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Quality Evaluation of Mozzarella Cheese from Different Milk Sources

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Abstract: Mozzarella cheeses prepared from buffalo, cow and mixture of cow and buffalo milks using commercially available starter cultures (*Streptococcus thermophilus, Lactobacillus delbrueckii subsp bulgaricus*) were analyzed for moisture, fat, protein, ash, pH, acidity and calcium content at different storage days (2, 16, 31, 45 and 60). Cheeses were also evaluated for meltability (to assess the functionality of cooked cheeses) and for various sensory attributes (taste, flavor, texture and overall acceptability) during storage. Cheese composition was significantly affected by milk sources. Buffalo cheese had higher nutritional value while cheese made from mixture of cow and buffalo milk had more meltability and scored more points in all sensory attributes.

Key words: Buffalo, cow milk, mozzarella cheese, chemical composition, meltability, sensory evaluation

Introduction

Cheese is the fresh or matured product obtained by the drainage (of liquid) after the coagulation of milk, cream, skimmed or partly skimmed milk, butter milk or a combination thereof, the process that transforms milk into cheese is called a technological process (Fox *et al*., 2000). Cheese is a popular food due to its diversity in application, nutritional value, convenience and good taste. The diversity is due to an increasing knowledge of the technology of cheese making and the biochemistry and microbiology of cheese ripening (Farky, 2004). Mozzarella Cheese is an unripened, soft and white cheese whose melting and stretching properties are highly suitable for Pizza making (Kindstedt, 1995). Although the demand for Mozzarella cheese in Pakistan is increasing due to expansion of Pizza parlors and fast food chains. Therefore to improve the process and quality of local cheese is the dire need of time. The functional properties of Mozzarella cheese develop in two distinct, but interdependent phases. The first phase occurs during manufacture, when the basic curd structure established and the second occurs during storage when functionality and curd structure alter (Rowney *et al*., 1999). Defect associated with Mozzarella cheese include a rubbery tough, texture, lack of flavor, paleness or green tint, inability to melt and poor stretchability (Fife *et al*., 1996). These functional properties of Mozzarella cheese are influenced by a multitude of factors that include cheese composition particularly moisture, fat content, pH, coagulating enzyme, starter culture, cooking and stretching, salt content and the changes occurring during aging and storage (McMahon *et al*., 1996). Buffalo's milk is ranked second in the world after cow's milk being more than 12% of the world, milk production (Ahmed *et al*., 2008). India and Pakistan are producing about 80% of the world's production of buffalo milk which is used for making different dairy products including soft and hard cheeses (Ahmed *et al*., 2008). In Pakistan, buffalo milk is 70% of the total milk produced. Due to high vitamin A, protein and low cholesterol in buffalo milk, it can be more preferred specie in cheese production (Zicarelli, 2004). Mozzarella cheese produced from buffalo milk is highly priced in most of the world. At present the main constraint in commercial exploitation appears to be the paucity of full understanding of the technical aspects in the manufacture of the product. In the present investigation a process has been standardized to manufacture mozzarella cheese of uniform composition from buffalo cow and milk of both. The products are further evaluated for quality to find out the suitable milk source for good quality mozzarella.

Materials and Methods

This study was conducted at NIFSAT during 2007-08.

Milk samples: The buffalo (breed Nili Ravi) and cow (breed Sahiwal) milk samples were obtained from Farm House, Institute of Animal Nutrition and Feed Technology, University of Agriculture, Faisalabad, Pakistan.

Cheese manufacturing: Mozzarella cheese was manufactured form cow, buffalo and mixture of buffalo and cow milks (1:1) after standardizing at 3% fat level using commercially available freeze dried starter cultures (*Streptococcus thermophilus, Lactobacillus delbrueckii subspecies bulgaricus)* following the method described by Tunick *et al*. (2000). Cheese samples were stored at 4°C±2°C for further evaluation.

Cheese evaluation

Chemical analysis: Cheese were analyzed for moisture, fat, protein, ash, pH, acidity and calcium content at

different storage days (2, 16, 31, 45 and 60). Moisture content was determined by oven drying, fat content using Babcock method, total protein by Kjeidhal method, ash content by igniting the cheese sample, acidity by titremetric method (AOAC, 1990) and the pH of cheese sample were determined by a pH meter (inoLab WTW Series 720). Calcium content was determined by flame photo meter as described by (Kirk and Sawyer, 1991).

Meltability: The meltability of cheese was determined by measuring the increase (%) in diameter of a cheese disc (7-mm thick and 45-mm diameter) on heating at 280°C for 4 min (Guinee *et al.*, 1999).

Sensory evaluation of cheese: Sensory evaluation of cheese for various attributes (taste, flavor, texture and overall acceptability) was carried out by a panel of trained judges using the nine -point hedonic scale (Land and Shepherd, 1988).

Statistical analysis: The data obtained was analyzed through analysis of variance as described by Steel *et al.* (1996).

Results and Discussion

Chemical analysis: Average chemical composition of different treatment (Table 1) varied significantly from each other. Moisture content of buffalo milk cheese (T_2) was significantly lower (50.49 %) than cow milk cheese (T_3) and cheese manufactured from mixture of cow milk and buffalo milk (T_3). In contrary to this fat and protein (17.13%, 15.0 7% respectively) were significantly higher in T_2 as compare to T_1 (16.69 %, 15.01 %, respectively) and T_3 (16.50%, 14.78 %, respectively). This would be due to higher total solid in buffalo milk than in cow milk (Ganguli, 1992). The buffalo milk is richer in fat and protein especially casein (Ahmed *et al.*, 2008) and casein is the major constituent that influences the cheese yield and chemical composition. Non-significant difference was found in ash content of all cheese samples. Higher calcium content (521 mg $100g^{-1}$) was found in T_1 than T_2 (510 mg $100g^{-1}$) and T_3 (488 mg $100g^{-1}$). The pH of the T_1 was significantly higher (5.27) than T_2 and T_3 which have non-significant difference. The higher pH in T_1 could be the reason that it contains higher calcium content than others. The pH of the product is influenced by biochemical changes during storage and composition of product. Calcium is important in the structure, texture and functionality of mozzarella cheese. Cheese firmness is associated with its calcium content, and its firmness decreased as calcium content decreases. During the cheese making process, the decrease in curd pH plays an important role in solubilizing the colloidal calcium phosphate from the casein matrix, thus freeing a large portion of calcium from the curd, losing it to the whey (Joshi *et al.*, 2003). Because firmness is a highly influential attribute on

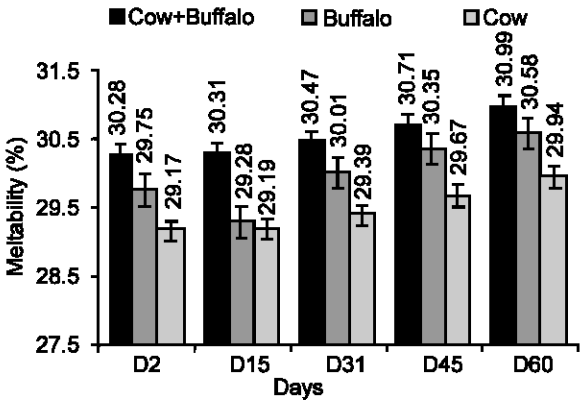

Fig. 1: Effect of storage on cheese meltability

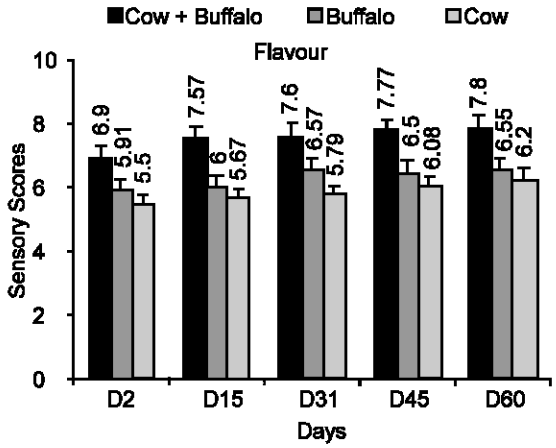

Fig. 2: Cheese flavor scores during storage

shredding quality, it is important to retain sufficient calcium in the cheese so it is not too soft and gummy when shredded. Significant difference was found in acidity of all cheese samples. The acidity prevents the growth of spoilage organisms, affects the activity of coagulant during manufacturing and ripening, solubilises the colloidal calcium phosphate, promotes syneresis and influences the activity of enzymes. Thus it affects the cheese texture and flavor quality.

Meltability: Meltability of mozzarella cheese is one of the important functional properties. The term meltability has been used to indicate the extent to which cheese flows and spreads upon heating. Meltability of different cheeses is presented in Fig. 1. The results depicted in figure clearly indicate that meltability was significantly affected by different treatment during storage. On 2nd day of storage (D2), T_1 had the maximum meltability (30.3%) followed by T_2 and T_3 which had 29.75% and 29.17 % melt, respectively. As the time period increased the meltability of all the cheeses increased significantly but the trend of increase remained same. The total increase

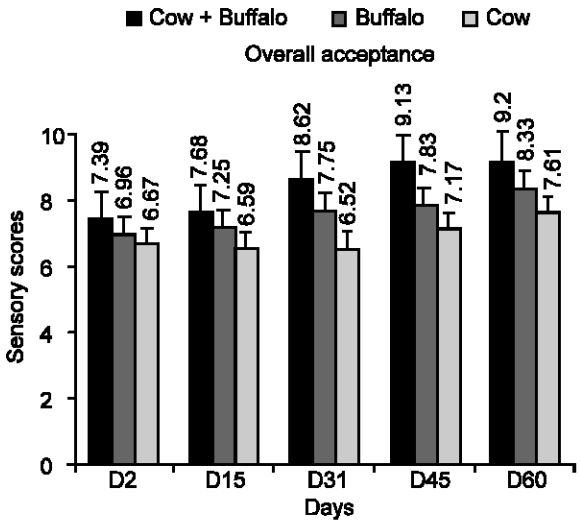

Fig. 3: Overall acceptability of cheese during storage

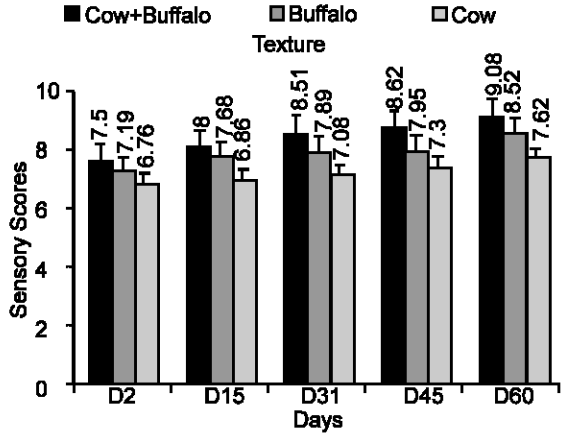

Fig. 4: Cheese texture during storage

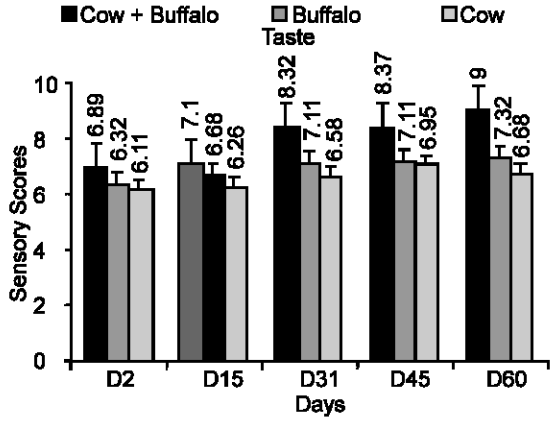

Fig. 5: Cheese Taste during storage

in meltability of cheese made from mixture of cow and buffalo, buffalo and in cow was 0.7%, 0.9% and 0.5%

Table 1: Average chemical composition of different cheese samples

Parameters	Mixture Buffalo+Cow T_1	Buffalo Milk T_2	Cow Milk T_3
Moisture (%)	$52.92^a \pm 1.35$	$50.49^b \pm 0.91$	$52.49^a \pm 0.49$
Fat (%)	$16.69^b \pm 0.39$	$17.13^a \pm 0.45$	$16.50^c \pm 0.50$
Protein (%)	$15.01^b \pm 0.76$	$15.07^a \pm 0.67$	$14.78^c \pm 0.78$
Ash (%)	$4.08^a \pm 0.22$	$4.11^a \pm 0.013$	$4.07^a \pm 0.02$
pH	$5.27^a \pm 0.16$	$5.24^b \pm 0.023$	$5.23^b \pm 0.037$
Acidity	$0.76^c \pm 0.01$	$0.78^a \pm 0.004$	$0.77^b \pm 0.018$
Ca (mg/100g)	$521^a \pm 29.40$	$510^b \pm 14.73$	$488^c \pm 5.97$

respectively, which indicates higher change in buffalo cheese followed by mixture and cow. There is a definitive period during storage after manufacture when mozzarella cheese has the unique functional characteristics that enable it to be used as pizza topping. The fresh cheese was typically firm and has poor melting properties and although it was stretchable. However as the cheese matures over period of 1-3 weeks, the texture softens and there is an increase in melt (Rowney, 1999). The improvement in meltability is due to dislodgment of para-casein matrix (Sheehan and Guinee, 2004).

Sensory evaluation of cheese: Significantly higher scores were awarded to the T_1 as compared to T_2 and T_3 for all sensory attributes (flavor, texture, taste and overall acceptance as illustrated in Fig. 2, 3, 4 and 5. Among sensory attributes the flavor is considered to be the most important factor for determining consumer's response. Flavor of all the treatments improved with storage days because during ripening the metabolic processes are responsible for the basic flavor and texture changes (Smit *et al.*, 2005). In cheeses when biochemical reactions continued for break down of fat and protein by activity of microbial and residual rennet more flavouring compound were produced and casein was hydrolyzed which give smooth texture.(Barbano *et al.*, 1994). The flavor of all cheeses from different milk sources was significantly affected. At D2 highest flavor score (6.9) was awarded to mixture of cow and buffalo cheese while lowest (5.5) to cow cheese. Scores increased with storage days and after sixty days highest flavor score (7.8) was given to mixture of cow and buffalo cheese. Result revealed higher overall acceptance, texture and taste for mixture of cow and buffalo milk cheese than other cheeses (Fig. 3, 4 and 5).

Conclusion: It is concluded from study that cheese from buffalo milk has higher fat and protein content than other cheese samples. Cheese from mixture of cow and buffalo milk had higher meltability and sensory scores, therefore more suitable for pizza toping than cheese from buffalo and cow milk.

References

Ahmed, S.I., F. Gaucher, E. Rousseau, Beaucher, M. Piot, J.F. Grongnet and F. Gaucheron, 2008. Effects of acidification on physic-chemical characteristics of buffalo milk, A comparison with cow's milk. Food Chem., 106: 11-17.

A.O.A.C., 1990. Official methods of analysis. The Association of Official Analytical Chemists. 15th Ed. Arlington, U.S.A.

Barbano, D.M., J.J. Yun and P.S. Kindstedt, 1994. Mozzarella cheese making by a stirred curd, no brine procedure. J. Dairy Sci., 77: 2687-2694.

Farkye, N.Y., 2004. Cheese Technology. Int. J. Dairy Tech., 57: 91-98.

Fife, R.L., D.J. McMahon and C.J. Oberg, 1996. Functionality of low fat mozzarella cheese. J. Dairy Sci., 79: 1903-1910.

Fox, P.F., T.P. Guinee, T.M. Cogan and P.L.H. McSweeney, 2000. Fundamentals of Cheese Science. Gaithersburg M.D., Aspen Publishers, Inc. Ireland.

Ganguli, N.C., 1992. In: N.M. Tulloh and J.H.G. Holmes (Eds), Buffalo production in subseries, production system approach, pp: 393-411.

Guinee, T.P., M.A.E. Auty and C. Mullin, 1999. Observations on the microstructure and heat induced changes in the viscoelasticity of commercial cheese. Aust. J. Dairy Tech., 54: 84-89.

Joshi, N.S., Muthukumarappan and R.I. Dave, 2003. Effect of calcium on physicochemical properties of fat-free mozzarella cheese. J. Food Sci., 68.

Kindstedt, P.S., J.J. Yun, D.M. Barbano and K.L. Larose, 1995. Mozzarella cheese impact of coagulant concentration on chemical composition, proteolysis and functional properties. J. Dairy Sci., 78: 2591-2597.

Kirk, R.S. and R. Sawyer, 1991. Pearson's Composition and Analysis of Foods. 9th ed. Longman Scientific and Technical, U.K., pp: 537-541.

Land, D.G. and R. Shepherd, 1988. Scaling and Ranking Methods. In: Sensory Analysis of Foods, J.R. Piggott (Ed). Elsevier Appl. Sci., pp: 155-185.

McMahon, D.J, M.C. Alleyne, R.L. Fife and C.J. Oberg, 1996. Use of fat replacers in low fat mozzarella cheese. J. Dairy sci., 79: 1911-1921.

Rowney, M.K., P. Roupas, M.W. Hickey and D.W. Everett, 1999. Factors affecting functionality of Mozzarella cheese. Aust. J. Dairy Tech., 54: 94-102.

Sheehan, J.J. and T.P. Guinee, 2004. Effect of pH and calcium level on the biochemical, textural and functional properties of reduced-fat Mozzarella cheese. Int. Dairy J., 14: 161-172.

Smit, G., B.A. Smit, J.M. Wim and J.M. Engels, 2005. Flavour formation by lactic acid bacteria and biochemical flavor profiling of cheese products. F.E.M.S. Microbio. Rey., 29: 591-610.

Steel, R., J.H. Torrie and D. Dickey, 1996. Principles and Procedures of Statistics. A biometrical approach, 3rd ed. McGraw Hill Book Co, Inc., New York.

Tunick, M.H., D.L. Van Hekken, P.H. Cooke, P.W .Smith and E.L. Malin, 2000. Effect of high pressure microfluidization on microstructure of mozzarella cheese. Lebensm.-Wiss. U.-Tech., 33: 538-544.

Zicarelli, L., 2004 .Buffalo Milk: Its properties, Dairy yield and Mozzarella Production. Vet. Res. Comm., 28: 127-135.