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RESEARCH ARTICLE

COMPARISON OF CHEMICAL COMPOSITION, MAJOR METALS AND VITAMIN C OF CAMEL AND COW RAW MILK.

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Abstract

This study includes the determination of the contents of some of the major components of camel's milk; and to compare them with their counterparts in cow's milk. The samples were analyzed chemically to determine the percentage of Protein, Fat, Total Solids (TS), Solid Non Fat (SNF), Lactose and Ash contents. Also included in the present study, is a comparative investigation of vitamin C (ascorbic acid) concentrations in samples of both types of milk by redox titration using iodine solution. For essential metals the raw milk sample was digested by wet digestion system, and then the metals (Na and K) were determined by flame photometer in the solutions of digested samples while, (Ca and Mg) were determined directly by flame atomic absorption spectrophotometer (FAAS). The investigation showed that Protein, Fat, Total Solid, Solid Non Fat; Lactose and Ash content were low in camel milk as compared to cow milk. Also, the major metals were higher in cow milk, but ascorbic acid content is high in camel's milk.

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Introduction:-

Milk is an excellent source of most essential minerals for human. It is part of a healthy diet. The composition of the milk of various animal species differs, but in every case it has a high priority in human nutrition ⁽¹⁾. Milk also contains antibodies which protect the young mammal against infection ⁽²⁾. Cow's milk has long been considered a highly nutritious and valuable human food and is consumed by millions daily in variety of products one can also use milk from goats and camels.

Chemically milk is described as an emulsion of fat in watery solution of sugar, mineral salts with protein in a colloidal suspension ⁽³⁾.

Sudan possesses large wealth of animal livestock of which camels constitute more than three million heads raised in north of 12° N latitude ⁽⁴⁾.

There are several studies have reported the essential components in various types of animal milk.

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Ghada Z. A. Soliman⁽¹⁾ was comparison studies of chemical and mineral contents of milk from human, cow, buffalo, camel and goat in Egypt, Asif Mahmood and Sumaira Usman⁽²⁾ were researched carried out to compare the physicochemical parameters of milk samples of four different species like buffalo, cow, goat and sheep, Sabahelkhier et.al⁽³⁾ were comparative determination of chemical constituents between human, goat, cow, camel and sheep milks, Omer and Eltinay⁽⁴⁾ were evaluated the changes happen in the gross composition of camel's raw milk during storage, AbouDonia⁽⁵⁾ was determined chemical composition of raw milk, A. Enb et.al⁽⁶⁾ were researched of Whole buffalo's and cow's milk as well as dairy products manufactured from them were analyzed for chemical composition and metal contents, Rihab A. Hassan et.al⁽⁴⁾ were studied the chemical composition and microbial contents of Gariss (fermented camels milk) collected from nomadic and transhumance herders. , Z. FARAH et.al⁽⁷⁾ were reported the vitamin content of camel milk, G. Konuspayeva et.al⁽⁸⁾ were studied the variability of vitamin C content in camel milk in Kazakhstan, M. Sikiric et.al.⁽⁹⁾ were determined of metals in cow's milk by flame atomic absorption, Y.W.Park et.al⁽¹⁰⁾ were researched the physicochemical characteristics of goat and sheep milk, H.E. Mohamed et.al.⁽¹¹⁾ were studied ascorbic acid concentrations in milk from Sudanese camels was done to describe the associations between vitamin C concentrations in milk, and either breed and stage of lactation, Semaghiul Birghila et.al⁽¹²⁾ were determined of the major and minor element in milk through ICP-AES, FARID et.al.⁽¹³⁾ were determined of trace elements in cow's milk in Saudi Arabia, S.Tautkus et.al⁽¹⁴⁾ were determined of Sr micro amounts in milk by flame atomic absorption spectrometry .

The objective of this study is to compare nutritive ingredients in cow and camel's milk available for Al Hajj Yusuf area consumers, in Khartoum state (Sudan) . These include determination of some of chemical composition; the major metals include Sodium , Potassium , Magnesium and Calcium, also determination of ascorbic acid by redox titration.

Experimental Procedure:-

Sampling:-

The row milk samples were collected at milking from cows and transferred into clean bottles (250 cm³), and stored in ice tank, then transported to analysis.

Chemical Analysis:-

A chemical constituent as Fat % was determined by Gerber method and the protein % was determined by Kjeldahl method described by AOAC (1990)⁽¹⁵⁾. Similarly, total solids %, ash %, solid non fat and lactose% also described by AOAC (1990).

Fat content:-

The Gerber method was used to determine fat content in milk. In clean dry Gerber tube Sulphuric acid (10 cm³) was poured into Gerber tube and then 10.94mL of milk sample was slowly added into Gerber tube followed by 1mL of amyl alcohol. The contents of Gerber tube were thoroughly mixed till no white particles could be seen. The Gerber tube was centrifuged at 1100 rpm for 5 minutes. Gerber tube was transferred to a water bath at 65°C for at least 3 minutes and the percent fat was recorded directly from the Gerber tube scale.

Total solid:-

The total solid contents were determined according to the modified method of AOAC (1990), 5 cm³ ml of the milk samples were weighed in dry clean flat bottomed aluminum dish and heated on a steam bath for 10-15 minutes .The dishes were placed in an oven at 100° C for 3 hour. Then was cooled in desiccators and weighed quickly. Weigh was repeated until the difference between the two reading was <0.1mg.the total solid (TS) contents were calculated as fallow:

$$T.S\% = W1/W2 \times 100$$

W1=Weight of sample after drying

W2=Weight of sample before drying

Ash content:-

he ash content was determined according to the method described in the AOAC (1990); 5 cm³ of the sample were weighed in crucible and evaporated to dryness on a steam bath. The crucibles were then placed in muffle furnace at 550-600°C until ashes were carbons free (2-3hour), and then crucible were cooled in a desiccators and weighed. The ash content was calculated using the following equation:

Ash % = $W1/W \times 100$

W1=weight of ash

W=weight of sample

Protein content:-

The protein content of milk samples was determined according to Kjeldahl method as described by AOAC (1990). 10 cm³ of each milk samples were poured into clean dry Kjeldahl flask. Kjeldahl tablets of CuSO₄ and concentrated H₂SO₄ (25 cm³) were added to the flasks. The flasks were heated until clean solution were obtained (2-3hours) and left for another 30 min. the flask were then removed and allowed to cool.

The digested milk samples were poured into volumetric flask (100 cm³) and dilute with distilled water. Then 15 cm³ of 40%NaOH was added to flask and content of flask was distilled. The distillate was received in conical flask (100 cm³) containing 10 cm³ of 2% boric acid plus three drops of indicator (bromocresol green+ phenolphthalein red)

The distillation was continued until the volume in the flasks was 75 cm³ then the flasks were removed from distillatory. The distillate was then titrated with 0.1 HCL until the end point (red colour) was obtained.

The protein content was calculated as follows:

$$N\% = T \times 0.1 \times 0.014 \times 100 / W$$

$$P\% = N\% \times 6.38$$

T=reading of titration

W=weight of original sample

N=total nitrogen

P=total protein

Lactose content:-

The Lactose content was determined by subtracting the sum of protein%, fat% and ash% from the total solid %. Fat from total solids

$$\text{Lactose\%} = \text{total solid \%} - (\text{protein\%} + \text{fat\%} + \text{ash \%})$$

Solid Non Fat (SNF):

The Solid non fat was determined by subtracting Fat from total solids.

$$\text{SNF\%} = \text{T.S\%} - \text{fat\%}$$

Determination of Concentration of Vitamin C (Ascorbic acid):

The vitamin C (Ascorbic acid) was determined in milk by redox titration⁽¹⁶⁾.

0.005 mol /L Iodine and 0.5% starch indicator solutions were prepared.

Preparation of milk samples:

20 cm³ of milk solution were transferred into a 250 cm³ conical flask and then added about 150 cm³ of distilled water and 1 cm³ of starch indicator solution. Then titrated against 0.005 mol/L iodine solution.

Determination of the major metal:

Calcium and Magnesium metals were analysed by flame atomic absorption (FAAS)⁽⁹⁾, while the Sodium and Potassium measured by flame photometer in each samples of milk.

All glassware was washed with detergent and water. After being rinsed with water for several times, it was soaked in 20% HNO₃ (v/v) for 24 h, and Then were soaked again in 20% HNO₃ (v/v) for 24 h. The glassware was then rinsed several times with deionized water, and dried. Deionized water obtained from a Milli-Q system, Hydrochloric acid (37%), Nitric acid (65%), and Hydrogen peroxide (30%) analytical grade (DFCL-Hindi).

Sample Digestion and Preparation of Analytes Solution for AAS and flame photometer:

The milk sample needs to be brought into clear solution to eliminate the organic part of milk, for analysis by the Atomic Absorption Spectrometer and flame photometer. For this reason the milk sample was first digested with chemicals^(9,13) where the organic matrix of milk was destroyed and left the element into a clear solution. Wet digestion method (i.e. digestion with nitric, sulfuric and perchloric acids) has been used in the present study⁽¹³⁾.

Known volume of milk (100ml) was evaporated dryness. About 1 gm sample was transferred into a 125 ml conical flask. A 10 ml HCl-H₂O₂ [1 + 1] mixture was added to it, and the flask was covered with a watch glass. The sample

was heated on a hot plate at 100°C for about 2 h, bringing it to a gentle boil. The digested solution was filtered into a 100 ml volumetric flask through 125 mm filter paper, and diluted with deionized water⁽¹⁷⁾.

Determination of Ca and Mg by Flame- AAS:

Instrumentation:-

A Shimadzu analyst 6800 model (Japan) flame atomic absorption spectrometer equipped with hollow cathode lamps was used for the analysis. The following Instrumental conditions for the determinations of metals in raw camel and cow's milk are given in Table (1).

Table (1):- Operation condition for determination Ca and Mg by FAAS:

<i>Operation condition</i>	<i>Ca</i>	<i>Mg</i>
Lamp current flow rate [mA]	10	8
Wavelength [nm]	422.7	285.2
Slit width [nm]	0.5	0.5
Fuel gas flow rate [L/min]	2.0	1.8
Flame type	Air-C ₂ H ₂	Air-C ₂ H ₂
Burner height	7	7

Determination of Sodium and Potassium by Flame Photometry:-

Instrumentation:-

JENWAY model PFP7 (UK) flame photometer for the determination of sodium and potassium concentrations was used (table 6).

Result and discussion:-

Results of chemical composition of camel and cow's milk samples which were collected from farms in Al Hajj Yusuf city were showed in Table (2). The means of Fat, protein, lactose, T.S, SNF and ash were in camel's milk [2.9, 3.09, 2.42, 9.52, 6.62 and 0.6 %, respectively] lower than those detected with cow's milk [4, 3.89, 3.5, 12.3, 8.3 and 0.7 %, respectively].

Table (2):- chemical composition of camel and cow's milk (%):

	Fat%	Protein%	Lactose%	Total solid%	Solid non fat%	Ash%
Camel milk	2.90±0.13	3.09±0.03	2.42±0.11	9.52±0.12	6.62±0.02	0.6±0.00
Cow milk	4.00±0.07	3.89±0.04	3.50±0.01	12.3±0.05	8.3±0.03	0.7±0.02

The Table (2) indicated the chemical content of cow milk is higher than camel milk. Cow's milk seems thicker than camel's milk because it generally contained higher total solids than camel's milk; fat content of cow's milk is higher than camel's milk. Because of its high fat content, cow's milk had considerably higher energy value than camel's milk. These results are agreement with those values reported by Ghada Z. A. Soliman⁽¹⁾ and Sabahelkhier et.al.⁽³⁾. these results are comparison with other results shown in table (3).

Table (3):- comparison of milk chemical content with other reported content:

Animal milk	Fat%	Protein%	Lactose%	Total solid%	Solid non fat%	Ash%	Reference
Camel milk	3.6	2.59	4.30	11.7	-	0.75	3
	2.35	2.06	4.41	9.78	7.45	0.94	4
	3.1	4.0	5.6	-	-	0.8	7
	4.85, 3.46	2.32, 2.58	-	11.29, 9.81	-	1.30, 0.87	9
	2.9- 5.38	3.01- 4.0	3.36- 5.8	-	7.01- 10.36	0.6- 0.8	10
	2.9-5.5	2.5-4.5	2.9-5.8	-	8.9-14.3	0.35-0.95	11
Cow milk	3.44-4.96	2.98-3.87	4.08-5.00	11.23-14.26	-	0.40-0.8	2
	3.75	3.40	4.80	12.8	-	0.71	3
	3.20	3.20	5.00	12.10	-	0.65	6
	4.6	3.4	4.9	-	-	0.7	7
	3.6	3.20	4.70	-	9.00	0.7	15

Vitamin C or ascorbic acid is a water soluble antioxidant that plays a vital role in protecting the body from infection and disease. It is not synthesized by the human body.

The content of vitamin C in raw camel and cow milk was studied; it showed in Table (4), the level of ascorbic acid in camel milk is higher than the cow milk; it plays a major part in the medicinal reputation of camel milk. Ascorbic acid is highly unstable especially with temperature change. these result for camel milk are support with given by FARAH et.al⁽⁷⁾ (26.2-61.1 mg/L) and G. Konuspayeva et.al⁽⁸⁾ (15-435mg/L), but different from Mohamed H.E. et al⁽¹¹⁾ had determined according three breeds of camels and affected by the stage of lactation.

In this study vitamin C was determined in row milk by different method from other reports (redox titration) whereas the other authors as Farah et al.⁽⁷⁾ had analyzed frozen milk by HPLC (High Performance Liquid Chromatography) and G.Konuspayeva et.al⁽⁸⁾ were quantified vitamin C on fresh milk by the colorimetric method using 2,6-dichlorophenolindophenol [2,6-DIPh]. Therefore, the observed differences in vitamin C milk concentration could be partly explained by the analytical conditions, and probably also by the analytical methods used.

Table (4):- The vitamin C of camel and cow's milk

Animal milk	Vitamin C mg/100ml
Camel milk	18.4±2.11
Cow milk	5.3±1.43

The results of metals analysis of camel and cow's milk are given in Table (5) and table (6). The concentration levels of major metal in row cow milk observed in this study are higher than those observed in raw camel milk.

Table (5):- Analytical characteristic for determination Ca and Mg by FAAS:

Parameter	Ca	Mg
Regression line	$y = 0.257x + 0.030$	$y = 0.276x + 0.001$
r^2 correlation coefficient	0.99	0.99
SD Standard Deviation	0.025	0.0026
Slope ± SD	0.0045	0.0043
intercept± SD	0.022	0.0027
LOD (Limit of detection) mg/ml	0.33	0.015

Table (6):- the major metals of camel and cow's milks (ppm):

Metal	Ca	Mg	Na	K
Camel milk	73.4	6.54	13.25	135
Cow milk	128.28	12.96	51	149

The differences in the values of nutritive contents obtained in this study compared to their analogues in other studies can be attributed to differences in bred species, feeding condition, hygienic follow up, water availability, and seasons of the year. The 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:-

There are differences in constituents of camel's milk compared to cow's milk. The most important property of camel milk is the high value of vitamin C. This high value contributes to a consideration that camel milk has a stimulating effect on the human immune system, provides sufficient vitamin C for people living in the desert, and presents normal acidity unfavorable for bacteria growth. The camel milk can be kept for longer periods than cow milk. Raw cow milk becomes sour after 2 days. Raw camel milk is richer vitamin C, so the camel milk is very much more nutritive and hygienic for human body.

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