The organoleptic properties of cheese prepared by raw milk had the highest score compared with cheese prepared from pasteurized milk. Good flavor is due to the natural flora present in raw milk which participates in flavor production (Law et al., 1980).

The highest organoleptic (8.25) was for cheese group number 17. It is produced from raw milk with addition of calcium Chloride, starter culture, and carob. Same grade was obtained for cheese group number 20. However, this group was produced from raw milk and addition of starter

This may be explained due to the role played by the addition of starter culture, which allowed the production of unique taste and structure (Dervisiglu et al., 2010).

The lowest organoleptic score (5.25) was for cheese group number 5. It's produced from pasteurized milk at 80ºC for 15 minutes.

3.3.1.2 Evening Cheese.

24 types of cheese produced from spring milk at evening time with different parameters are shown in Table 2.2. All of them invested into different analysis at the time of production, and after 2 months.

3.3.1.2.2 Cheese Yield

The yield of all cheese groups were calculated to evaluate the best parameters and conditions to obtain the highest yield in cheese production.

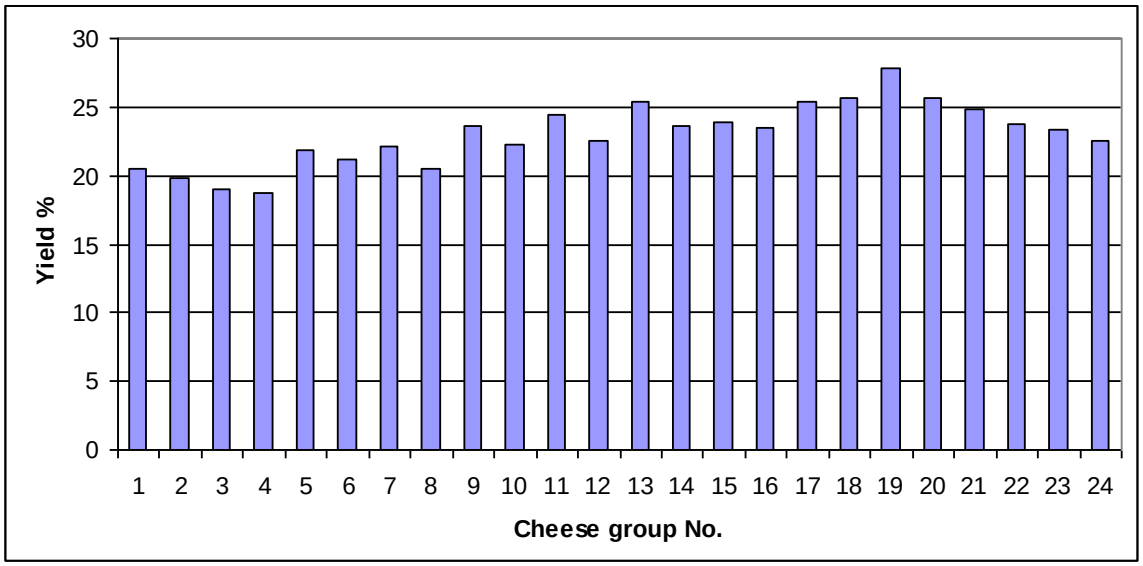

Fig 3.34 Cheese yield % obtained from spring milk at the evening time.

Fig 3.34 showed that cheese group 19 has the highest yield, because this cheese type is produced from raw milk without any heat treatment. Also the figure shows that cheese group 4 produced from milk after pasteurized at 80°C for 30sec have the lowest yield. This is a normal result because heat treatment has a negative effect on cheese yield, as heat treatment increases protein, fat, and total solid will decrease. These results are in agreement with (Singh et al., 2001) who found that heat treatment cause denaturation of whey protein and make a complex interaction between whey protein, fat globules, minerals and casein resulting in long coagulation time and weak curd.

3.3.1.2.2 Chemical Analysis.

Protein, fat, total solids and ash were determined for all cheese produced in spring farms at the evening time and shown in Fig 3.35.

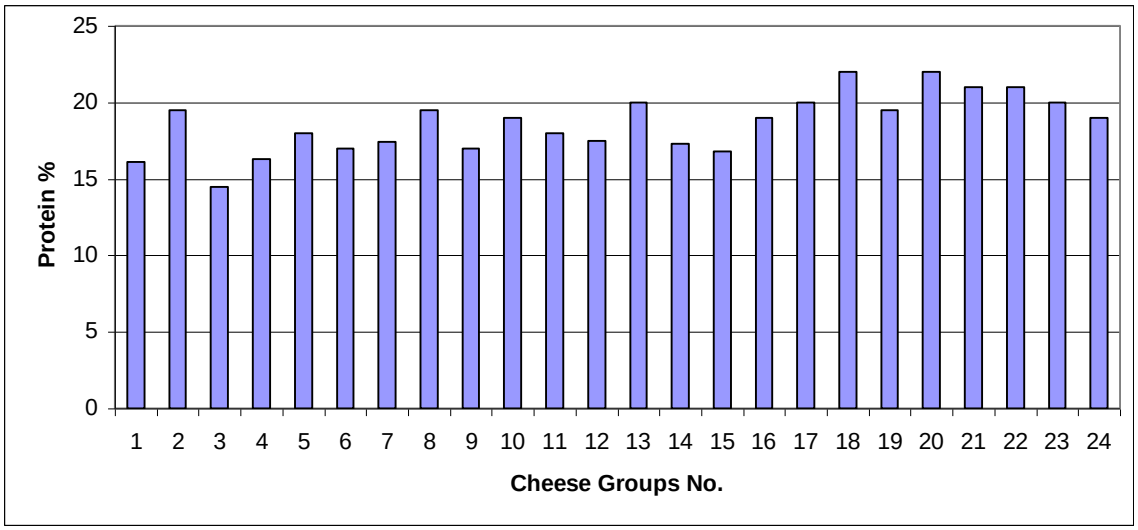

Fig 3.35 Protein content for the 24 cheese groups produced in spring farms at evening time.

As shown in Fig 3.35, the highest protein value was found in cheese group number 18 and 22 (which was produced from milk without heat treatment, and with addition of starter culture, rennet and calcium chloride in group 18 and the same condition for cheese group 22 but without starter culture and calcium chloride); it was 22%. At the same time the lowest protein content was found with group number 3 (which produced from milk past. At 80°C for30 sec, with calcium chloride, and addition of rennet and starter culture); it was 14.5%.

Variation of protein content in cheese group refers to the parameters used during cheese manufacturing; heat treatment have a negative effect on protein content in cheese, this result was reported by (Awad et al., 2006) who found that pasteurization decrease the protein content in cheese, because heat make protein denaturation. Also the same result was reported by (Yun et al., 1993) and (Fox et al., 1993) who found that cheese produced from fresh milk have more protein content than cheese produced from pasteurized milk.

Protein percentage in cheese was reported by (Sulieman et al., 2007) who found that protein content in cheese was between 15.40-20.60, the same finding was reported by (Najaf et al., 2008) who found that protein content in cheese are between 16.5-21.9%.

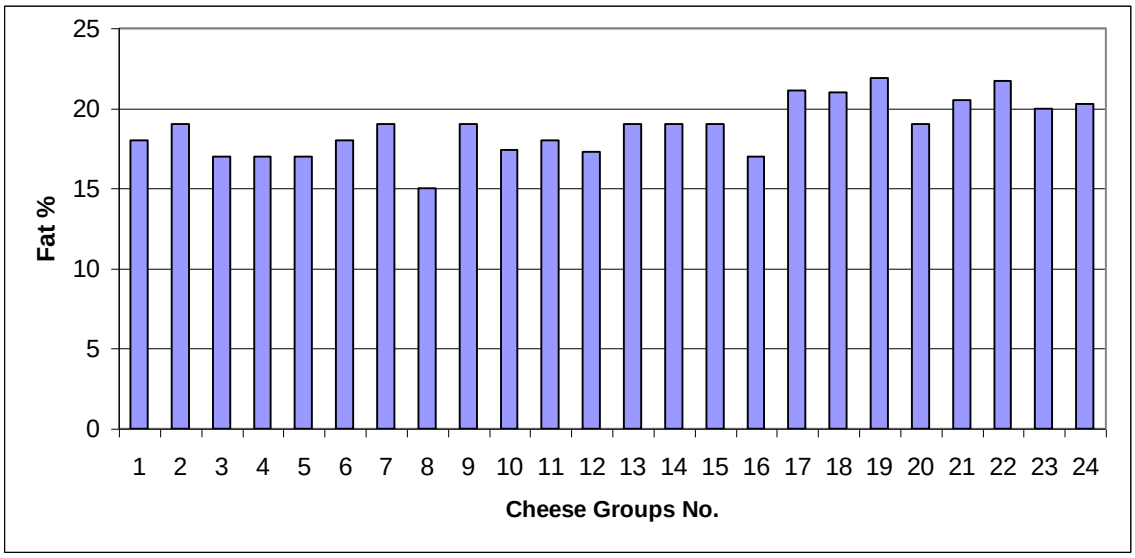

Fig 3.36 Fat content for the 24 cheese groups produced in spring farms at evening time.

As shown in Fig 3.36 the highest fat content was in cheese group number 19 (which was produced from unpasteurized milk, with addition of starter culture, Calcium Chloride and Rennet); it was 25 %. At the same time the lowest fat content was found in cheese group number 8 (which produced from past. Milk at 80°C for 30 sec, and rennet); it was 15%.

These variations in fat content between cheese groups can be explained by the same reason discussed in spring cheese.

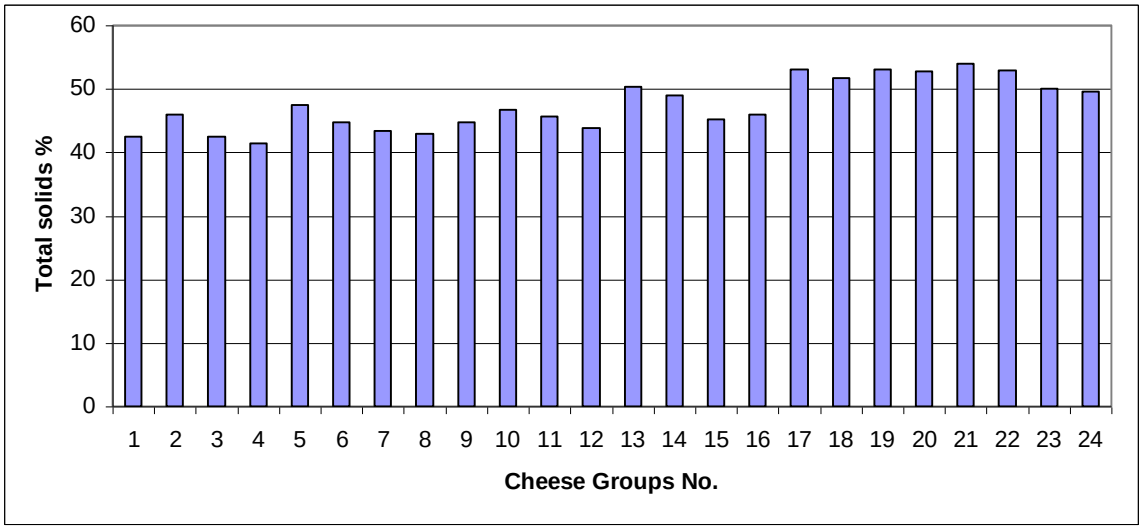

Fig 3.37 Total solids content for the 24 cheese groups produced in spring farms at evening time.

As shown in Fig 3.37 the highest total solid percent are found in cheese group number 21 (which was produced from unpasteurized milk, rennet, calcium chloride and carob): it was 54%. At the same time the lowest total solid percent are found in cheese group number 4 (which was produced from past. milk at 80°C for 30 sec, starter culture, and rennet); it was 41.4%.

These variations in total solid between cheese groups can be explained by the same reasons discussed in (3.2.2.3)

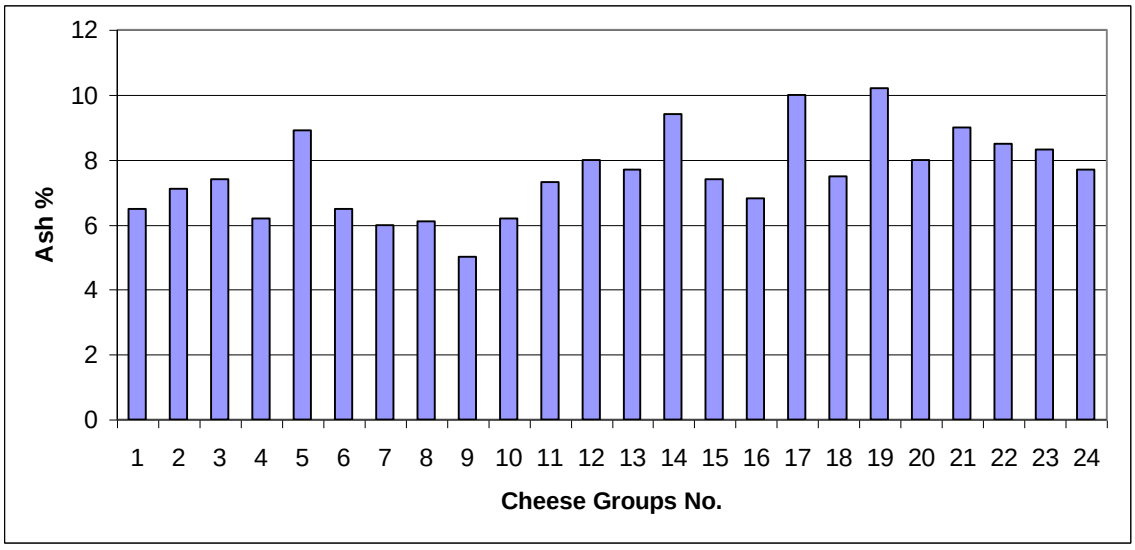

Fig 3.38 Ash % for the 24 cheese groups produced in spring farms at evening time

As shown in Fig 3.38 the highest ash content was found in cheese group number 19 (which was produced from unpasteurized milk, with rennet, starter culture and calcium chloride); it was 10.2 %, followed by cheese group number 17 (which was produced from unpasteurized milk, with all addition); it was 10%. At the same time the lowest ash content are found in cheese group number 9 (which was produced from past. milk at 80 ºC for 30 sec, with all addition); it was 5 %.

These variations of ash content between cheese groups can be explained by the same reasons discussed in spring cheese.

After 2 month all samples tested with the same chemical composition and the result found reported are in table 3.5.

Table 3.5 Chemical Analysis (after 2 months) for cheese produced in spring at evening time

Sample	Protein	Fat	TS%	Ash
1	15.7	18	42.4	6.5
2	19.4	19	46	7.1
3	14.5	16.9	42	7.5
4	16.2	16.7	41	6.6
5	17.5	17	46	9
6	17	18	44.5	6.8
7	17.3	18.8	43.5	6
8	19	14.6	42	6.1
9	16.1	19	44	5.2
10	18.2	17	46	6
11	17	17.7	45	7.5
12	16.7	16.5	42	8.5
13	19	19	4.5	8
14	17	18.1	46.7	9.5
15	16	18	43	7.8
16	18.4	15.9	43	7
17	19.1	19.6	52	10.2
18	21	19.5	50.3	8
19	18	20	53	19.5
20	21	18	50.5	8.5
21	18.7	18	50.4	9.4
22	19.9	20.2	50	8.7
23	18.2	18	48	8.5
24	17.5	19	46.6	8

As in morning cheese, the result shows that protein, fat, and total solid content decreased (Table 3.5) during storage period, because of the activity of lipolytic and proteolytic enzyme and microorganisms. In which cheese group 21 has the highest decreased value of protein and fat content, where it decreased from 21% to 18.7%, and from 20.5% to 18% respectively.

This result is in agreement with (Osman et al., 2009) who found that fat, protein, and total solids content decreased with the advancement of storage periods while ash content and titrable acidity increased. The same result were found by (Litopoulou et al., 1992) who found that the rate of proteolytic and lipolytic enzyme and organisms in cheese from raw milk were higher than in pasteurized one.

3.3.1.2.3 Microbial Analysis.

All cheese produced in spring season at evening time were subjected to different microbial analysis, which are yeast and mold, total plate count, and total coliform.

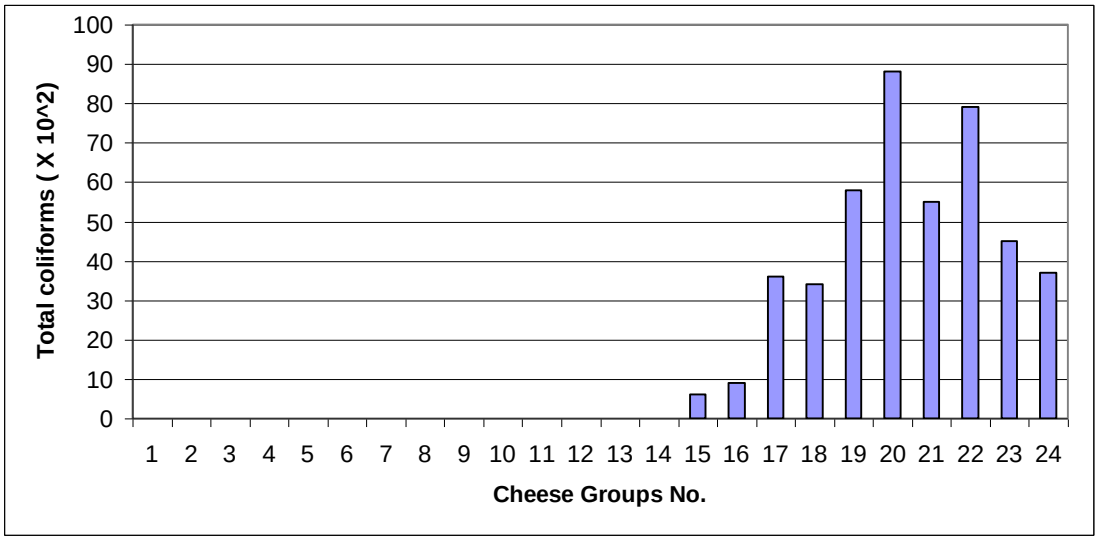

Fig 3.39 Coliforms results (at 0 time) for cheese produced in spring at evening time

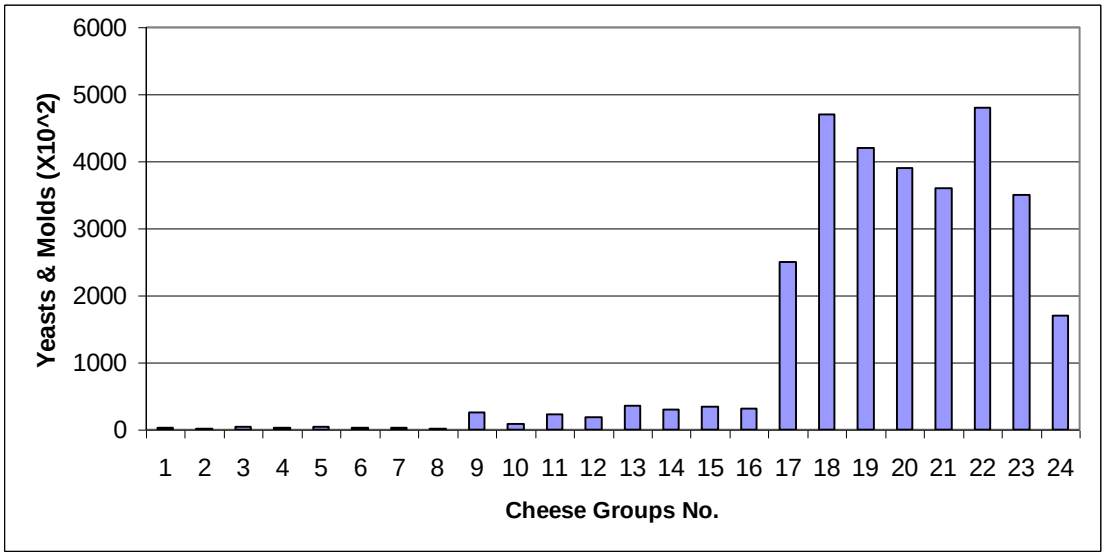

Fig 3.40 Yeasts and Molds (at 0 time) for cheese produced in spring season at evening time

Fig 3.39 and Fig 3.40 showed that cheese, which produced from unpasteurized milk, had a high load of Coliform and Yeasts & Molds, while cheese from pasteurized milk had no growth of coliform and slight growth of yeasts and molds.

After two months of storage microbial analysis measured again and reported in table 3.6

Table 3.6 Microbial analysis result (after 2 month) for cheese produced in spring at evening time

Sample	Total Coliforms (10^2)	Y&M (10^2)
1	0	40
2	0	17
3	0	48
4	0	25
5	0	43
6	0	37
7	0	40
8	0	17
9	0	270
10	0	100
11	0	243
12	0	199
13	0	370
14	0	310
15	3	360
16	5.5	330
17	29	280
18	26	4800
19	24	4400
20	54	4000
21	46	3700
22	36	4800
23	20	3700
24	16	1800

Table 3.6 showed that during storage period of cheese coliform load decreased and yeasts & Molds increased. These changes of number of microorganisms can be explained by the same reasons discussed in morning spring cheese.

3.3.2 Summer Cheese.

All milk taken from the spring farms (Abu dies and Rafat farms) were collected twice during morning and evening and converted into cheese with different conditions and parameters.

3.3.2.1 Morning Cheese.

24 types of cheese produced from summer milk at morning time with different parameters are shown in table 2.2. All of them were subjected into different analysis at the time of production, after one month, and after 2 months.

3.2.2.1.1 Cheese Yield

The yield for all cheese groups were calculated to evaluate the best parameters and conditions to obtain the highest yield in cheese production. The obtained results are shown in Fig 3.41.

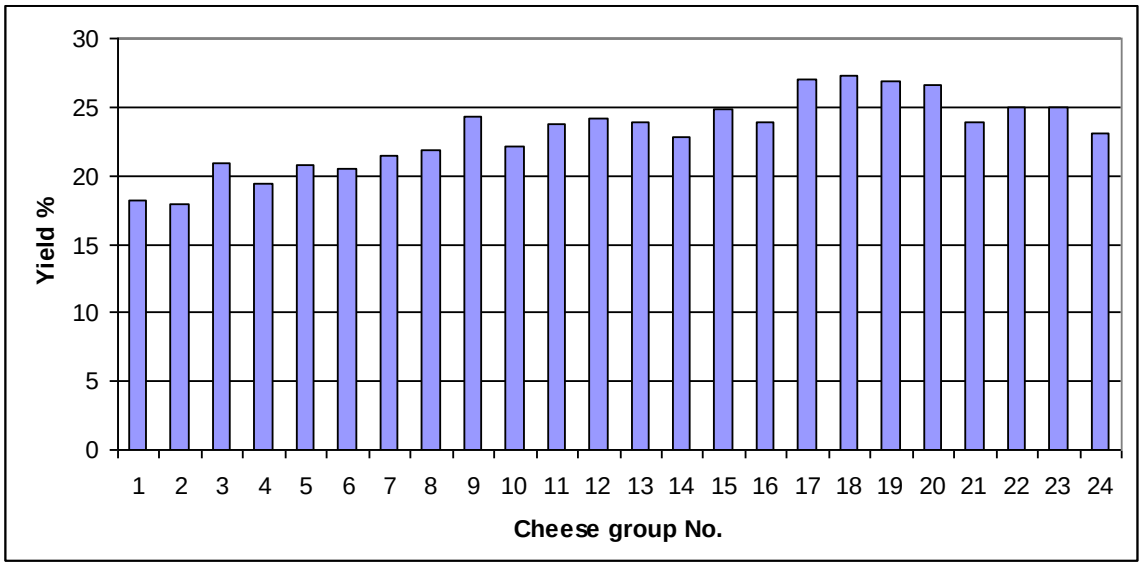

Fig 3.41 Yield % for cheese produced in summer season at morning time.

From Fig 3.41 it was found that cheese group 18 has the highest yield, because this type of cheese produced from raw milk without any heat treatment. Also the figure shows that group 2 of cheese produced from milk after pasteurized at 80°C for 30sec have the lowest yield percent. This is a normal result because heat treatment has a negative effect on cheese yield. As heat treatment increases, protein, fat, and total solid will decrease. These results are in agreement with (Singh et al., 2001) who found that heat treatment causes denaturation of whey protein and make a complex interaction between whey protein, fat globules, minerals and casein resulting in long coagulation time and weak curd.

3.2.2.1.2 Chemical Analysis

Protein, fat, total solids and ash were determined for all cheese produced in summer farms at the morning time.

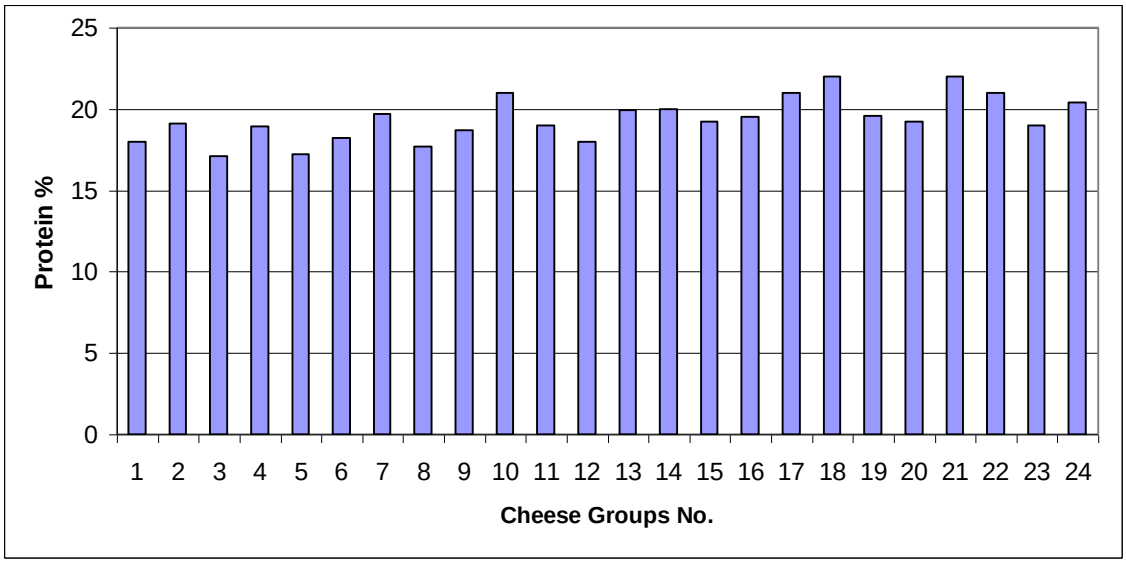

Fig 3.42 Protein content results for cheese produced in summer season at morning time (0 time)

As shown in Fig 3.42, the highest protein value was found in cheese group number 18 and 21 (which was produced from milk without heat treatment, and with addition of starter culture, rennet and the same condition for group 21 but without starter culture); the protein value was 22%. At the same time the lowest protein content was found in cheese group number 3 (which produced from milk past. At 80°C for 30 sec, and addition of rennet, calcium chloride, and starter culture); it was 17.1%.

Variation of protein content in cheese group refer to the parameters used during cheese manufacturing, heat treatment have a negative effect on protein content in cheese, this result was reported by (Awad et al., 2006) who found that pasteurization decrease the protein content in cheese, because heat make protein denaturation. Also the same result reported with (Yun et al., 1993) and (Fox et al., 1993) who found that cheese produced from fresh milk have more protein content than cheese produced from pasteurized milk.

Protein percentage in cheese was reported by (Sulieman et al., 2007) who found that protein content in cheese was between 15.40-20.60, the same finding were reported by (Najaf et al., 2008) who found that protein content in cheese were between 16.5-21.9%.

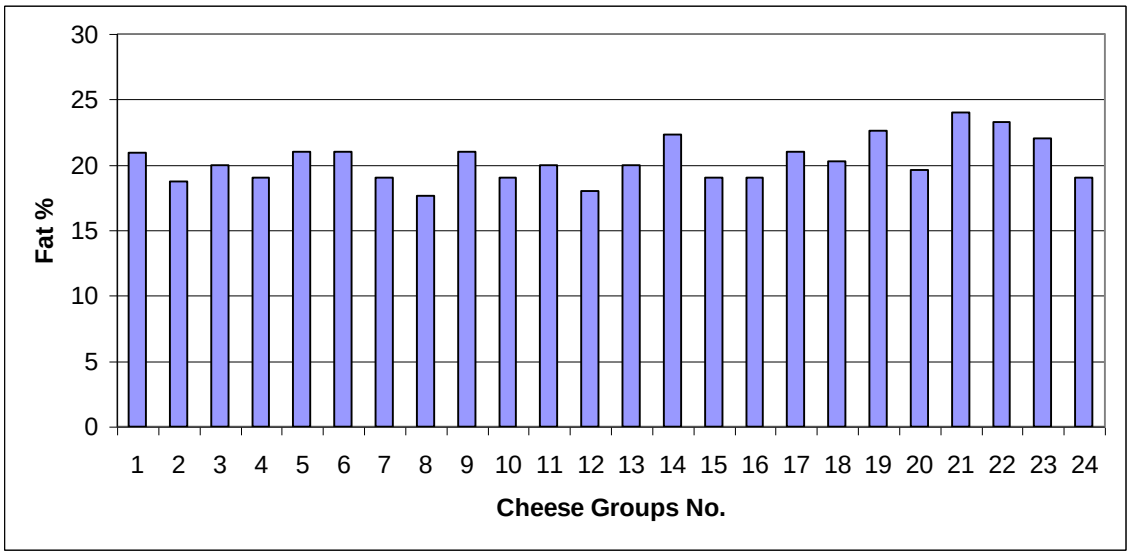

Fig 3.43 Fat content results for cheese produced in summer season at morning time (at 0 time).

As shown in Fig 3.43 the highest fat content was in cheese group number 21(which was produced from unpasteurized milk without addition); it was 24 %. At the same time the lowest fat content was found in cheese group number 8 (which was produced from past. Milk at 80°C for 30 sec, and with rennet); it was 17.1%.

These variations in fat content between cheese groups can be explained by the same reason discussed in spring cheese.

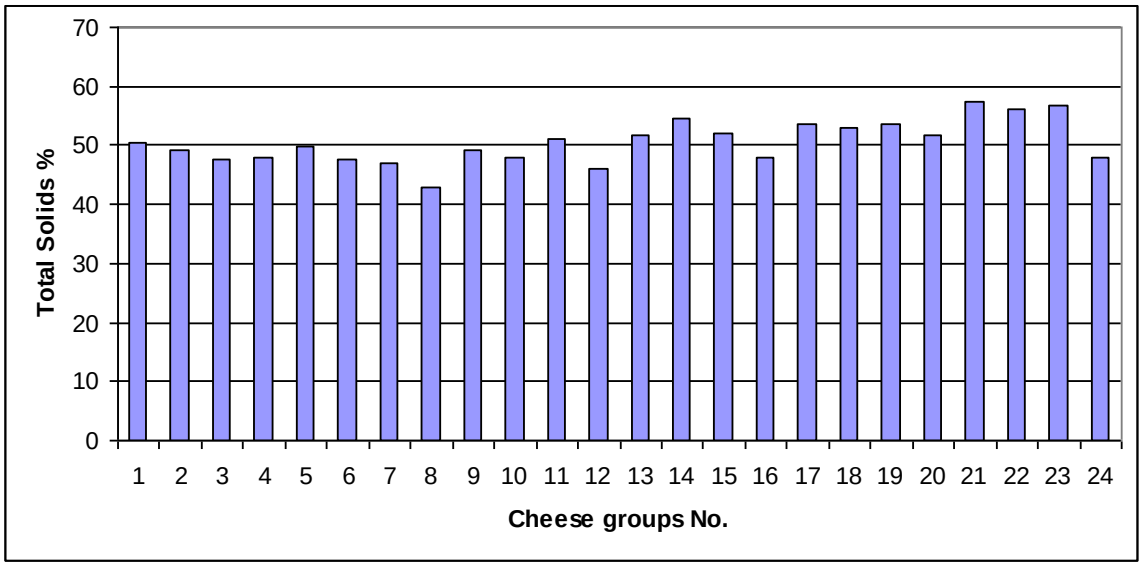

Fig 3.44 Total solids content results for cheese produced in summer season at morning time.

As shown in Fig 3.44, the highest total solid percent found in cheese group number 21 (which was produced from unpasteurized milk, with rennet, calcium chloride and carob): it was 57.5%. At the same time the lowest total solid percent found in cheese group number 8 (which was produced from past. milk at 80°C for 30 sec and with rennet); it was 42.9%.

These variations in total solid between cheese groups can be explained by the same reasons discussed in spring cheese.

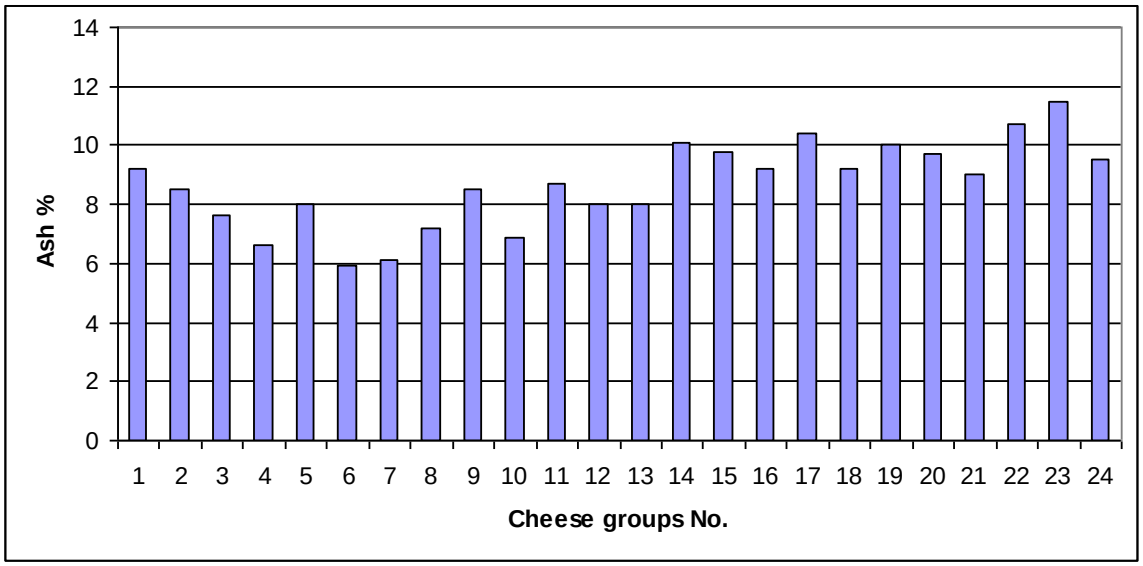

Fig 3.45 Ash content results for cheese produced in summer season at morning time.

As shown in Fig 3.45, the highest ash content was found in cheese group number 23 (which was produced from unpasteurized milk, rennet, and carob); it was 11 %, followed with cheese group number 21 (which was produced from unpasteurized milk, CaCl2, calcium chloride, and rennet); it was 11.5%. At the same time the lowest ash content found in group number 6 (which produced from past. milk at 80 ºC for 30 sec, rennet, and carob); it was 5.9 %.

These variations of ash content between cheese groups can be explained by the same reason discussed in spring cheese.

Chemical composition re measured after 2 months of storage to indicate the quality of cheese during storage period. Result reported in Table 3.7.

Table 3.7 Chemical composition results (after 2months)for cheese produced in summer season at morning time.

Sample	Protein	Fat	TS%	Ash
1	18	20.9	50.6	9.5
2	19	18.7	48.6	8.7
3	17	19.8	47	7.9
4	18.6	18.6	46.3	6.8
5	17	21	47.5	8.2
6	18.2	20.7	46.2	6
7	19.7	18.5	46	6.3
8	17.5	17	42.9	7.6
9	18.3	20	49.2	9
10	20.4	18	48	7.4
11	18.4	18.6	48.3	9
12	17.2	17	44	8.5
13	19.9	19	50	8.5
14	19.4	21	53	10.6
15	18.5	18	50	10.4
16	18.6	18	47.3	9.5
17	20	19.6	51	10.7
18	21	19	51	9.7
19	18	21	52	10.7
20	18	18	58.6	10
21	20	22.5	55	9.5
22	19.6	22	54	11
23	17.7	20.7	52.7	12
24	19	18	48	10

3.2.2.1.3 Microbial Analysis.

All cheese produced in summer season at morning time subjected to different microbial analysis, which are yeast and mold, total plate count, and total *Coliform*. The results obtained from analysis are shown in Fig 3.46 and 3.47.

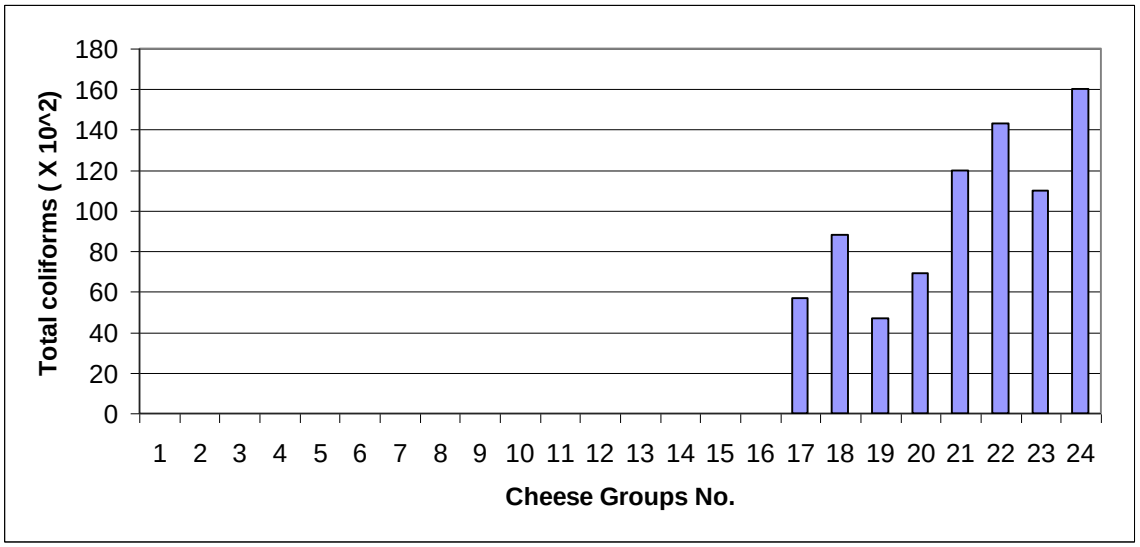

Fig 3.46 Total Coliforms result (at 0 time) for cheese produced in summer season at morning time.

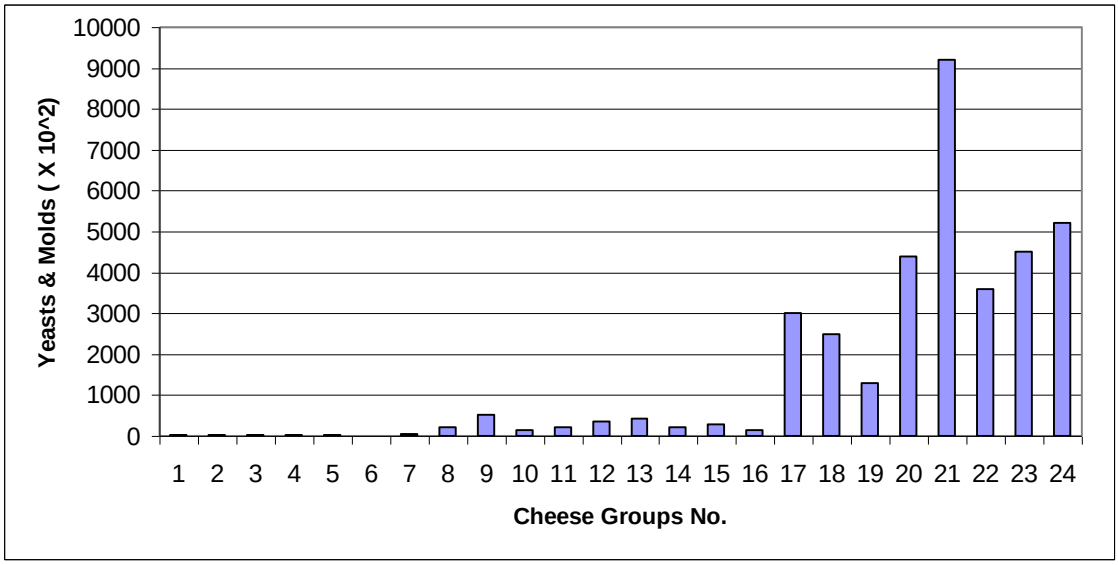

Fig 3.47 Yeasts and Molds result (at 0 time) for cheese produced in summer season at morning time.

After two months of storage microbial analysis were done again to evaluate the quality of cheese, and the result obtained are reported in Table 3.8

Table 3.8 Microbial analysis result (after 2 months) for cheese produced in summer season at morning time.

Sample	Total Coliforms (10^2)	Y&M (10^2)
1	0	33
2	0	36
3	0	16
4	0	30
5	0	17
6	0	44
7	0	55
8	0	240
9	0	530
10	0	160
11	0	230
12	0	370
13	0	440
14	0	240
15	0	300
16	0	160
17	20	3300
18	55	3000
19	33	1900
20	25	4700
21	59	9500
22	74	4300
23	63	5000
24	73	5600

Table 3.8 showed the same result which are obtained from spring cheese, Coliforms decreased during cheese storage, while yeasts & Molds increased for the same reason discussed later.

3.3.2.1.4 Sensorial Analysis

The organoleptic properties of cheese prepared by raw milk had the highest score compared with cheese prepared from pasteurized milk. Good flavor is due to the natural flora present in raw milk which participates in flavor production (Law et al., 1980).

Table 3.9 Sensory Evaluation of cheese produced in spring semester at morning time.

Cheese Group Number	Flavor	Aroma	Texture	Color	General Acceptance
Group 1	6	6	6	7	6.25
Group 2	5	6	6	7	6
Group 3	6	6	5	5	5.5
Group 4	7	7	5	6	6.25
Group 5	6	7	5	5	5.75
Group 6	6	5	5	6	5.5
Group 7	7	6	6	7	6.5
Group 8	8	6	5	6	6.25
Group 9	7	7	7	6	6.75
Group 10	6	6	6	6	6
Group 11	7	7	6	7	6.75
Group 12	6	7	6	7	6.5
Group 13	6	6	8	5	6.25
Group 14	7	6	6	6	6.25
Group 15	7	7	6	6	6.5
Group 16	8	8	8	8	8
Group 17	**8**	**9**	**8**	**8**	**8.25**
Group 18	7	8	8	8	7.75
Group 19	8	8	8	8	8
Group 20	**8**	**8**	**8**	**9**	**8.25**
Group 21	8	7	7	8	7.5
Group 22	**8**	**8**	**9**	**8**	**8.25**
Group 23	7	9	7	8	7.75
Group 24	8	8	8	8	8

3.2.2.2 Evening Cheese.

3.2.2.2.1 Cheese Yield

The yield for all cheese groups were calculated to evaluate the best parameters and conditions to obtain the highest yield in cheese production. The results obtained are shown in Fig 3.48.

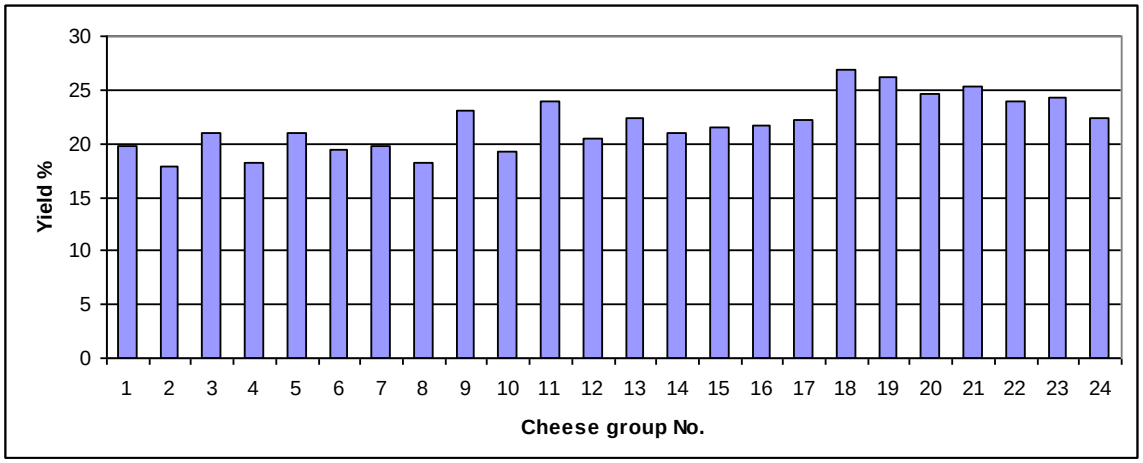

Fig 3.48 Yields % results produced in summer season at evening time

From fig 3.48, cheese group 18 have the highest yield, because this cheese type produced from raw milk without any heat treatment. Also the figure shows that group 4 of cheese produced from milk after being pasteurized at 80°C for 30sec have the lowest yield. This is a normal result because heat treatment has a negative effect on cheese yield, in which as heat treatment increases, protein, fat, and total solid will decrease. These results are in agreement with (Singh et al., 2001) who found that heat treatment cause denaturation of whey protein and make a complex interaction between whey protein, fat globules, minerals and casein resulting in long coagulation time and weak curd.

3.2.2.2.2 Chemical Analysis.

Protein, fat, total solids and ash were determined for all cheese produced in summer farms at the evening time.

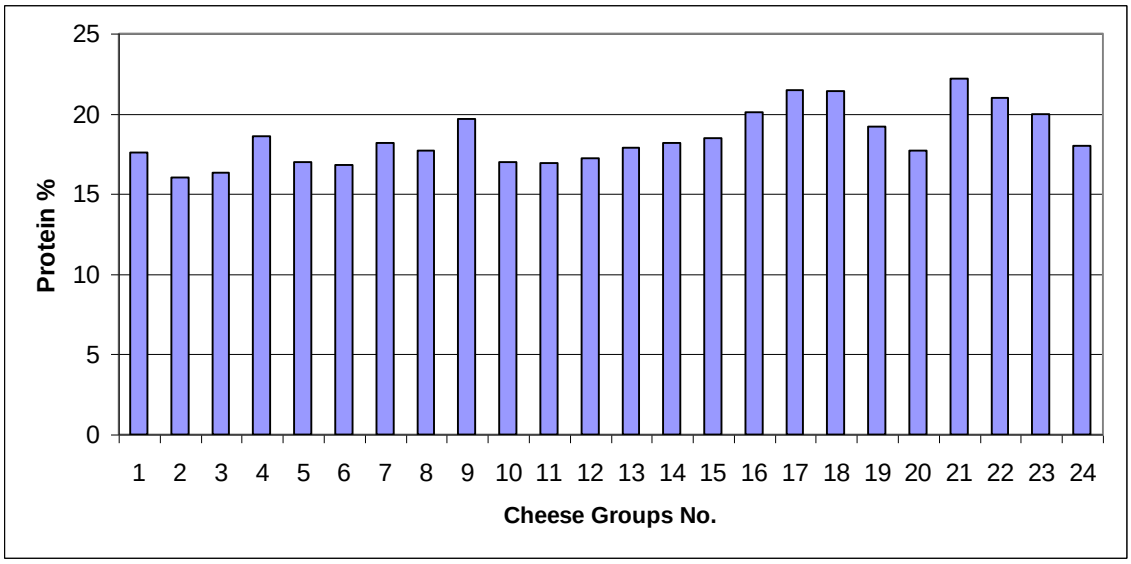

Fig 3.49 Protein content results for cheese produced in summer season at evening time.

As shown in Fig 3.49, the highest protein value was found in cheese group number 21 (which was produced from milk without heat treatment, and with addition of rennet and calcium chloride); it was 22.2%. At the same time the lowest protein content was found in cheese group number 2 (which was produced from milk past. at 80°C for 30 sec, and with addition of rennet, starter culture and carob); it was 14%.

Variation of protein content in cheese group refer to the parameters used during cheese manufacturing, heat treatment have a negative effect on protein content in cheese, this result reported by (Awad et al., 2006) who found that pasteurization decreased the protein content in cheese, because heat cause protein denaturation. Also the same result was reported by (Yun et al., 1993) and (Fox et al., 1993) who found that cheese produced from fresh milk have more protein content than cheese produced from pasteurized milk.

Protein percentage in cheese was reported by (Sulieman et al., 2007) who found that protein content in cheese was between 15.40-20.60, the same finding was reported with (Najaf et al., 2008) who found that protein content in cheese between 16.5-21.9%.

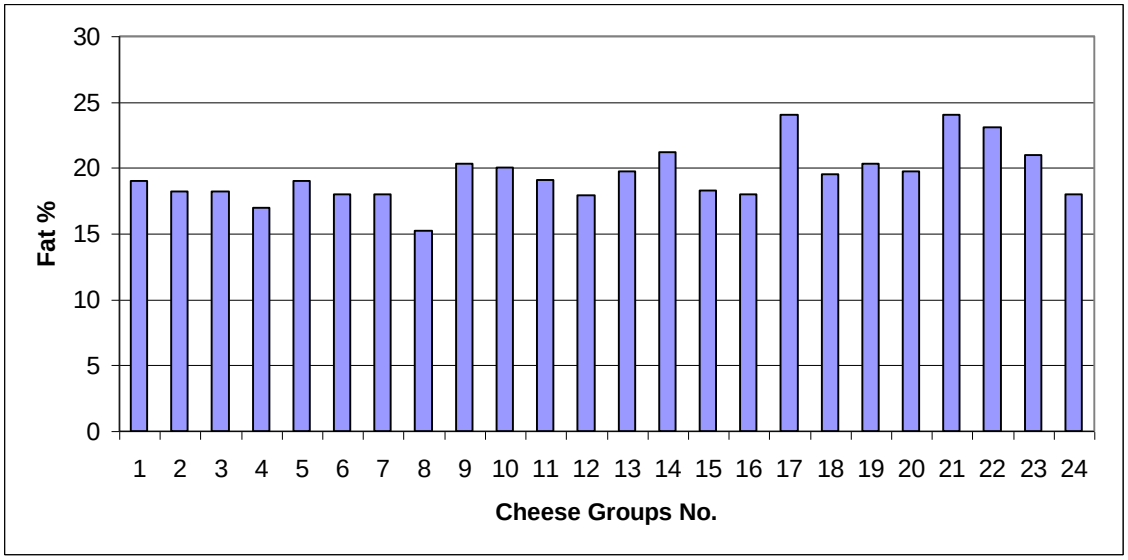

Fig 3.50 Fat content results for cheese produced in summer season at evening time.

As shown in Fig 3.50, the highest fat content was found in cheese group number 21(which was produced from unpasteurized milk, and without addition); it was 24 %. At the same time, the lowest fat content was found in cheese group number 8 (which was produced from past. Milk at 80°C for 30 sec, and with rennet); it was 15.2%.

These variations in fat content between cheese groups can be explained by the same reason discussed in spring cheese.

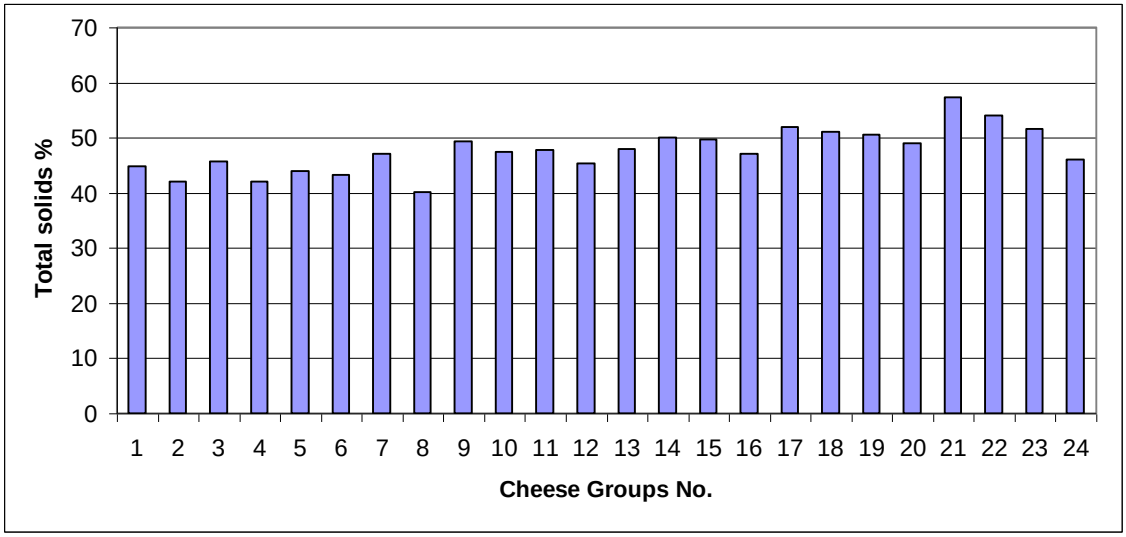

Fig 3.51 Total solids content results for cheese produced in summer season at evening time.

As shown in Fig 3.51, the lowest total solid percent was found in cheese group number 21 (which was produced from unpasteurized milk, with rennet, calcium chloride and carob): it was 57.4%. At the same time, the lowest total solid percent was found in cheese group number 8 (which was produced from past. milk at 80°C for 30 sec, with starter culture, and rennet); it was 40.7%.

These variations in total solid between cheese groups can be explained by the same reasons discussed in spring cheese.

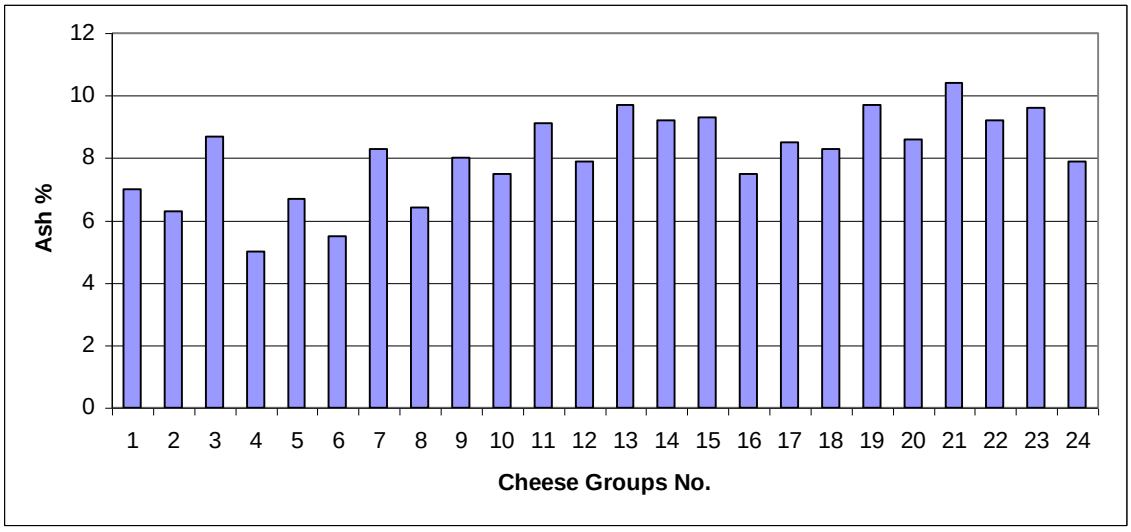

Fig 3.52 Ash content results for cheese produced in summer season at evening time.

Fig 3.52 shows that the highest ash content was in cheese group number 21 (which was produced from unpasteurized milk, with rennet, calcium chloride and carob); it was 10.4 %. At the same time, the lowest ash content was found in cheese group number 4 (which was produced from past. milk at 80 ºC for 30 sec, with rennet, and starter culture); it was 5.5 %.

These variations of ash content between cheese groups can be explained by the same reasons discussed in spring cheese.

Chemical composition for cheese measured after 2 months of storage, in order to verify the quality of cheese. The result obtained are reported in Table 3.10

Table 3.10 Chemical composition (after 2 months storage) for cheese produced in summer season at evening time.

Sample	Protein	Fat	TS%	Ash
1	17.3	18.7	44	7
2	15.6	17.6	41.5	7
3	16	18	45	9.6
4	18.4	16.7	42	6
5	17	18	43.3	7.5
6	16.4	17.2	42.1	6.4
7	18	17	45.7	8.3
8	17.3	15	40.2	6.4
9	19	19.3	48	8.6
10	16.5	19	46	8.5
11	16.5	18.4	45.5	10
12	16.5	17	44	8.6
13	17	18.4	48	10.5
14	17.4	20	48.4	10
15	18	17	47.5	10
16	19	17	45.4	8
17	19	21.6	52	9
18	19.3	18	49.3	9
19	18	19	48	10.6
20	16.3	18	45.1	9.5
21	20	21.5	53.3	11.3
22	19.3	22	52.4	9.6
23	18	18	48	10
24	16.5	17	44	8.4

The result shows that protein, fat, and total solid content decreased during storage period due to the same reason discussed in spring cheese (Table 3.10)

3.2.2.2.3 Microbial Analysis.

All cheese produced in summer season at evening time were subjected to different microbial analysis, which were yeast and mold, total plate count, and total coliform. The results obtained from analysis are recorded in table 3.27.

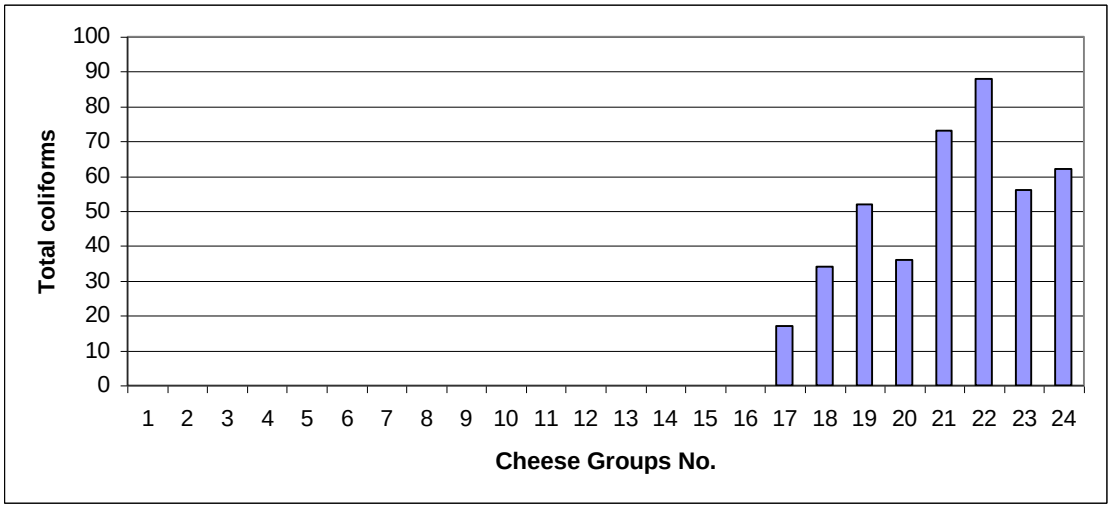

Fig 3.53 Total Coliform result (at 0 time) for cheese produced in summer season at evening time.

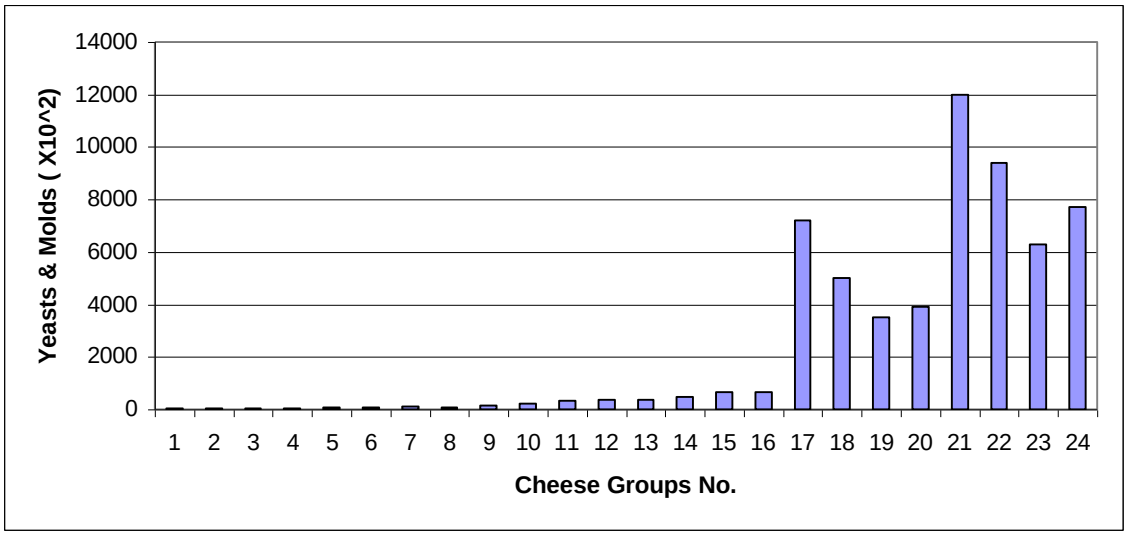

Fig 3.54 Yeasts and Molds result (at 0 time) for cheese produced in summer season at evening time.

Fig 3.53 and 3.54 showed that cheese produced from unpasteurized milk have higher microbial load than cheese produced from pasteurized one.

After two months of storage microbial analysis measured again to evaluate the quality of cheese, the results obtained showed that protein, fat, and total solids decreased during storage period and were reported in table 3.11. this reduction is due to the same reason discussed in spring cheese.

Table 3.11 Microbial Analysis (after 2 month storage) for cheese produced from evening milk at summer season

Sample	Total Coliforms (10^2)	Y&M (10^2)
1	0	45
2	0	47
3	0	40
4	0	59
5	0	67
6	0	76
7	0	125
8	0	92
9	0	230
10	0	250
11	0	360
12	0	380
13	0	390
14	0	510
15	0	670
16	0	690
17	9	7400
18	22	5200
19	43	3700
20	20	4300
21	45	12300
22	61	9700
23	37	6500
24	34	8000

3.2.4 Illustration of The Effect of Additives.

In this section all parameters used in cheese production will be discussed to highlight its effect on cheese quality.

3.2.4.1 Effect of Carob

Carob affect on organoleptic properties of cheese, since it produced cheese with off-white color. This is related to the color of carob, taste, and aroma. The effect result was positive, while the effect on texture seems to produce very hard texture. This is related to high molecular weight of carob where its colloidal polysaccharides composed of galactose and mannose unit combined through glycosidic linkages.

The total yeast and mold count were slightly higher in cheese made by addition of carob. This increase may be correlated to the higher acidity of raw milk which may improve their growth as reported by (Hamed et al., 1992)

3.2.4.2 Effect of Starter Culture

Starter culture addition affected the physicochemical characteristics of cheese, since it increased ash, pH, acidity, fat, and total solids, but it decreased the protein content. These results were in agreement with results obtained by (Dagdemir et al., 2008) and (Khosrowshahi et al., 2006)

On the other hand, (Sert et al., 2007) reported that starter culture had no effect on chemical composition of cheese, but it had an effect on organoleptic quality. However, the microbial growth decreased.

Addition of starter culture had also affected the organoleptic properties of the cheese. It had a role in production of cheese with white color, taste, and aroma was uniform, the texture was very good.

3.2.4.3 Effect of $CaCl_2$ Addition

Calcium Chloride addition affected the physicochemical characteristics of cheese where it increased ash, fat, protein, and total solids, while it decreased the time of coagulation, also it affected on the shelf-life of the cheese where it increased.

Some results founded by (El Zubeir et al., 2008) and (Wolfschoon-Pompo et al., 1998). Who found that the addition of calcium chloride to the cheese caused hardness of cheese and increased of shelf-life.

(Emstrom et al., 1958) and (Mcmahon et al., 1984) found that the addition of calcium chloride increased cheese coagulation and the firmness of the curd, where increasing calcium chloride concentration enhancing aggregation of para-casein micelles.

3.3 Factors Affecting Yogurt product

The other product which was produced from raw milk is yogurt using different conditions and parameters. Milk obtained from Abu dies farm were collected together, analyzed and different groups of yogurt were produced.

The most important factors studied during yogurt production are three different heat treatment (Boiling for 1 sec, Past. at 90ºC for 10 seconds, and past. at 70ºC for 30 minutes) and three different storage conditions before processing (without storage, freezing for 24 hours, and cooling for 24 hours)

3.3.1 Factors Affecting Morning Yogurt

Nine different groups of yogurt were produced according to table 2.3 from milk collected at morning time and then subjected to different analysis; at 0 time of production and after 2 weeks.

The three major analysis carried out at 0 time and after 2 weeks of storage, were chemical composition, Microbiological, and sensorial analysis.

3.3.1.1 Chemical Analysis

All yogurt samples produced at morning time were subjected to different chemical composition analysis such as, protein, fat, ash, and total solids.

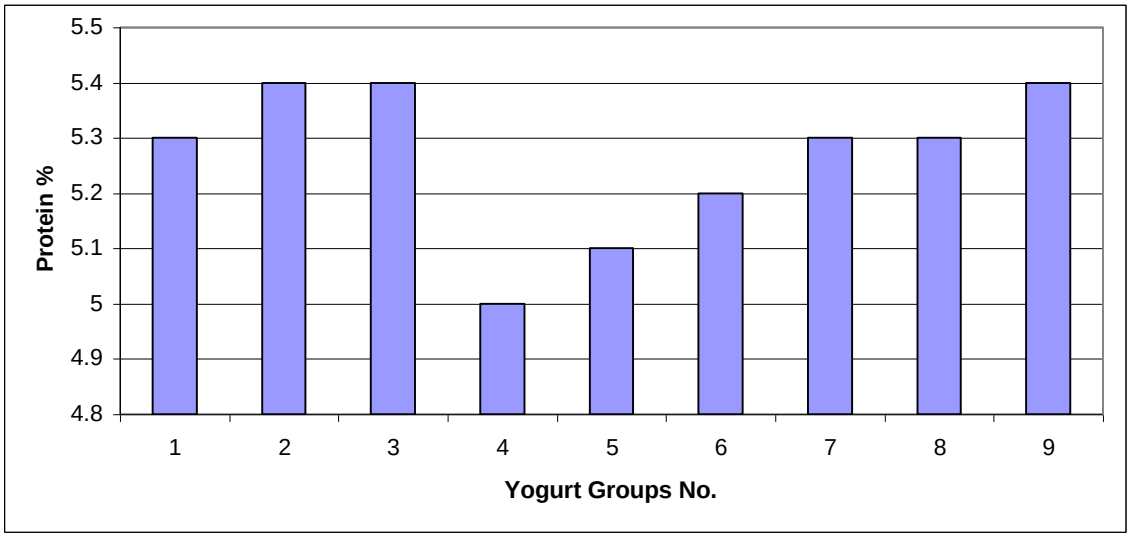

Fig 3.55 Protein content in yogurt produced at morning time

Fig 3.55 showed that protein was affected by heat treatment, as heat treatment increased, the availability of protein increased, because heat effect on whey and casein protein structure. This finding in agreement with (Lee et al.,1988) and (Doan et al.,1942) who found that protein availability increased with both heating and fermentation.

Storage of milk affected protein content according to type of storage, in which refrigeration storage for 24 hours induces decrease in protein content in yogurt, while results show no effect of freezing on protein content. Refrigeration had less effect on proteolysis than freezing. Decreasing protein content during refrigeration storage refer to the activity of proteolytic microorganisms and enzyme (Psoni et al., 2005)

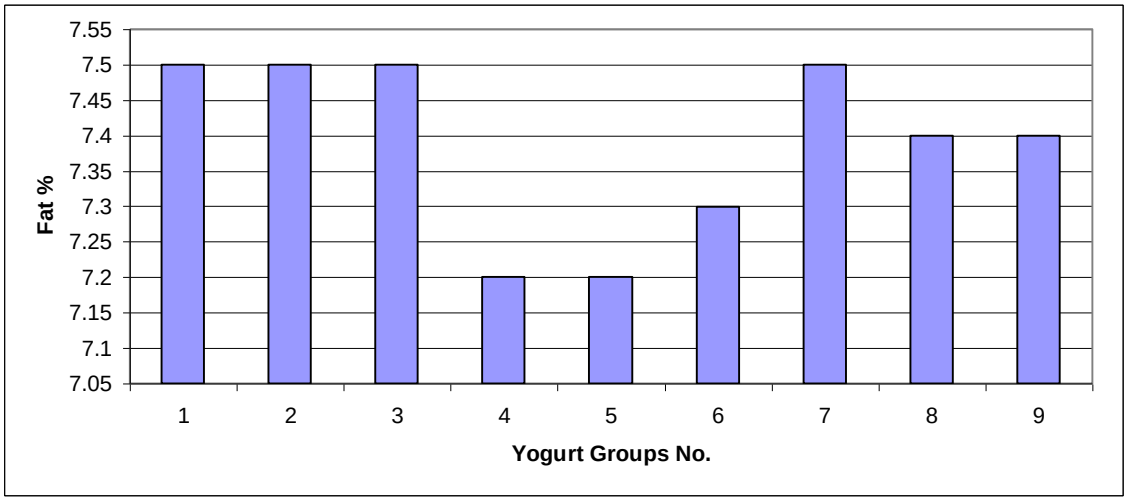

Fig 3.56 Fat content in yogurt produced at morning time

Fig 3.56 showed that there was no noticeable effect of heat treatment on fat content in yogurt. Fat content was affected by the method of storage of milk before yogurt manufacturing. Freezing of milk effect on fat content was lower than refrigeration. Decreasing fat content during refrigeration storage refer to the activity of lipolytic microorganisms and enzyme (Psoni et al., 2005)

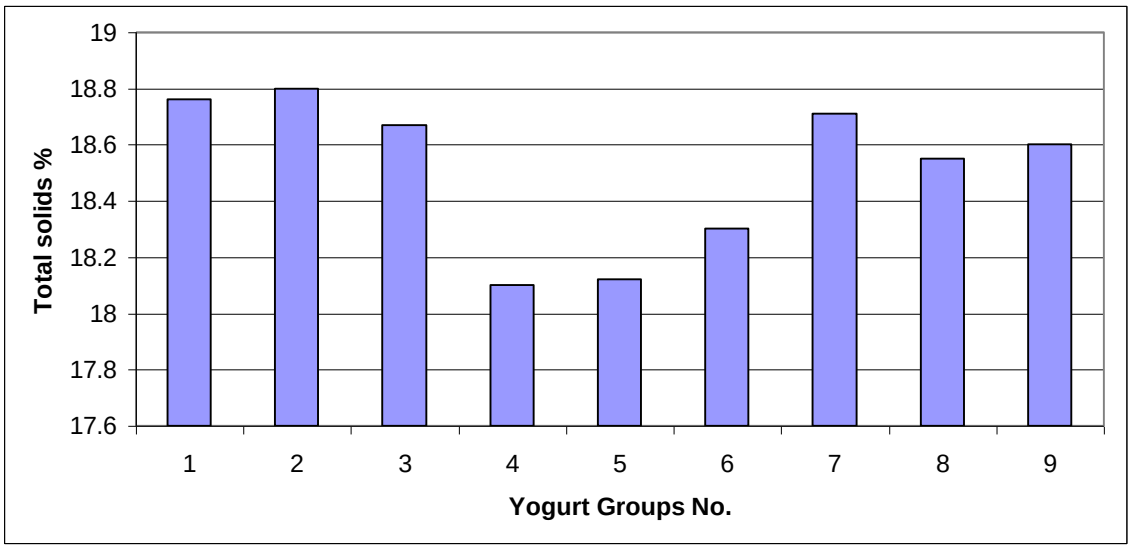

Fig 3.57 Total solids content in yogurt produced at morning time.

In total solid of yogurt was affected with storage condition and heat treatment applied on milk before fermentation. But there was no constant correlation between total solids changes and processing conditions, because there were two factors affecting total solid in yogurt. The first one is increasing or decreasing amount of protein, the second was decreasing amount of lactose and ash during heat treatment.

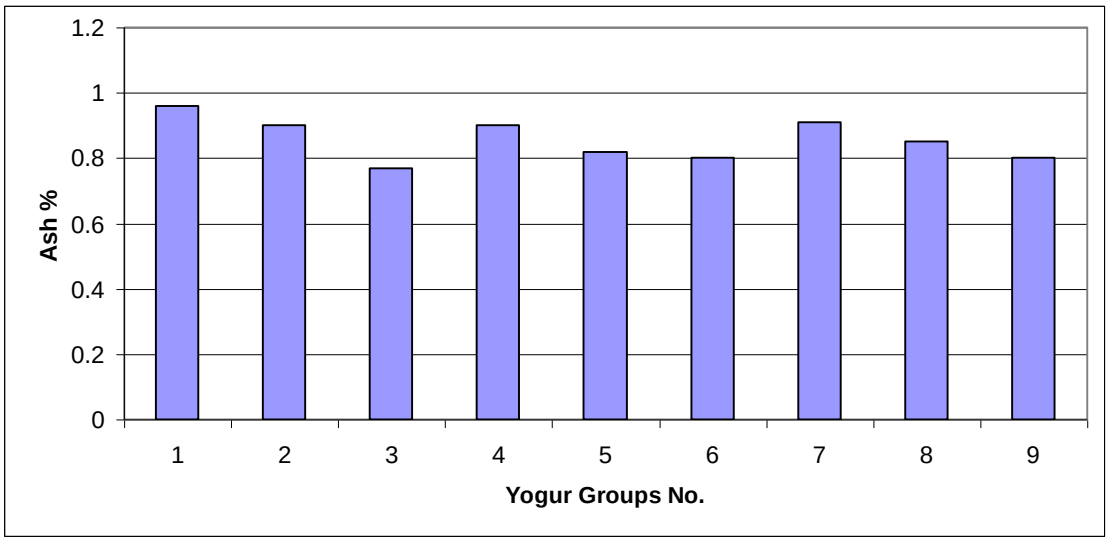

Fig 3.58 Ash content in yogurt produced at morning time.

Fig 3.58 showed that there was no effect of storage condition on ash content in yogurt. While ash content decreased during heat treatment. Boiling treatment has the highest effect on ash content. This result was found in agreement with (Kanka et al., 1989) who found that minerals are affected with heat during pasteurization process.

3.3.1.2 Microbiological Analysis.

To evaluate the microbial quality of yogurt Total *Coliforms* and Yeasts & Molds were examined in all yogurt group, the results are obtained reported in Table 3.12.

Table 3.12 Microbial analysis result (at 0 time) for yogurt produced in morning time

Sample	*Coliforms*	Y & M
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0

Heat treatment used in yogurt preparation was efficiency to destroy all *Coliforms* and yeasts & molds load present in yogurt. This result in agreement with Alakali, et al (2008) who found that sample yogurt treated at 85ºC shows no fungal and *Coliform* growth after yogurt production.

After 2 weeks of yogurt production samples tested microbiologically in order to evaluate quality of yogurt during storage. The results obtained from analysis reported in Table 3.13

Table 3.13 Microbial analysis (after 2 weeks storage) for yogurt produced from morning milk.

Sample	*Coliforms*	Y & M (10^1)
1	0	15
2	0	11
3	0	3
4	0	17
5	0	13
6	0	5
7	0	15
8	0	12
9	0	4

Table 3.13 shows that yeasts and Molds in yogurt grow after two weeks of storage. This finding is in agreement with (Alakali et al., 2008) who found that yeasts and molds increased during the period of storage.

2.3.1.3 Sensorial Analysis

Table 3.14 showed the sensorial analysis result for yoghurt produced from morning milk during spring season, which was evaluated according to the hedonic scale.

Table 3.14 Sensorial analysis for yogurt produced from morning milk.

Cheese Group Number	Flavor	Aroma	Texture	Color	General Acceptance
Group 1	8	8	8	7	7.75
Group 2	8	7	7	7	7.25
Group 3	8	8	7	8	7.75
Group 4	9	8	7	8	8
Group 5	9	9	7	8	8.25
Group 6	9	9	7	7	8
Group 7	8	9	7	7	7.75
Group 8	8	8	7	9	8
Group 9	8	8	7	8	7.75

From Table 3.14, the results showed that heat treatment affect inversely on yoghurt texture, where the most viscous yogurt was obtained by low temperature treatment. These finding were in agreement with (Beal et al., 1998) and (lapropoulos et al., 1983)

Storage of milk before yoghurt processing enhance organoleptic properties of yoghurt, where refrigeration enhance the production of ethanol and diacetyl. This result is in accordance with (Gueimonde et al., 2001).

On the other hand, there is no literature discussing the effect of milk freezing on yoghurt quality.

3.2.2 Factors Affecting Evening Yogurt

Nine different groups of yogurt were produced as shown in table 2.3 from milk collected at evening time and then subjected to different analysis; at 0 times of production and after 2 weeks.

3.3.1.1 Chemical Analysis

All yogurt samples produced at morning time are subjected to different chemical analysis such as, protein, fat, ash, and total solids. The results obtained were showed in Fig 3.59.

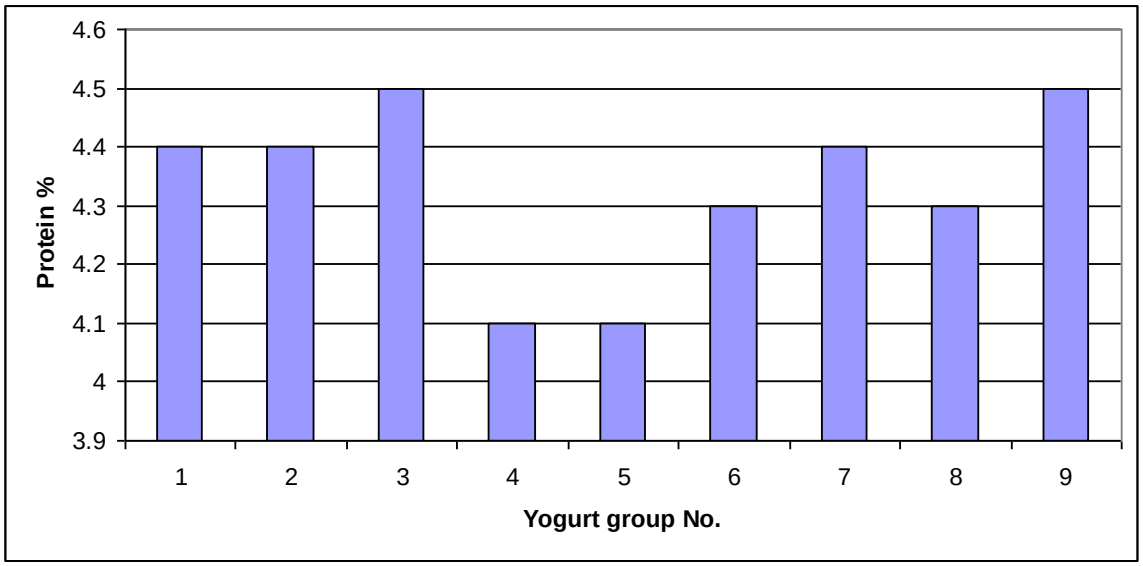

Fig 3.59 Protein content in yogurt that produced from evening milking milk

Fig 3.59 showed that protein are affected by heat treatment, as heat treatment increased, the availability of protein increased, because heat effect on whey and casein protein structure. This findings in agreement with (Lee et al., 1988) and (Doan et al., 1942) who found that protein availability increased with both heating and fermentation.

Storage of milk affect protein according to method of storage, in which refrigeration storage for 24 hours cause to significant decrease on protein content in yogurt than freezing, while results show no effect of freezing on protein content, because refrigeration had less effect on proteolysis than freezing. Decreasing protein content during refrigeration storage refer to the activity of proteolytic microorganisms and enzyme (Psoni et al., 2005)

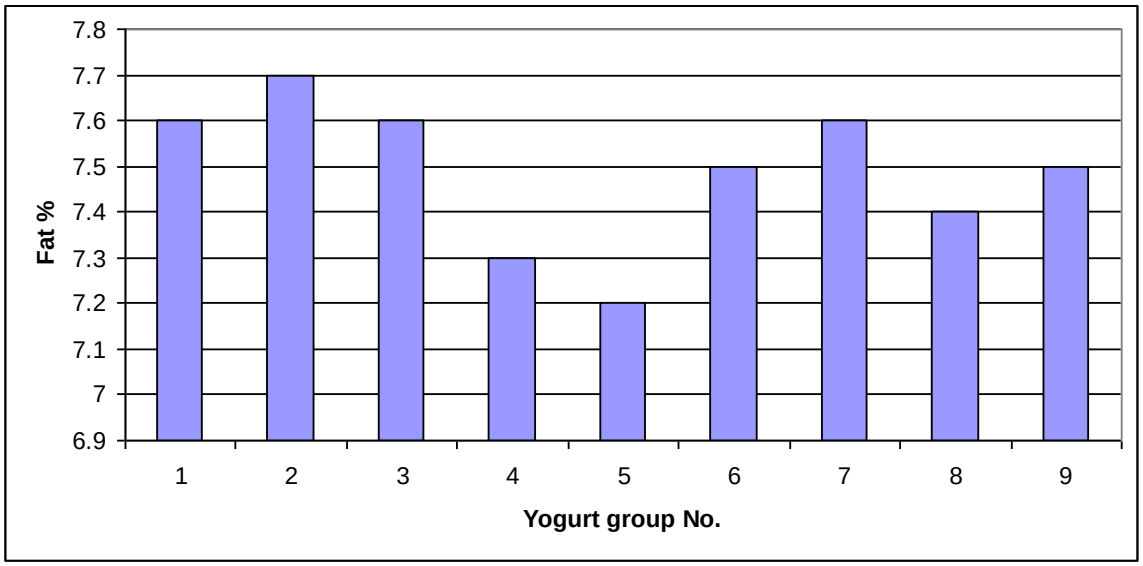

Fig 3.60 Fat content in yogurt produced at evening time

Fig 3.60 showed that there was no noticeable effect of heat treatment on fat content in yogurt. Effect of milk storage on fat content was at refrigeration storage more noticeable than in freezing. Fat content decreased in yogurt stored at refrigeration conditions. Decreasing fat content during refrigeration storage refer to the activity of lipolytic microorganisms and enzymes (Psoni et al., 2005)

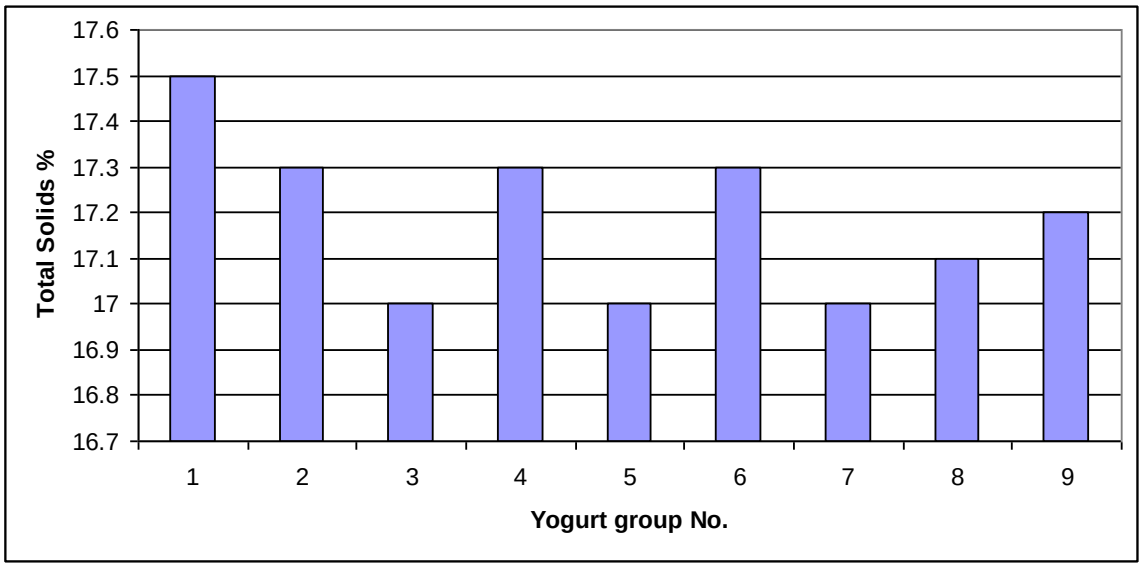

Fig 3.61 Total solids content in yogurt produced at evening time.

As for total solid in yogurt, it was found that total solids are affected with storage condition and heat treatment applied on milk before fermentation. But there was no constant correlation between total solids changes and processing conditions, because there were two factors affecting total solid in yogurt. The first one is increasing or decreasing amount of protein, the second was decreasing amount of lactose and ash during heat treatment.

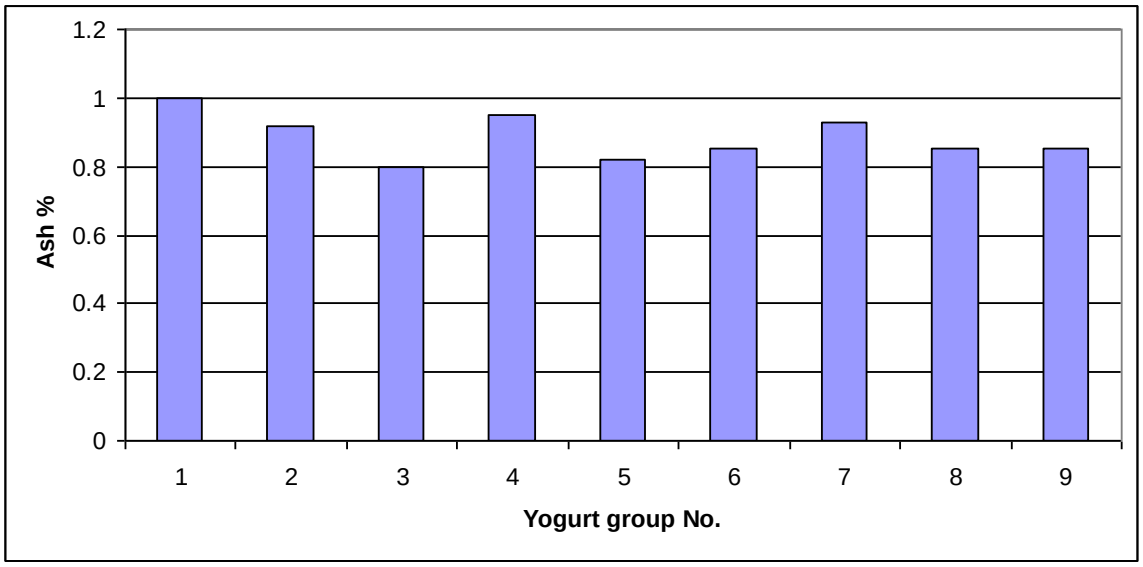

Fig 3.62 Ash content in yogurt produced at evening time.

Fig 3.62 shows that there was no effect of storage condition on ash content in yogurt. While ash content decreased during heat treatment. Boiling treatment found with the highest effects on ash content. Results which obtained was in agreement with (Kanka et al., 1989) who found that minerals were affected by heat during pasteurization process.

3.3.1.2 Microbiological Analysis.

To evaluate the microbial quality of yogurt, Total *Coliforms* and Yeasts & Molds were examined in all yogurt groups, the results obtained are reported in Table 3.15.

Table 3.15 Microbial analysis (at 0 time) for yogurt produced in evening time

Sample	*Coliforms*	Y & M
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0

Heat treatment used in yogurt preparation was efficient to destroy all *Coliforms* and yeasts & molds load present in yogurt.

This result is in agreement with (Alakali et al., 2008) who found that sample yogurt treated at 85ºC shows no fungal and *Coliform* growth after yogurt production.

After 2 weeks of yogurt production samples are tested microbiologically in order to evaluate the quality of yogurt during storage. The results obtained from analysis are reported in table 3.16.

Table 3.16 Microbial analysis (after 2 weeks) for yogurt produced at evening time.

Sample	*Coliforms*	Y & M (10^1)
1	0	17
2	0	15
3	0	5
4	0	15
5	0	15
6	0	8
7	0	22
8	0	10
9	0	6

Table 3.16 showed that yeasts and Molds in yogurt grow after two weeks of storage. This finding was in agreement with (Alakali et al., 2008) who found that yeasts and molds increased during the period of storage.

There was no coliform growth on yogurt after two weeks of storage due to the highest acidic condition present in yogurt.

3.3.1.3 Sensorial Analysis

Table 3.17 showed the sensorial analysis result for yoghurt produced from morning milk during spring season, which was evaluated according to the hedonic scale.

Table 3.17 Sensorial analysis for yogurt produced from evening milk.

Cheese Group Number	Flavor	Aroma	Texture	Color	General Acceptance
Group 1	8.5	8	8	7	7.875
Group 2	7.5	7	7	7	7.125
Group 3	8	8	7	8.5	7.875
Group 4	8.5	8	7	8	7.875
Group 5	9	9	7	8	8.25
Group 6	8	9	7	7.5	7.875
Group 7	8	8	6.5	6.5	7.25
Group 8	8	8	6.5	9	7.875
Group 9	8	8	7	8	7.75

From Table 3.17 the results showed that heat treatment affect inversely on yoghurt texture, where the most viscous yogurt was obtained by low temperature. These finding were in agreement with (Beal et al., 1998) and (lapropoulos et al., 1983)

Storage of milk before yoghurt processing enhance organoleptic properties of yoghurt, where refrigeration enhance the production of ethanol and diacetyl. This agreement in accordance with (Gueimonde et al., 2001).

On the other hand, there is no literature discussing the effect of milk freezing on yoghurt quality.

Chapter Four Results & Discussions: Goat milk

4.1 Introduction

This chapter includes the results of characterization of sheep milk and discusses the main changes for milk components during lactation period.

4.1.1 Factors Affecting Raw milk

The main factors which may affect raw milk composition are; morning and evening milking time, and lactation period. Milk composition variation was studied during lactation period. Samples were taken at the beginning of lactation cycle, at mid of the cycle and finally at the end of lactation. Milk was collected from the farm at morning and evening time.

Samples were collected from the goat farms and were analyzed separately using milk analyzer to determine the chemical composition of milk. The major components of milk studied were; fat, protein, total solids, and lactose.

4.1.1.1 Effect of Milking Time on Protein Content

Protein content changes were studied in morning milk and evening milk.

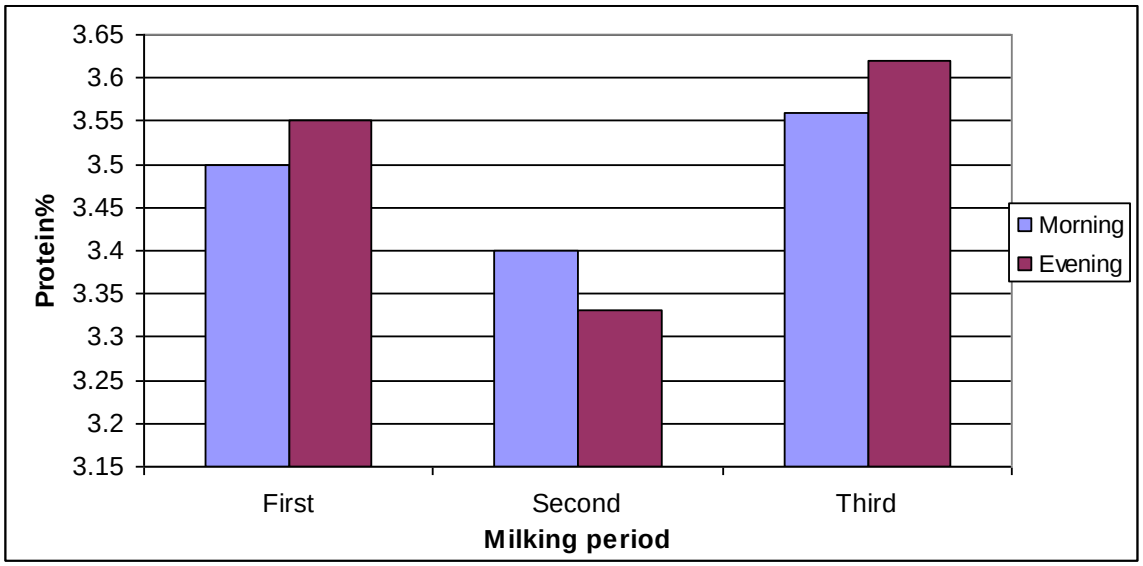

Fig 4.1 Protein content for goat milk obtained from Rafat farm during the lactation period at morning and evening time.

Fig 4.1 showed that protein content in beginning and end of lactation cycle were higher in evening than morning milk, meanwhile in second period, morning milk is higher in protein content than evening. These variations refer to the quantity of milk and the intervals time between morning and evening milking.

Different studies had shown the presence of the variation between morning and evening milk, morning milk has higher protein content than evening milk as reported by (Haenlein et al., 2002). Other studies found that there were no difference between morning and evening milking time for sheep and goat milk as reported with (Kasetelic et al., 2006).

On the other hand some studies showed that evening milk has higher protein content than morning milk, as the result obtained with (Gilmore et al., 1963) and (Gilbert et al., 1973) who found that protein content in evening milk higher than morning milk.

Protein content is affected with the milk yield during milking, as milk quantity increased, protein content decreased. This finding is in agreement with (Haenlien et al., 2002) who found that milk composition concentration increases as quantity of milk decreases.

(Fuerttes et al., 1997) found that milk composition concentration related inversely to the milk yield.

During the end of lactation cycle, protein content decreased in second period and then increased in the end of period. This finding in agreement with (Lancu, et al., 2009) who found that protein decreased in second period and then slightly increased in the last period (9.46, 9.12, and 9.72).

On the other hand (Simos et al., 1991) who found that protein and casein content were fairly constant over the milking period.

4.2.2 Effect of Milking Time and Lactation Period on Fat Content

Fat content changes in milk were also studied twice per day; morning and evening during the three period of lactation.

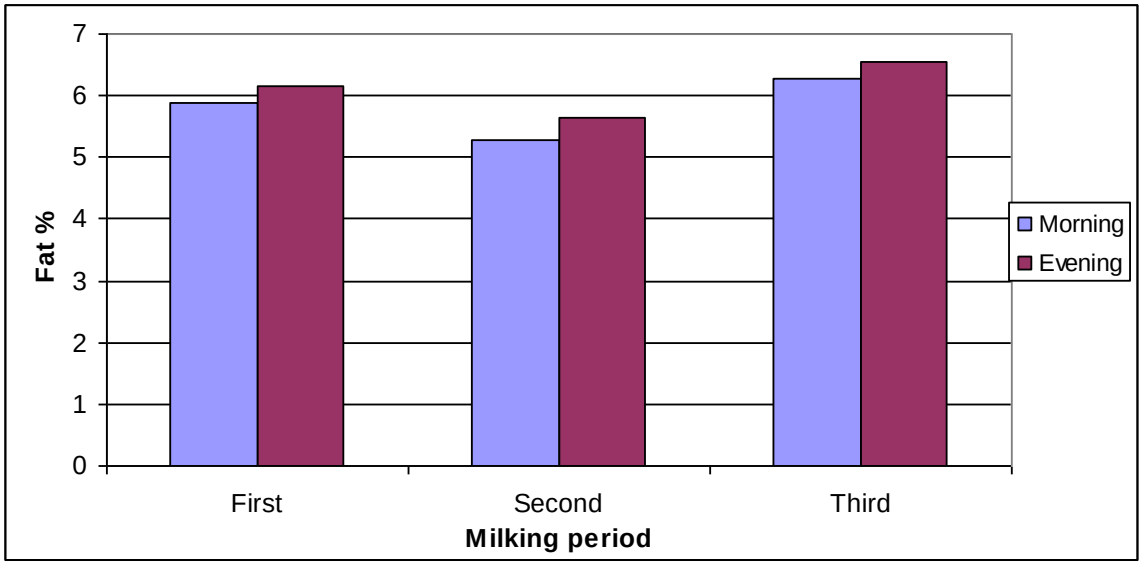

Fig 4.2 Fat content for goat milk obtained from Rafat farm during the three period of milking at morning and evening time.

Fig 4.2 showed that fat content in evening milk is higher than morning milk during the three period of milking. These variations refer to the quantity of milk and the intervals time between morning and evening milking.

Fat content decreased in the second period of milking and then increased in the third milking period to a value higher than in the first period. This finding is in accordance with (Lancu et al., 2010) who found that fat content decreased in second period and then increased in the last period (5.27, 4.21, and 5.49) respectively.

On the other hand (Simos et al., 1991) found that fat content decreased progressively with advancing of milking period.

4.2.3 Effect of Milking Time and Lactation Period on Lactose Content.

Lactose content changes in milk were studied twice per day; morning and evening milking time during the three periods of milking.

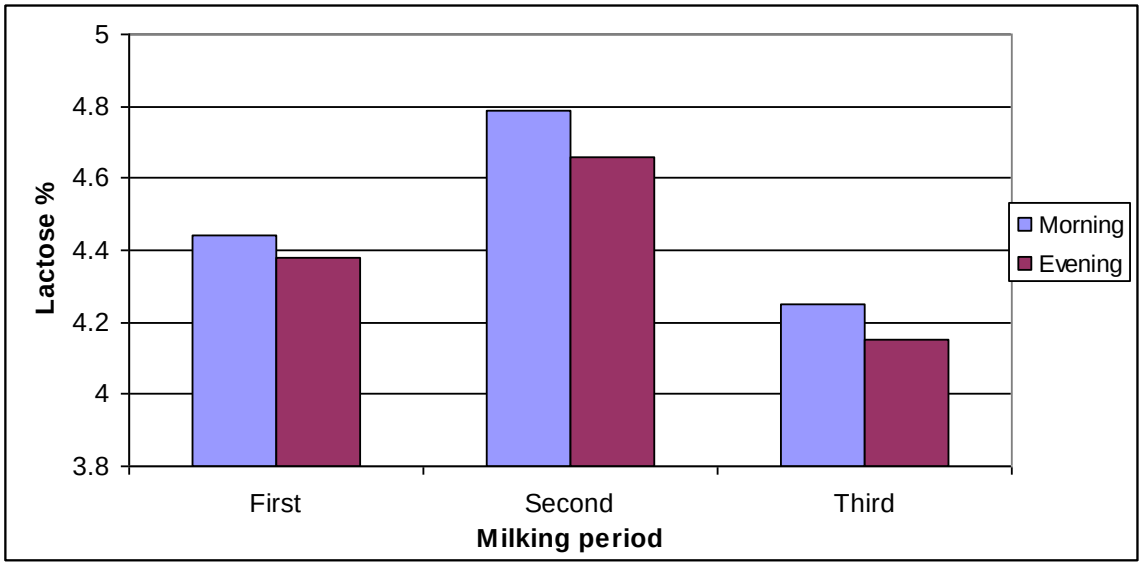

Fig 4.3 Lactose content for goat milk obtained from Rafat farm during the three period of milking at morning and evening time.

Fig 4.3 showed that lactose content in morning milk is higher than that in evening milk, because there is a negative relation between fat and protein together and lactose. At the same time lactose positively related with milk quantity. These finding in accordance with (Fuertes et al., 1997) who found that lactose content positively related to milk quantity, while it is inversely related with fat, protein, and total solids content.

Lactose content increased in the second period and then decreased in the last period. These findings in agreement with (Simos et al., 1991) who found that lactose content increased during the first two months after weaning and then decreased until the end of lactation.

On the other hand (Lancu et al., 2010) showed that lactose decreased in the second period and then increased in the last period (9.46, 9.12, and 9.72)

4.2.4 Effect of Milking Time and Lactation Period on Total Solids Content

Total solids content changes in milk were studied twice per day which are; morning and evening milking time during the three periods of milking.

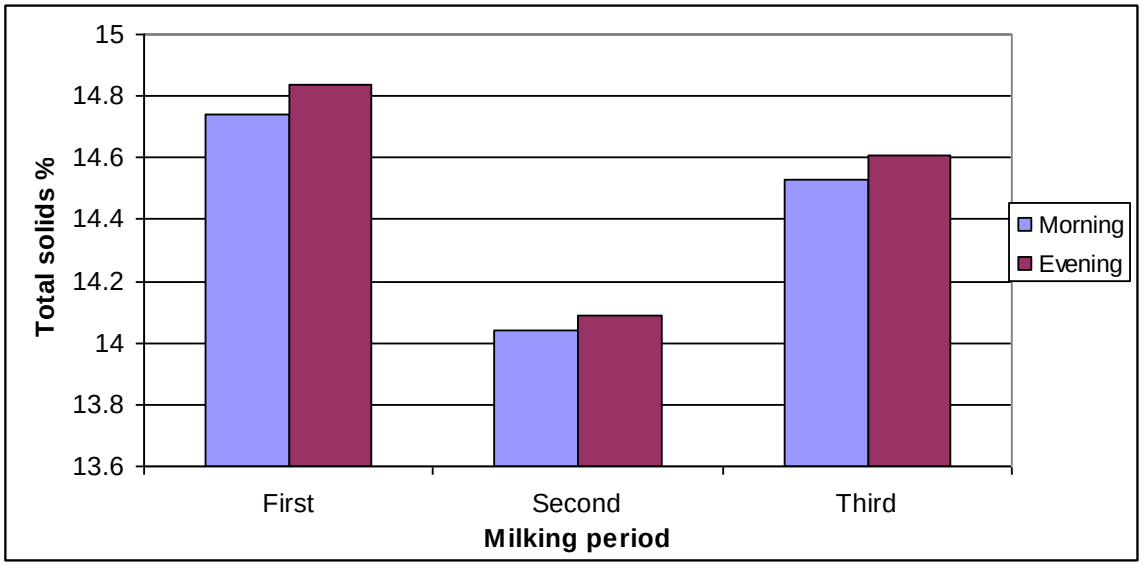

Fig 4.4 Total solids content for goat milk obtained from Rafat farm during the three period of milking at morning and evening time.

Fig 4.4 showed that total solids in evening milk are higher than morning milk. This variation refers to the increasing amount of protein and fat in evening than morning milk.

Total solids content decreased in the second period (because fat and protein decreased) and increased in the last period of milking (because fat protein increased). This finding in accordance with (Lancu et al., 2010) who found that total solids content decreased in second period and then increased in the last period.

Chapter Five Conclusion & Future Work

Conclusion

Chemical components for sheep milk increased during the lactation periods and this is due to the decreasing amount of milk. Decreasing amount of milk in udder leads to concentrate chemical components.

Different results were found in goat milk, in which chemical components (fat, protein, and total solids) decreased in the second period of milking and increased in the last period of milking.

Sheep milk had higher chemical components in evening milking time than morning milking time. The same results were also found in goat milk.

Each farm had a different chemical components result, this is due to the different type and species used in this study. Genetic factor considered one of the most important factors which affected chemical composition in milk.

Cheese produced from unpasteurized milk obtained the highest score of chemical composition (protein, fat, ash, and total solids) and sensorial analysis.

Calcium chloride plays an important role in cheese making by enhancing texture of and decreasing time of coagulation.

Starter culture also plays an important function in cheese by creating acidic condition against the microbial growth and it contributes mainly in organoleptic properties of cheese.

Cheese which was produced from pasteurized milk at 65ºC for 30 minutes had better value than cheese from pasteurized milk at 80ºC for 15 minutes.

The difference between summer and spring milk not clear because the farms used in spring weren't the same used in summer, so the species of sheep and goat and were different so the comparison failed.

In general to produce a high quality cheese, cheese must produce according to the following parameters:

- Starting with unpasteurized milk
- Addition of starter culture (2%)
- Addition of Calcium chloride (0.05%)
- Addition of Carob (1-3%)
- Boiling cheese after production

Future Work

Further research must be carried out to evaluate the other factors which may affect small ruminant's milk, as blood test for the same animals used in our research to highlight the effect of genetic factor on milk composition. Also study the effect of diet type on milk composition.

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