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PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF COW'S AND BUFFALO'S MILK IN *QENA* GOVERNORATE

Hamad, M. N. E.[1] and A. A. Baiomy[2]

1- Food Science and Dairy Department, Faculty of Agriculture, "Qena", South Valley University.

2- Animal production Department, Faculty of Agriculture "Qena", South Vally University.

ABSTRACT

This study was carried out to evaluate some physical properties and chemical composition of lactating animals in *Qena* governorate, Egypt. Composite samples of cows' (baladi breed) and buffalo's milks were collected from twelve individual farms in *Qena*. Physical parameter used to monitor the quality of milk samples was physical (specific gravity). The samples were also analysed for gross composition, as well as the incidence of some minerals, and fatty acids composition of milk fat. The specific gravity for both cow's "baladi" and buffalo's milk were similar, and contents significantly ($p<0.05$) higher amounts of fat, protein, ash and total solids were detected in buffalo milk than for cow milk.

Cow milk fat differed contained significantly ($p<0.05$) lower amounts of medium chain fatty acids (C10:0) and contained significantly ($p<0.05$) higher content of (C16:1 and C18:1), than buffalo milks, while buffalos milk fat contained significantly ($p<0.05$) higher contents of (C16:0) and (C18:0) than cow milks.

The levels of Ca, P, Na, K and Fe in the buffalo's milk ash were significantly higher ($P<0.05$) than those in the cow milk ash.

Keywords: Cow, buffalo, milk, physical, chemical composition, fatty acids, minerals.

INTRODUCTION

Milk and dairy products are part of a healthy diet which, besides cow's milk, sheep's, goats and buffalo's milk are involved (Hinrichs, 2004). Milk is a complex mixture of fats, proteins, carbohydrates, minerals, vitamins and other minor constituents dispersed or dissolved in water (Harding, 1999). Milk is an important part of the human diet and the nutritional significance of milk is apparent from the fact that daily consumption of a quart (1.14 liters) of milk furnishes approximately all the daily requirements from fat, calcium, phosphorus, riboflavin, one half of the protein, one third of vitamin A, ascorbic acid, thiamine and one fourth of calories needed daily by an average individual (Bilal and Ahmad, 2004).

Numerous studies have focused on cow milk, although milks from other animal species, such buffaloes, sheep, goats and camels are essential to the human diet in various parts of the world. Buffalo milk is the second most produced milk in the world with 82 billion litres produced each year (12.5% of milk produced in the world), after cow's milk (≈84% with 551 billion litres) (IDF, 2007). Buffalo milk is also one of the richest milks from a compositional point of view, particularly; fat which constitutes the main buffalo milk solids and is responsible for its high energy and nutritive value. The environmental

conditions play an important role in the determination of the composition of milk. No cited studies have been carried out on the composition of lactating animals in *Qena* government. *Qena* is part of Upper Egypt characterized by high temperature throughout the whole year, which may have an adverse effect on the production and composition of milk. Therefore, the present study is considered on of the first which concerned with the composition of buffalo milk and milk fat of cows and buffaloes in *Qena*.

MATERIALS AND METHODS

Composite milk samples (500 ml) of baladi cows and Egyptian buffaloes during their high lactation period were collected once a week from twelve farmers in *Qena* governorate during the period from January to October 2009. The composite samples of milk were proposed with drawn from the morning and evening milking of the individuals. A total of 440 samples of cow and 259 of buffalo milk were analyzed.

The pH was measured using digital pH meter (Model PTI-6, Aqua Chemical Co., Devon, U.K.) equipped with a combined glass electrode. Specific gravity was detected by using lactometer as described by Aggarwala & Sharma (1961). The fat content was determined by the Gerber method according to James (1995), total solids, ash and protein contents according to A.O.A.C. (1995), and the solids not fat (SNF) and lactose contents were determined by differences, as indicated:

• SNF content = TS % - Fat % • Lactose % = TS % - (Fat % + Protein % + Ash %)

The sodium, potassium and calcium contents were determined, by ashing of samples, dissolution of the ash by flame photometer (Corning 410, Sherwood Scientific Limited, UK) as described by Kirk & Sawyer (1991). Inorganic phosphorus by the colorimetric method of Fiske & Subbarow (1925), and iron and lead by absorption spectrophotometer (Perkins Elmer Instrument Model 2380, Perkin Elmer, Michigan, USA) as described by A.O.A.C. (1995).

The fatty acids were determined by Gas-Liquid Chromatography (GLC) according to the procedure of Ackman (1972). The fatty acid methyl esters were analyzed by using PYE-Unicam Model P V4550 gas-Liquid Chromatography with dual-flame ionization detector.

Data were statistically analyzed according to the General Linear Model (G.L.M) and the differences between means were detected by Duncan`s Multiple Range Test, SAS (1998).

RESULTS AND DISCUSSION

Table (1) shows that the specific gravity of baladi cow's milk was slightly lower than buffalo's milk. These results agreed with those reported by Lee *et al.* (2002) and Mahboba & Ibtisam (2007).

pH values of fresh cow milk (Table 1) ranged from 6.41 and 6.79 with an average of 6.65±0.191, while pH values of buffalo's milk was between 6.56 and 6.76, with an average of 6.61±0.174. These results were relatively

similar to those reported by Mahboba & Ibtisam (2007), Ahmad *et al.* (2007) and Hajirostamloo & Mahastie (2008).

Table (1): Specific gravity and pH values of cows "baladi" and buffalo's milk samples collected from different sources in *Qena*. (Mean ± Se).

Item	Cow "Baladi"			Buffalo		
	Min.	Max.	Mean	Min.	Max.	Mean
S.G	1.028	1.034	1.0312±0.0008	1.0301	1.036	1.0314±0.0009
pH	6.41	6.79	6.65±0.191	6.56	6.76	6.61±0.174

Min.: minimum, Max.: maximum, S.G: Specific gravity.

Comparison of the overall composition of buffalo and cow "baladi" milk revealed that large differences were existed between them (Table 2). Thus, contents of fat, protein, lactose, ash and total solids contents were significantly ($p<0.05$) higher in buffalo milk than in cow milk. These results are in agreement with the findings of various authors (Spanghero & Susmel, 1996 and Ahmed, *et al.* 2008). Although buffalo's milk had higher lactose content than cows milk, differences between them were not significantly.

Table (2): Chemical compositions of cows "baladi" and buffalo's milk samples collected from different sources in *Qena*. (Mean ± Se).

Item	Cow "Baladi"	Buffalo
	Mean	Mean
Fat (F. %)	4.28 ± 0.1^{b}	7.80 ± 0.21^{a}
Protein (P. %)	3.37 ± 0.05^{b}	4.15 ± 0.04^{a}
Lactose (L. %)	4.47 ± 0.58^{a}	5.03 ± 0.80^{a}
(Ash %)	0.69 ± 0.01^{b}	0.77 ± 0.02^{a}
Solids Not Fat (SNF %)	8.53 ± 0.8^{b}	9.89 ± 0.15^{a}
Total Solids (TS %)	12.81 ± 0.24^{b}	17.70 ± 0.54^{a}
Water (W %)	87.19 ± 0.99^{a}	83.17 ± 0.92^{b}

a and b means in the same row followed by different letters are significantly different($p<0.05$).

The mean fat content of buffalo's milk in the present study ranged from 7.80±0.21, range of fat whereas the mean values obtained by (El-Sokkary & Hassan, 1949; Abd El_Salam& El_Shibiny, 1966 and Asker *et al.*, 1974) was 7.14%. Also, the total protein content of buffalo milk previously studied by (El-Sokkary & Hassan, 1949; Dastur, 1956; Abd El_Salam & El_Shibiny, 1966) was higher in buffalo milk.

The ash content (0.77%) was significantly ($p<0.05$) higher in buffalo milk than for cow milk (Table 2). These results are in agreement with the findings of various authors (El-Sokkary & Hassan, 1949; Abd El_Salam& El_Shibiny, 1966 and Asker *et al.*, 1974; Spanghero & Susmel, 1996 and Ahmed, *et al* 2008).

The total solids content of buffalo's milk being 17.7 %, was markedly higher than that of cow milk (12.81%), which means an increase of solids in buffalo's milk of 4.89 g/Kg as compared to cow milk. These results were in

agreement with those reported (Abd El_Salam & El_Shibiny, 1966; Spanghero and Susmel, 1996; Asker *et al.*, 1974 and Ahmed, *et al*, 2008)

Table (3) shows the average composition of fat buffaloes and cows milk. Both milk had the same fatty acid profile, but with variable differences in the individual fatty acids present. C14:0, C16:0, C18:0 and C18:1 represent the major fatty acids present in both milk. Buffalo's milk fat contained significantly ($p<0.05$) higher C16:0 and C18:0 fatty acids and concerning C18:1 was higher in cow's milk fat. C14:0 content was not significantly different in the two milks. The whole saturated fatty acids contents of buffaloes milk (66.23±0.50) was significantly ($p<0.05$) higher than that of cows milk fat. These results were in agreement with those of Soliman *et al.* (1980), who obtained a whole value of C14:0 + C16:0 + C18:0 and of C18:1 in cow's milk fat of 57.9 and 31.1%, respectively, and 61.3 and 32.9% for buffaloes milk fat, respectively, but contrary to those reported by Haggag *et al.* (1987), being 18.4 and 23.0% for unsaturated fatty acids in cows and buffaloes milk, respectively. These results are also in accordance with previous studies of Varrichio *et al.*, 2007; Blasi *et al.*, 2008 and Ménard *et al.* (2010).

Table (3): The fatty acid composition of fat milk samples from different regions of *Qena*. (Mean ± SE).

Fatty acids %	Cows "Baladi"	Buffalo
C6:0	1.80±0.19[a]	1.92±0.14[a]
C8:0	0.78±0.21[a]	0.86±0.09[a]
C10:0	3.20±0.40[a]	2.12±0.27[b]
C12:0	5.17±0.30[a]	4.61±0.20[a]
Unknown	0.65±0.32[a]	0.42±0.21[b]
C14:0	12.40±0.66[a]	11.46±0.50[a]
C14:1	1.58±0.17[a]	1.16±0.09[a]
C15:0	2.50±0.30[a]	2.29±0.37[a]
C16:0	25.69±0.57[b]	29.27±0.40[a]
C16:1	2.79±0.20[a]	1.77±0.23[b]
C18:0	8.83±0.76[b]	13.28±1.2[a]
C18.1	30.82±1.40[a]	27.60±0.64[b]
C18.2	2.77±0.50[a]	2.28±0.30[a]
C18.3	1.020±0.30[a]	0.96±1.20[a]
Total fatty acids%	100	100
Saturated %	62.12±1.25[b]	66.23±0.50[a]
Unsaturated%	37.88±1.55[a]	33.77±0.60[b]
Saturated:Unsaturated%	1.64 :1	1.96 :1

[a and b] **Means in the same row followed by different letters are significantly different ($p<0.05$).**

The short-chain fatty acid contents (C6:0 to C8:0) were not significantly different in buffalo and cow milks (Table 3). Cow milks contained significantly ($p<0.05$) lower amounts of medium chain fatty acids (C10:0). Regarding the long-chain fatty acids, buffalo milks contained significantly ($p<0.05$) higher contents of (C16:0) and (C18:0) than cow milks, while, cow milk contained significantly ($p<0.05$) higher content of (C16:1 and C18:1) than buffalo milks. These results were similar to those obtained by Varricchio *et al.* (2007), who

found that saturated fatty acids (65.5%) predominated in buffalo milk fat; monounsaturated and polyunsaturated fatty acids were 27.0% and 4.5%, respectively.

Table 4 shows the content of Ca, P, Na, K, Fe and Pb in the ash (p.p.m.) of baladi cow and buffalo's milk.

The levels of Ca, P, Na, K and Fe in the buffalo's milk ash were significantly higher ($P<0.05$) than those in the baladi cow milk ash. When these values in Table (4) were expressed as (p.p.m.) in the ash of milk, all except that of Pb were also higher ($P<0.05$) in buffalo's milk. The most pronounced differences between the two types of milk, when the mineral composition is expressed in terms of the quantities present in a given volume of milk, are due to the different amounts of total solids in the two types of milk, as mentioned previously. One of the main reasons why milk is considered an exceptionally important food is its rich mineral content. These results were in agreement with those reported (Satomi & Kunihiko, 2006; Ahmad *et al.* 2007; Ariota, *et al.* 2007; Hajirostamloo & Mahastie, 2008 and Ceballos, *et al.* 2009).

Table (4): Mineral contents in the ash of baladi cows and buffaloes milk in *Qena* (p.p.m.). (Mean ± SE).

Mineral contents	Cows "baladi"	Buffalo
Ca	1098 ± 17.30^{b}	1288 ± 17.82^{a}
P	490 ± 22.32^{b}	589 ± 16.70^{a}
Na	1193 ± 24.37^{b}	1333 ± 25.61^{a}
K	292 ± 11.41^{b}	423 ± 12.71^{a}
Fe	2.28 ± 0.059^{b}	3.29 ± 0.051^{a}
Pb	0.09 ± 0.009^{a}	0.11 ± 0.008^{a}

a and b means in the same row followed by different letters are significantly different ($p<0.05$).

Conclusion

Egyptian buffalo's milk contained higher solids, fat, protein and ash "Ca, K, Na, P and Fe" contents than cow's milk in *Qena* governorate. Buffalo's milk fat had significantly higher total saturated "C16:0 and C18:0, and less total unsaturated and C18:1 fatty acids in that of baladi cows milk.

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الخصائص الفيزيائية والتركيب الكيميائي لألبان الأبقار البلدية والجاموس بمحافظة قنا

محمد نور الدين فريد حماد[١] وأحمد عبد الجليل بيومي[٢]

١- قسم علوم الأغذية والألبان – كلية الزراعة – جامعة جنوب الوادي.

٢- قسم الإنتاج الحيواني – كلية الزراعة – جامعة جنوب الوادي.

أجريت هذه الدراسة لتقدير بعض الخصائص الفيزيائية والكيميائية خلال موسم الحليب لبعض أنواع الحيوانات فى محافظة قنا بمصر.

أُخذت عينات مركبة من ألبان الأبقار البلدية وألبان الجاموس المحلي تم جمعها من أثني عشر مكان مختلف من المزارعين الفرديين في محافظة قنا.

تم تقدير بعض الخواص الفيزيائية (الوزن النوعي)، كما تم إجراء التحليلات الكيميائية جميعها وبعض المعادن والأحماض الدهنية المكونة لدهن اللبن.

وجد أن الوزن النوعي لكلا النوعين اللبن البقري "البلدى" واللبن الجاموس كانت متشابهة، ووجد أن اللبن الجاموسي ذو معنوية بشكل كبير (أقل من ٠.٠٥) علي نسب أكبر من البروتين والدهون، والرماد والمواد الصلبة الكلية عن اللبن البقري البلدي. اللبن البقري البلدي يحتوي علي نسب من الأحماض الدهنية تختلف من عن النسب الموجودة في دهن اللبن الجاموسي حيث وجد من التحليل أن اللبن البقري ذو معنوية أقل لحد كبير (أقل من ٠.٠٥) في الحامض الدهني (C10:0) ونسب معنوية أعلي لحد كبير (أقل من ٠.٠٥) في محتوى الأحماض الدهنية (C16:1 و C18:1) من لبن الجاموس، في حين أن لبن الجاموس ذو معنوية (أقل من ٠.٠٥) أعلى في محتوياته من الحامض الدهني (C16:0) و(C18:0) من لبن الأبقار البلدية.

مستويات الكالسيوم والفوسفور، الصوديوم، الحديد والبوتاسيوم في رماد لبن الجاموس ذو معنوية أعلى (أقل من ٠.٠٥) من تلك التي في رماد لبن الأبقار البلدية.

قام بتحكيم البحث

أ.د / طه عبد الحليم نصيب	**كلية الزراعة – جامعة المنصورة**
أ.د / محمد عبد السلام الحسيني	**المركز القومي للبحوث**