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RESEARCH ARTICLE

SURVIVAL OF YOGHURT CULTURE IN SPRAY DRIED AND CHEMICALLY STABILIZED SPRAY DRIED YOGHURT POWDER DURING STORAGE

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ABSTRACT

A study has been designed to evaluate the effect of spray drying on the survivability of yoghurt culture and its storage stability in different conditionally preserved yoghurt. For that a standardized recipe of formulation were used to prepare the yoghurt with lactic acid fermenter viz., *Lactobacillus delbruecki ssp. bulgaricus* and *Streptococcus salivarius ssp. thermophilus* and then subjected to spray drying. Ascorbic acid and monosodium glutamate were added to impart stabilization during storage because of the anti oxidant properties. Microbial analysis was carried out on different storage days 0 day, 30th day stored at (4 & 30˚C) with or without addition of stabilizer. The analyzed results revealed that, chemically stabilized yoghurt powder had showed higher microbial counts than the non-stabilizer added yoghurt powder and significantly ($p<0.01$) differed. Comparatively, survival rate for *S. salivarius ssp. thermophilus* was higher in chemically stabilized yoghurt powder than *L. delbrueckii ssp. bulgaricus at* both the storage temperature up to 30 days. There was no significant difference in the survival of *L.delbrueckii* ssp. *bulgaricus* in spray dried and chemically stabilized spray dried powder during storage at 4°C and 30°C upto 30 days.

INTRODUCTION

Yoghurt is a coagulated milk product obtained by lactic acid fermentation through the action of *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus salivarius* ssp. *thermophilus* from milk and milk products with or without optional addition such of milk powder, skimmed milk powder, whey powder etc.Consumption of yoghurt is recommended as a remedy for gastrointestinal disorders and for lactose intolerant people. The digestibility of yoghurt is much better than that of ice cream (Guven and Karaca, 2002) along with the proven enhancing role played in strengthening the immune system and synthesis of vitamin C (Latha Sabiki and Mathur, 2001). In yoghurt, bioavailability of copper, calcium, iron, zinc, manganese and phosphorus are high as compared to milk (Sherwood, 1990). Obviously a fluid milk product has limited shelf life and is not readily transportable to distant markets at low cost. A dry product could better serve these needs.Drying yoghurt is a very old method of preservation. At present, drying yoghurt is carried out by using modern machines and processing.The spray drying of microorganisms began with the study by Rogers (1914) of dried milk cultures of lactic acid bacteria.Powdered Yoghurt with a clean, fresh flavour is obtained from spray drying technology with viable cultures of *S.salivarius* ssp. *thermophilus* and *L.delbrueckii* ssp. *bulgaricus*. Active cultures are guaranteed for 1 year under cool, dry conditions. The present study was undertaken to compare the stability of spraydried yoghurt powder with chemically stabilized spray dried yoghurt powder.

Part of M.V.Sc.,Thesis submitted by first author and approved by Tamilnadu veterinary and Animal Sciences University.

MATERIALS AND METHODS

Fresh whole cow milk collected from the dairy plant, Department of Dairy Science, Madras Veterinary College was used. Whole milk was standardized to 2 per cent fat by addition of skim milk. Skim milk powder was added to increase the solids-not-fat content (SNF) to 14 per cent level.

The SNF content of the milk was determined as per IS: 1183-1965.Milk fat was determined by Gerber's method described in IS: 1224(PartI-1977).Sugar was added at the rate of 7 per cent and stabilizer at a level of 0.2 per cent. The yoghurt mix was warmed to 54°C, homogenized at 2500 psi, pasteurized at 85°C for 30 min and cooled to 45°C (Tamime and Deeth, 1980). The cultures used were *Lactobacillus delbrueckii, ssp.bulgaricus* and *Streptococcus salivarius ssp thermophilus* (NCDC 144). The batch was inoculated with 2 per cent starter culture comprising of *Streptococcus salivarius* ssp. *thermophilus* and *Lactobacillus delbrueckii* ssp. *bulgaricus* in the ratio of 1:1. The inoculated yoghurt mix was filled into plastic cups and incubated at 42°C until the desired pH of 4.2 was attained. The cups were stored in the refrigerator at 4°C until further use.Spray drying of yoghurt was carried out by slightly modifying the procedure followed by Kim and Bhowmik (1990). Yoghurt was vigorously stirred in a Waring Blender for 1 min (20 sec at low speed; 20 sec high speed; and 20 sec again at low speed) and rapidly warmed to 30°C before spray drying. Stirred yoghurt was diluted with equal quantity of water in order to prevent clogging of the nozzle during spray drying in a laboratory-scale spray drier. Indian make (Jektron Engineers Pvt. Ltd., Pune) laboratory model of 2kg/h capacity with co-current parallel air flow type fitted with centrifugal, spraying device was used. Survival of yoghurt culture at different outlet temperatures were studied. The outlet temperature was fixed based upon the minimum moisture content and maximum survival of yoghurt culture. For chemical stabilization of yoghurt ascorbic acid (12.5 g/L) and mono sodium glutamate (12.5 g/L) were added before spray drying. The data obtained were statistically analysed as per the procedure of Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The data with respect to survival of *S.salivarius* ssp. *thermophilus* in fresh yoghurt, spray dried powder and chemically stabilized spray dried yoghurt powder during storage are given in Table 1. The mean $\pm$ SE with regard to survival of *S.salivarius* ssp. *thermophilus* for fresh yoghurt, spray dried powder (zero day) spray dried powder on 30th day at 4°C and 30°C and were 9.38 $\pm$ 0.18, 7.06 $\pm$ 0.38, 6.44 $\pm$ 0.39 and 5.89

± 0.40 respectively. The mean ± SE with regard to survival of *S.salivarius* ssp. *thermophilus* for chemically stabilized fresh yoghurt, chemically stabilized spray dried powder (zero day), chemically stabilized spray dried powder on 30th day at 4°C and 30°C were 9.38 ± 0.18, 8.30 ± 0.23, 7.79 ± 0.32 and 7.35 ± 0.25 respectively. The survival of *S.salivarius* ssp. *thermophilus* were higher in chemically stabilized spray dried powder than in spray dried powder during storage. Statistical analysis of data with regard to survival of *S.salivarius* ssp. *thermophilus* revealed significant difference ($p < 0.01$) between spray dried and chemically stabilized spray dried powder at zero day and for 30 days at 4°C and 30°C respectively.

This might be due to ascorbate depletion during storage, which leads to decrease in stabilization effect and culture viability.

Conclusion

After the detailed investigation has been made / carried out to improve the survival rate of yoghurt culture during spray drying and subsequent storage, it was concluded that the possible survival chances were higher in chemically stabilized yoghurt powder than that of control.

Table 1. *S.salivarius* ssp. *thermophilus* count in spray dried and chemically stabilized spray dried yoghurt powder during storage

Sl.No.	Sample	Yoghurt control	Type Chemically stabilized	t-value
		$\log_{10}$ cfu/ml	$\log_{10}$ cfu/ml	
1.	Fresh yoghurt (before drying)	9.38 ± 0.18	9.38 ± 0.18	0.00
2.	Spray dried powder (zero day)	7.06 ± 0.38	8.30 ± 0.23	2.78**
3.	Spray dried powder (30th day at 4°C)	6.44 ± 0.39	7.79 ± 0.32	2.67**
4.	Spray dried powder (30th day at 30°C)	5.89 ± 0.40	7.35 ± 0.25	3.09**

**Indicating significant difference at 1% level ($p < 0.01$)).
"Chemically stabilized" indicates addition of ascorbic acid and mono sodium glutamate.

Table 2. *L.delbrueckii* ssp. *bulgaricus* count in spray dried and chemically stabilized spraydried yoghurt powder during storage

Sl.No.	Sample	Yoghurt control	Type Chemically stabilized	t-value
		$\log_{10}$ cfu/ml	$\log_{10}$ cfu/ml	
1.	Fresh yoghurt (before drying)	8.56 ± 0.28	8.56 ± 0.28	0.00
2.	Spray dried powder (zero day)	6.25 ± 0.25	7.19 ± 0.20	2.99**
3.	Spray dried powder (30th day at 4°C)	5.73 ± 0.22	6.32 ± 0.28	1.68
4.	Spray dried powder (30th day at 30°C)	5.19 ± 0.25	5.77 ± 0.31	1.45

** Indicating significant difference at 1% level ($p < 0.01$)
"Chemically stabilized" indicates addition of ascorbic acid and mono sodium glutamate.

This result obtained is in agreement with Porubcan and Sellers (1975) who reported that ascorbic acid and monosodium glutamate impart stabilization during storage because of the antioxidant properties of the ascorbate coupled with the moderating effect of glutamate in controlling the rate of ascorbate oxidation. The data with respect to survival of *L.delbrueckii* ssp. *bulgaricus* in spray dried and chemically stabilized spray dried yoghurt powder are given in Table 2. The mean ± SE with regard to survival of *L.delbrueckii* ssp. *bulgaricus* for fresh yoghurt, spray dried yoghurt powder on zero day, spray dried powder on 30th day at 4°C and 30°C were 8.56 ± 0.28, 6.25 ± 0.25, 5.73 ± 0.22 and 5.19 ± 0.25 respectively. The mean ± SE with regard to survival of *L.delbrueckii* ssp. *bulgaricus* for fresh yoghurt, chemically stabilized spray dried powder (zero day), chemically stabilized powder 30th day at 4°C and 30°C were 8.56 ± 0.28, 7.19 ± 0.20, 6.32 ± 0.28 and 5.77 ± 0.31 respectively. Statistical analysis of data with regard to survival of *L.delbrueckii* ssp. *bulgaricus* revealed that there was significant difference ($P < 0.01$) between spray dried powder (zero day) and chemically stabilized spray dried powder (zero day). Teixeira *et al*., (1995) reported that ascorbic acid can acts both as an antioxidant and as a pro-oxidant. Survival of cell concentrates of *L.delbrueckii* ssp. *bulgaricus* following spray drying in skim milk with ascorbic acid and monosodium glutamate was higher during storage at 4°C. Higher mean values (7.19 ± 0.20) were obtained for survival of *L.delbrueckii* ssp. *bulgaricus* in chemically stabilized spray dried powder than mean values of 6.25 ± 0.25 for survival of *L.delbrueckii* ssp. *bulgaricus* in spray dried yoghurt powder immediately after spray drying (zero day). These results are in concurrent with Porubcan and Sellers (1975), but no significant difference was noticed on storage at 4°C and 30°C for 30 days with respect to survival of *L.delbrueckii* ssp. *bulgaricus* in spray dried and chemically stabilized spray dried yoghurt powder.

- The role of spray drying in yoghurt manufacture is highly significant in the growth, activity and maintaining the viability of yoghurt cultures if proper amount of stabilizer added in the formulation before subjecting to spray drying.
- Survival rate of *S. salivarius ssp. thermophilus* was higher than *L. delbrueckii ssp. bulgaricus at* both the storage temperature up to 30 days.
- Economic point of view, as the nature of yoghurt powder is less weight when compared to whole yoghurt, it become very easy for transport and even storage too.

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