Journal of Veterinary and Animal Sciences. 29 (1998) 6-11

MICROBIOLOGICAL AND SENSORY QUALITIES OF FILLED YOGHURT INCORPORATING CONDENSED COCONUT WATER*

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One of the main problems in the preparation of commercial yoghurt is maintenance of its structure. Unlike cheese where the whey is drained off, yoghurt must retain the whey within the matrix of casein micelle. This is achieved by increasing the total solids of yoghurt mix by addition of skim milk powder and hence it is priced high as compared to milk. Addition of coconut fractions in dairy products with an aim to reduce the cost has attracted the attention of scientists in different parts of the world. In the present trial an attempt was made to prepare yoghurt by replacement of Milk-Solids-Not-Fat (MSNF) with solids from condensed coconut water and the microbiological and sensory attributes of the product were studied.

Materials and Methods

Fresh cow milk and cream were collected from Dairy Plant, Kerala Agricultural University, Mannuthy, Thrissur and coconut water from copra manufacturers. Coconut water was condensed using "Anhydro type Lab E.W.O. 1688" vacuum evaporator at a temperature of 45°C maintaining a vacuum of 70 cm of mercury and then cooled to 5°C. The proportionate quantity of ingredients for yoghurt preparation was derived by linear programming model. The treatments were divided into TC (control containing 14 per cent MSNF, 3 per cent fat and 6 per cent sugar), T_2 (25 per cent replacement of MSNF using condensed coconut water without gelatin), T_3 (T_2 + gelatin at 0.5 per cent level), T_4 (50 per cent replacement of MSNF using condensed coconut water without gelatin) and T_5 (T_4 + 0.5 per cent gelatin). The yoghurt culture containing 1:1 ratio of *Streptococus salvarius* ssp. *thermophilus* YH-S and *Lactobacillus delbrueckii* ssp. *bulgaricus* YH-L (procured from NDRI, Karnal) were added at the rate of 4 per cent. The method described by Baig (1994) was followed in the preparation of yoghurt. A pilot heat stability test was conducted to find out the amount of trisodium citrate required to provide sufficient heat stability of the yoghurt mix.

Tyrosine value was estimated by the method described by Lowery *et al.* (1951) and the viable count of starter culture by the method described by Baig (1994). The coliform counts were enumerated by using Violet Red Bile Agar (Indian Standards : 5401, 1969). The procedure described in Indian Standards : 5403 (1969) was used to enumerate yeast and mould count. The samples of set yoghurt were subjected to sensory evaluation by a panel of six judges using the score card adopted by Pearce and Heap (1974). The cost of the product was calculated from the linear programming model based on the cost of ingredients. The data from six trials were subjected to statistical analysis (Snedecor and Cochran, 1967). Completely randomised design (CRD) was

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used to test the significance between control and treatments.

Results and discussion

Tyrosine value is an index of proteolysis. The minimum mean tyrosine value of 0.188 was observed in T_5 and maximum of 0.326 in control (Table 1 and Fig. 1). Statistical analysis of the data revealed no significant difference between control, T_2 and T_3 but

Table 1 Microbiological qualities of filled Yoghurt using condensed coconut water

Characters			Control	Treatments			
			TC	T2	T3	T4	T5
Tyrosine value (mg/g)		Range	0.28-0.39	0.25-0.32	0.24-0.32	0.16-0.23	0.16-0.22
		Mean±SE	a 0.326±0.030	a 0.282±0.026	a 0.276±0.028	b 0.195±0.021	b 0.188±0.018
VIABLE COUNT	*L. bulgaricus* count (cfu/ml)	Range (10^8)	2.13-2.58	2.09-2.51	2.03-2.45	2.04-2.39	2.07-2.30
		Mean±SE	a $2.38x10^8$ $\pm1.76x10^7$	a $2.28x10^8$ $\pm1.73x10^7$	a $2.24x10^8$ $\pm1.72x10^7$	a $2.25x10^8$ $\pm1.55x10^7$	a $2.22x10^8$ $\pm1.63x10^7$
	S. thermophilus count (cfu/ml)	Range (10^9)	2.01-2.32	1.95-2.34	1.90-2.32	1.74-2.21	1.72 - 214
		Mean±SE	a $2.23x10^7$ $\pm1.84x10^7$	a $2.11x10^7$ $\pm1.40x10^7$	a $2.08x10^7$ $\pm1.30x10^7$	b $1.93x10^7$ $\pm1.74x10^7$	b $1.90x10^7$ $\pm1.73x10^7$
Coliform count (cfu/ml)		Range	1.00-5.00	3.00-6.00	3.00-7.00	3.00-7.00	2.00-7.00
		Mean±SE	3.17±0.60	4.33±0.49	4.83±0.60	4.67±0.67	4.68±0.72
Yeast and mould count (cfu/ml)		Range	8.00-16.00	10.00-19.00	14.00-23.00	14.00-19.00	12.00-19.00
		Mean±SE	a 11.83±0.31	b 14.00±1.3	b 17.50±1.3	b 16.50±0.89	b 16.00±1.3

Means bearing the common letters as superscript do not differ significantly

FIG. 1 TYROSINE VALUE OF YOGHURT

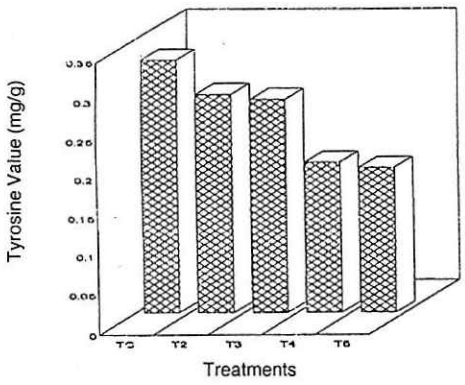


FIG. 2. VIABLE COUNT OF YOGHURT

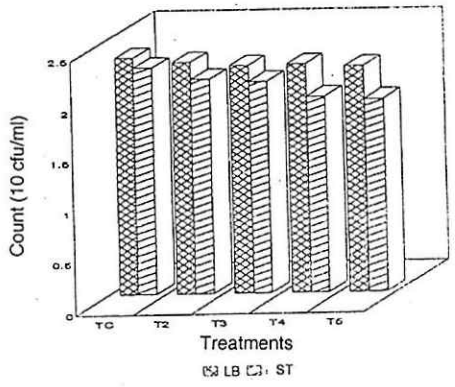
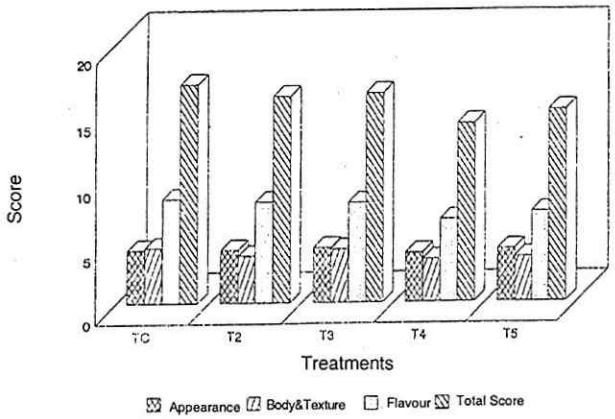


FIG. 3.SENSORY EVALUATION OF YOGHURT



significant difference ($P < 0.01$) from T_4 and T_5. Treatments T_4 and T_5 were statistically at par. The higher tyrosine value recorded in control may be due to higher protein content. Alm (1982) reported that the degree of proteolysis depends upon the intensity of heat treatment of milk before inoculation, the buffering capacity of milk proteins and its degradation level, type of starter used and amount of proteolytic enzyme liberated by the organisms. In case of control, more protein might have degraded during heat treatment which resulted in more surface for the action of bacterial enzymes leading to higher tyrosine value. In treatments T_4 and T_5, low level of tyrosine value was observed probably due to the higher level of minerals and low protein in the above treatments which lead to slower growth of starter organism, especially *S. thermophilus*, resulting in low proteolytic activity. This trend was observed in the bacterial count also.

The viable count included *L. bulgaricus* count (cfu/ml) and *S.thermophilus* count of set yoghurt (Table 1 and Fig. 2). The *L. bulgaricus* count of control ranged from 2.13 x 10^8 to 2.58 x 10^8 and for treatments T_2, T_3,

T_4 and T_5, 2.09 x 10^8 to 2.51 x 10^8, 2.03 x 10^8 to 2.45 x 10^8, 2.04 x 10^8 to 2.39 x 10^8 and 2.07 x 10^8 to 2.30 x 10^8 respectively. Statistical analysis showed no significant difference between control and treatment and among treatments. The results of the present study were similar to the reports of Hamann and Marth (1984) indicating that addition of condensed coconut water does not produce any appreciable change in the growth of *L. bulgaricus*. The lower mean *S. thermophilus* count of 1.90 x 10^7 was observed in T_5 and maximum of 2.23 x 10^7 in control. Statistical analysis revealed no significant difference between control and treatments T_2 and T_3, but significant difference ($P < 0.01$) from T_4 and T_5. FAO/WHO recommended a level of 1.5 to 450 million count for good quality yoghurt (Lalas and Mantes, 1986). The lower count of *S. thermophilus* in 50 per cent replacement cases may be due to higher level of minerals especially calcium and potassium in the condensed coconut water.

The coliform count showed no significant difference between control and treatment and among treatments (Table 1). Indian standards (1973) has specified the limits of coliform count in fermented products as less than 10 cfu/ml and the results obtained in the present study were within this limit, indicating that addition of condensed coconut water does not produce any change in coliform count. The yeast and mould count showed significant difference ($P < 0.01$) between control and treatments (Table 1). A higher count noticed in treatments may be due to the stimulating factor for yeast and moulds present in the coconut water (Krishnamoorthy, 1994). Eventhough there was significant difference between control and treatments, the counts were within the recommended range of 100 cfu/ml (Indian Standards: 7035, 1973).

The maximum score for appearance (4.67) was recorded in control yoghurt and minimum of 3.45 in T_4 (Table 2 and Fig.3). The statistical analysis showed no significant difference between control and treatments and among treatments. The scores obtained in the present investigation are in close agreement with the reports of Shakeel-Asgar and Thompkinson (1994). Body and texture scores showed no significant difference between control and T_3 but significantly higher ($P<0.01$) than T_2, T_4 and T_5 and these scores were statistically at par (Table 2 and Fig. 3). The maximum score of 4.43 was observed in control and minimum of 2.83 in T_4. The results of the present investigation were in agreement with the reports of Chawla and Balachandran (1994), indicating that addition of yoghurt incorporating condensed coconut water replacing 25 per cent of MSNF had comparable body and textural characters as that of normal yoghurt. The minimum flavour score of 5.5 was recorded in T_4 and maximum of 9.17 in control (Table 2 and Fig. 3). The statistical analysis revealed no significant difference between control and treatments T_2 and T_3 indicating that 25 per cent replacement of MSNF with condensed coconut water with or without added gelatin had comparable flavour score as that of control, where as the scores for the control and above treatments (T_2 and T_3) were statistically higher ($P<0.01$) than T_4 and T_5. The results of the present investigation were similar to the reports of Mehanna and Mehanna (1989). The minimum total score of 12.15 was recorded in T_4 and maximum of 17.44 in control (Table 2 and Fig. 3). The statistical analysis showed no significant difference between control and treatments T_2 and T_3 and these mean scores were significantly higher ($P< 0.01$) than T_4 and T_5 indicating that replacement of condensed coconut water at 25 per cent level

Table 2 Sensory attributes of filled yoghurt using condensed coconut water

Characters		Control	Treatments			
		TC	T2	T3	T4	T5
Appearance Score	Range	4.05 - 4.67	3.90 - 4.42	3.95 - 4.55	3.45 - 4.22	3.83 - 4.33
	Mean±SE	4.21±0.10	4.16±0.08	4.31±0.09	3.91±0.14	4.15±0.08
Body and Texture Score	Range	4.22 - 4.43	3.40 - 4.00	4.00 - 4.40	2.83 - 3.98	3.17 - 4.15
	Mean±SE	a 4.38±0.04	b 3.68±0.10	a 4.18±0.05	b 3.40±0.17	b 3.54±0.14
Flavour Score	Range	7.50 - 9.17	7.00 - 8.67	7.00 - 8.67	5.50 - 7.00	6.30 - 7.67
	Mean±SE	a 8.12±0.24	a 7.86±0.28	ab 7.79±0.29	b 6.47±0.22	b 7.02±0.23
Total Score	Range	15.85 - 17.44	14.52 - 16.72	15.73 - 16.80	12.15 - 14.85	13.94 - 15.65
	Mean±SE	a 16.71±0.33	a 15.78±0.17	a 16.02±0.40	b 13.74±0.30	b 14.70±0.72

Means bearing the common letters as superscript do not differ significantly

with or with out gelatin had a similar score as that of control. The results of the present study were in close agreement with the reports of Mistry and Hassan (1992) and Baig (1994).

The cost estimation indicated that when replacement level increased the cost of ingredients per 100 g of yoghurt decreased. When the replacement levels were 25 and 50 per cent, the percentage reduction in cost were 8.0 and 19.30 per cent respectively as compared to control yoghurt. The savings in cost in gelatin added treatments were 3. 6 and 15.05 per cent when replacements were at 25 and 50 per cent respectively. The reduction in cost for experimental yoghurt should be attributed to the lower cost of condensed coconut water as compared to skim milk powder.

Summary

A detailed investigation was carried out to assess microbiological and sensory attributes of yoghurt made by incorporating condensed coconut water in partial replacement of MSNF at 25 and 50 per cent

levels with and without gelatin. There was no significant difference in tyrosine value between control and treatments. No significant difference was observed in *L. bulgaricus* and coliform count but significant difference ($P < 0.01$) between control and treatment was observed with *S. thermophilus* count and yeast and mould count.

Acknowledgement

Sincere thanks are due to the Dean, College of Veterinary and Animal Sciences, Mannuthy for providing necessary facilities to conduct the work and for giving permission to publish the work.

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