Proceedings of the Sixth Academic Sessions, University of Ruhuna 2009
Vol. 6 pgs 124 - 128

A comparative study of the quality of yoghurt marketed in Southern Sri Lanka by large scale manufacturers and by rural households

N.M.N.K. Narayana, M.M.K. Premakumara and P.K. Lal
Department of Animal Science, Faculty of Agriculture, University of Ruhuna
✉ *nayananarayana@yahoo.com*

Abstract
Yoghurt is an end product of controlled lactic fermentation by thermophillic lactic acid bacteria namely *Streptococcus thermophillus* and *Lactobacillus delbruekki* ssp. *bulgaricus*. It is one of the most popular fermented milk products worldwide and come in a variety of textures, fat content, flavours etc. Apart from the commercial (C) dairies many small scale (SS) yoghurt producers are scattered through out the country and at present, yoghurt production is increasing as one of the major self employment ventures. However, the quality of the yoghurt marketed by different producers is different. Therefore, a study was conducted to compare the quality of yoghurt marketed by commercial dairies and small scale producers in Southern Province of Sri Lanka and to compare it with Sri Lanka Standards. The samples of yoghurts (from 2 batches) marketed by five C and five SS manufacturers were collected from retail shops in Matara District of Sri Lanka. Each time, three yoghurts from one manufacturer was collected for physico-chemical and microbiological analysis; transported immediately to the laboratory and kept in the refrigerator. Microbiological quality of the yoghurt samples were tested on the same day for coliforms, yeast and mould counts. Physico-chemical parameters such as pH, titratable acidity, MSNF%, fat% and protein% were also determined. Sensory evaluation was conducted for C and SS yoghurts by 30 panelists using 5 point hedonic scale. Complete Randomized Design was used and data were analyzed using SAS (Ver. 6.12) and SPSS (Ver. 10.0) computer packages. Mean pH of the C yoghurts was 4.02±0.19 while in SS yoghurts 4.13±0.19 and were not significantly different ($p>0.05$). Titratable acidity% (C 1.0±0.13, SS 1.0±0.13), MSNF% (C 13.5±1.83, SS14.08±1.1) and fat% (C 3.15±0.09, SS 3.38±0.40) were also had no significant differences ($p>0.05$) and those values comply with Sri Lanka Standards. Further, CP% (C 3.57±0.0.69, SS 3.15±0.48) showed no significant difference ($p>0.05$). Coliforms were detected only in SS yoghurts. Yeast (C 0.62±0.03 log cfu/g, SS 3.5±0.37 log cfu/g) and mould (C 0.28±0.06 log cfu/g, SS 2.52±0.34 log cfu/g) counts were significantly higher ($p<0.05$) in yoghurts produced by SS producers and the values exceeded the standards. Significant differences ($p<0.05$) were observed in physico-chemical and microbiological parameters of the yoghurts among C as well as SS producers. A significant difference ($p<0.05$) was observed only in flavour score in C and SS yoghurts while highest score for overall acceptability was obtained by a SS yoghurt even though it was not significant. However, based on the microbiological studies it can be concluded that, SS yoghurts were not according to the standards and hygienic conditions should be improved to market a quality product for consumer safety and satisfaction.

Keywords: Commercial, Small Scale, yoghurt, quality

Introduction

The introduction of fermented milk products into the diet of man is thought to date back to the dawn of civilization. Even though it is not certain, it is likely that consumption of fermented or cultured milk products such as yoghurt, butter and cheese occurred nearly around 6500 years ago in some countries of the world like Britain. Although, fermented milk products such as yoghurt were originally developed simply as a means of preserving the nutrients in milk, it was soon discovered that, by fermenting with different microorganisms, an opportunity existed to develop a wide range of products with different flavours, textures, consistencies and more recently health attributes(McKinley, 2005).

Yoghurt is an end product of controlled lactic fermentation by thermophillic lactic acid bacteria namely *Streptococcus thermophillus* and *Lactobacillus delbruekki* ssp. *bulgaricus*. It is one of the most popular fermented milk products worldwide and come in a

variety of textures (set, stirred, drinking), fat content (low fat, non fat, normal), flavours (natural, vanilla, strawberry, etc. Set type vanilla flavoured yoghurt is the most popular and widely available yoghurt in Sri Lanka.

Sri Lanka has one of the highest yoghurt consumption rates in the Asian region with annual yoghurt consumption being 12,000 metric tones. This was as a result of increased per capita income and higher living styles (http://sundaytimes.lk/080518/FinancialTimes/ft329.html). Apart from the commercial (C) dairies many small scale (SS) yoghurt producers are scattered through out the country and at present, yoghurt production is increasing as one of the major self employment ventures due to its profitability. However, the quality of the yoghurt marketed by different producers is different. Further, many small scale producers face problems of continuing the production of yoghurt due to marketing failures. This is due to poor quality of yoghurts marketed by some processors and would be due to the factors such as practicing of sub standard hygienic procedures during the manufacturing, use of sub standard processing conditions, use of improper starter cultures, use of inappropriate storage and marketing conditions etc. Further, often buyers choose a popular brand of yoghurt rather than selecting a less popular brand.

The traditional and commercial methods for the manufacture of yoghurt are different and former process has following drawbacks as mentioned by Tamime and Robinson (1985). Successive inoculations of the starter culture tend to change the desired ratio between the microorganisms used in the yoghurt manufacture. The low incubation temperature (e.g. ambient) results in slow acidification of the milk as compared with the optimum conditions of 40-45 °C for 2 ½ to 3 hours. The slow rate of acid development may promote undesirable side effects which can adversely affects the quality of the yoghurt and no control over the level of lactic acid produce during the fermentation stage.

However, it is observed that some small scale yoghurts are comparable with the yoghurts produce by commercial manufacturers and some times much better than that. Therefore, a study was conducted to compare the quality of yoghurt marketed by commercial dairies and small scale producers in Southern Province of Sri Lanka and to compare it with Sri Lanka Standards to check whether they are according to the standards.

Materials and Methods

The samples of yoghurts (from 2 batches) marketed by five C and five SS manufacturers were collected from retail shops in Matara District of Sri Lanka. Each time, three yoghurts from one manufacturer was collected for physico-chemical and microbiological analysis; transported immediately to the laboratory and kept in the refrigerator. Microbiological quality of the yoghurt samples were tested on the same day for coliforms SLS 516: Part 3:1982) and yeast and mould counts (SLS 516: Part 2:1991). Physico-chemical parameters such as pH, titratable acidity, Milk Solid Non Fat (MSNF) %, fat% and protein% were also determined. pH was determined using a standard pH meter. Titratable acidity and MSNF% of the yoghurt samples were determined according to the methods given in SLS 735: Part 2: 1987 and Amendment No. 01 of SLS 824: Part 2: 1989 respectively. The method described by Tamime and Robinson (1985) was utilized to measure the fat% of yoghurt samples. Protein % was determined by Kjeldhal Method. Sensory evaluation was conducted for C and SS yoghurts by 30 panelists using 5 point hedonic scale. Three commercial and 2 small scale yoghurts were selected for the sensory evaluation based on the easiness of handling and market availability. Complete Randomized Design was used and data were analyzed using SAS (Ver. 6.12) and SPSS (Ver. 10.0) computer packages.

Results and discussion

The pH of C and SS yoghurts were 4.02±0.19 and 4.13±0.19 respectively (Table 1). These values were not significantly different. Yogurt should set firm when the proper acid level is achieved (pH 4.6) (http://www.uga.edu/nchfp/publications/nchfp/factsheets/yogurt.html). Reduction of pH of yoghurts was reported by Sofu and Ekinci (2007) with storage period. The tested market yoghurt samples were collected nearly around one week before the expiry date. Therefore, the pH is less than normal fresh yoghurt. Titratable acidity of C and SS yoghurts were also not significantly different and the values were 1.0±0.13 and 1.0±0.13 respectively (Table 1). These acidity values are in line with the acidity values reported by Haj *et al*, 2007 for stirred yoghurts. According to Sri Lanka Standards (Anon, 1989), titratable acidity should be within the range of 0.8 to1.25% for normal, low fat and non fat yoghurts. Hence, these both yoghurt samples were according to the standards with respect to the acidity value.

Table 1. Comparison of mean (±SD) physico-chemical parameters of C and SS yoghurts

Parameter	C	SS	Remarks
pH	4.02±0.19	4.13±0.19	NS
Titratable acidity%	1.0±0.13	1.0±0.13	NS
MSNF%	13.5±1.83	14.08±1.1	NS
Protein%	3.57±0.69	3.15±0.48	NS
Fat%	3.15±0.09	3.38±0.40	NS

NS=not significant

Table 2. Comparison of Microbiological quality of C and SS yoghurts

Parameter	C	SS	Remarks
Coliforms (MPN/g)	0	10.6±0.27	*
Yeast (Log cfu/g)	0.62±0.03	3.5±0.37	*
Mould (Log cfu/g)	0.28±0.06	2.52±0.34	*

* =significant at 0.05 probability level

As shown in the Table 1, MSNF%, Protein% and Fat% were also not significantly different between C and SS yoghurts. According to Sri Lanka Standards (Anon, 1989), yoghurt should contain minimum of 8% of MSNF and minimum of 3% milk fat (in the case of full fat/normal yoghurts) and the findings were comply with the standard values. Protein% found was in line with the values reported by Haj *et al*, 2007.

Table 2 shows the microbiological quality differences of C and SS yoghurts. Coliforms were detected only in SS yoghurts and not detected in commercial yoghurts indicating the poor hygienic procedures practice by SS processors during the manufacturing process, storage and transportation. Further, yeast (C 0.62±0.03, SS 3.5±0.37) and mould (C 0.28±0.06, SS 2.52±0.34) counts were significantly different between C and SS processors and the higher values were observed in the yoghurt samples obtained from SS processors. These values exceeded the standard limits {(yeast <1/g and mould < 1000 (log 3)/g} given in Sri Lanka Standards (Anon, 1989)

Comparison of physico-chemical and microbiological parameters of yoghurt produced by C processors are indicated in table 3. pH of the yoghurt samples among some manufacturers was significantly different and it lied between 3.76 and 4.30. Titratable acidity also showed significant differences among some C processors and the range is from 0.92 to 1.18. However, these values are in agreement with the standard values (Anon, 1989) for yoghurts. Even though, MSNF% was significantly low in yoghurt produced by C_5 the value is comply with the standards. Fat% and protein % were also different among different manufactures (Table 3).

Coliforms were not detected in any yoghurt sample manufactured by any C processors. However, yeast was detected (3.14 log cfu/ml) in the samples of C_3 manufacturer only and it slightly exceeded the standard limit of 3 log cfu/ml as mentioned in Sri Lanka Standards (Anon, 1989). Moulds were detected in the samples of C_1 and C_2 manufacturers. The values were 0.74 and 0.65 log/cfu/ml respectively.

Table 3. Comparison of physico-chemical and microbiological parameters of yoghurt produced by commercial processors

Parameter	C_1	C_2	C_3	C_4	C_5
pH	4.08^b	4.30^a	3.76^c	3.98^b	3.98^b
Titratable acidity%	0.96^c	0.92^c	1.18^a	1.09^b	1.08^b
MSNF%	12.48^{ab}	15.31^a	14.75^a	13.90^{ab}	11.08^b
Protein%	2.97^b	3.24^b	4.23^a	4.46^a	2.98^b
Fat%	3.05^c	3.3^a	3.2^b	3.1^c	3.1^c
Coliforms	AB	AB	AB	AB	AB
Yeast (Log cfu/g)	0^b	0^b	3.14^a	0^b	0^b
Mould (Log cfu/g)	0.74^a	0.65^a	0^a	0^a	0^a

C_1 to C_5 = Commercial Processor 1 to Commercial Processor 5 ,AB = absent, ^{a,b,c} Means within the same raw without a common superscript differ significantly ($p<0.05$)

Table 4. Comparison of physico-chemical and microbiological parameters of yoghurt produced by small scale processors

Parameter	SS_1	SS_2	SS_3	SS_4	SS_5
pH	4.31^{a}	4.24^{a}	3.87^{b}	4.17^{ab}	4.07^{ab}
Titratable acidity%	0.84^{b}	1.0^{ab}	1.19^{a}	0.99^{ab}	0.96^{b}
MSNF%	14.5^{ab}	15.03^{a}	14.5^{ab}	13.95^{ab}	12.53^{b}
Protein%	3.07^{b}	3.27^{b}	3.91^{a}	2.57^{c}	2.94^{bc}
Fat%	3.0^{d}	nd	4.0^{a}	3.3^{b}	3.2^{c}
Coliforms (MPN/g)	2^{a}	45^{b}	2^{a}	2^{a}	2^{a}
Yeast (log cfu/g)	3.65^{b}	4.04^{a}	3.15^{c}	3.54^{b}	3.15^{c}
Mould (log cfu/g)	3.15^{a}	3.15^{a}	0^{b}	3.15^{a}	3.15^{a}

SS_1 to SS_5 = Small Scale Processor 1 to Small Scale Processor 5

nd = not determined

^{a,b,c,d} Means within the same raw without a common superscript differ significantly ($p<0.05$)

Table 5. Comparison of average score of various organoleptic characteristics of different yoghurts

Treatment	Character				
	Flavour	colour	texture	odour	overall acceptability
SS1	3.5^{ab}	3.65^{a}	3.80^{a}	3.35^{a}	3.55^{a}
C1	2.85^{a}	3.10^{a}	3.25^{a}	3.0^{a}	3.10^{a}
C2	3.05^{ab}	3.65^{a}	3.75^{a}	3.55^{a}	3.10^{a}
SS2	3.05^{ab}	3.60^{a}	3.05^{a}	3.40^{a}	3.45^{a}
C3	3.95^{b}	3.30^{a}	3.15^{a}	3.90^{a}	3.35^{a}

^{a,b} Means within the same colomn without a common superscript differ significantly ($p<0.05$)

Table 4 shows the comparison of physico-chemical and microbiological parameters of yoghurt produced by small scale processors. Significant differences were observed in physico-chemical and microbiological parameters of yoghurts among SS processors. Even though, physicochemical parameters were comply with standard values, yeast and mould counts were exceeded the standard limits (Anon, 1989) indicating the poor hygienic procedures practice during manufacturing, storage and distribution. Eurther coliforms were detected in every yoghurt sample produced by SS processors.

Table 5 shows the sensory scores gained by different yoghurts and significant differences were only observed in flavour scores. Even though, highest flavour score was obtained by C_3, the value was not significant with SS_1, SS_2 and C_2 processors. Flavour is lowest in the yoghurt manufactured by C_1 processor. Other sensory attributes were not significantly different in the yoghurt samples produced by different processors.

Conclusion

Even though, SS yoghurts were comparable with the commercial yoghurts, it can be concluded that, based on the microbiological studies they were not according to the standards and hygienic conditions should be improved to market a quality product for consumer safety and satisfaction. Therefore, it is suggested to improve the knowledge of these small scale yoghurt processors and explain the value of hygienic food production through training programmes.

References

Anon (1987) Sri Lanka Standards 1987: 735: Part 2

Anon (1989) Sri Lanka Standards 1989: 824: Part 2

Anon (1982) Sri Lanka Standards 1982: 516: Part 3

Anon (1991) Sri Lanka Standards 1991: 516: Part 2

Anon (1989) Sri Lanka Standards 1989: 824 Part 2: Amendment No.01

Haj, M.H.M. , Owni, O.A.O.E. and Zubeir, I.E.M.E. (2007) Assesment of chemical and microbiological quality of stirred yoghurt in Khartoum State, Sudan. Research Journal of Animal and Veterinary Sciences, 2:56-60.

http://sundaytimes.lk/080518/FinancialTimes/ft329.html Visited on 23-01-2009

http://www.uga.edu/nchfp/publications/nchfp/factsheets/yogurt.html Visited on 23-01-2009

Mckinley, M.C.(2005). The nutrition and health benefits of yoghurt. A Review. International Journal of Dairy Technology 58 (1), 1-12.

Sofu A. and Ekinci, F.Y. (2007). Estimation of Storage Time of Yogurt with Artificial Neural Network Modeling J. Dairy Sci. 90:3118–3125

Tamime, A.Y. and Robinson, R.K. (1985). Yoghurt Science and Technology. Pergamon Press Ltd., Headington Hill Hall, Oxford OX3 OBW, England.