Journal of Stored Products and Postharvest Research Vol. 1(1), pp. 9-12, May 2010
Available online at http://www.academicjournals.org/jsppr

Full Length Research Paper

Optimization of the level of guar gum in low fat yak milk paneer

G. Kandeepan* and S. Sangma

National Research Center on Yak (ICAR), Dirang, West Kameng District, Arunachal Pradesh 790101, India.

Accepted 23 March, 2010

Growing market for health promoting food products offers scope to develop dietary fiber enhanced low fat paneer. Therefore, a study was undertaken to compare sensory quality attributes of full fat, low fat and dietary fiber enhanced low fat paneer prepared from yak milk. Optimization of fat to 1% level significantly increased density but decreased casein in yak milk. Yield was significantly reduced in low fat fiber enhanced yak milk paneer. A well acceptable low fat paneer with improved body and texture can be prepared with 1% fat in yak milk. Guar gum as dietary fiber can be successfully incorporated in low fat yak milk paneer at the level of 0.15% with improved body and texture and juiciness.

Key words: Yak, milk, full fat, low fat, guar gum, dietary fiber, paneer, sensory quality.

INTRODUCTION

Yak *(Poephagus grunniens)* is a unique bovine species living at very high altitude of 3000 - 6000 m above mean sea level. It is well adapted to extreme cold, low atmospheric oxygen concentration, high solar radiation and poor feed resources. Despite the challenging living conditions, yak serves as the sole source of income to the yak herdsmen by means of its valuable products (Kandeepan and Sangma, 2009).

Yak milk is a highly nutritious product rich in fat, essential minerals and healthy poly unsaturated fatty acids like conjugated linoleic acid and omega 3 fatty acids (Neupaney et al., 2003; Or-Rashid et al., 2008; Peng et al., 2008). The composition of yak milk includes around 8.50% fat, 4.25% protein, 18.77% total solids and 0.87% total ash (Mondal and Pal, 1996; Sharma et al., 2006). Yak milk is creamy white in colour, having thick consistency and peculiar wet yak hair odour or sweat odour which is more prevalent in winter season. Preparation of paneer, an acid coagulated milk product, from yak milk is an excellent way to overcome this odour.

Traditionally, paneer is prepared from full fat milk resulting in rich flavour, soft consistency and lower sliceability. In India, around 3% of the total milk produced is processed into paneer (Aneja et al., 2002). Paneer is an ubiquitous product in India, having great demand among the consumers in national and international market. Paneer from yak milk needs special attention in this regard with emphasis on growing concerns of health related problems arising from the consumption of fat rich milk products. It is often blamed for its high content of fat and lack of dietary fiber, a much needed component for a healthy food. Consumption of fat rich food products increases the risk of arterial hypertension, coronary heart disease and obesity. Several clinical investigations have proved that dietary fibers have the potential to reduce blood low density lipoprotein cholesterol by 2 mg/dL (Brown et al., 1999), risk of diabetes mellitus type 2 (Willet et al., 2002), coronary heart disease (Bazzano et al., 2003), blood pressure by 2.8/1.1 mmHg (Streppel et al., 2005), obesity (Liu, 2003) and colorectal cancer (Schatzkin et al., 2007).

Guar gum, also called guaran, is a polysaccharide composed of galactose and mannose sugars. It is primarily the ground endosperm of guar beans. The guar seeds are dehusked, milled and screened to obtain the guar gum. It is typically produced as a free flowing, pale, off-white colored, coarse to fine ground powder. Guar gum is a viscous, soluble dietary fiber having better emulsifying, thickening and stabilizing properties which can also prevent the growth of ice crystals in frozen foods (Chaplin, 2009). It acts as a bulk forming laxative. It is claimed to be effective in promoting regular bowel movements and relieve constipation and chronic related

*Corresponding author. E-mail: drkandee@gmail.com. Tel: +91 3780 242259. Fax: +91 3780 242273.

functional bowel ailments such as diverticulosis, Crohn's disease, colitis and irritable bowel syndrome (Anonymous, 2009). The increased mass in the intestines stimulates the movement of waste and toxins from the bowel and colon. Guar gum dissolves in water and absorbs it to become a gelatinous, viscous substance which is fermented by bacteria in the colon into gases and physiologically active byproducts. Because it is soluble, guar gum is able to absorb toxic substances released by bacteria that cause infective diarrhea.

Guar gum is used in dairy to thicken the milk, yogurt, kefir and processed cheese products. It helps to maintain homogeneity and texture of ice creams and sherbets. But there is no evidence of any research intervention on the value addition of paneer from yak milk with dietary fiber for promoting it as healthy food. Poorest of the poor people, the yak herdsmen would also fetch a higher price for his product, if there is a shift in processing from full fat paneer to low fat paneer incorporated with dietary fiber. This would add variety to the category of milk products prepared from yak milk, offering wide choice of food available for the consumers in order to select according to their health status. But till date, there is no information available on the development and quality evaluation of dietary fiber incorporated low fat yak milk paneer. Therefore, an investigation was undertaken with an objective to optimize the level of guar gum to incorporate in low fat yak milk paneer.

MATERIALS AND METHODS

Milk collection

Yak milk was obtained from the Institute's farm of National Research Centre on Yak, Nyukmadung, Arunachal Pradesh, India. The milk was transported to the processing unit in aluminium cans. The filtered clean fresh milk was utilized for the experiment.

Cream separation

The cream of the yak milk was separated by using cream separator (Lakshmi Ball Bearing Cream Separator, RS-11, Chadha Electro Industries, Delhi, India). The discs were placed into the bowl spindle and the bowl was assembled. The bowl was placed onto the separator machine and covered with cream and skim milk outlets and float device. The milk to be separated was weighed and warmed to 40°C. The representative sample was taken for testing. The machine was started and allowed to attain maximum speed. The separator was flushed with scalding water. After all water had run out, warm milk was put in the supply tank and the flow rate was maintained. The cream and skim milk were collected from their respective outlets into clean and dry containers of known tare weight. When all the milk had been separated, the system was flushed with hot water to rinse the cream spout. The weight of cream and skim milk obtained were recorded and representative samples were drawn for testing.

Standardization of fat percentage

The fat content of the milk for preparing low fat paneer was optimized to 1% by Pearson square method (Thompkinson and Latha, 2006). A square was drawn and the desired fat required in the mix was placed in the centre. The fat percent of materials to be mixed was placed at the left hand corners of the square. The value in the centre was subtracted from the larger number at the left hand corner of the square. The remainder was placed at the diagonally opposite right hand corner. Similarly the smaller number was subtracted and the remainder was placed diagonally opposite at right hand corner. The numbers on the right hand side represented parts of each of original materials to be blended to make a product of fat percent given in the centre. The numbers at the right hand side were added which represented parts of finished product.

Preparation of guar gum

Gar gum solution was prepared by blending appropriate quantity of guar gum in 250 ml of boiled 1% citric acid solution in a mixer grinder (Khaitan home mate 807 JS mixer grinder, Khaitan Co., Kolkata, India) for 15 s pause 15 s at very low speed.

Preparation of paneer

Full fat paneer was prepared without reducing the level of fat but low fat paneer was prepared from the standardized level of 1% fat in yak milk. The standardized milk was heated to 90°C for 15 s and cooled to 76°C. Then 1% citric acid boiled and kept at 70°C was mixed with the guar gum solution and added to the hot milk. The whole content was allowed to cool to 70°C. The coagulum settled within 10 min. Then the coagulum was transferred to a muslin cloth or strainer. The whey was allowed to drain and coagulated mass was pressed with weight (about 5 times the weight of coagulum) for 10 min. The blocks were immersed in chilled water at 4°C for 3 h. Excess water was drained and the product was packaged in low density polyethylene (LDPE) bags and stored at 4°C.

Quality evaluation

The composition of yak milk was analyzed in a milk analyzer (Milkana Superior, Mayasan. A.S. Istanbul, Turkey). The yield of the paneer was recorded as the total quantity of milk taken upon the weight of paneer produced for each group.

Sensory evaluation

A trained panel was used to study the perceived differences between the different groups of paneer by scoring descriptive profile of sensory attributes. A ten member trained panelists consisting of scientists and research assistants of National Research Centre on Yak (ICAR), Dirang, Arunachal Pradesh, India. Panelists were trained according to guidelines for sensory analysis of milk products and well acquainted with different sensory attributes during their under graduate/post graduate/doctoral programme. They were briefly explained about the nature of the experiment without disclosing the identity of samples.

Samples were warmed (40 - 45°C) using microwave oven (LG electronics India (P) Ltd., Mumbai) for 1 min and served to the panelists. Each panelist received two cubes from each sample of paneer in a statistically randomized order. Each session included samples from all groups of paneer. Panelists were provided with filtered water to cleanse their pallets between samples. Panelists evaluated samples for appearance, flavour, body and texture and juiciness using eight-point scales (1 = extremely poor to 8 = excellent). Panelists reported scores to the nearest half-point increment. Panelists' scores were averaged for statistical analysis.

Table 1. Comparison of the composition of full fat and low fat yak milk.

Parameters	Yak milk	
	Full fat	Low fat
Fat (%)	5.07 ± 0.09[a]	1.03 ± 0.18[b]
Solids not fat (%)	9.16 ± 0.20	9.39 ± 0.16
Protein (%)	3.47 ± 0.08	3.53 ± 0.06
Casein (%)	2.93 ± 0.04[a]	1.31 ± 0.07[b]
Density (g/cm^3)	1.0319 ± 0.77[b]	1.0342 ± 0.83[a]

n = 10 Means with different superscripts in the same row indicate significant difference ($p < 0.05$).

Table 2. Comparison of yield and sensory quality full fat, low fat and guar gum incorporated paneer from yak milk.

Parameters	Full fat paneer	Low fat paneer	Guar gum incorporated low fat paneer		
			0.10%	0.15%	0.20%
Yield (%) [#]	21.67 ± 0.56[a]	15.94 ± 1.47[b]	13.78 ± 0.12[c]	13.54 ± 0.14[c]	13.27 ± 0.01[c]
Sensory attributes [##*]					
Appearance	7.50 ± 0.06[a]	7.25 ± 0.02[b]	7.20 ± 0.03[b]	7.15 ± 0.04[b]	7.00 ± 0.04[c]
Flavour	7.50 ± 0.06[a]	6.80 ± 0.03[b]	6.70 ± 0.03[bc]	6.66 ± 0.02[cd]	6.55 ± 0.04[d]
Body and texture	6.50 ± 0.05[e]	6.80 ± 0.03[c]	6.90 ± 0.02[b]	7.10 ± 0.04[a]	6.60 ± 0.02[d]
Juiciness	7.25 ± 0.03[a]	6.45 ± 0.03[c]	6.50 ± 0.03[c]	6.75 ±0.02[b]	6.26 ± 0.03[d]

#n = 5, ##n = 50. *Based on 8 point descriptive scale. Means with different superscripts in the same row indicate significant difference ($p < 0.05$).

Tests were conducted under white fluorescent lights in partitioned booths to isolate panelists.

Statistical analysis

The data were analyzed using SPSS (version 10.0 for Windows; SPSS, Chicago, III., U.S.A.) with randomized block design (Snedecor and Cochran, 1995). The data were subjected to analysis of variance, least significant difference and Duncan's multiple range test to compare the means to find the difference between groups. The smallest difference ($D_{5\%}$) for two means to be significantly different was $p < 0.05$.

RESULTS AND DISCUSSION

The result of the composition of full fat and low fat yak milk is shown in Table 1. It indicated that reducing the level of fat significantly ($p < 0.05$) reduces the level of casein in the yak milk. Optimization of the level of fat to 1% in yak milk significantly increased the density of the milk compared to the full fat yak milk. Decreasing the level of fat increased the level of total solids which contributed to the increase in density of the milk.

The result of the yield and sensory characteristics of full fat, low fat and guar gum incorporated paneer from yak milk is presented in Table 2. The physicochemical attributes of low fat paneer was significantly ($p < 0.05$) distinct compared to the full fat yak milk paneer (Kandeepan et al., 2009). The yield of paneer was significantly ($p < 0.05$) different between full fat paneer, low fat paneer and guar gum incorporated low fat paneer. The yield did not differ significantly between the different levels of guar gum incorporation in low fat paneer. Decreasing the level of fat probably reduces the level of fat globules available for the casein molecule to bind during the coagulation by the addition of citric acid to the hot milk.

The low fat paneer from yak milk improved the body and texture of the product which was appreciated by the scores reported by sensory panel, as shown in Table 2. The improved body and texture scores offered very good sliceability to the paneer. However, the scores reported for the appearance, flavour and juiciness were significantly ($p < 0.05$) lower than the sensory scores of full fat paneer (Kandeepan et al., 2009). The decrease in appearance, flavour and juiciness scores was attributed to the lower level of fat present in the paneer. The appearance scores of low fat paneer did not differ signifycantly up to 0.15% incorporation of guar gum. Although, flavour scores differed significantly ($p < 0.05$) with the addition of guar gum in low fat paneer, the level of addition was significantly ($p < 0.05$) acceptable up to 0.15%. Incorporation of guar gum as dietary fiber signifycantly ($p < 0.05$) improved the body and texture of the low fat paneer, 0.15% level scoring highly significant value. This improved body and texture might be attributed to the

better thickening property of the guar gum. The juiciness of low fat paneer was significantly ($p < 0.05$) improved with 0.15% level of addition of guar gum in low fat paneer.

Conclusion

Reducing the level of fat significantly increased the density but decreased the casein content in yak milk. A well acceptable low fat paneer can be prepared with 1% level of fat in yak milk. Low fat content of the yak milk significantly reduces the yield. Incorporation of guar gum in low fat yak milk paneer significantly improves the body and texture but reduces the flavour. Guar gum as dietary fiber can be successfully incorporated in low fat paneer at the level of 0.15% with improved body and texture and juiciness of low fat yak milk paneer.

ACKNOWLEDGMENT

The authors thank the Director, National Research Centre on Yak (ICAR), Dirang, for providing necessary facilities to accomplish this research.

REFERENCES

Aneja RP, Mathur BN, Chandan RC, Banerjee AK (2002). Technology of Indian Milk Products, Delhi, India: A Dairy India Publication. pp. 51-59.

Anonymous (2009). Wikipedia. http://en.wikipedia.org/wiki/Guar_gum.

Bazzano LA, He J, Ogden LG, Loria CM, Whelton PK (2003). Dietary fiber intake and reduced risk of coronary heart disease in US men and women: the National Health and Nutrition Examination Survey I Epidemiologic Follow-up Study. Arch. Int. Med. 163(16): 1897-1904.

Brown L, Rosner B, Willet WW, Sacks FM (1999). Cholesterol-lowering effects of dietary fiber: a meta-analysis. Am. J. Clin. Nutr. 69(1): 30-42.

Chaplin M (2009). Water Structure and Science: Guar Gum. London: London South Bank University website. http://www.lsbu.ac.uk/water/hydro.html.

Kandeepan G, Sangma S (2009). Technologies for processing traditional yak milk products. Beverage Food World. 36(8): 47-48.

Kandeepan G, Sangma S, Bhattacharya M, Ghosh MK, Konwar P, Ormilla K, Krishnan G, Jayakumar S, Chouhan VS, Ramesha KP (2009). Quality characteristics of traditional yak milk paneer. In: Programme and compendium of invited papers and abstracts, International conference on yak husbandry challenges and strategies, April 20-22, Dirang, Arunachal Pradesh, India: National Research Centre on Yak (ICAR). p. 164.

Liu S (2003). Relation between changes in intakes of dietary fiber and grain products and changes in weight and development of obesity among middle-aged women. Am. J. Clin. Nutr. 78(5): 920-927.

Mondal D, Pal RN (1996) Chemical composition of yak milk. Ind. J. Dairy Sci. XLIX: 12.

Neupaney D, Jin Bo Kim, Ishioroshi M, Samejima K (2003). Study on some functional and compositional properties of yak butter lipid. Anim. Sci. J. 74(5): 391-397.

Or-Rashid MM, Odongo NE, Subedi B, Karki P, McBride BW (2008). Fatty acid composition of yak *(Bos grunniens)* cheese including conjugated linoleic acid and trans-18:1 fatty acids. J. Agri. Food Chem. 56: 1654-1660.

Peng YS, Brown MA, Wu, JP, Wei LX, Wu JL, Sanbei DZ (2008). Fatty acid profile in milk fat from qinghai plateau yak at different altitudes and parities. . Anim. Sci. October 1, 2008.

Schatzkin A, Mouw T, Park Y, Subar AF, Kipnis V, Hollenbeck A, Leitzmann MF, Thompson FE (2007). Dietary fiber and whole-grain consumption in relation to colorectal cancer in the NIH-AARP Diet and Health Study. Am. J. Clin. Nutr. 85 (5): 1353-1360.

Sharma DK, Ghosh K, Raquib M, Bhattacharya M (2006). Yak products' profile: an overview. J. Food Sci. Technol. 43(5): 447-452.

Snedecor GW, Cochran WG (1995). Statistical Methods, 8th edn. New Delhi: Oxford and IBH Publishing Co.

Streppel MT, Arends LR, Veer PV, Grobbee DE, Geleijnse JM (2005). Dietary Fiber and Blood Pressure .A Meta-analysis of Randomized Placebo-Controlled Trials. Arch. Int. Med. 165: 150-156.

Thompkinson DK, Latha Sabikhi (2006). Laboratory Manual Market Milk. Karnal, India: National Dairy Research Institute. pp. 37-39.

Willet W, Manson J, Liu S (2002). Glycemic index, glycemic load, and risk of type 2 diabetes. Am. J. Clin. Nutr. 76: 274S-280.