Journal of Veterinary and Animal Sciences. 29 (1998) 1-5

PHYSICO-CHEMICAL PROPERTIES OF FILLED YOGHURT INCORPORATING CONDENSED COCONUT WATER*

S.P. Malarkannan and P.I. Geevarghese**
Department of Dairy Science
College of Veterinary and Animal Sciences, Mannuthy

Yoghurt is a globally accepted nutritious and valuable food, characterised by its typical aroma, flavour and semisolid consistency. It is priced high because of the higher percentage of solids compared to milk, reducing its demand. If the cost of the product can be reduced, the nutritious yoghurt can be made cheaper and available to all sections of consumers. This study was designed to use condensed coconut water to replace a part of Milk-Solids-Not-Fat (MSNF) in yoghurt in an attempt to reduce its cost.

Materials and methods

Coconut water used in the trials was collected from Copra manufacturers. The collected water was filtered and condensed to approximately 20 per cent total solids by "Anhydro Type Lab. E.W.O. 1688" vacuum evaporator at a temperature of 45°C maintaining a vacuum of 70 cm of mercury. The yoghurt cultures, namely *Streptococus salvarious ssp. thermophilus* YH-S and *Lactobacillus delbrueckii ssp. bulgaricus* YH-L (procured from NDRI, Karnal, Haryana) were maintained separately in sterile skim milk and subcultured at weekly intervals. The cultures were tested periodically for purity and activity.

The 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). Starter culture was added at the rate of 4 per cent in the above treatments. The method described by Baig (1994) was followed in the preparation of yoghurt. A pilot heat stability test was conducted to find out the minimum quantity of trisodium citrate required to provide sufficient heat stability of yoghurt mix. The experiment was carried out with six replications. The data obtained were subjected to statistical analysis (Snedecor and Cochran, 1967) using completely randomised design (CRD).

Time taken to reach the pH of 4.6 was taken as setting time (Baig, 1994). The acidity and fat were determined by using the procedure described by Tamine and Robinson (1985). The pH was measured using a digital

---

* *Part of M.V.Sc. thesis submitted to Kerala Agricultural University, Mannuthy, Thrissur by the first author*

** *Present address: 7, Meenakshi Street, South Street, Aruppukottai, 626 101* pH meter. Total protein and Non protein nitrogen (NPN) were estimated by the method described in Indian Standards: 1479, part II (1961). Method described by Chandrasekhara *et al.* (1957) was followed to measure the curd tension. The apparent viscosity values of the samples were measured with a Brook Field Viscometer Model DV-I after refrigerating the sample overnight following the manufacturer's instruction. The equipment was standardized and the spindle was allowed to rotate and then it was immersed into the sample slowly to avoid channelling effect. Readings were taken at 20°C after 10 minutes of spindle rotation (speed 2.5 revolutions/min, spindle number 4).

Results and discussion

The pH of 4.6 was taken as the cut off point in the fermentation process of yoghurt (Tamine and Robinson, 1985). Statistical analysis showed significant difference ($P<0.01$) between control and treatments (Table 1) as well as between the treatments. Increasing trend in the setting time from 3.47 to 4.28 h was observed with higher replacement levels of MSNF with solids from condensed coconut water. This may probably be due to higher concentration of minerals in condensed coconut water which might have led to slow growth of starter organisms. Yousef and Rusli (1995) reported that calcium fortification may increase the culturing time resulting in yoghurt with weak body and this may be the reason attributed to the slow growth of starter organism in treatments, which contained higher concentration of minerals especially calcium and potassium. The mean acidity (Table 1) was 0.922 in control and were 1.052, 1.037, 1.035 and 1.008 in treatments T_2, T_3, T_4 and T_5 respectively. The acidity percentage showed significant increase ($P < 0.01$) as replacement level increased and this can be attributed to the sodium citrate added to the yoghurt mix for maintaining the heat stability. Baisya and Bose (1975) have also reported that addition of sodium citrate increased the acid production. The mineral profile and the composition of coconut water might have also contributed to increased acidity in treatments.

The mean pH (Table 1) for control was 4.537 and were 4.555, 4.558, 4.565 and 4.577 for treatments T_2, T_3, T_4 and T_5 respectively. Statistical analysis revealed no significant difference between the treatments and control indicating that replacement of condensed coconut water at 25 and 50 per cent level produced yoghurt having comparable pH as that of control. Marshall (1982) recommended pH of 4.4 to 4.6 and 4.6 to 4.7 for maintaining desirable body and texture and proper balance of *S. thermophilus* and *L. bulgaricus*. Statistical analysis of fat content in yoghurt showed no significant difference between control and treatments. Alm (1982) recommended yoghurt with 3 per cent fat as ideal for obtaining good flavour and mouthfeel.

The minimum mean protein content of 3.302 per cent was observed in T_4 and maximum of 5.766 per cent in control (Table 1). A decreasing trend in protein content was observed as percentage replacement increased but a significant difference ($P < 0.01$) was noted between control and treatments and among treatments in yoghurt mix. This might have occurred due to lower protein content in the coconut water (Jayalekshmy *et al.*, 1986). The NPN values (Table 1) showed significant difference ($P < 0.01$) between control and treatments as well as between treatments. Increasing trend (53.43 ± 1.28

Table 1 Physico chemical properties of filled Yoghurt using condensed coconut water

Characters		Control	Treatments			
		TC	T2	T3	T4	T5
Setting time (h)	Range	3.40-3.52	4.08-4.18	4.17-4.22	4.20-4.27	4.24-4.32
	Mean±SE	3.47±0.018 [a]	4.13±0.019 [b]	4.18±0.013 [b]	4.25±0.011 [c]	4.28±0.011 [c]
Titratable acidity (as % lactic acid)	Range	0.88-0.98	1.01-1.08	0.97-1.07	0.99-1.07	0.96-1.06
	Mean±SE	0.922±0.02 [a]	1.052±0.01 [b]	1.037±0.02 [b]	1.035±0.01 [b]	1.008±0.02 [b]
pH	Range	4.53-4.56	4.55-4.56	4.55-4.57	4.56-4.57	4.57-4.58
	Mean±SE	4.537±0.011	4.555±0.002	4.558±0.004	4.565±0.005	4.577±0.002
Fat (g %)	Range	2.80-3.20	2.70-3.20	2.90-3.20	2.80-3.10	2.90-3.20
	Mean±SE	3.00±0.14	3.02±0.16	3.08±0.11	2.98±0.13	3.05±0.12
Protein (g/100 ml)	Range	5.520-5.980	3.740-4.110	3.830-4.110	3.180-3.410	3.180-3.460
	Mean±SE	5.766±0.07 [a]	3.918±0.06 [b]	3.957±0.05 [b]	3.302±0.05 [c]	3.328±0.05 [c]
NPN (mg/100 ml)	Range	35.700-52.700	49.300-57.800	51.000 -59.600	52.200-69.700	58.200-69.950
	Mean±SE	43.15±2.64 [a]	53.43±1.28 [b]	54.50±1.31 [b]	60.55±2.37 [c]	61.08±2.28 [c]
Curd tention (g)	Range	26.000-32.000	12.000-15.500	17.000-21.500	11.000-14.000	16.000-19.500
	Mean±SE	28.337±1.08 [a]	14.167±0.49 [b]	19.167±0:67 [c]	12.833±0.46 [b]	17.667±0.65 [c]
Viscosity (p)	Range	233.85-277.89	115.37-162.741	161.76-197.30	90.95-131.17	111.79-151.10
	Mean±SE	252.27±7.34 [a]	140.04±7.22 [b]	169.29±10.45 [c]	118.05±7.32 [b]	133.28±6.11 [b]

Means bearing the common letters as superscript are not significantly different.

in T_2 as compared to 61.08 ± 2.28 in T_5) in NPN content in treatments may be due to higher level of NPN (21.0 mg per cent) in the coconut water (Jayalekshmy *et al.*, 1986). Mehanna and Mehanna (1989) observed that curd tension increased with the addition of stabilizers. This may be the reason for higher curd tension values in T_3 (19.167 ± 0.67) and T_5 (17.667 ± 0.65) than their corresponding pair T_2 (14.167 ± 0.49) and T_4 (12.833 ± 0.46) (Table 1). The higher mean curd tension value of 28.337 g in the control may be due to higher casein and total protein which increased the curd tension (Rao *et al.*, 1964).

There was a significant decrease ($P<0.01$) in viscosity values in the treatment as compared to control. The higher viscosity observed in the control may be due to higher protein content (5.766 per cent) than in the treatments (3.302 to 3.957) Builova *et al.* (1983) reported that viscosity was increased with higher levels of protein. The increased viscosity value of 169.29 p and 133.28 p in treatment T_3 and T_5 respectively as compared to their corresponding treatments may be due to addition of gelatin (Table 1). Jogdand *et al.* (1991) reported that viscosity of Yoghurt was increased with incorporation of gelatin.

Summary

An attempt was made to incorporate condensed coconut water in partial replacement of MSNF at 25 and 50 per cent level in filled yoghurt containing 0.5 per cent gelatin and without gelatin to study its physico chemical properties which was compared with normal yoghurt. No significant difference was observed in pH and fat content between control and treatment yoghurt. Significant difference ($P < 0.01$) in titratable acidity, protein and NPN percentage was recorded between control and treatments. The curd tension and viscosity decreased with higher level of replacement but this property improved to certain extent by addition of gelatin. The setting time and NPN content increased with higher replacement level.

Acknowledgement

The authors are grateful to the Dean, College of Veterinary and Animal Sciences, Mannuthy, Thrissur for providing facilities and giving permission to publish the article.

References

Alm, L. (1982). Effect of fermentation on proteins of Swedish fermented milk products. *J. Dairy Sci.* **65**;1696-1704

Baig, M.I. (1994). Effects of incorporation of condensed cheese whey and *Bifidobacterium bifidum* in yoghurt. Thesis submitted to Kerala Agricultural University, India for award of Ph.D degree

Baisya, R.K. and Bose, A.N. (1975). Role of inoculating organisms on the physicochemical changes of milk and on final curd (Dahi) quality. *Indian J. Dairy Sci.* **28**:179-183

Builova, L.A., Molotov, S.V. and Panina, N.O. (1983). Optimization of composition of yoghurt made from butter milk. *Pishchevaya Technologiya*, **1:** 90-91. Cited in *Dairy Sci. Abstr.* **46**: 2473

Chandrasekhara, M.R., Swaminathan, M., Bhatia, D.S. and Subramanian, V. (1957). Infant food from buffalo milk. 1. Effects of different treatments on curd tension. *J. Food Sci.* **6**: 226-228

Indian Standards: 1479. (1961). *Methods of test for dairy industry part II. Chemical analysis of milk.* Bureau of Indian Standards, New Delhi

Jayalekshmy, A., Arumughan, C., Narayanan, C.S. and Mathew, A.G. (1986). Changes in chemical composition of coconut water during maturation. *J. Food Sci. Tech.* **23**: 203-207

Jogdand, S.B., Lembhe, A.F., Ambadkar, R.K. and Chopade, S.S. (1991). Incorporation of additives to improve the quality of Dahi. *Indian J. Dairy Sci.* **44**: 459-460

Marshall, K.R. (1982). Industrial isolation of milk proteins: Whey proteins. Cited in *Developments in dairy chemistry I. Protein.* Applied Science Publishers, London, U.K. pp. 339-374

Mehanna, N.M., and Mehanna, A.S. (1989). On the uses of stabilizer for improving some properties of cow's milk Yoghurt. *Egypt. J. Dairy Sci.* **17**: 289-296

Rao, R.V., Chopra, V.C., Stephen, J. and Bhalerao, V.R. (1964). Studies on the curd tension of milk *J. Food Sci. Tech.* **1**: 19-22

Snedecor, G.W. and Cochran, W.G. (1967). *Statistical methods.* 6th ed., Oxford and I.B.H. Company, Calcutta

Tamine, A.Y. and Robinson, R.K. (1985). *Yoghurt Science and Technology.* Pergamon press, Oxford

Yousef, A.E. and Rusli, M. (1995). Modification of starter culture for production of calcium fortified Yoghurt. *Cult. Dairy Prod. J.* **30**(4): 20-25