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Quality characteristics of camel milk during different heat treatments

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***Abstract**: The study was conducted to determinate the effect of different heat treatments on the chemical composition and microbial contents of camel milk during storage. Two litter of fresh camel milk were purchased from farm in Sharag Eneele region .The milk samples were pasteurized in water path divided into four equal portion at temperatures 72 ºc/15 s ,75 ºc/10 min , 80 ºc/5 min and 65ºc/30 min. first temperature was control sample under sterile conditions the portion samples stored at 7 ºc for different storage periods days (0, 5, 10 , 12 , 14) .samples were examinedforfat, protein, total solids, lactose, pH, fee fatty acid , casein and total bacteria countin the storage period days. The statistical analysis revealed that significant difference in both chemical parameter at (P<0.05) and storage period at (P<0.01). The pH contents in this study did not affect significantly by different heat treatments and different storage period of camel milk .however the heat treatment and storage period had significant (p<0.05). effect on the total bacterial count.The study showed that increased of bacterial count (2.77%) was for the control heat treatment (72 °C/15 Seconds)and decreased in value (2.45) was for the (80 °C/5 min).also the increased of bacterial count (3.67%) was for the day 14.the decreased bacterial count (0.73) was for day zero.the protein , total solids and FFA contents were decreased on the treatment (65℃/30min) on day 14,but FFA on day 12.*

***Keywords:** camel milk composition, bacterial count, heat treatment, shelf life*

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I. Introduction

Sudan is an agricultural country with a large animal wealth of which camel's.According to statistics camel population in Sudan ranks first among the Arab countries and second in the world according to last estimation of camels in Sudan are 4.715000 heads [1] There are two species of camels: the dromedary or Arabian camel (*Camelus dromedarius*, one hump) and the Bactrian camel (*Camelus bactrianus*, two humps) [2] The camel may stay several months without drinking under very hot conditions, it may drink only every eight to ten days and loose up to 30 percent of its body weight through dehydration [3].The camel is among the animals mentioned in the Quran as a miracle of the God [4].the camel production systems in central Sudan were maintained under intensive, semi-intensive and traditional system [5].

Camel's milk is generally opaque-white, it has a sweet and sharp taste, but sometimes it taste salty. The changes in taste is caused by the fodder and availability of drinking water [6]. Milk is one of the most important camel products, which is consumed by traditional owners and herders and is not exploited commercially [7]. The researchers indicated that camel's milk has many properties that make it very useful to consumers [8].The milk could be sterilized by heating the milk at 110°C for 30 min. All the spores could be killed but this high temperature for long duration affects the milk quality. The UHT could be the best way to sterilize the milk by heating at 130°C for 30 sec or at 145°C for one sec. One should select the heating system which results in less undesirable changes, least expensive and fit in working area. Pasteurization may be one of the most feasible ways to improve the milk shelf life. There are many pasteurization techniques used to preserve milk.

In general the average amount of components of camel milk is protein 3.4%; fat 3.5%; lactose 4.4%; ash 0.79%, while water covers 87% [9].Milk is the most important product obtained from camel milk being a complete food, helps to provide a nutritious and balanced diet to nomadic desert people under harsh conditions. The composition of milk varies widely and contains 2.9- 5.5% fat, 2.5-4.5% protein, 2.9-5.8% lactose, 0.35-0.95%minerals and 8.9-14.3% solids-not-fat. It also contains the essential vitamins, which include vitamin A, vitamin D, vitamin B1, B2 and B12 and vitamin C. The content of vitamin C is of specific interest as its levels are three times that of cow milk and one-and-a-half that of human milk. The vitamin C content varies between 5.7 and 9.8 mg percent [10].the results published in FAO data The average amount of components of camel

milk is protein 3.1%; fat 3.5%; lactose 4.4%; ash 0.79%, and total solids 11.9% [11],[12].The total amount mineral dromedary camel milk is between 0.60 to 1.0 percent [11]. There are significant fluctuations in minerals level due to the differences in feeding, breed, water intake [13] Camel milk is rich source of various minerals *like* Na, K, Ca, P Mg Fe, Zn, Cu are present in camel milk [14]. Lactoperoxidase system in fresh camel milk was activated within half an hour of the milking using various levels of thiocyanate and hydrogen peroxide (10-70:10-70 ppm ratios) and efficacy was evaluated. The best lowest activation level 20:20 was found to be effective in preserving raw camel milk up to 18-20 hours at 37˚C [15].

Lactoferrinalso Known as lactotransferrin is glycoprotein. It belongs to a class of transferrins. A familiar characteristic of this protein family is its ability to bind two metal cations (preferably Fe 3+) to the binding sites that are structurally closely related. The majority of lactoferrin is needed for transportation or storage of iron. Lactoferrin was reported to act as iron scavenging in body secretions [16].

Camel milk could soon become the new superfood due to its high nutritional value, easy digestibility and low share of fat. Due to the less daily milk production than in cows, price of milk is higher, what is the only obstacle to the introduction of this food in everyday eating habits.. The rapidly dividing cells of the immune system are sensitive to zinc deficiency. The role of Zn in the development and maintenance of a normally functioning immune system has been well established. Antibacterial and antiviral activities of these proteins of camel milk were studied [17].

The differences of microbial counts were found between raw milk and heat treated milk during storage. Moreover, the shelf life of heat-treated camel milk was high compared with raw milk. It was concluded that heat treatment improves the microbial quality and extends the shelf life of camel milk. [18]. Moreover the procedure of heat treatment is known to improve the quality of dairy product by killing the pathogenic microorganisms and increasing the shelf life [19]).

II. Materials And Methods

In this study four treatments were carried out the first treatment was control the camel milk was heated at 72 ˚C/ 15 sec., in the second treatment the milk was heated at 65ºc/30 min., in the third and fourth treatments the pasteurization temperature was 75 ºc/10 s and 80 ºc/5 s respectively. This study was conducted during the period from December 2015 – to January 2016 at dal dairy factory in biochemistry and microbiology laboratory.

Materials:

Camel milk, plate count agar, petri dishes, thermometers, glass bottle.

Milk sampling and storage:

Bulk camel milk sample was purchased (2 liters) from one-humped camels herd in Sharag Eneele region .Milk was well-preserved and save in air tight plastic and storage in refrigerator at (4 - 7°C) and transfer to Dal dairy factory for analysis in biochemistry laboratory with milkoscan device and microbiology laboratory.

In the laboratory all equipment tools used in the analysis was sterilized to avoid any contamination during the heat treatment also the devices were properly calibrated, milk samples were divided into 4 equal portions (500ml) then each portion divided into two equal parts (250ml) packed into glass bottle (250 mg capacity) well covered in all treatment the milk samples were placed into automatic water bath and the temperature adjusted to the required temperature for each treatment for the specified time for each treatment then after that the milk samples removed from the water bath after pasteurization and cooled to 5˚ C. Therefore, the pasteurized milk samples in all treatments were stored at refrigeration temperature (7cº) for 14 days. Chemical and microbiological analysis of milk samples was determined at intervals of; 0, 5, 10, 12 and 14 days of storage .The experiment will be carried out in triplicates.

Chemical Analysis:-

Chemical composition (fat, protein , ash, total solids (TS), acidity, casein ,lactose and free fatty acid (FFA) of camel milk samples were determined by Milkoscan device (FTI(Fourier Transmission Infra Red);Brand-FOSS) while, pH was determined according to [20].

Milko scan Operation Procedure:-

Eight mls of homogenous camel milk sample at 5 – 55 ˚C were taken for reading the chemical parameters by Milkoscan only 1.3 ml of the samples was red by the device within 30 seconds two readings were made by the Milkoscan and printed the average results of readings.

Microbial analysis

Total Viable Bacterial Count (TVBC)

TVBC was determined by [21] method using plate count agar.

Enumeration of Total Spores
The method of [22] was used for the enumeration of total spores using nutrient agar .

Statistical analysis procedure:-
The SPSS (2016) program[23], version 12 will be used for the Data analysis. General linear models will be used to estimate the effect of heat treatment on chemical compotation and microbiological contents of camel milk.

III. Results

Effect of heat treatment on the chemical composition of camel milk :-

The effect of heat treatment on chemical composition (table 1) showed significant differences in all chemical parameter except pH . the highest fat content (3.04%) and total solid (10.33%) were for 80 C°/5 min. while the lower one was for 75C°/10 min.. Moreover protein (2.17%) and lactose (3.97%) were the highest in 75C°/10 where as protein was lowest (2.06) in 65 C°/30 min and lactose was lowest (3.95) in 75C°/10 min .
FFA% was highest in 75C°/10 min and was the lowest in 75C°/10 min however casein was the highest in 75C°/10 min and it was the lowest in 65 C°/30 min . The effect of heat treatment on chemical composition (table 1) showed that significant difference in all chemical parameter at ($P<0.05$) except of pH .
Effect of heat treatment on the microbial load of camel milk:
The results in table 2 showed the effect of heat treatment on the microbial load of the camel milk. The highest bacterial count (2.77 log cfu/ml) was for the camel milk sample heated at 72 °C/15 Sec while the lowest value (2.45 log cfu/ml) was for the milk samples treated at 80 °C/5 min .

IV. Discussion

The highest fat content (Table 1) of the camel milk samples could be due to the effect of pasteurization temperature and holding time which stimulate the oxidation reactions and cause fat and protein deterioration . These findings are in line with those of [25] and disagree with the finding of[24] who reported that heat treatment had no significant effect on the fat value of milk.

The highest protein content (table 1) was found in (75C°/10min, while the lowest one was in 65 C°/30 min treatment, this might be due to stimulation of the oxidation reactions which cause protein deterioration [25]. These findings are in accordance with the those of [26] who reported that the non protein nitrogen (NPN), non casein nitrogen (NCN) and whey protein nitrogen (WPN) gradually decreased with increase in thermal treatments while casein percent and the percentage of denaturation were increased.

The highest Total solids content (table 1) was (10.33%) for 80 C°/5 min while the lowers for 75C°/10 min . This result probably due to loss of moisture with high temperature . These results were in accordance with the findings of [17].

The lactose content of camel milk sample was affected by heat treatment (table 1) It increased with 75°C/10 min and decrease with 72 C°/15sec. .This result might by due to protein cross-linking reactions. The above results are in agreement with [27] who reported that the lactose in gariss increase by pasteurization and decrease by boiling, however the results were not agreed with the those of [28] who reported that there is a decrease value of lactose in pasteurized milk.

The pH contents in this study was significantly ($P\leq0.05$) affected by different heat treatments of camel milk(table 1) these results were in agreement with those of [8]. And was not in accordance with those by[29];[30] and [31] who found that increase in temperature result in increasing the pH of milk samples, they reported that heat treatment causes some possible physico-chemical changes that results in decreasing the pH of milk due to increase in concentration of lactic acid produced from degradation of lactose content. They also reported that changes in Calcium phosphate is also responsible for decreasing the pH and thus increase the acidity of milk samples.

The free fatty acid contents (table 1) was highest in 72C°/15 sec. while was lowest in 75C°/10 min. These results probably due to low pasteurization temperature insufficient for inactivation the native lipases and stable bacterial lipases [32].

These findings are in line with those of [33] who reported that the pasteurization had an influence on SFFA (total free fatty acid) contents in ewes milk .Heating at 72C°/30s caused an increase in butyric and in capric acid, but temperature 95C°/5min and 85C°/20min decrease butyric acid content by 75% and 54% respectively. the casein content was highest in 75C°/10 min and it was lowest in 65 C°/30 min which showed increase trend with the thermal treatment of camel milk samples . This could be attributed to the impact to of whey proteins denaturation that co-precipitated with the caseins. This agreed with the that obtained by [26] who reported that increasing the severity of thermal treatments, of camel milk resulted in increase in the values of casein content and whey protein. On the other hand, the results of WPN and CN came also in agreement with

the those achieved by [31] for raw and thermally treated (85°C /5 min.) samples of camel's milk. The corresponding values were 0.102 and 0.059 % for WPN and 0.348 and 0.391 % for CN, respectively.

The high bacteria count in the camel milk samples treated with 72C/15 sec. might be due to shorter holding time that might not affect the thermoduric bacteria which withstand the high temperature short time pasteurization..These results were in agreement with[19] who reported that the process of heat treatment is known to improve the quality of dairy product by killing the pathogenic microorganisms and increasing the shelf life .

V. Conclusion

It is concluded that heat treatment showed significant effect on the chemical and microbial load of the camel milk the best heat treatment was found to be the pasteurization of camel milk at 72 ˚C/15 sec.

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Table 1: Effect of heat treatment on the chemical composition of camel milk

Chemical composition (%)	**Heat treatments**				
	72 C°/15seceonds	75C°/10 minutes	80 C°/5 minutes	65 C°/30 minutes	Significant
Fat	2.92±0.13^{c}	2.64±0.46^{d}	3.04±0.02^{a}	2.94 ±0.10^{b}	**
Protein	2.11±0.35^{c}	2.17±0.27^{a}	2.15±0.27^{b}	2.06±0.44^{d}	**
Total solids	10.30±0.03^{b}	9.98±0.51^{c}	10.33±0.13^{a}	10.29±0.12^{b}	**
Lactose	3.95±0.05^{c}	3.97±0.04^{a}	3.96±0.04b^{c}	3.96±0.04^{ab}	**
pH	6.29±0.29	6.27±0.30	5.84±1.51	6.32±0.37	NS
FFA	0.67±0.13^{a}	0.39±0.18^{c}	0.47±0.17^{b}	0.49±0.31^{b}	**
Casein	1.55±0.07^{c}	1.66±0.01^{a}	1.63±0.01^{b}	1.48±016^{d}	**

N=3
Different superscript letters in the same row means significance different at P<0.05
**= significant difference at P<0.01
NS= No significant different

Table 2: Effect of different heat treatments on the total bacterial count of Camel milk

Heat treatment	Total Bacterial Count (log CFU/ml)
72 °C/15 Seconds	2.77^{a}
75 °C/10min	2.65^{b}
80 °C/5 min	2.45^{d}
65 °C/30 Minutes	2.57^{c}
Standard error	0.013
Significant	**

Means bearing different superscripts are significantly different (P<0.05)

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