The Journal of Animal and Plant Sciences, 23(1 Suppl.): 2013, Page: 58-61
ISSN: 1018-7081

QUALITY ASSESSMENT OF YOGHURT PRODUCED AT LARGE (INDUSTRIAL) AND SMALL SCALE

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ABSTRACT

The quality of fermented dairy products is a delicate subject. In addition to processing conditions, it largely depends on pre and post process handling. The present study is concerned with the physicochemical and microbiological quality of commercially available yogurt in Faisalabad, Pakistan. For this purpose, two branded (produced at large scale) and three unbranded (produced at small scale) yoghurt samples were collected from the city and were analyzed in triplicate. The data was analyzed by complete randomized design (1-factor factorial) and comparison of means was done by Duncan's multiple range test. The coliform count in branded samples was nil or ignorable. However, unbranded samples contained a higher count of coliforms. The branded samples were monocultured (*S. thermophilus*), which does not fulfill the quality criteria as *L. bulgaricus* is also needed for good quality yoghurt. In contrast, in unbranded samples, both the bacteria were present but their growth was uncontrolled. The fat, lactose and total solid contents were low in unbranded yoghurt samples than in branded samples showing lack of standardization. However, acidity and syneresis value of branded samples were low as compared to unbranded samples.

Key words: Yoghurt quality, yoghurt culture, Physicochemical quality, Microbiological quality, Commercial market.

INTRODUCTION

Yoghurt is one of the oldest fermented milk products, tremendously popular all over the world. It is a very rich source of protein, calcium and vitamins. Yoghurt is fermented by lactic acid producing bacteria, *S. thermophilus* and *L. bulgaricus* or some additional bacteria having mutual complementing metabolism (Vinderola and Reinheimer, 1999). The natural yoghurt is characterized by a smooth and viscous gel like texture and has a delicate walnutty flavor (Fuquay et al., 2011). In fact, the fermentation of lactose by lactic acid bacteria results in the production of lactic acid, carbon dioxide, acetic acid, diacetyl, acetaldehyde and several other components giving a characteristic flavor to yoghurt (Tamine and Robinson, 2004). However very careful processing is required for the production of safe and good quality yoghurt. In fact, even a little contamination may deteriorate the quality of yoghurt and may have very negative effects on consumer health.

In Pakistan, very minute quantity of processed yoghurt (branded) is available and yoghurt is mainly manufactured by local people (Gawalas) at small level (unbranded), which is locally called dahi. In contrast to branded yoghurt, the conditions (milk standardization, culture concentration, viability, incubation temperature and time etc.) for the production of unbranded (dahi) yoghurt are not controlled. In addition, there are no well defined standards for fermented dairy products. As a result, the quality of yoghurt/dahi in local market from shop to shop is highly variable. However, people are becoming more and more conscious about the quality of food products.

The quality of yoghurt is governed by a number of factors. In fact, inferior milk quality, unhygienic conditions and the use of "wild type" of starter culture give rise to poor grade dahi, having lower shelf life. In addition, microbiological aspect is one of the most important factors. The microbial quality of yoghurt reflects towards the quality and acceptability of the yoghurt. Due to unhygienic conditions there is possibility of microbial contamination (pathogens), which may have serious impact on the health of consumers. Further, unhygienic vending conditions (open packs, higher contamination) also deteriorate the keeping quality of yoghurt (Aziz, 1985). In contrast there is an increasing demand for taste, quality, stability and shelf life of the yoghurt from customer side. Hence the research in the field of quality assessment of yoghurt marketed is the basic need to create awareness among common people. For this purpose some branded (industrial) and unbranded (locally produced dahi) samples of yoghurt from Faisalabad city (3rd largest city of Pakistan) were collected and were assessed for their quality.

MATERIALS AND METHODS

Sample Collection: Three samples (A, B and C) of unbranded (hand made local yoghurt named as dahi) yoghurt and two samples (D and E) of branded yoghurt (industrial) were collected at the same time from local market of Faisalabad under sterilized conditions. Three random samples were taken from each branded and unbranded yoghurt sample. The branded samples were in their original packing and unbranded samples were collected in sterilized bottles. The samples were analyzed as soon as possible after the manufacturing.

Microbiological Analysis: Total viable count of *S. thermophilus, L. bulgaricus* and Coliform was determined by standard plate count method as described by Coppuccino and Sherman (1996). The selective media used for viable count of *S. thermophilus, L. bulgaricus* and Coliform were Neutral red chalk lactose agar, Acetate agar and Violate red bile agar respectively as described by Harrigan and McCance (1976).

Chemical Analysis: Fat percentage was determined by centrifugation method as described by

Pearson (1976). Acidity percentage was determined by titration and pH was measured by digital pH meter after calibration. Lactose percentage was determined by filtration and total solids percentage was determined by hot air oven according to the method described by AOAC (2006).

Physical Analysis: Syneresis value was measured according to the method of Peri et al. (1985).

Statistical Analysis: The collected data was statistically analyzed by complete randomized design (1-factor factorial) and comparison of means was done by Duncan's multiple rang test according to Steel et al. (1997).

RESULTS AND DISCUSSION

Microbiological Analysis: The microbiological quality assessment of yoghurt is mainly concerned with two aspects: 1) protection of the consumers against exposure to any health hazard and 2) ensuring that the material is not suffering microbiological deterioration during its anticipated shelf-life (Caballero, 2003). In fact, it is helpful in assessing that to what level, the hygienic precautions have been adopted during production, which allows the prediction of product shelf life and identification of potential health hazards (pathogens).

The microbiological analysis of branded yoghurt samples showed the presence of coliforms, indicating some type of mishandling even at the industry. In contrast, a higher quantity (103 cfu/ml) of coliforms was observed in unbranded yoghurt samples showing the intensity of high mishandling. The higher coliforms count could be attributed to the unsanitary conditions prevailing at the time of manufacturing process. In addition, this number may also reflect the post-process contamination. The average coliform count varied between 8 to 45 cfu/ml in branded yoghurt samples. While in case of unbranded yoghurt samples it varied between 88 to 103 cfu/ml. Analysis of variance showed a highly significant difference among the samples in means of coliform count as shown in table 1. The results were in agreement with that of Al-Hadethi et al. (1992).

For having good characteristics of yoghurt, the ratio of *S. thermophilus* and *L. bulgaricus* should be 1:1. In fact the former are related mainly to the production of acidity, while the latter in addition to acidity have main participation for the production of flavor producing compounds (acetaldehyde, acetic acid, volatile fatty acids, ethanol etc.). In this study, yoghurt culture assessment (Table 1) showed that the branded samples were mono-cultured (*S. thermophilus*), indicating that it does not fulfill the quality criteria of yoghurt with respect to culture quality. In contrast, in unbranded samples, both the common yoghurt species (*S. thermophilus* and *L. bulgaricus*) of lactic acid producing bacteria were present. However, sometimes we have outgrowth of S. thermophilus and sometimes outgrowth of *L. bulgaricus* showing uncontrolled conditions of culture development. In addition, the total count of yoghurt culture was higher in branded samples as compared to in unbranded samples (Table 1). In fact, the use of viable monoculture under controlled conditions results in higher count of these bacteria in branded samples. In contrast, the poor viability and uncontrolled conditions might be a reason for lower count in unbranded yoghurt samples.

Chemical Analysis: The chemical analysis shows the extent of adulteration in milk used for yoghurt production and deterioration of its components. The results obtained in this study showed that fat percentage in unbranded samples was highly variable and was varied between 0.60% and 3.43% (Table 2). The lower level of fat might be due to the preparation of yoghurt from cream extracted milk. In contrast, the fat in branded samples was around 3%, in fact this percentage of fat is sufficient for making yoghurt in accordance with the results of Chawala and Balachandran (1993).

The study showed that the pH was above 4 in all the branded samples, while in unbranded samples the pH was even less than 4 resulting in higher acidity as compared to unbranded samples (Table 2). In fact, the prolonged and uncontrolled fermentation, results in lower pH and more acidity. In addition, there is no proper system of culture dosage in unbranded yoghurt, which largely affects the acidity of the final yoghurt (Abrar et al., 2009).

The lactose contents were slightly greater in branded samples than in unbranded samples. However, the lactose contents in all the samples were around 4.5 in agreement with the results of Masood (1997). On other hand, high solid contents were observed in branded samples and were calculated to be about 16.75% and 14.23% in D and C samples respectively. This might be due to the presence of high quantity of stabilizer present in the branded samples. In contrast, 10 – 11% total solids were observed in unbranded samples, which show that non-standardized or adulterated milk was used for yoghurt preparation. The values of total solids observed in this study are in agreement with the results of Tayar et al. (1993).

Physical Analysis: The results showed that minimum level of synersis was present in branded yoghurt (D samples), while maximum values were present in unbranded yoghurt (C samples), which is 1.09 and 3.14 respectively. The reason of low syneresis values in branded yoghurt could be due to the use of stabilizer and standardized milk in its preparation as compared to unbranded yoghurt which is in agreement with the results of Masood (1997).

Table1: Microbiological analysis (Mean) of branded and unbranded yoghurt samples collected from local market of Faisalabad.

Samples		Coliform count (cfu/ml)	*S. thermophilus* count (cfu/ml)	*L. bulgaricus* count (cfu/ml)
Unbranded Yoghurt	A	92	$6.06X10^{3}$	$1.15X10^{6}$
	B	88	$1.16X10^{3}$	$5.50X10^{5}$
	C	103	$3.20X10^{4}$	$1.27X10^{6}$
Branded Yoghurt	D	8	$1.81X10^{11}$	0.00
	E	45	$5.76X10^{11}$	0.00
F-value		244.593^{**}	67.984^{**}	13.157^{**}

cfu = colony forming units, * = significant (P<0.05), ** = highly significant (P<0.01), NS = Non significant (P>0.05).

Table2: Physicochemical analysis (Mean) of branded and unbranded yoghurt samples collected from local market of Faisalabad.

Samples		Fat (%age)	pH (value)	Acidity (%age)	Lactose (%age)	Total Solids (%age)	Syneresis (ml/450g)
Unbranded Yoghurt	A	3.40	3.87	1.18	4.31	10.62	2.76
	B	3.43	3.86	1.2	4.27	10.76	2.68
	C	0.60	3.91	1.15	4.39	9.79	3.14
Branded Yoghurt	D	3.50	4.11	0.95	4.71	16.75	1.09
	E	2.63	4.03	1.03	4.62	14.23	1.95
F-value		297.457^{**}	15.5347^{**}	14.886^{**}	12.98^{**}	11263.91^{**}	13.157^{**}

* = significant (P<0.05), ** = highly significant (P<0.01), NS = Non significant (P>0.05).

Conclusion: Based on the results of the present study, it can be concluded that the overall picture of yoghurt quality assessment needs emphasis on quality control during processing and storage. Also standardization of milk for yoghurt manufacture should be observed to meet legal standards and adjustment of yoghurt mix should approach the standard of the yoghurt package label. This study has shown that there are variations in the quality of unbranded yoghurt samples in the market of Faisalabad. In branded samples, only *Streptococcus thermophilus* was present, which do not fulfill the quality criteria as per cultural counts of yoghurt are concerned, where both the cultures (*S. thermophilus* and *L. bulgaricus*) are required in a ratio of 1:1. In unbranded samples, an uncontrolled growth of these bacteria has been observed. In addition, the unbranded samples were positive for Coliform count, which indicates insufficient process sanitation and also raises concerns of consumer health.

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