Minufiya J. Agric. Res. Vol.40 No. 4(1): 925 – 933 (2015) "**http://www.mujar.net**"

THE QUALITY OF ICE MILK MADE BY REPLACING BUFFALOE'S MILK WITH CAMEL'S MILK

K. M. K. Kebary, Seham I. Farag, A. N. Zedan, A. H. El-Sonbaty and Samera H. S. Helal

Department of Dairy Science and Tech., Fat. of Agric., Menoufia Univ., Shibin El-Kom, Egypt.

(Received: May. 10 , 2015)

ABSTRACT: *Effect of substituting 0.0 (C), 20 (T_1), 40 (T_2), 60 (T_3), 80 (T_4) and 100 (T_5) buffaloe's milk with camel's milk on the quality of ice milk was studied. Replacement of buffaloe's milk with camel's milk did not affect significantly ($p \leq 0.05$) the total solids, titratable acidity, pH values, fat content, protein content and ash content by increasing the rate of replacing buffaloe's milk with camel's milk. Specific gravity of mixes and the resultant ice milk, weight per gallon of mixes and the resultant ice milk and viscosity decreased significantly ($p \leq 0.05$) by increasing the rate of replacing buffaloe's milk with camel's milk. Overrun, melting resistance and the total scores of organoleptic properties increased significantly by replacing buffaloe's milk with camel's milk. It is possible to replace up to 100% of buffaloe's milk with camel's milk. To get a product with high nutritional and healthy values and without detrimental effects on the resultant ice milk quality.*

Key word: *Ice milk, buffaloe's milk, camel's milk.*

INTRODUCTION

Camel's milk is important component in the human diet in arid and semi-arid zones, as it milk contains all the essential nutrients Abu Dhabi (2003) reported that camel's milk have some immunity components such as IGG molecules that have proved to be effective against microbial diseases both viral and bacterial.

Camel herders attribute many properties of camel's milk, including medicinal and health effects. In fact, camel milk is also used in the treatment of diabetes, spleen's problem, tuberculosis, asthma, anemia and general liver diseases, fatigue in old people and as a feed supplement to milking mothers (Mohammed *et al.,* 2005). Small fat globules in camel's milk make it excellent for the ice milk making. Vaishali and Madhu (2013) observed a great potential of camel milk in the field of ice milk development for economic and nutrition security. Also, Prajapati, *et al., (*2012) cleared that the camel's ice milk mixes has significantly lower viscosity and the experimental ice milk had lower melting resistance and higher overrun compared to control ice milk.

The objectives of this study were to investigate the effect of replacing buffalo's milk with camel's milk on the chemical composition, physical and sensory properties of ice milk and to monitor the changes of ice milk quality during freezing storage.

MATERIALS AND METHODS

Ingredients:

Buffalo's milk was obtained from the herd belonging to the Faculty of Agriculture, Menoufia University, Shibin El-Kom, camel's milk was obtained from camel farm at (Barajil, Giza) (Table 1). During winter, cream was obtained by separating buffaloe's and camel's milk in the pilot plant of Department of Dairy Science and Technology, Faculty of Agriculture, Menoufia University, Shibin El-Kom. Skim milk powder was obtained from Fresno, California, USA. Sucrose, gelatin and vanilla obtained from the local market.

Table (1). The gross composition of raw dairy ingredients used for ice milk.

Milk	Total solids (%)	Fat (%)	Ash (%)	Protein (%)	Lactose (%)	Acidity (%)	pH value
Buffaloes' milk	16.32	6.60	0.85	4.77	4.10	0.15	6.57
Camel's milk	12.57	3.80	0.78	4.22	3.77	0.12	6.81

Manufacture of ice milk:

Vanilla ice milk mixes were prepared according to the method of Khader *et al.* (1992) with the following composition: 4% fat, 13.0% milk solids not fat, 15% sugar, 0.7% gelatin and vanilla. Six batches of ice milk were prepared by replacing zero, 20, 40, 60, 80 and 100% of the buffaloe's milk used in the manufacture of ice milk with camel's milk (Table 2). All mixes were heat treated at 85°C for 10 min., then rapidly cooled to 5°C and aged at the same temperature over night.

Vanilla was added prior to freezing and ice milk mix was frozen in batch-type freezer (BTM 10 "Staff Ice System" Rimini-Italy DAI, 1959). The resultant ice milk was packaged in plastic cups (120 cm^3) and stored in deep freezer at -18°C $\pm$ 2 for 10 weeks. Each ice milk batch was analyzed when fresh (0 time) and after 10 weeks chemical and physical properties but sensory evaluation every two weeks. The whole experiment was duplicated.

Physical and chemical analysis:

The prepared ice milk mixes were analyzed before freezing for viscosity as described by Morrison and Macjary (2001), specific gravity was determined according to Winton (1958), weight per gallon was calculated according to Burke (1947). The resultant ice milk was tested for total solids, ash and protein content according to A.O.A.C (2010), titratable acidity, pH values and fat (Ling, 2008), specific gravity (Winton, 1958), weight per gallon (Burke, 1947), overrun (Sommer, 1951) and melting resistance (Arbuckle, 1986).

Sensory evaluation:

Fifteen panelists from the staff members of Department of Dairy Science and Technology evaluated the organoleptic properties of ice milk when fresh, 2 weeks, 4 weeks, 8 weeks up to 10 weeks according to Kebary *et al.* (1998) as follows: (45) for flavor, (35) for body and texture, (10) for melting property and (10) for colour.

Statistical analysis:

Factorial design 2 factors × 3 replicates and the Completely Randomized Design were used to analyze all the data, and Student Newman Keuls Test was followed to make the multiple comparisons (Steel and Torrie, 1980) using Costat program. Significant differences were determined at ($p \leq 0.05$).

RESULTS AND DISCUSSION

The total solids (TS), fat content and total protein of ice milk from all treatments were not significantly different ($p > 0.05$) (Tables 3, 8) which means that replacement buffaloe's milk with camel's milk did not affect significantly ($p > 0.05$) these constituents in the resultant ice milk. These results could be attributed to the similar composition of both buffaloe's milk and camel's milk used in ice milk manufacture. The total solids, fat content and total protein of all ice milks were not changed significantly ($p > 0.05$) during storage period (Tables 3, 8). These results agree with those reported by Kebary (1996).

Titratable acidity and ash content of ice milk samples were not significantly ($p > 0.05$) different from each other which means that replacement of buffaloe's milk with camel's milk did not affect the titratable acidity and ash content of the resultant ice milk at any times of storage period (Tables 4, 8). Similar results were reported by Mahran *et al.* (1976) and titratable acidity and ash content of all ice milk samples did not change significantly ($p > 0.05$) during storage period (Tables 4, 8). There were no significant (p >

0.05) differences in pH values of ice milk samples made from buffaloe's milk with camel's milk (Tables 3, 8). pH values of all ice milk sample did not change significantly ($p > 0.05$) as storage period advanced.

Table (2). Formula of ice cream mixes made by replacing of buffaloe's milk with camel's milk.

Ice milk ingredients	Ice milk treatments					
	C*	T_1	T_2	T_3	T_4	T_5
Fresh skim milk buffaloe's	1.940	1.552	1.164	0.776	0.388	-
Fresh skim milk camel's	-	0.388	0.776	1.164	1.552	1.940
Fresh cream buffaloe's	0.400	0.320	0.240	0.160	0.080	-
Fresh cream camels	-	0.080	0.160	0.240	0.320	0.400
Skim milk powder (96.1 solids)	0.222	0.222	0.222	0.222	0.222	0.222
sugar	0.450	0.450	0.450	0.450	0.450	0.450
Gelatin	0.021	0.021	0.021	0.021	0.021	0.021
Vanilla	0.010	0.010	0.010	0.010	0.010	0.010
Total (k.g)	3.043	3.043	3.043	3.043	3.043	3.043

* C = Control Ice milk treatment made from buffaloe's milk.
T_1, T_2, T_3, T_4 and T_5 = Ice milk treatments made by replacing buffaloe's milk with camel's milk at the rate of 20, 40, 60, 80 and 100%, respectively.

Table (3). Effect of replacing buffaloe's milk with camel's milk on total solids, total protein and fat contents during storage period of ice milk for 10 weeks at -18°C.

Ice milk treatments	Total solids content (%)		Total protein content (%)		Fat content (%)	
	Storage period (weeks)		Storage period (weeks)		Storage period (weeks)	
	0	10	0	10	0	10
C*	32.62	32.60	4.98	4.81	3.94	3.91
T_1	32.56	32.53	4.93	4.76	3.93	3.90
T_2	32.47	32.44	4.87	4.70	3.91	3.88
T_3	32.40	32.37	4.82	4.65	3.90	3.87
T_4	32.33	32.30	4.76	4.59	3.89	3.86
T_5	32.26	32.23	4.71	4.54	3.88	3.85

* See Table (2).

Table (4). Effect of replacing buffaloe's milk with camel's milk on ash content, titratable acidity and pH values during storage period of ice milk for 10 weeks at -18°C.

Ice milk treatments	Ash content (%)		Titratable acidity (%)		pH values	
	Storage period (weeks)		Storage period (weeks)		Storage period (weeks)	
	0	10	0	10	0	10
C*	1.09	1.08	0.22	0.19	6.33	6.52
T_1	1.08	1.07	0.22	0.19	6.35	6.56
T_2	1.07	1.06	0.22	0.19	6.37	6.57
T_3	1.05	1.04	0.21	0.19	6.38	6.58
T_4	1.04	1.03	0.21	0.19	6.41	6.59
T_5	1.03	1.02	0.21	0.18	6.42	6.6

* See Table (2).

Replacement of buffaloe's milk with camel's milk decreased significantly ($p \leq 0.05$) the viscosity, specific gravity and weight per gallon of ice milk mix (Tables 5, 8), which means that, replacing of buffaloe's milk with camel's milk had significant effect on these properties (Tables 5, 8).

Replacement of buffaloe's milk with camel's milk caused a pronounced increase ($p \leq 0.05$) of the overrun of ice milk being 31.27, 38.31, 54.44, 58.96, 65.69 and 70.95% for treatments C, T_1, T_2, T_3, T_4 and T_5, respectively (Tables 6, 8). These results might be due to the decrease of the viscosity in ice milk mixes which subsequently helps to incorporate air in ice milk mix (Tables 6, 8) (Prajapati *et al.,* 2012).

Specific gravity and weight per gallon of ice milk followed almost similar trends (Tables 6, 8). Replacement of buffaloe's milk with camel's milk caused a marked ($p \leq 0.05$) decrease in specific gravity and weight per gallon of the resultant ice milk (Tables 6, 8). This decrease was proportional to the ratio of replaced buffaloe's milk (Tables 6, 8). Specific gravity and weight per gallon had an opposite trends to that of the overrun which explain the decrease in specific gravity and weight per gallon by increasing the rate of replacing buffaloe's milk with camel's milk (Kebary *et al.,* 1998 and Moussa *et al.,* 2008).

Replacing buffaloe's milk with camel's milk caused an obvious decrease in the melting resistance which may be due to the presence of some constituents in camel's milk and / or the high overrun, where air serves as an insulator and reduce heat transfer (Kebary, 1996).

Scores of organoleptic properties (flavor, body and texture, melting quality and colour) during storage of ice milk samples are presented in Table (7). Replacement of buffaloe's milk with camel's milk up to 100% increased the scores of flavor, body & texture, colour and the total scores of the organoleptic properties of the resultant ice milk samples (Table 7, 8). From the previous, it is clear that the camel's milk can be used to replace up to 100% of buffaloe's milk to get a product with high sensory properties without any undesirable changes in the flavour, body & texture and colour.

It could be concluded that, replacement of buffaloe's milk with camel's milk did not affect significantly the total solids, fat content, total protein, ash content, titratable acidity and pH values of the resultant ice milk samples while it increased the overrun and decreased the melting resistance. Increasing the rate of replacement up to 100% improved the organoleptic properties; therefore it is possible to make a good quality ice milk with replacing up to 100% buffaloe's milk with camel's milk.

Table (5). Effect of replacing buffaloe's milk with camel's milk on ice milk mixes properties.

Ice milk	Specific gravity (g/ cm)	Weight / gallon (kg)	Viscosity
C*	1.343	5.085	152.0
T_1	1.300	4.922	134.0
T_2	1.291	4.890	128.0
T_3	1.274	4.823	120.0
T_4	1.250	4.732	115.0
T_5	1.226	4.641	107.0

* See Table (2).

Table (6). Effect of replacing buffaloe's milk with camel's milk on properties of the resultant ice milk.

Ice milk	Specific gravity	Weight / gallon	Overrun (%)	Melting resistance (%)					
				15 min	30 min	45 min	60 min	75 min	90 gm
C*	1.023	3.873	31.27	-	15.38	44.87	83.33	89.73	99.99
T_1	0.936	3.543	38.31	-	16.24	43.72	78.71	88.70	99.99
T_2	0.910	3.445	54.44	-	25.10	55.77	86.45	99.95	-
T_3	0.900	3.407	58.96	15.72	44.29	75.73	87.16	99.99	-
T_4	0.887	3.358	65.69	19.86	54.16	81.24	90.26	99.29	-
T_5	0.880	3.331	70.95	20.11	55.73	85.19	91.10	99.30	-

* See Table (2).

Table (7). Changes in the organoleptic properties during the storage period of ice cream made with replacing buffaloe's milk with camel's milk.

Ice milk treatments	P.B.R.C•	Flavor (45)	Body and texture (35)	Melting properties (10)	Colour (10)	Total (100)
	Ice milk storage period for (0 week)					
C*	0.0	42.0	30.0	10.0	9.0	91.0
T_1	20	43.0	32.0	10.0	9.0	94.0
T_2	40	43.0	32.0	10.0	9.0	94.0
T_3	60	44.0	32.0	9.0	10.0	95.0
T_4	80	44.0	32.0	9.0	10.0	95.0
T_5	100	45.0	32.0	8.0	10.0	95.0
	Ice milk storage period for (2 week)					
C*	0.0	42.0	29.0	10.0	9.0	90.0
T_1	20	43.0	31.0	10.0	9.0	93.0
T_2	40	43.0	32.0	10.0	9.0	94.0
T_3	60	43.0	32.0	9.0	10.0	94.0
T_4	80	43.0	32.0	9.0	10.0	94.0
T_5	100	45.0	32.0	8.0	10.0	95.0
	Ice milk storage period for (4 week)					
C*	0.0	41.0	29.0	10.0	9.0	89.0
T_1	20	42.0	30.0	10.0	9.0	91.0
T_2	40	42.0	32.0	9.0	9.0	92.0
T_3	60	42.0	32.0	9.0	10.0	93.0
T_4	80	42.0	32.0	9.0	10.0	93.0
T_5	100	44.0	32.0	8.0	10.0	94.0
	Ice milk storage period for (6 week)					
C*	0.0	41.0	29.0	10.0	9.0	89.0
T_1	20	42.0	30.0	10.0	9.0	91.0
T_2	40	42.0	32.0	9.0	9.0	92.0
T_3	60	42.0	32.0	9.0	10.0	93.0
T_4	80	42.0	32.0	9.0	10.0	93.0
T_5	100	44.0	32.0	8.0	10.0	94.0
	Ice milk storage period for (8 week)					
C*	0.0	41.0	29.0	10.0	9.0	89.0
T_1	20	41.0	30.0	10.0	9.0	90.0
T_2	40	41.0	31.0	9.0	9.0	90.0
T_3	60	41.0	31.0	9.0	10.0	91.0
T_4	80	42.0	31.0	9.0	10.0	92.0
T_5	100	43.0	32.0	8.0	10.0	93.0
	Ice milk storage period for (10 week)					
C*	0.0	41.0	29.0	10.0	9.0	89.0
T_1	20	41.0	30.0	9.0	9.0	89.0
T_2	40	41.0	31.0	9.0	9.0	90.0
T_3	60	41.0	31.0	9.0	9.0	90.0
T_4	80	42.0	31.0	9.0	10.0	91.0
T_5	100	42.0	32.0	8.0	10.0	92.0

* See Table (2).
• Percent of buffaloe's milk replaced with camel's milk.

The quality of ice milk made by replacing buffaloe's milk with camel's milk

Table 8

REFERENCES

Abu Dhabi (2003). Camel milk plasma may help produce anti-microbial vaccine. By Khitam Al-Amir, Staff Reporter 05-07-2003, Gulf-News online edition.

AOAC (2010). The official method of analysis, 18th ed. association of Official Analytical Chemists. Inc., Allington, Virginia, USA.

Arbuckle, W. S. (1986). Ice cream. 4th ed., the AVI Publishing Co. INC. West Port. Connecticut, USA.

Burke, A. D. (1947). Practical Ice Cream Making. The Olsen publishing Co. Milwaukee, Wis. USA.

Kebary, K. M. K. (1996). Viability of *Bifidobacterium bifidum* and its effect on quality of frozen zabady. Food Res. Int., 29: 431 – 437.

Kebary, K. M. K., S. Hussein and R. M. Badawi (1998). Improving viability of bifidobacteria and their effect on frozen ice milk. Egyptian J. Dairy Sci., 26: 319.

Khader, A. F., Seham I. Farag, A. M. Moussa and A. M. El-Batawy (1992). The use of whey protein concentrate in ice cream mixes. Menoufia J. Agric. Res., 17: 637 – 647.

Ling, E. R. (2008). A Text Book of Dairy Chemistry. Vol. 2-3rd. Chapman & Hall., Ltd., London.

Mahran, G. M., S. M. Khalafalla, S. M. Farahat and F. M. Havez (1976). The use of butter milk solids in ice cream. Egyptian J. Dairy Sci., 4: 27.

Mohammed, B., G. Vias and B. Faye (2005). Camel milk production and transformation in sub-Saharan Africa. (NATO Science Series: Life and Behavioural Sciences, Vol. 362). Desertification combat and food safety: the added value of camel producers, Ash Kabad, Turkmenistan, pp. 200 – 208.

Morrison, K. R. and E. M. Macjary (2001). Viscosity of lactose and whey protein solutions. Inter. J. Food Properties, 4: 441 – 454.

Mousa, A. M., A. I. Hamed, K. M. Kebary, I. I. Badran and A. M. Gaber (2008). Ice milk quality attributes as affected by trypsinized whey proteins. Menoufia J. Agric. Res., 33: 1405.

Prajapati, T. P., S. V. Pinto, M. M. Trivedi, A. B. Patel and K. N. Wadhwani (2012). Utilisation of Kachchhi camel milk for manufacture of medium fat ice cream. J. Camel Practice and Research, 19:249-253.

Sommer, H. H. (1951). The theory and practice of ice cream making. 6th Ed. Published by the Author, Madison, Wisconsin., USA.

Steel, R. G. D. and J. H. Torrie (1980). Principle and procedures of statistics. Abiometrical Approach. 2nd Ed. MC. Graw Hill Book Co. New York.

Vaishali, S. and G. Madhu (2013). Potential of using camel milk for ice cream making. J. Camel Practice and Res., 20 (2): 271 – 275.

Winton, A. L. (1958). Analysis of Foods. 3rd printing {p. 6} John Wiley and Sons Ince. New York.

جودة المثلوج اللبنى المصنع باستبدال اللبن الجاموسى بلبن الجمال

خميس محمد كامل كعبارى ، سهام إبراهيم فرج ، أحمد نبيل زيدان ، على حسن السنباطى ، سميرة حسن شحاته هلال

قسم علوم وتكنولوجيا الألبان – كلية الزراعة – جامعة المنوفية – شبين الكوم – مصر

الملخص العربى :

لبن الجمال له فوائد صحية وغذائية عديدة لذلك يهدف هذا البحث إلى دراسة تأثير استبدال اللبن الجاموسى بلبن الجمال أثناء تصنيع المثلوج اللبنى كمصدر لرفع القيمة الغذائية والصحية . لذا تم تصنيع ٦ معاملات باستبدال اللبن الجاموسى بلبن الجمال بنسب : صفر (كنترول) ، ٢٠ ، ٤٠ ، ٦٠ ، ٨٠ و ١٠٠% .

ولقد أوضحت النتائج المتحصل عليها ما يلى :

- لم يُؤثر استبدال اللبن الجاموسى بلبن الجمال على نسب كل من الجوامد الكلية والدهن والبروتين الكلى والرماد والحموضة وقيم الـ pH .
- أدى استبدال اللبن الجاموسى بلبن الجمال إلى خفض كل من الوزن النوعى والوزن بالجالون واللزوجة لمخاليط المثلوج اللبنى .
- ازدادت نسب الريع بينما انخفض كلاً من الوزن النوعى والوزن بالجالون والمقاومة للانصهار بزيادة نسب الاستبدال .
- زيادة نسب استبدال اللبن الجاموسى بلبن الجمال حتى نسبة استبدال ١٠٠% أدى إلى زيادة درجات التحكيم وأعطى مثلوج لبنى ذو صفات حسية ممتازة ولم يتأثر بالتخزين حتى ١٠ أسابيع على درجة حرارة –١٨°م .

Table (8). Statistical analysis of chemical composition and organoleptic properties of ice cream made with replacing buffaloe's milk with camel's milk.

Ice milk properties	Effect of treatments							Effect of storage period (days)							
	Multiple comparisons●							Multiple comparisons●							
	Mean squares	C♦	T_1	T_2	T_3	T_4	T_5	Mean squares	0	2	4	5	6	8	10
Chemical properties:															
Total solids (%)	0.114	A	A	A	A	A	A	0.027	A	-	-	A	-	-	A
Titratable acidity (%)	0.024	A	A	A	A	A	A	0.011	A	A	A	-	A	A	A
pH value	0.010	A	A	A	A	A	A	0.064	A	A	A	-	A	A	A
Fat (%)	0.032	A	A	A	A	A	A	0.027	A	-	-	A	-	-	A
Total protein content (%)	0.060	A	A	A	AB	AB	AB	0.095	A	-	-	A	-	-	AB
Ash content (%)	0.036	A	A	A	A	A	A	0.031*	A	-	-	A	-	-	A
Physical properties:															
Specific gravity (Mix)	0.033*	A	B	C	D	E	F	-	-	-	-	-	-	-	-
Weight / gallon (Mix)	0.048*	A	B	C	D	E	F	-	-	-	-	-	-	-	-
Viscosity (Mix)	504.800*	A	B	C	D	E	F	-	-	-	-	-	-	-	-
Specific gravity (result)	0.056*	A	B	B	B	B	B	-	-	-	-	-	-	-	-
Weight / gallon (esult)	0.080*	A	B	C	D	E	F	-	-	-	-	-	-	-	-
Overrun (%)	483.354*	F	E	D	C	B	A	-	-	-	-	-	-	-	-
Melting resistance loss (%)	300.080*	A	B	C	D	E	F	-	-	-	-	-	-	-	-
Total organoleptic scores	27.556*	B	AB	A	A	A	A	25.156*	A	A	AB		AB	B	C

♦ See Table (2). * Significant at 0.05 level ($p \leq 0.05$).

● For each effect the different letters in the same row means the multiple comparisons are different from each other, letter A is the highest mean followed by B, C, … etc.