COMPARATIVE STUDY OF MILK COMPOSITION AND FAT GLOBULE SIZE IN VARIOUS MAMMALS

Tahir Zahoor & Riaz Ahmad Riaz
Department of Food Technology,
University of Agriculture, Faisalabad

Milk is a basic food for all age groups, having a very complex chemical composition which differs among species and breeds. It is a perishable commodity which undergoes various deteriorative reactions, peroxidation being the main one. Such a reaction also depends upon the fat globule size of milk from different animals. Hence the composition and size of fat globules in milk have a definite effect and were therefore determined in different species of animals. The study showed significant variation in size of milk fat globules, maximum being 5.80 μ in buffalo and minimum 2.96 μ in camel.

INTRODUCTION

Milk has very complex chemical composition which differs not only among various species but also within species and even among individuals within that species. Wide variation in the composition of milk seems important in connection with the use of milk in human diet, especially when it furnishes a large part of food intake, as it does for infants. Fat globule size in milk also plays an important role in acceptability and keeping quality of milk. It varies with species, breed, stage of lactation and environmental conditions(Webb *et al.*, 1974). In dairy industry homogenisation process is carried out to reduce the fat globule into very small size, so that the taste becomes even and the shelf life of milk may increase by changing the physical structure of fat. It is also important for separation of fat from milk during churning of cream, shipping of milk or cream, and cheese making. The present study was an attempt to investigate the variation in milk composition and milk fat globule size in different species of milk producing animals in Pakistan.

MATERIALS AND METHODS

Composite samples of fresh milk of different species of animals such as cow, buffalo, sheep, goat except camel were obtained from the Livestock Experiment Station, University of Agriculture, Faisalabad.

Composition: Protein was determined by formol titration and specific gravity by using lactometer according to the methods described by David (1977). Lactose was analysed by Lane and Eynon method as described by Egan *et al.* (1981). Fat, SNF, Ash and Moisture were assessed according to A.O.A.C. (1984).

Fat globule size: The fat globule size was measured by microscopic technique of Cruickshank *et al.* (1975). A drop of representative milk sample was put onto well cleaned glass slide and smeared with the help of wireloop. Two drops of methylene blue dye were added onto it, set aside for 2-3 minutes and dried in air. After approximately five minutes the slide was rinsed with distilled water and dried. One drop of oil emulsion was added and the fat globule size was determined under the microscope. At

least five readings were taken from a single slide, selecting various places at random and multiplied with microscopic factor (i.e., 1.66). The results were computed as weighted means for fat globule size.

RESULTS AND DISCUSSION

Composition: The results of milk composition of different species of animals are presented in Table 1.

Table 1. Effect of species on composition of milk

Milk source	Specific gravity	Moisture (%)	Fat (%)	Protein (%)	Lactose (%)	Ash (%)	SNF (%)
Cow	1.0258	86.28 ± 0.21	5.23 ± 0.05	3.91 ± 0.20	5.34 ± 0.04	0.69 ± 0.03	8.49 ± 0.29
Buffalo	1.0288	84.57 ± 0.19	6.85 ± 0.05	4.77 ± 0.32	5.23 ± 0.06	0.70 ± 0.01	8.57 ± 0.19
Sheep	1.0318	84.79 ± 0.19	6.05 ± 0.01	5.77 ± 0.13	4.29 ± 0.06	0.87 ± 0.01	9.16 ± 0.19
Goat	1.0256	85.73 ± 0.25	5.72 ± 0.22	4.63 ± 0.07	4.57 ± 0.08	0.83 ± 0.01	8.54 ± 0.5
Camel	1.0297	87.02 ± 0.32	4.62 ± 0.05	4.30 ± 0.02	2.73 ± 0.05	0.66 ± 0.07	8.35 ± 0.32

Values have been expressed as means ± SD of four observations.

Cow: Mean percentage content of various constituents in cow milk was 5.23 ± 0.05 fat, 3.91 ± 0.20 protein, 5.34 ± 0.40 lactose, 0.69 ± 0.03 ash, 8.49 ± 0.21 SNF and 86.28 ± 0.21 moisture. The specific gravity was 1.0258. The values obtained for fat and SNF were almost the same as described by Tahir and Ali (1983).

Buffalo: Buffalo's milk samples contained 6.85 ± 0.05% fat, 4.77 ± 0.32% protein, 5.23 ± 0.06% lactose, 0.70 ± 0.01% ash, 8.57 ± 0.19% SNF, and 84.57 ± 0.19% moisture. The specific gravity was 1.0288. The values obtained for protein, ash and SNF were found to be within the range as described by Jabbar (1983).

Sheep: Sheep milk contained 6.05 ± 0.01% fat, 5.77 ± 0.13% protein, 4.29 ± 0.06% lactose, 0.87 ± 0.01% ash, 9.16 ± 0.19% SNF and 84.79 ± 0.19% moisture. The specific gravity was 1.0318. The values for protein, lactose and ash obtained in case of sheep milk samples conformed to the average values reported by Webb *et al.* (1974).

Goat: Goat milk contained 5.72 ± 0.22% fat, 4.63 ± 0.07% protein, 4.57 ± 0.08% lactose, 0.83 ± 0.01% ash, 8.54 ± 0.25% SNF and 85.73 ± 0.25% moisture contents. The specific gravity was 1.0256. Fat, protein, lactose and ash contents were slightly higher than those reported by Webb *et al.* (1974).

Camel: Percentage values of various constituents in milk of camel were 2.73 ± 0.05 lactose, 0.66 ± 0.07 ash, 8.35 ± 0.32 SNF and 87.02 ± 0.32 moisture. The specific gravity was found to be 1.0297. Average values for fat and protein were found to be slightly lower than those observed by Webb *et al.* (1974). A comparative picture of the composition of milk of various species has been shown in Table 1. Variation in the composition of different milks is considered to be due to different factors such as different species, breeds, herd management, feed, season, milk yield, stage and number of lactations as indicated by Webb *et al.* (1974).

Fat globule size: Mean values for milk fat globule size in cow, buffalo, sheep, goat and camel were found to be 4.26, 5.80, 3.80, 4.06 and 2.96 μ respectively as shown in Table 2.

Table 2. Size of fat globules in milk of various species

Milk source	Weighted means (Repeats)					Single value (Mean ± SD)
	1	2	3	4	5	
Cow	4.08 (55)	3.80 (55)	4.06 (56)	4.47 (63)	4.88 (44)	4.26 ± 0.422[b]
Buffalo	6.00 (73)	6.10 (48)	5.10 (74)	6.05 (60)	5.77 (65)	5.80 ± 0.413[a]
Sheep	3.24 (95)	4.00 (131)	3.72 (53)	4.60 (71)	3.46 (70)	3.80 ± 0.528[b]
Goat	4.15 (119)	4.10 (121)	3.75 (67)	3.86 (124)	4.45 (131)	4.06 ± 0.272[b]
Camel	2.45 (94)	3.09 (137)	3.55 (198)	3.06 (146)	2.64 (125)	2.96 ± 0.429[c]

Figures shown in parentheses indicate number of observations used for calculating weighted meansl; SD = Standard deviation; ** Highly significant.

Milk fat globule size in case of buffalo was found to be significantly larger when compared with other species.

Fat globule size in camel milk was found to be 2.96 μ ± 0.43, almost half of the size of fat globule in buffalo milk. Fat globules in milk of cow, sheep and goat also varied quite a bit in size (Table 2).

REFERENCES

A.O.A.C. 1984. Official Methods of Analysis. The Association of Official Analytical Chemists. Arlington, Virginia, USA.

Cruickshank, R., J.P. Duguid, B.P. Marmion and R.H.A. Swain. 1975. Medical Microbiology. Churchill Livingstone, Edinburgh, UK.

Davide, C.L. 1977. Laboratory Guide in Dairy Chemistry Practicals. FAO Regional Dairy Development and Training Centre for Asia and the Pacific. Dairy Training and Research Institute, Univ. Philippines at Los Banos, College, Laguna.

Egan, H., R.S. Kirk and R. Sawyer. 1981. Pearson's Chemical Analysis of Foods. Churchill Livingstone, New York.

Jabbar, M.A., A. Khalil and M. Rafique. 1982. Study on the composition of milk in different sheep breeds as affected by genetic and non-genetic factors. Annual Report, Directorate of Livestock Production Research Institute, Bahadurnagar (Okara).

Jabbar, M.A. 1983. Comparative study of milk composition in respect of protein, lactose, casein and macro-minerals including calcium, magnesium, phosphorus and sulphur in the milk of buffalo, Sahiwal and crossbred cows. Annual Report, Directorate of Livestock Production Research Institute, Bahadurnagar (Okara).

Tahir, M.S. and S. Ali. 1983. Effect of urea feeding on milk production and milk composition in Sahiwal cows. Annual Report, Directorate of Livestock Production Research Institute, Bahadurnagar (Okara).

Webb, B.H., A.H. Johnson and J.A. Alford. 1974. Fundamentals of Dairy Chemistry. The Avi Publishing Company, USA.