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Xylooligosaccharide Enriched Yoghurt: Physicochemical and Sensory Evaluation

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Abstract: Enrichment of yoghurt with xylooligosaccharide (XO) at different levels was studied with physicochemical and sensory analysis. Yoghurt prepared by incorporation of XO were compared for these characteristics to the yoghurt containing stabilizer (gelatin, 0.4% w/w) in addition to XO. Moisture contents, pH, acidity and total solids were studied. These attributes were significantly affected by the use of stabilizer and rate of XO incorporation. Use of gelatin produced better results in terms of lowering syneresis and improved appearance, body and texture. Addition of XO upto 3.5% did not influence taste and overall acceptability but higher levels contributed aftertaste.

Key words: Xylooligosaccharide, yoghurt, buffalo milk,

Introduction

Yoghurt is a fermented dairy product which has been used since centuries for being nutritious and tasty. Certain therapeutic properties associated with yoghurt have increased both its production and consumption all over the world. Many health benefits like protection against gastrointestinal upsets, lowering cholesterol, improved lactose digestion, enhanced immune response, better protein, iron and calcium assilmilation are due to live bacteria present in yoghurt (Marona and Pedrigon, 2004).

Many non digestible oligosaccharides (NDO) have been identified to be used in food products as functional ingredients because of proved health claims. Xylooligosaccharides (XO) are newly invented functional food ingredient having various valued physiological properties like maintenance of gastrointestinal health, reduction in cholesterol levels and low cariogenicity. Moreover, these NDO have an acceptable odour, having sweetness that is 30% of sucrose with no offtaste and low calorific value, enables its application in processed foods (Vazques *et al*., 2000). Such NDO have positive effect through increase in growth of bifidobacteria (Gibson and Roberfroid, 1995).

Addition of some NDO (as prebiotic) affected the properties of dairy products by increased syneresis, enhanced permeability and tendency to reduce lower shear stress (Ispen *et al*., 2001).

Augmented dietary status of yoghurt which is one of popular fermented dairy product with acceptable sensory qualities, was the basic objective of the study. The main focus of this work was to produce XO enriched yoghurt for enhanced nutritional properties and acceptable sensory attributes. To confirm this hypothesis, physicochemical and sensory characteristics of XO enriched yoghurt at various storage intervals were determined.

Materials and Methods

Buffalo milk was procured from university dairy farm, University of Agriculture, Faisalabad. Spray dried XO was produced in another experiment by chemical and enzymatic hydrolysis of almond shells. Commercial freeze dried starter culture of *lactobacillus thermophilus* and *lactobacillus bulgaricus* was provided by Chr Hansen Co. (A/S, Hors-, Denmark). Sugar and gelatin were purchased from local market.

Experimental planning and sampling

XO enriched yoghurt preparation:

1: Yoghurt was made from buffalo milk standardized at 3% fat, 9% SNF level.
2: Milk was pasteurized at 95°C for 5 min, homogenized, divided into 9 equal batches and cooled to 45-50°C.
3: All batches were inoculated @ 2.5% v/v culture.
4: Control treatment was prepared without addition of stabilizer or XO.
5: Other eight treatments were prepared by incorporation of XO at the levels 1.5%, 2.5%, 3.5% and 4.5%; among which four without addition of stabilizer (gelatin), four with addition of stabilizer @ 0.5%.
6: The blend was incubated at 45°C±1°C in plastic cups (100 ml) for about 4 hours.
7: Samples were stored at 4°C.

Analysis of physicochemical attributes: Yoghurt samples were tested for fat by Gerber method (British Standard Institution, 1955), in the case of yoghurt this was done by using 11.3g sample of yoghurt in the butyrometer. pH was measured using pH meter (WTW pH-340-A, Germany). Acidity and total solids were determined according to the method described in AOAC (1990).

Table 1: Mean values of the physicochemical attributes of the experimental yoghurts

Treat-ment	pH	Acidity (La)	Total Solids	Syneresis ml/100ml)
T_0	4.36[a]	0.79[d]	14.88[c]	7.53[a]
T_1	4.13[b]	0.81[d]	15.05[bc]	6.00[bc]
T_2	3.93[cd]	0.78[d]	15.22[abc]	6.45[b]
T_3	3.75[de]	0.83[cd]	15.36[ab]	6.58[b]
T_4	3.60[e]	0.93[a]	15.51[a]	6.06[bc]
T_5	4.15[b]	0.83[cd]	15.12[abc]	5.49[c]
T_6	3.96[c]	0.85[bcd]	15.24[abc]	5.58[c]
T_7	3.77[cde]	0.88[abc]	15.39[ab]	5.59[c]
T_8	3.66[e]	0.91[ab]	15.53[a]	5.77[bc]

*Significant difference were obtained between mean values marked with different letter in the same column.

For syneresis, 5ml of yoghurt was centrifuged at 5000 rpm for 20 minutes at 4°C and separated whey was measured after 1 minute. Whey separation amount was expressed as volume of separated whey per 100 ml of yoghurt (Rodarte *et al.*, 1993).

Sensory evaluation: For assessment of overall acceptability of XO enriched yoghurt was done by a panel of judges from among the faculty and research scholars at NIFST, University of Agriculture, Faisalabad. Panel constituted judges who were trained and familiar for yogurt's attributes and showed their willingness. Appearance, body and texture, flavor and over all acceptability were rated on a5 point scale, scoring 5 for excellent, 1 for poor. As recommended by IDF (1987), the attributes of flavor and body and texture were given priority over others by multiplying their scores by 5 and 4 respectively. Total scores were obtained by adding the scores of all attributes. Yoghurt samples were coded with numbers and presented together to panel members in day light. Water was provided for rinsing mouth after each sample.

Statistical analysis: The parameters of this study were designed according to two factor completely randomized design. Effect of XO incorporation in experimental treatments, with or without stabilizer addition was checked by ANOVA. Duncan's Multiple Range Test was used to conclude statistically different groups (Steel *et al.*, 1997).

Results and Discussion

Physicochemical Attributes of XO incorporated Yoghurt

The results of physicochemical properties of eight types of experimental yoghurts are given in Table 1. Significant increase was found in acidity by the addition of XO and also during the storage period at 4±1°C ($P < 0.05$). This has been observed by some researchers that incorporation of non digestible oligosaccharide in food products increased acidity (Voregen, 1998 and Sako *et al.*, 1999). In the yoghurts enriched with XO up to level of 1.5%, 2.5%, 3.5% and 4.5%, acidity continued to increase till the end of storage. The acidity of XO enriched yoghurt was more than that of control treatment without addition of XO (Table 1). In the same way, pH of all treatments decreased constantly in the storage period; because of slightly acidic nature of XO, higher concentration of XO resulted in lowering pH of experimental yoghurts, while addition of stabilizer up to 0.4% did not affect pH significantly (Table 1).

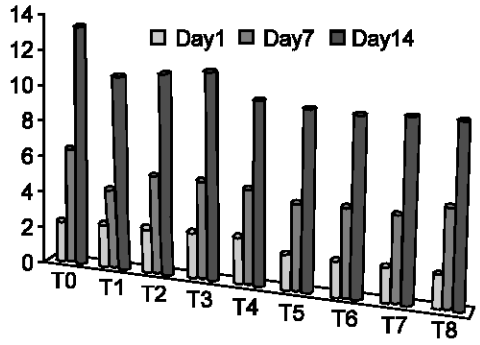

Fig. 1: Syneresis (ml/100ml) study of all experimental yoghurts during storage period.

The total solids of yoghurt increased with the addition of XO and stabilizer while the syneresis declined (Table 1). The results for the effect of storage on syneresis are presented in Fig. 1 which reveals that syneresis increased in all experimental treatments through the entire period of storage. It is obvious from the graph that though addition of XO in yoghurt treatments lowered the syneresis but use of stabilizer up to 0.4% significantly decreased the whey separation. Statistical analysis (Table 1) shows that results were highly significant both for treatments and storage period which are similar to the findings of Lelievre (1977) who examined that the syneresis rate increased with the decrease in pH of yoghurt samples. The increase in syneresis can be due to arrangement of protein network (Walstra *et al.*, 1985). The scores for all the sensory attributes lowered with increased amounts of XO. However, the scores improved with the addition of stabilizer. The yoghurt sample containing up to 3.5% XO with stabilize were found highly acceptable (Fig. 2).

Among sensory attributes, flavor is considered to be the most important factor for determining consumer's response. Results show that effect of storage was highly significant on flavor of all treatments; Kamaruzzaman *et al.* (2002) also reported a decrease in flavor of yoghurt during storage intervals. The addition of XO did not have a bad impact on flavor rather it was quite acceptable (Fig. 2). Texture was affected significantly during storage in all experimental yoghurts; however addition of stabilizer along with XO had a remarkable improvement in scores of experimental yoghurts for body and texture (Fig. 2), which is in accordance with Jawalekar *et al.* (1993) who studied the effect of stabilizer addition on

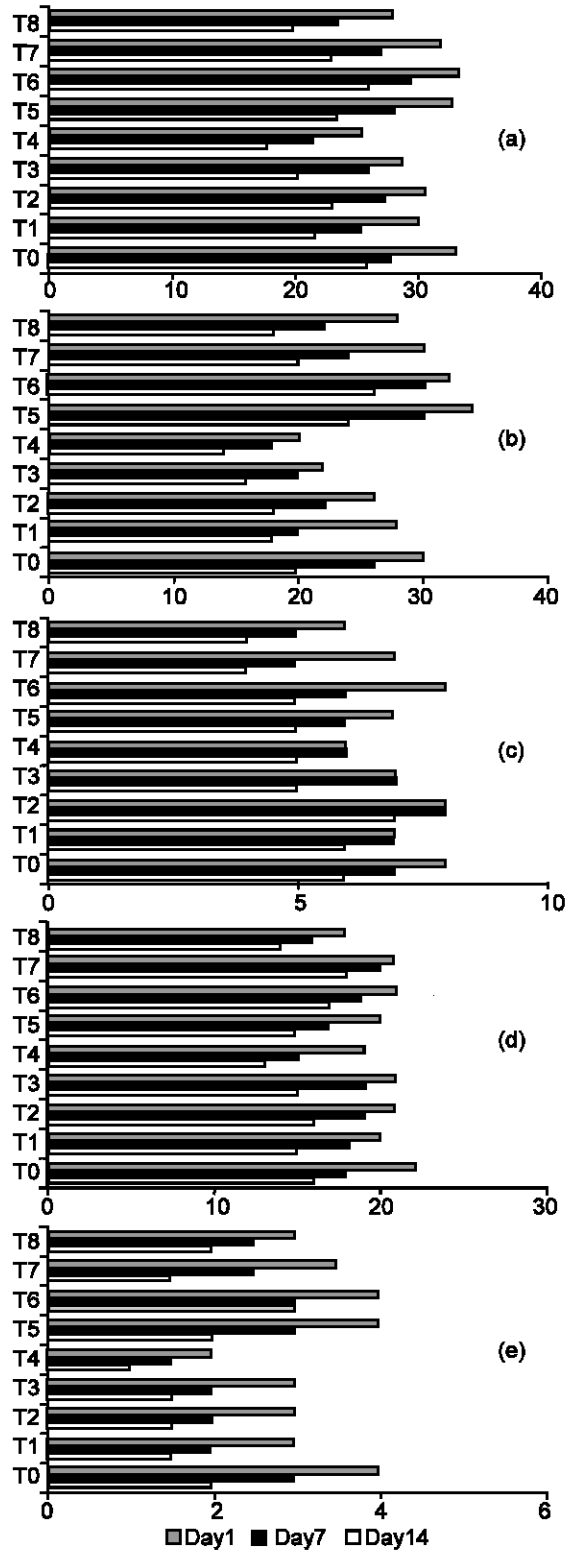

Fig. 2: Sensory evaluation of experimental yoghurts over storage period (a) overall acceptability (b) body and texture (c) aroma (d) flavor (e) appearance.

textural characteristics of buffalo milk yoghurt, concluding increased curd tension, greatest effect by gelatin and least by starch.

Conclusion: The exploring area of functional foods shows considerable promise to expand dairy industry in new arenas. Dairy food fits naturally with both pro- and pre-biotics which have a beneficial effect on the host by altering gastrointestinal flora. Prebiotics are defined as non digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of beneficial bacteria in colon. An attempt was made to check the suitability of using XO (NDO/ prebiotic) in yoghurt at different levels with and without stabilizer. It can be concluded keeping the results of organoleptic attributes for all experimental yoghurts that yoghurt enriched with XO up to the level of 3.5% with stabilizer (gelatin, 0.4%) was a successful treatment in terms of overall acceptability, allowing use of XO to have enhanced health benefits associated with this NDO.

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