Determination of milk constituents in three types of mammals milk (camel, cow, and goat) in comparison with two types of milk powder

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Acknowledgements

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Abstract

The study was carried out to investigate the composition of milk in three species of lactating mammals (camel, cow, and goat) compared to two type of milk powder. Casein was isolated and studied.

Milk samples were collected from healthy animals and supermarket; they were analyzed to investigate the following biochemical parameters: Protein, fats, ash, lactose, total solid, pH, moisture. The fresh milk samples were applied to SDS-page to determine the molecular weights using standard protein marker.

The highest protein content was reported in cow milk, while camel showed the lowest content of protein. Lactose was found to be highest in powder milk no.1 and goat within the lactating animals. Fats content was found to be high in cow and powder milk no.1. The highest moisture content was reported in camel compared to cow and goat. Each type of fresh milk has a unique electrophoretic pattern.
INTRODUCTION

Milk is one of the greatest blessings that given to Humans by Nature. Milk is considered a complete and great food. Milk as a biological fluid is well designed to the requirements of the specific offspring. Therefore, the composition of milk differs markedly among different species.

Milk like other important nutrients contains essential dietary constituents including water, protein, carbohydrate, fat, vitamins, and minerals in optimal amounts to maintain health and growth of young animals and human.

Milk is secreted as a complex mixture of these components. Each component can be discussed separately.

The objective of this study is to investigate the components of milk with special emphasis to milk proteins. Study will address the milk in three types mammals compared with two types of milk powder.
1.1. **Milk components:**

**Proteins**

The total protein component of milk is composed of numerous specific proteins. The primary group of milk proteins is the caseins. There are four different types of casein proteins: αs1-, αs2-, β-, and κ-caseins. Milk also contains dozens of other types of proteins beside the caseins including enzymes. All other proteins found in milk are grouped together under the name of whey proteins. The major whey proteins in milk are beta-lactoglobulin and alpha-lactalbumin. These other proteins are more water-soluble than the caseins and do not form larger structures. Protein varies, but not as much as milk fat varies among species, ranges from 1 to 1.4% (Fox, 1992).

The average mean composition of the protein of camel milk are generally similar to those of cow milk (Mehaia, 1987 and Farah, 1993).

A number of studies determined the concentration of protein content in camel milk and it was found that the concentration of protein ranged from 2 to 5.5% (Knoess, 1977; Sawaya et al, 1984 and Farah, 1993).

**Casein:**

Casein is composed of several similar proteins which form a multi-molecular, granular structure called a casein micelle. In addition to casein molecules, the casein micelle contains
water and salts (mainly calcium and phosphorous). Some enzymes are associated with casein micelles.

The micelle structure of casein in milk is an important part of the mode of digestion of milk in the stomach and intestine, the basis for many of the milk products industries (such as the cheese industry), and the basis for our ability to easily separate some proteins and other components from cow milk. Casein is one of the most abundant organic components of milk, in addition to the lactose and milk fat. Individual molecules of casein alone are not very soluble in the aqueous environment of milk. However, the casein micelle granules are maintained as a colloidal suspension in milk. If the micellar structure is disturbed, the micelles may come apart and the casein may come out of solution, forming the gelatinous material of the curd.

Caseins have an appropriate amino acid composition that is important for growth and development of the nursing young. This high quality protein in animal milk is one of the key reasons why milk is such an important human food.

**Lipids**

Milk fat is secreted in the form of a fat globule surrounded by a membrane. Each fat globule is composed almost entirely of triacylglycerols and is surrounded by a membrane consisting of complex lipids such as phospholipids, along with proteins. These act as emulsifiers which keep the individual globules from coalescing and protect the contents of these globules from various enzymes in the fluid portion of the milk. Although 97–98% of lipids are triacylglycrols, small amounts of di- and monoacylglycerols, free cholesterol and cholesterol esters, free fatty acids, and phospholipids are also present. Unlike protein and carbohydrates, fat composition in milk varies widely in the composition due to genetic, lactational, and nutritional factor difference between different species.
Carbohydrates:

Milk contains several different carbohydrate including lactose, glucose, galactose, and other oligosaccharides. The lactose gives milk its sweet taste. Lactose is a disaccharide composite of two simple sugars, glucose and galactose.

Lactose:

Lactose is the main carbohydrate found in milk and it is essentially unique to milk. A number of studies determine the concentration of lactose in camel milk and it was found that the concentration of lactose in camel milk ranged from 2.9 to 5.3% (Yagil and Etzion, 1980; Wilson, 1984).

Whereas, lactose content of goat milk was found to be ranged from 4 to 4.6% (Jenness, 1980; Mepham, 1983 and Jensen, 1995).

The lactose content of cow milk is 4.8% (Harold, 1990).

Vitamins and minerals:

Milk is a good source of many vitamins. Vitamins A, B6, B12, C, D, K, E, thiamine, niacin, biotin, riboflavin, folates, and pantothenic acid are all present in milk. Minerals of milk are Calcium, phosphate, magnesium, sodium, potassium, citrate, and chlorine.

The major minerals found in milk are Ca and p. they are both mostly associated with the casein micelle structure (Fox, 1992). The mineral content of camel milk reported by several investigators indicated that the concentration of the major salts showed a wide range of variation (Sawaya et al, 1984; and Mohamed, 1990).
water:

Water is the main constituent of milk and it forms the major part. It was found that the water or moisture of camel milk ranged from 89-91% (Mnoess, 1977; Yagil and Etzoin, 1980; Sawaya et al.).

The water content of goat milk ranged from 88-90% (Ensmiger and parker, 1986; Jensen, 1995 and Bencini and Pulina, 1997) slightly similar to that of camel milk.

It is the most variable constituents of camel milk (Falah, 1997). Many studies determined the concentration of fat in camel milk and it was found that the concentration of fat in camel milk ranged from 1.9-5.6% (El-Bahay, 1962; Kon and Cowie, 1972; Wilson, 1984 and Bayouni, 1990).

In contrast fat content of cow milk which ranged from 3.5-5.8% (Webb et al, 1974; Walstra and Jensen, 1995). Fat content of goat milk was found ranged from 3 to 3.5% (Jenness, 1980; Mephann, 1983 and Jensen).

<table>
<thead>
<tr>
<th></th>
<th>Fat</th>
<th>Crude protein</th>
<th>casein</th>
<th>Lactose</th>
<th>ash</th>
<th>Total solid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow</td>
<td>3.80</td>
<td>3.35</td>
<td>2.78</td>
<td>4.75</td>
<td>0.70</td>
<td>12.60</td>
</tr>
<tr>
<td>Goat</td>
<td>4.24</td>
<td>3.70</td>
<td>2.80</td>
<td>4.51</td>
<td>0.78</td>
<td>13.18</td>
</tr>
<tr>
<td>camel</td>
<td>1.9</td>
<td>5.5</td>
<td>2.3</td>
<td>2.9</td>
<td>0.75</td>
<td>10.36</td>
</tr>
</tbody>
</table>

Source (Potter & Hotochkiss, 1996; Al- Bahay, 1962; Davies, 1939).

There are a number of factors which affect the milk composition. Also many of
the factors discussed below are affected indirectly by the level and type of feed.

2.1.2 Factors Affecting Milk Components:

- **Effect of Breed:**
  Large variations in the milk components, especially in the fat content are shown by the different breeds of cows (Pearson, 1970).
  
  The cow breed or crossbreeding affects also the milk solids and milk volume, which means increasing the economic value of the milk (Villalobos and Garrick, 2002).

- **Effect of Season:**
  The general seasonal trends in composition of bulk milk are well defined. The fat content is highest in one season and lowest in the other. These changes are a reflection of other factors, particularly the seasonal variations in feeding and the stage of lactation. Seasonal changes vary also with locality (Pearson, 1970).
  
  A study done by Bernabucci, et al., (2002) stated that the milk from cows in summer had lower content of crude protein and casein, and higher milk serum.
  
  On the other hand Catillo, et al., (2002), stated that the season of calving affects milk yield only in the first days of lactation, with the lowest production levels for summer calving.

- **Effect of Stage of Lactation:**
  
  Colostrums differ markedly in composition from normal milk. The total solids content of colostrums may be as high as 25% and consist mainly of protein. The fat, SNF, and protein content of milk are maximum in early lactation, then fall to a minimum for SNF and protein after 6 weeks and for fats at about 10 weeks and finally
increase until the end of lactation. (Pearson, 1970).

Ostersen, et al. (1997) suggested that there was a relationship between the lactational variation in milk protein and the cow's body condition at calving. The casein reached the maximum limit in the mid-lactation; it was in low degree in last lactation. These variations were related to the fat metabolism and energy status of cows during lactation.

Kelly, et al. (1998) stated that the milk in late lactation led to the production of milk that was abnormal in character, and this may be linked to the reduced quality of dairy products manufactured from such milks.

- **Effect of Age of the animal:**

  The fat and solid non-fat (SNF) content decrease with successive lactation. There is a drop of about 0.79% in each of 2nd, 3rd, and 4th lactation after which the fall is less pronounced. (Pearson, 1970).

  On the other hand, Catillo, et al. (.2002) stated that the milk yield lactation curves were lower in younger animals than older animals until 20 weeks from parturition. No effect of age on calving could be observed for fat and protein percentages.

- **Effect of Mental and Physical Condition of animal:**

  Excitement, worry or discomfort are liable to have adverse effect on both the quality and quantity of milk produced. (Pearson, 1970)
• **Effect of Milking Interval:**

Morning milk has a lower fat content than that of evening milk due to the interval between milking being longer at night than during the day (Pearson, 1970).

Ayadi et al. (2004) stated that the short term effects of milking were explained by the changes observed in alveolar and cisternal milk ratio. Fat content in alveolar milk remained constant during the first 16 hours, increasing rapidly thereafter, reaching the maximum level at 24 hours (6.95%). Fat content in cisternal milk decreased with milking interval and reached its minimum level at 24 hours (0.96%). Total fat yield tended to increase for cisternal milk with longer milking intervals, but it increases markedly for alveolar milk.

Milk protein content increases in cisternal milk fraction and tended to increase in the alveolar milk fraction with long milking intervals, but values do not differ between cisternal and alveolar fraction. Total protein yield increases with milking intervals in both fractions.

**1.1.3 Milk reaction (pH):**

Cow's milk reaction (pH) is usually between 6.4 and 6.6. The total acidity of freshly drawn milk is usually about 0.14% (as lactic acid). On storage, the acidity increases due to the action of micro-organisms. A sour taste is perceptible at an acidity of about 0.3%. When the pH reaches 4.6, milk curdles at ordinary temperature (Pearson, 1970).
Objective of this research:

1. To identify the major components of three different types of mammals milk (camel, goat, and cow) in comparison to two types of powder milk.

2. Isolation and characterization of milk proteins in the study samples.
CHAPTER TWO
MATERIALS AND METHODS

2.1 Materials:

2.2 Methods:

Milk Samples:

Milk samples were collected from three species of mammals (camel, cow, and goat). The milk of camel and cow was collected from the farm of Khartoum University in Khartoum North (shambat). The milk of goat was collected from a farm in Khartoum (jabal awliah). The two powder milk samples were purchased from Khartoum supermarket.

2.1. Samples Preparation:

Collected samples were divided into three portions:

The first portion was used for isolation of casein content in samples.

The second portion was used as a liquid to determine the biochemical components of milk.

The last portion was used for isolation and characterization of milk protein.

2.2.1 Isolation of Milk Protein:

1. 100 ml beaker was weighted to determine the mass.

2. Milk powder was prepared by adding 40 gm of powder milk to 1 liter of water.
3. 50 ml of milk was added to the beaker and it was re-weight to determine the mass of the milk.

4. The beaker containing the milk was placed into the water bath at 40 C.

5. Acetic acid was added to the milk slowly as drops until no more precipitate was formed when a drop of acid is added.

6. The mixture was filter into another beaker by pouring it through cheesecloth.

7. The ethanol was added to the solid to remove the fat from curd and it was stir for 5 minutes.

8. The mixture was filter and collects the solid to weight it.

2.2.2 Chemical analyses of milk samples:

The chemical composition of milk was determined after heat treatment of milk.

2.2.2.1 Moisture content

Moisture content was determined according to the modified method of AOAC (1990). 5 g of milk sample was placed in a clean dried flat-bottomed aluminum dish. The weight of sample and dish were recorded (w1), and the dishes were heated on a steam bath for 10-15 minutes and placed to an air oven at 100 C for 3 hours. The dishes were transferred to desiccators to cool and weighted. Heating, cooling and weighting were repeated several times until the difference between successive weighting was less than 0.5 mg (w2). The moisture content was calculated from the following equation:

\[ \text{Moisture content (\%)} = \frac{w_1 - w_2}{5} \times 100 \]

2.2.2.2 Fat content

The fat content was determined by Gerber method according to AOAC (1990) as follows: 10 ml sulfuric acid (density 1.815gm/ml at 20C) was poured into a clean Gerber tube, followed
by the addition of 10.94 ml milk, the tube were then thoroughly mixed till no white particles were seen, centrifuged at 1100 revolution per minute (rpm) and transferred to a water bath at 65°C for 3 minute. The column of the fat was then recorded immediately.

2.2.2.3 Protein content

The protein content was determined by Kjeldahl method (AOAC, 1990).

In Kjeldahl flask 10 ml milk were placed. Two Kjeldahl tables (1 mg NaSO4 and equivalent of 0.1 mg Hg) were added. 25 ml of concentrated sulfuric acid (density of 1.86 mg/ml at 20°C) was added to the flask. The mixture was then digested on a heater until a clean solution was obtained (2.5 hours), and the flask was removed and left to cool.

The digested sample was poured in a volumetric flask (100 ml) and diluted to 100 ml with distilled water. The distillate was received in a conical flask containing 25 ml of 2% boric acid plus 3 drops of indicator (bromocresol green plus methyl red). The distillation was continued until the volume in the flask was 75 ml. the flask was then removed from the distillatory.

The distillate was then titrated against 0.1N HCL until the end point was obtained (red color). Protein content was calculated as follows:

\[
\text{Nitrogen (\%) = } T \times 0.1 \times 0.014 \times 20 / \text{weight of sample} \times 100
\]

\[
\text{Protein (\%) = Nitrogen (\%) \times 6.38}
\]

Where:

\[ T = \text{titration figure.} \]

\[ 0.1 = \text{normality of HCL} \]

\[ 0.014 = \text{atomic weight of nitrogen} / 1000. \]
20 = dilution factor.

2.2.2.4 Total solid content

Total solid content was determined according to the modified method of AOAC (1990). 5g milk sample was placed in a clean dried flat-bottomed aluminum dish. The weight of sample and dish were recorded, and the dishes were heated on a steam bath for 10-15 minutes and placed to an air oven at 100 °C for 3 hours. The dishes were transferred to desiccators to cool and weighted. Heating, cooling and weighting were repeated several times until the difference between successive weighting was less than 0.5mg. The total solid content was calculated from the following equation:

Total solids (%) = \( \frac{W_1}{W_0} \times 100 \)

Where:

\( W_1 \) = weight of sample after drying.

\( W_0 \) = weight of sample before drying.

2.2.2.5 Ash content

The ash content was determined according to AOAC (1990). 5g of milk were weighted into a suitable clean dry crucible and evaporated to dryness on steam bath, and the crucibles were placed in a muffle furnace at 550 °C for 1.5-2 hours, cooled in desiccators and weighted. The ash content was calculated as follows:

Ash (%) = \( \frac{W_1}{W_0} \times 100 \)

Where:

\( W_1 \) = weight of ash.

\( W_0 \) = weight of sample.
2.2.2.6 Lactose content

The lactose content was determined by Anthron method. 1ml milk was pipette in 500ml volumetric flask and dilute to 500 ml with distil water and mixed. 0.5 ml of this mixture was transferred to a boiling tube by a pipette. Then the mixture was placed in an ice bath. 10 ml of ice cold Anthrone reagents was added to the sample and to a boiling tube containing 0.5 ml STD solution (standard) and one containing 0.5 ml distil water (blank) was placed in a boiling water bath for 6 minutes and then transferred to an ice-bath for 30 minutes then the O.D was recorded at 625 nm.

Calculation

\[
\text{(g) Lactose content} = 200 \left( \text{O.D of sample} - \text{O.D of blank} \right) \times 47.5 \times 500 \div \left( \text{O.D of standard} - \text{O.D of blank} \right) \times 1000 \times 1000
\]

\[
= \text{O.D of sample} - \text{O.D of blank} / \text{O.D of std.} - \text{O.D of blank} \times 4.75 = \text{g/100 ml}
\]

2.2.2.7 (pH) value

The pH value was measured by using the pH meter.

2.2.3 Determination of protein molecular weight by SDS-page

The electrophoresis is technique that involves the separation of proteins in an field. The rate of protein migration is dependent upon the net charge, size, and shape of the molecule. Electrophoresis is usually performed in gels. This gels are sandwiched between two pieces of glass and run in vertical position with two buffer container, one at top of the gel (stacking buffer), and one at the bottom (Resolving buffer). The electric current applied flows the two buffer chambers.
2.2.3.1 Buffers preparation

(A) 30% Acrylamide solution:

30 g acrylamide
0.8 g N’N’- bis- methylene- acrylamide
The two components was diluted to 100 ml with deionized water and stored in the dark at 4 C.

(B) Lower tris buffer (4x)
18.17 g Tris base
4.0 ml 10% SDS
The two components was adjusted pH to 8.8 with concentrated HCl , then diluted to 100 ml and stored at 4 C.

(C) Upper Tris buffer (4x)
6.06 Tris base
4.0 ml 10% SDS
The two components was adjusted pH to 6.8 with concentrated HCl , then diluted to 100 ml and stored at 4 C.

(D) Tris – glycine reservoir buffer (4x)
12 g Tris base
57.6 g glycine
These was diluted to 1000 ml and stored at 4 C.
(E) 10% SDS
50 g SDS was dissolved in 450 ml deionized water with gentle stirring and it was bring to
500 ml then stored at room temperature.

(F) Ammonium persulfate solution (APS)
0.1 g APS (electrophoresis grade) was dissolved in 1 ml deionized water.

2.2.3.2 Gel preparation

(A) Resolving gel (lower gel)

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deionized water</td>
<td>2.45 ml</td>
</tr>
<tr>
<td>4x lowe Tris buffer</td>
<td>2.5 ml</td>
</tr>
<tr>
<td>30% Acrylamide solution</td>
<td>5.0 ml</td>
</tr>
<tr>
<td>10% APS</td>
<td>50 micro/l</td>
</tr>
<tr>
<td>TEMED</td>
<td>5.0 micro/l</td>
</tr>
</tbody>
</table>

(B) Stacking gel (upper gel)

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deionized water</td>
<td>3.05 ml</td>
</tr>
<tr>
<td>4x upper Tris buffer</td>
<td>1.25 ml</td>
</tr>
<tr>
<td>30% Acrylamide solution</td>
<td>0.67 ml</td>
</tr>
<tr>
<td>10% APS</td>
<td>25 micro/l</td>
</tr>
<tr>
<td>TEMED</td>
<td>5.0 micro/l</td>
</tr>
</tbody>
</table>

Electrophoresis of milk samples:

Isolated proteins were applied to SDS-PAGE to determine the molecular weights
using standard protein marker, molecular weight range:

10.5-175 kDa.
Procedure

1. 10 micro/l of each milk samples and pre-stained kaleidoscope standard proteins was loaded into adjacent wells on half of the gel.
2. The protein samples was Electrophoresed at 150 volts until bromophenol blue marker dye has migrated to 1 cm of the bottom of the gel (this step was taken about one hour).
3. The gel was removed from electrophoresis chamber and stain overnight in coomassie blue.
4. Finally, digital image of the gel was obtained.

Determination of Molecular weights

Isolated proteins were applied to SDS-PAGE to determine the molecular weight using standard protein marker, molecular weight range: 10.5-175 kDa.
CHAPTER THREE

RESULTS

3.1 quantities of isolated casein in milk samples:

Results of casein quantity in camel, cow, goat milk samples, and two types of powder milk where shown in table 3.1. The highest weight of isolated casein was shown in powder milk no. 1 (5.7 mg) while that of camel showed the lowest value. The quantity of casein in cow milk is nearly to that in goat milk with small variation between them. Whereas the camel milk was showed lower quantity of casein.

Table 3.1: the weight of isolated casein (gm) from 50 ml of milk samples

<table>
<thead>
<tr>
<th>Samples</th>
<th>Means of casein weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camel</td>
<td>1.9</td>
</tr>
<tr>
<td>Cow</td>
<td>3.5</td>
</tr>
<tr>
<td>Goat</td>
<td>3.1</td>
</tr>
<tr>
<td>Powder 1</td>
<td>5.7</td>
</tr>
<tr>
<td>Powder 2</td>
<td>4.8</td>
</tr>
</tbody>
</table>

3.2 chemical composition of milk samples:

The chemical composition of milk samples were shown in table 3.2
Moisture, ash, Total solid, lactose, fat, crude protein, and d PH.
Powder milk no. 1 sample showed the highest content in moisture (90.35%) and then the camel milk sample. The highest ash content was showed in cow milk (1.34%). Camel, goat milk showed similar in ash content (1.22%). Total solid content in cow milk was the higher content (14.18%) compared to other samples. The lactose content in the powder milk no. 1 was higher than other samples (6.27%). Fats content in the powder milk no. 2 was higher (3.3%) and then the powder no. 1 (3.0%). The cow milk sample showed the highest content of crude protein (3.65%). Eventually the PH in the powder milk no. 1 was high (6.94%) and then the powder milk no. 2 (6.93%).
Table 3.2: chemical composition (%) of milk samples

<table>
<thead>
<tr>
<th>Samples</th>
<th>Moisture%</th>
<th>Ash%</th>
<th>T.solid %</th>
<th>Lactose%</th>
<th>Fat %</th>
<th>Crude protein%</th>
<th>PH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camel</td>
<td>90.9</td>
<td>1.22</td>
<td>9.06</td>
<td>5.08</td>
<td>2.4</td>
<td>1.75</td>
<td>6.2</td>
</tr>
<tr>
<td>Goat</td>
<td>87.83</td>
<td>1.22</td>
<td>12.16</td>
<td>6.22</td>
<td>2.5</td>
<td>3.3</td>
<td>6.32</td>
</tr>
<tr>
<td>Cow</td>
<td>85.81</td>
<td>1.34</td>
<td>14.18</td>
<td>5.13</td>
<td>1.8</td>
<td>3.65</td>
<td>6.48</td>
</tr>
<tr>
<td>Powder 1</td>
<td>90.35</td>
<td>1.1</td>
<td>9.64</td>
<td>6.27</td>
<td>3.0</td>
<td>2.45</td>
<td>6.94</td>
</tr>
<tr>
<td>Powder 2</td>
<td>89.51</td>
<td>1.14</td>
<td>10.48</td>
<td>6.03</td>
<td>3.3</td>
<td>2.8</td>
<td>6.93</td>
</tr>
</tbody>
</table>
3.3 **molecular weight of camel, cow, and goat milk samples:**

The SDS-PAGE electrophoretic patterns of cow, goat, and camel milks are presented in Figure 1. Each type of milk has a unique electrophoretic pattern. In cow's milk, casein was separated into two major fractions αs-casein and β-casein. In goat and camel milks, also there are two casein fractions were remarked.

The molecular weights of three mammals milk samples are nearly similar to each other and they are restricted between 66kDa and 95 kDa according to the molecular weight of protein marker (ladder).
Figure 1.3: Acrylamide gel separates proteins of mammal milk samples.

A: cow milk
B: goat milk
C: camel milk
Figure (2.3): milk components and their percentage in the milk samples.
Figure (3.3) isolation casein quantities for milk samples.
CHAPTER FOUR

Discussions

There are many factors lead to the variation in the milk composition such as season, breed, lactation, and mental condition of animals. These factors can affect not on the milk composition between different animals only but they can affect the milk composition between the individual of the same species. The concentration of milk protein is greatly influenced by the lactation which is highest in early and late lactation and lowest when production is highest. Percentages of whey and casein proteins decrease during the first five weeks of lactation. After week five, milk protein percentage increases through the rest of lactation while milk production decrease.

According to the table of result the high content of lactose was in milk powder no.1 compared to other samples. this explain by the fact that the producers of milk powder are intend to add more sugar in the milk powder to make it more tasty and desirable for consumers. The percentage of protein in the milk powder no.1 are acceded (2.45%) in comparison to the percentage of protein in cow milk (3.65%).

Powder milk is used more largely than fresh milk because it has a much longer shelf life than fresh milk and does not require refrigeration. One of the purposes for manufacturing powdered milk is the ease of bulk transportation. The fat content in milk samples are varies but the highest content in milk powder. Emerging science findings indicate that milk fat contains several components such as conjugated linoleic acid (CLA), sphingomyelin, butyric acid, which may potentially protect against major chronic disease. Milk fat may also have a beneficial effect on bone health, according to experimental animal studies.
In the lactation species the highest moisture content was showed in camel milk (90.9%) water does not provide a nutritional benefit in the same manner as proteins or vitamins, for example. However, water is extremely important in human metabolism. Water is a major component in the body. Water maintains blood volume, transports nutrients like glucose and oxygen to the tissues and organs, and transports waste products away from tissues and organs for elimination by the body. Water maintains body temperature regulation through sweating. And this observed in the Bedouins whom depend on the camel milk totally because it provides a nutritional benefit and good source of water.

In general, the proteins in milks of different animals share a large number of characteristics. Many of these proteins have approximately the same molecular weight across species. However, milks from different mammals also present difference in relative proportions and characteristics of caseins and whey proteins and in the amino acids composition of similar proteins.

According to the SDS-PAGE electrophoretic patterns of cow, goat and camel milks are presented in (figure 1.3). Each type of milk has a unique electrophoretic pattern. Each type of three samples of milk has two major fractions of casein α-casein, and β-casein and the molecular weights of these fractions are restricted between 62-95 kDa due to the protein marker molecular weight.

The minor difference in the molecular weights of casein in the three milk samples of mammals may be because the difference in the amino acids composition, and peptides from milk sample to another. This means that each protein has its own unique structure.

The study was reported by (Mora-Gutierrez et al., 1995) to determination of molecular weight of casein. The SDS-page electrophoretic pattern of cow, goat and human milks showed the α-casein and β-casein fractions are quite similar in ratios 56.5 and 43.5% of total casein. In goat and human milk the β-casein is the dominant
(70.2%), while αs-casein is minor (29.8%) in comparison to the cow milk α-casein as the dominant.
Conclusion:

There are many factors that can affect the milk composition.

The percentage of casein protein is high in the cow milk in comparison to other lactating species.

The molecular weight of lactating species are vary and restricted between 62-95 kDa according to protein marker.
REFERENCES:


