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## Changes in Chemical Composition of Camel's Raw Milk During Storage

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**Abstract:** A total of 70 samples of individual dromedary raw milks were collected from different areas in UAE. The milk samples were divided into three portions under sterile conditions the 1st portion stored at 4°C, the 2nd portion stored at 7°C, the 3rd portion stored at room temperature (25-30°C). Samples were examined for pH, acidity, fat, protein, lactose, total solids and ash contents. The results shows that there were significant changes in pH, acidity, lactose, total solids and insignificant changed in fat, protein, during storage. The storage duration of raw camel milk was estimated at 4°C, 7°C and room temperature (25-30°C), the results was 42 days at 4°C, 15 days at 7°C, 3 days, at room temperature.

**Key words:** Camel milk, chemical composition, storage

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### INTRODUCTION

Raw milk may be defined as poly disperse system, which has a temperature of 38C directly after milking. This extremely heterogeneous system is not very stable; creaming and microbiological deterioration is well known changes which take place during storage. In addition to changes in the microbiological status of raw milk, several physical and chemical alterations occur, including changes in the rennet coagulation time and curd firmness and reduced yields of cheese, as well as increases-casein content and flavor defects (Reimedes, 1987).

Ohri and Joshi (1961) reported that camel's milk soured in 8hr when kept at 30°C, compared with cow's milk, which soured within 3 h at the same temperature.

Yagil *et al.* (1984) stored camel's milk, women's milk and cow's milk at 30°C and refrigerated at 4°C. He found that at room temperature women's milk turned extremely sour within 24 h reaching a pH of 5.5. Cow's milk becomes sour within 2 days with pH of 5.7. Camel's milk remained un changed for 5 days with a pH of 5.8. Refrigerated unstirred women's milk separated into a fat layer and a sticky liquid layer within 2 days. Within 5 days the milk had coagulated and developed a pungent odour. Unstirred cow's milk slowly separated into a coagulum surrounded by milk-serum in 7 days. After 10 days the milk was rancid with a pungent odour. Unstirred camels milk slowly separated within 10 days, but did not coagulate. After 2 months of standing the milk tasted the same as before. After 3 months it had a very unpleasant smell.

The aim of the present study is to evaluate the changes that might happen in the gross composition of Camel's raw milk during storage.

### MATERIALS AND METHODS

**Collection of milk samples:** Camel's milk samples were collected from 70 lactating camels, from private camel herds, from different areas. All camels were in mid lactation (2nd to 5th month of lactation). A box containing ice was used to provide cold storage during transportation to the laboratory. The milk samples were divided into three portions under sterile conditions the 1st portion stored at 4°C, the 2nd portion stored at 7°C, the 3rd portion stored at room temperature (25-30°C). Twenty Samples were examined for pH, acidity, fat, protein, lactose, total solids and ash contents. Samples at room temperature were analyzed daily. Samples stored at 7°C were analyzed at two-week intervals, while samples stored at 4°C at three-week interval (Those intervals of analysis based on pre-experiments results).

**Sample containers:** 1000 mL, autoclave able plastic containers were used for the collection of samples. Containers were sterilized at 120°C for 15 min and kept ready for milk collection from different sites.

**Chemicals:** All chemicals used were analytical grade.

**Preparation of the udder:** Healthy and uninfected camels were used for milk collection. The udder was cleaned and washed with disinfectant solution (Safflon; 20% concentration) and was kept on the udder 5-10 min., before collection of samples. 20 mL of the 1st milk leaving the udder was discarded.

**Types of analysis conducted:** The following parameters were analyzed, pH, acidity, density, ash, moisture, fat, protein, lactose and total solids.

**pH determinations:** The pH of the milk was determined by a pH meter at 25°C according to APHA (1972).

**Acidity, density, gross composition determinations:** The acidity, density, total solids, ash, lactose and protein contents were determined according to AOAC (1995) methods.

**Fat determination:** Fat was determined according to Rose Gottleb method (Person, 1967).

**Data analysis:** SAS program was used for the data analysis (SAS, 1997).

## RESULTS AND DISCUSSION

The presence of many organic compounds in milk helps various types of microorganisms to decompose it and causing different chemical changes.

Table 1 shows the physicochemical characteristics of camel milk stored at 4°C. The mean value of pH at 4°C on the day of collection (1st reading) as 6.6, accompanied by a slight decrease in 3rd week (2nd reading) and a further decrease to 5.8 at day 42 (3rd reading). Yagil (1982) reported no change in the pH of camel's milk, stored at 4°C after 2 days of collection. Titratable acidity at 4°C rose from 0.2-0.4-0.6% for the 1st, 2nd and 3rd readings, respectively. The mean values of fat during storage at 4°C were 2.4, 2.4 and 2.5% for the 1st, 2nd and 3rd readings, respectively. The observed data indicated no significant change in milk fat content when the milk was refrigerated at 4°C. The mean values of protein were as follows: 2.1, 2.8, 2.7% for the 1st, 2nd and 3rd reading, respectively and that mean a slight changes had occurred during storage at 4°C. Lactose content was the most constituent affected by storage at different temperatures. At 4°C the mean value decreased from 4.4% at the day of collection to 3.26% at the 2nd reading and 2.68% at the 3rd reading. The decrease of lactose during storage could be attributed to the activity of microorganisms. Total solids mean value at 4°C decreased slightly from 9.8-9.5-9.0% at the 1st, 2nd and 3rd readings, respectively. The mean values of ash content increased from 0.94% at the day of collection to 1.0% at the 2nd reading and 1.1% at the 3rd reading. Moisture content increased slightly from 90.2% at the day of collection to 90.4-9.6% for the 2nd and 3rd reading, respectively.

Table 2 shows Physicochemical characteristics of camel milk stored at 7°C the mean value of pH at 7°C on the day of collection (1st reading) as 6.6 then decreased to 5.9 at the end of the 1st week (2nd reading) and then decreased slightly by the end of the 2nd week (3rd reading). At 7°C the acidity rose from 0.2-0.3% by the end of the 1st week and to 0.55% at the 2nd week. The mean values of fat during storage at 7°C were 2.4, 2.5 and 2.5%, for the 1st, 2nd and 3rd reading, respectively. That

means no significant change in fat content was observed when milk was refrigerated at 7°C. The mean values of protein content at 7°C were 2.1, 2.1 and 2.0% for the 1st, 2nd and 3rd readings, respectively. The mean value of Lactose content at 7°C decreased from 4.4% at the day of collections to 4.1% at the 2nd reading to 3.6% at the 3rd reading. Total solids mean value at 7°C decreased from 9.8% at the day of collection to 9.6% at the 2nd reading and to 9.4% at the 3rd reading. The mean values of ash content were 0.94, 1 and 1.1% at the 1st, 2nd and 3rd reading, respectively. No significant change in the moisture content at 7°C.

Table 3 shows the physicochemical characteristics of camel milk stored at room temp (25-30°C) the mean value of pH at room temperature as 6.6 at the day of collection to 5.6 in the 2nd day (2nd reading) to 5.4 at the 3rd day (3rd reading). At room temperature the acidity rose from 0.2-0.4-0.5% for the 1st, 2nd and 3rd reading, respectively. These results differ from those of Yagil (1982) who reported that souring of camel's milk at room temperature, was after 7 days collection, while Ohri and Joshi (1961) reported that camel milk when left to stand at room temp, the acidity rapidly increases after 8 h. These differences in results may be due to differences in milking practices. At room temperature, the mean values of fat were 2.4, 2.7 and 3.1% for the 1st, 2nd and 3rd readings, respectively. The data indicate a significant increase in fat when milk stored at room temperature. The percentage of total protein was 2.1% in the 1st reading, 2.1% in the 2nd reading and 2.2% in the 3rd reading. The percentage of total proteins was insignificantly altered during storage at room temperature. The mean value of Lactose content at room temperature, decreased from 4.4% in the 1st reading to 3.34% at the 2nd reading and to 3.28% at the 3rd reading, respectively. Total solids mean value at room temperature decreased from 9.8% at the day of collection to 9.7% at the 2nd reading, then decreased to 9.3% at the 3rd reading, respectively. The mean values of ash content at room temperature were 0.94, 1.1 and 1.11% from the 1st day of collection, to the 2nd and 3rd day, respectively. The mean value of moisture content was 90.2% at the day of collection to 90.5% at the 2nd day and 90.3% at the 3rd day.

Table 4 represents the storage duration of raw camel milk, at 4°C, 7°C and room temperature. Eleven samples out of seventy samples stored at room temperature were spoiled within 2 days, 47 samples out of seventy samples were spoiled after 3 days and 12 samples out of seventy were spoiled in 4 days. At 7°C 1 sample out of 70 was spoiled after 11 days, 20 samples out of 70 were spoiled after 14 days, 38 samples out of 70 samples were spoiled after 15 days, 3 samples out of 70 samples were spoiled after 18 days and eight samples out of 70 samples were spoiled after 22 days. For samples kept at 4°C, 4 out of the 70 samples tested

Table 1: Physicochemical characteristics of camel milk stored at 4°C

Variables	Mean values			LSD
	1st reading (0-day)	2nd reading (21-days)	3rd reading (42-days)	
pH	6.57 <sup>a</sup>	6.13 <sup>b</sup>	5.8 <sup>c</sup>	0.04
Acidity %	0.20 <sup>c</sup>	0.41 <sup>b</sup>	0.64 <sup>a</sup>	0.08
Fat %	2.35 <sup>a</sup>	2.44 <sup>a</sup>	2.52 <sup>a</sup>	0.53
Protein %	2.06 <sup>b</sup>	2.79 <sup>a</sup>	2.71 <sup>a</sup>	0.22
Lactose %	4.41 <sup>a</sup>	3.26 <sup>b</sup>	2.68 <sup>c</sup>	0.28
Total Solids %	9.78 <sup>a</sup>	9.54 <sup>ab</sup>	8.97 <sup>b</sup>	0.73
Non Fat total Solids %	7.35 <sup>a</sup>	7.06 <sup>a</sup>	6.65 <sup>b</sup>	0.31
Ash %	0.94 <sup>a</sup>	1.03 <sup>a</sup>	1.08 <sup>b</sup>	0.05
Moisture %	90.20 <sup>b</sup>	90.53 <sup>ba</sup>	90.95 <sup>a</sup>	0.70

\*Means with same letter are not significantly different

Table 2: Physicochemical characteristics of camel milk stored at 7°C

Variables	Mean values			LSD
	1st reading (0-day)	2nd reading (7-days)	3rd reading (15-days)	
pH	6.57	5.92	5.80	0.06
Acidity %	0.202	0.34	0.55	0.09
Fat %	2.35	2.46	2.54	0.51
Protein %	2.06	2.08	2.04	0.19
Lactose %	4.41	4.05	3.63	0.24
Total Solids %	9.78	9.62	9.37	0.70
Total Non Fat Solids %	7.35	7.23	6.91	0.36
Ash %	0.94	1.04	1.07	0.05
Moisture %	90.20	90.38	90.64	0.71

\*Means with same letter are not significantly different

Table 3 Physicochemical characteristics of camel milk stored at room temp. (25-30°C)

Variables	Mean values			LSD
	1st reading (0-day)	2nd reading (2-days)	3rd reading (3-days)	
pH	6.57 <sup>a</sup>	5.59 <sup>c</sup>	5.74 <sup>b</sup>	0.09
Acidity %	0.20 <sup>c</sup>	0.41 <sup>b</sup>	0.50 <sup>a</sup>	0.08
Fat %	2.35 <sup>c</sup>	2.72 <sup>b</sup>	3.06 <sup>a</sup>	0.53
Protein %	2.06 <sup>a</sup>	2.08 <sup>a</sup>	2.1 <sup>a</sup>	0.19
Lactose %	4.41 <sup>a</sup>	3.34 <sup>b</sup>	3.28 <sup>c</sup>	0.25
Total Solids %	9.78 <sup>a</sup>	9.73 <sup>a</sup>	9.32 <sup>a</sup>	0.85
Non Fat Total Solids %	7.45 <sup>a</sup>	6.33 <sup>b</sup>	6.04 <sup>b</sup>	0.32
Ash %	0.94 <sup>c</sup>	1.05 <sup>b</sup>	1.11 <sup>a</sup>	0.05
Moisture %	90.21 <sup>a</sup>	90.52 <sup>a</sup>	90.27 <sup>a</sup>	0.92

\*Means with same letter are not significantly different

Table 4: Storage duration of camel raw milk

Degree of temperature	Raw Camel Milk	
	No. of deteriorated samples	Storage days
4°C	4	37
	50	42
	5	44
	11	46
7°C	1	11
	20	14
	38	15
	3	18
25°C	8	22
	11	2
	47	3
	12	4

were spoiled after 37 days, 50 samples out of 70 samples were spoiled after 42 days, 5 samples were spoiled after 44 days and 11 samples were spoiled after 46 days. These results differ from those reported by Yagil (1990) who reported that camel milk stored at room temperature remains unchanged for 5 days then becomes sour within the next 2 days. That camel milk stored at 4°C remains unchanged for 3 months. Camel milk has good keeping quality compared to cow milk. Raw cow milk as reported by Yagil (1990) became sour within 2 days when left at room temperature and within 10 days when refrigerated at 4°C.

Table 5 shows the Storage duration of Camel Milk Compared with Cow Milk. Ahmed (1995) reported that the keeping quality of the raw cow milk samples at room,

Table 5: Storage duration of camel raw milk compared with cow milk (Mean values)

Degree of temperature	Raw camel milk	Raw cow milk
4°C	42 days	7 days*
7°C	2 weeks	70 h**
30°C	3 days	2 days*

\*Adapted from Yagil *et al.* (1984), \*\*Adapted from Ahmad (1995)

refrigerator and deep freeze temperature was 3.5, 70 h and >4 weeks, respectively.

Generally, there was little change in camel milk during storage at different temperatures, the obvious change was on odour and taste but it did not coagulate. This agrees with Sohail (1983) who reported that camel milk is less affected by storage and the acidity increases slowly. It was comparable to that reported by Yagil (1990) who reported that camel milk didn't coagulate after 2 months of standing, at room temperature and that shaking was enough to bring the milk back into its original form.

**Conclusion:** From the foregoing results it could be concluded that camel milk is less affected by storage and can be kept for comparatively long periods than cow milk.

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