

PJN

ISSN 1680-5194

PAKISTAN JOURNAL OF
NUTRITION

ANSI*net*

308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Evaluation of Yogurt Prepared from Locally Propagated Starter Culture

Haider Khan¹, Mohammad Amin Shah¹ and Junaid Ali Shah²

¹Dairy Technology Laboratory, Animal Sciences Institute,
National Agricultural Research Centre, Islamabad, Pakistan

²Department of Microbiology, Hazara University, Mansehra, Pakistan

Abstract: This study aimed to propagate starter culture locally for yogurt preparation and conduction of sensory evaluation trials for testing the quality of developed starter culture. Experiments were conducted to select the strains of *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus* having most suitable properties for preparation of quality yogurt. The selection criteria included lactic acid production ability and aroma production. To propagate the starter culture whey based medium was found to successfully support the growth of desirable bacterial isolates and, therefore, used to propagate the yogurt culture. The propagated culture was then used for preparation of yogurt and sensorial evaluation of the yogurt was done. The results indicated that the yogurt was liked very much in terms of colour, texture, flavour and taste. Finally a comparative sensory evaluation was done between a sample of local dahi and yogurt prepared from locally propagated culture. It was observed that the yogurt prepared from locally propagated culture was significantly better in quality as compared to yogurt (dahi) prepared by traditional method.

Key words: Yogurt, Starter culture, Sensory evaluation, *Lactobacillus delbrueckii* ssp., milk

INTRODUCTION

Pakistan is fourth largest milk producing country in the world. It is currently producing about 50 billion litres of milk annually (Pakistan Economic Survey, 2013-14). However, a large volume of milk is either consumed raw or is processed by traditional methods. Traditionally yogurt is prepared by back slopping method (use of undefined culture). This undefined starter culture is often contaminated with a variety of undesirable and/or pathogenic microorganisms. This not only results in a low quality product but is also a health hazard for the consumers. It has been observed that the yogurt prepared by defined starter culture generally do not contain any coliform bacteria whereas the yogurt (dahi) prepared by traditional back slopping method does contain coliforms with an average of 4.39×10^3 cfu/ml (Younus *et al.*, 2002). The presence of coliforms is an indicator of poor hygienic quality.

Various species of Lactic Acid Bacteria (LAB) have been isolated from traditional dahi which include *Lactobacillus delbrueckii* ssp. *bulgaricus*, *Lactobacillus helveticus*, *Lactobacillus acidophilus*, *Streptococcus thermophilus* and *Lactobacillus casei* (Masud *et al.*, 1991). The presence of various species of LAB in varying proportions in undefined starter culture results in variable acidity and texture of yogurt from batch to batch. In contrast yogurt prepared by defined starter culture always contains strains of only two species *L. delbrueckii* ssp. *bulgaricus* and *S. thermophilus* in a 1:1 ratio. This results in a superior quality product whose acidity and texture stays the same from batch to batch (Farnworth *et al.*, 2007).

Various studies have been conducted in Pakistan for hunting dairy starter strains from different sources. Five samples of traditional yogurt were collected from Faisalabad city. Isolates of *L. delbrueckii* ssp. *bulgaricus* and *S. thermophilus* obtained from these samples were used for preparation of yogurt. The yogurt sample was then compared with yogurt prepared from imported starter culture. No significant difference was observed in the quality of the two samples in terms of texture, flavor and aroma indicating the suitability of local isolates for preparation of yogurt starter culture (Anjum *et al.*, 2007). Fifteen strains each of *L. delbrueckii* ssp. *bulgaricus* and *S. thermophilus* were isolated from dahi prepared by back slopping and two strains from branded yogurt prepared from defined starter culture. The isolates were tested for their acid producing ability. It was observed that more than 50% of *S. thermophilus* strains were fast acid producers whereas majority of *L. delbrueckii* ssp. *bulgaricus* strains were mild acid producers. Yogurt was prepared with different combination of the strains of two species. Organoleptic evaluation indicated that yogurt prepared by combination of *L. delbrueckii* ssp. *bulgaricus* Lb5 and *S. thermophilus* St. 4 was most acceptable, indicating the suitability of these strains to be used as starter culture (Soomro and Masud, 2008).

The above account shows that work has been done in Pakistan to hunt for most desirable yogurt producing strains. However, no work has been done to propagate these strains. This study was, therefore, planned to fulfill this need and already isolated yogurt starter strains were propagated to prepare local starter culture.

Sensory evaluation was then done with an aim to judge consumer acceptance of yogurt prepared from developed culture.

MATERIALS AND METHODS

The study was conducted at Dairy Technology Laboratory, Animal Sciences Institute, National Agricultural Research Centre, Islamabad. The aim of the study was to locally propagate yogurt starter culture from available bacterial strains and to use the culture for yogurt preparation and to evaluate the sensory attributes of yogurt to determine its quality.

Selection of bacterial strains: Ten strains each of *S. thermophilus* and *L. delbrueckii* ssp. *bulgaricus* were screened for the most desirable characteristics (high acid production and aroma). The strains had been isolated from yogurt and local dahi samples collected from local market. The strains were coded as given in Table 1.

Propagation of bacterial strains: A whey based medium was found suitable for growing the bacterial strains. The composition of the medium is given in Table 1.

The selected strains were individually grown in 1 L flask using whey based medium with control of pH and temperature. For growth of *S. thermophilus* pH was maintained at 6.5 and for growth *L. delbrueckii* ssp. *bulgaricus* pH was maintained at 5.5 during the growth period. The temperature was maintained at 42°C for growing the bacterial strains.

Harvesting and preservation of bacterial cells: The bacterial cells were harvested during the early stationary phase by centrifugation. The cell pellet thus obtained was then resuspended in 10% skim milk supplemented with 4% monosodium glutamate added as a cryoprotectant. The resuspended cells of *S. thermophilus* and *L. delbrueckii* ssp. *bulgaricus* strains were then mixed in a 1:1 ratio to form the yogurt starter culture. This starter culture was preserved by freezing at -20°C.

Yogurt preparation from locally propagated starter culture: The frozen starter culture was rejuvenated by inoculating in skim milk at the rate of 2% followed by incubation at 42°C for 4 h. The coagulated skimmed milk was then used for yogurt preparation at the rate of 1.5%. The yogurt thus obtained was then subjected to sensory evaluation on a 9 point hedonic scale (Wichchukit and O'Mahony, 2014) to evaluate the performance of local starter culture. The quality parameters included color, texture, flavor and taste. Finally the quality of yogurt prepared using locally propagated starter culture was compared with a sample

of traditional yogurt (dahi) collected from local market and a comparative analysis was done.

Statistical analysis: Descriptive statistical analysis and paired t-test was performed using Microsoft Excel-2007 software.

RESULTS AND DISCUSSION

Yogurt is a fermented dairy product prepared by inoculation of milk with strains of *S. thermophilus* and *L. delbrueckii* ssp. *bulgaricus* (Elli et al., 2006). The quality of yogurt is not only dependent on the quality of milk used but also on the type of bacterial strains used for preparing this product. In Pakistan large quantities of yogurt are prepared by back slopping method (use of undefined culture). This undefined starter culture is often contaminated with a variety of undesirable and/or pathogenic microorganisms. This not only results in a low quality product but may also be a health hazard for the consumers. This is due to the reason that defined starter culture is not commonly available. This study was, therefore, conducted to utilize selected and already characterized strains of *S. thermophilus* and *L. delbrueckii* ssp. *bulgaricus* (Table 1) to develop defined local yogurt culture. The strains of the two bacterial species were used in a 1:1 ratio to form the culture which was then used to prepare yogurt. The yogurt was subjected to sensory evaluation on a 9 point Hedonic scale (Wichchukit and O'Mahony, 2014), where 1 corresponding to Dislike extremely and 9 to like extremely and 5 score was regarded as neither like nor dislike. The results of the evaluation are shown in Fig. 1.

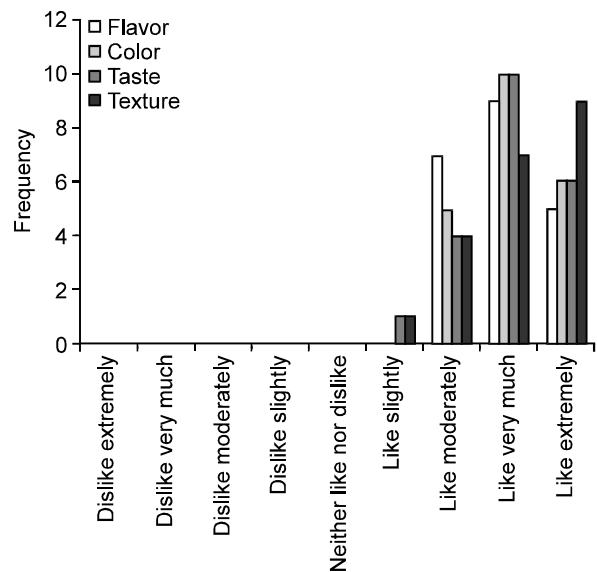


Fig. 1: Sensory Evaluation of yogurt prepared by using locally propagated starter culture on a 9-point Hedonic scale (1= dislike extremely and 9 = Like extremely)

The figure shows the sensory evaluation of yogurt by 21 evaluators. The results indicate that the yogurt prepared by defined starter culture was liked very much by the majority of evaluators and very few liked slightly in terms of taste and texture, while none disliked the yogurt.

Descriptive statistical analysis showed that the mean score for flavor was 7.9 ± 0.77 , whereas the mean scores for color, taste and texture were 8.04 ± 0.74 , 8 ± 0.84 and 8.14 ± 0.91 , respectively. In a similar study yogurt was prepared with different combination of the strains of two species. Organoleptic evaluation indicated that yogurt prepared by combination of *L. delbrueckii* ssp. *bulgaricus* Lb5 and *S. thermophilus* St. 4 was most acceptable, indicating the suitability of these strains to be used as starter culture (Soomro and Masud, 2008).

In terms of percentage of likeness for different attributes of sensory evaluation the results are presented in Fig. 2a-d.

A glance at Fig. 2 shows that 40% of the evaluators liked the flavor of yogurt very much and 35% extremely liked

the flavor of yogurt. Similarly in terms of taste and texture 50 and 35% of the evaluators liked the yogurt very much, respectively, whereas only 5% of evaluators showed reduced likeness of yogurt in terms of taste and texture. Finally to conclude the study a comparative analysis was done between the yogurt prepared by locally propagated starter culture and a sample of traditional dahi (prepared from undefined culture) obtained from local market (Fig. 3). A paired t-test was performed to determine if the locally developed starter culture was producing a better quality yogurt as compared to dahi in terms of flavor, color, taste and texture. The results of the t-test revealed that the yogurt prepared from locally developed culture was far superior in quality as compared to traditional dahi and the difference between the mean values was significant ($p < 0.05$). It is due to the reason that the presence of various species of lactic acid bacteria and other undesirable microorganisms in varying proportions in undefined starter culture results in variable acidity and texture of yogurt. In contrast yogurt

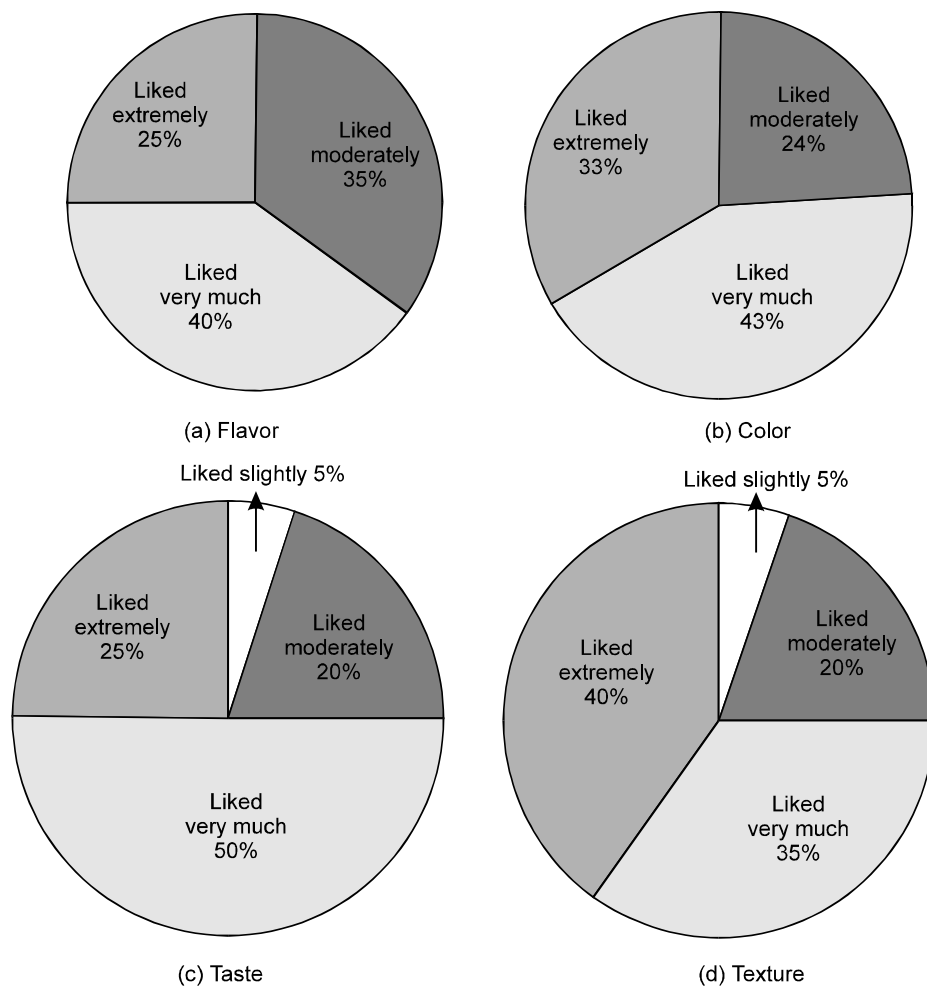


Fig. 2: Percentage acceptability of yogurt prepared by locally developed starter culture in terms of sensory attributes (a) flavor (b) color (c) taste and (d) texture

Table 1: Bacterial strains used for yogurt starter culture preparation

<i>S. thermophilus</i>	<i>L. delbrueckii</i> ssp. <i>bulgaricus</i>
DT, St-1	DT, Lb-1
DT, St-2	DT, Lb-2
DT, St-3	DT, Lb-3
DT, St-4	DT, Lb-4
DT, St-5	DT, Lb-5
DT, St-6	DT, Lb-6
DT, St-7	DT, Lb-7
DT, St-8	DT, Lb-8
DT, St-9	DT, Lb-9
DT, St-10	DT, Lb-10

Table 2: Composition of whey based medium

Ingredient	Conc. (g/L)
Sweet whey powder	30
Casein hydrolysate	10
Yeast extract	7
Dipotassium monohydrogen phosphate	13.2
Monopotassium dihydrogen phosphate	12.6

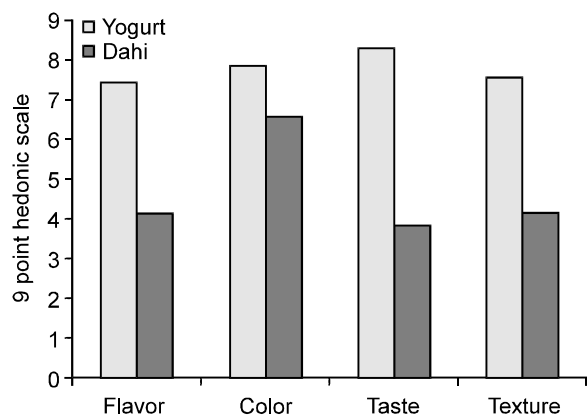


Fig. 3: Comparison of yogurt prepared using locally propagated defined culture and traditional dahi prepared from undefined culture

prepared by defined starter culture always contains strains of only two species *L. delbrueckii* ssp. *bulgaricus* and *S. thermophilus* in a 1:1 ratio. This results in a superior quality product whose acidity and texture stays the same from batch to batch (Farnworth *et al.*, 2007).

Conclusion: Yogurt starter culture can be propagated locally which can be used to prepare better quality yogurt as compared to traditional dahi.

ACKNOWLEDGEMENTS

The authors are indebted to Dr. Sarfraz Ahmed, Project Director, RADP (Research for Agricultural Development Program) for providing funding for this study. Thanks are also extended to Mohammad Younas and Tahir Ali Khan for helping in the experimental work of the study.

REFERENCES

- Anjum, R.R., T. Zahoor and S. Akhtar, 2007. Comparative study of yoghurt prepared by using local isolated and commercial imported starter culture. *J. Res. Sci.*, 18: 35-41.
- Elli, M., M.L. Callegari, S. Ferrari, E. Bessi, D. Cattivelli, S. Soldi and J.M. Antoine, 2006. Survival of yogurt bacteria in the human gut. *Appl. and Environ. Microbiol.*, 72: 5113-5117.
- Farnworth, E.R., I. Mainville, M.P. Desjardins, N. Gardner, I. Fliss and C. Champagne, 2007. Growth of probiotic bacteria and bifidobacteria in a soy yogurt formulation. *Int. J. Food Microbiol.*, 116: 174-181.
- Masud, T., K. Sultana and M.A. Shah, 1991. Incidence of lactic acid bacteria isolated from indigenous dahi. *Asian-Aust. J. Anim. Sci.*, 4: 329-331.
- Pakistan Economic Survey, 2013-14. Ministry of Finance, Government of Pakistan.
- Soomro, A.H. and T. Masud, 2008. Selection of yogurt starter culture from indigenous isolates of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* ssp. *bulgaricus* on the basis of technological properties. *Ann. Microbiol.*, 58: 67-71.
- Younus, S., T. Masud and T. Aziz, 2002. Quality evaluation of market yogurt/dahi. *Pak. J. Nutr.*, 1: 226-230.
- Wichchukit, S. and M. O'Mahony, 2014. The 9 point hedonic scale and hedonic ranking in food science: some reappraisals and alternatives. *J. Sci. Food and Agric.*, (DOI 10.1002/jsfa.6993).