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Effect of Various Stabilizers on Whey Separation (Syneresis) and Quality of Yoghurt

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Abstract: This study was carried out to investigate the effect of various stabilizers on whey seperation (syneresis) and the quality of set yoghurt. Yoghurt was prepared by using seven various stabilizers like pectin, guargum, carboxymethyl cellulose (CMC), carrageenan, sodium alginate, cornstarch and gelatin at 0.4% in milk containing 3.5% milk fat and total solids 16.6%. Various determinations such as pH, acidity, lactose and syneresis level were made at 0, 5, 10 and 15 days of storage interval. It was observed that there was gradual decrease in pH and increase in acidity in all samples during 15 days at 10°C ± 1. Lactose contents decrease in all Yoghurt samples during storage due to its conversion into lactic acid. It was observed that cornstarch tend to reduce syneresis followed by gelatin, pectin, guargum, CMC, Carrageenan, sodium alginate while comparing with control.

Key words: Set yoghurt, stabilizers, syneresis, storage period

Introduction

Yoghurt is a fermented milk product obtained by lactic acid fermentation through the action of *Lactobacillus bulgaricus* and *Streptococcus thermophilous* with one or more of other optional ingredients, such as sugar, stabilizers and colours. It is highly nutritious and easily digestible as compared to milk due to the predigested nutrients by bacterial starters. The protein complex fractions of milk are changed to such simpler form in yoghurt during fermentation. It can be easily digested and assimilated by the body. In Pakistan yoghurt is being prepared in two ways. One way is the traditional and other is the commercial method. By traditional method, yoghurt (Dahl) is prepared at home and by shopkeepers. It has short shelf life with poor body texture characteristics and problem of syneresis. The commercial yoghurt was recently introduced in the country and is in growing stages as reported by Izher and Anwar (1997). With the development of science and technology, chemical additives are used in the food industry on commercial scales and dairy industry is not exception to it. Whey separation or syneresis is a big problem of yoghurt. Actually whey separation occurs when body of yoghurt is shaken particularly during transportation for marketing in distinct market centres by Anonymous (1996). Different stabilizers are used to over come the problem of syneresis and to create desired texture and stability during processing and storage of yoghurt. The stabilizers are classified into following groups as natural gums including plant extracts (pectin), seed flour (guargum), cellulose derivatives (carboxyl methyl cellulose) seawood extracts (carrageenan and sodium alginate), cereal starches, cornstarch and gelatin from animal source (Jawalekar *et al.,* 1993). In this study different stabilizers were tested to control the syneresis and asses keeping quality during storage of yoghurt for 15 days at 10°C on basis of acidity development, pH decrease and lactose conversion into lactic acid. The objectives of this research were (i) to determine the effect of various stabilizers on syneresis and (ii) to determine the effect of storage period on change of pH, acidity and lactose of yoghurt during storage of yoghurt for 15 days.

Materials and Methods

The research work was conducted at Dairy Technology Research Laboratory, Animal Sciences Institute, National Agricultural Research Centre (NARC), Islamabad.

Preparation of yoghurt milk: Fresh buffalo milk was obtained from Livestock Research Station, NARC. Milk was standardized to 3.5% milk fat by separation of excess fat and SNF were increased by addition of skimmed milk powder to obtain 16.6% total solids in yoghurt milk.

Addition of stabilizer: Stabilizer such as pectin, guargum, CMC, Carrageenan, sodium alginate, cornstarch and gelatin were added at 0.4% in each batch. Control batch was also prepared without addition of stabilizer. Yoghurt was prepared by method described by Izher and Anwar (1997).

Preparation of yoghurt: The yoghurt mix was pasteurized at temperature of 95°C for 5 minutes in insulated Vat and then cooled down to 42°C. The yoghurt mix was inoculated with starter culture at 2% and filled in plastic cups immediately and incubated at 42°C till body was set and desired pH was obtained 4.2 ± 0.05 and acidity (0.90 ± 0.051% developed. The yoghurt was cooled to 4°C in order to stop further fermentation and then stored for period of 15 days at 10°C ± 1 for further studies.

Chemical analysis of yoghurt samples: The yoghurt samples were analyzed for acidity and pH determination according to AOAC (1990) and lactose estimation according to Triebold and Aurand (1963).

Testing of Syneresis (whey separation): Susceptibility to syneresis was determined by using the drainage test described by Modler *et al*. (1983).

Statistical analysis: The data thus obtained was subjected to statistical analysis using their functions factorial design according to Steel and Torrie (1980).

Results and Discussion

The quality of yoghurt samples was evaluated on basis of changes in pH, acidity, lactose and whey separation (Syneresis) during storage at 10°C ± 1 for 15 days. The results are described below.

Table 1: Effect of various stabilizers on change of pH during storage of yoghurt at 10°C ± 1

Treatment/days	0	5	10	15	Mean
Control	4.143 cde	4.064 fg	3.881 hi	3.624 mn	3.928 de
Pectin	4.161 cd	4.061 g	3.887 h	3.733 kl	3.961 bed
Guargum	4.143 cde	4.073 efg	3.843 hi	3.580 n	3.910 e
CMC	4.170 bc	4.096 defg	3.897 h	3.700 kl	3.966 bc
Carrageenan	4.162 cd	4.182 abc	3.849 hi	3.703 kl	3.974 abc
S. alginate	4.158 cd	4.073 efg	3.850 hi	3.677 lm	3.939 cde
Cornstarch	4.248 a	4.080 efg	3.887 h	3.810 ij	4.006 a
Gelatin	4.236 ab	4.133 cdef	3.857 hi	3.757 jk	3.996 ab
Mean	4.178 a	4.095 b	3.869 c	3.698 d	-

Values present average of 3 replicates. Different superscripts differ significantly at $p<0.05$

Table 2: Effect of various stabilizers on change of percent acidity during storage of yoghurt at 10°C ± 1

Treatment/days	0	5	10	15	Mean
Control	0.890 aqp	0.953 kl	1.270 ef	1.555 mn	1.162 a
Pectin	0.881 r	0.950 mnop	1.287 hi	1.390 e	1.127 e
Guargum	0.893 nop	1.043 j	1.234 fgh	1.457 bc	1.134 a
CMC	0.886 pq	0.945 m	1.263 efg	1.407 cd	1.115 c
Carrageenan	0.882 q	0.903 lmnop	1.312 e	1.463 b	1.140 bc
S. alginate	0.883 nop	0.997 jk	1.280 ef	1.447 bcd	1.152 ab
Cornstarch	0.755 pq	0.924 lmn	1.137 l	1.267 efg	1.021 e
Gelatin	0.781 r	0.910 lmno	1.217 gh	1.303 d	1.053 d
Mean	0.856 d	0.953 c	1.252 b	1.414a	-

Percent acidity values are average of 3 replicates. Different superscripts differ significantly at $p<0.05$

Table 3: Effect of various stabilizers on lactose percent durin storae of yoghurt at 10°C ± 1

Treatment/days	0	5	10	15	Mean
Control	3.881 fghi	3.810 m	3.738 no	3.668 p	3.774 f
Pectin	4.010 b	3.960 cd	3.892 fg	3.853 ijk	3.929 b
Guargum	3.939 d	3.884 fgh	3.813 lm	3.737 no	3.843 d
CMC	3.931 de	3.860 hijk	3.800 m	3.710 o	3.825 f
Carrageenan	3.958 cd	3.900 fg	3.840 kl	3.757 n	3.864 c
S. alginate	3.938 d	3.871 ghij	3.808 m	3.710 o	3.832 df
Cornstarch	4.050 a	4.018 b	3.970 c	3.903 ef	3.985 a
Gelatin	3.953 cd	3.903 ef	3.843 jk	3.737 no	3.859 c
Mean	3.958 a	3.901 b	3.838 c	3.759 d	-

Percent lactose values are average of 3 replicates. Different superscripts differ significantly at $p<0.05$

Table 4: Effect of various stabilizers on syneresis (ml) during storage of yoghurt at 10°C ± 1

Treatment/days	0	5	10	15	Mean
Control	1.933 q	7.922 l	13.87 a	21.09 a	11.20 a
Pectin	0.944 s	2.489 op	6.233 l	8.589 h	4.564 f
Guargum	1.400 r	2.700 o	6.722 k	11.40 g	5.556 e
CMC	1.933 q	3.156 n	7.189 j	14.84 d	6.781 d
Carrageenan	2.333 op	6.100l	12.47 f	18.40 b	9.825 b
S. alginate	3.244 n	5.322 m	11.56 g	16.22 c	9.086 c
Cornstarch	0.500 t	1.544 r	5.289 m	6.856 jk	3.547 h
Gelatin	0.767 st	2.167 pq	5.267 l	7.989 l	4.222 c
Mean	1.632 d	3.925 c	8.661 b	13.17 a	-

Syneresis (ml) values are average of 3 replicates. Different superscripts differ significantly at $p<0.05$

pH: The effect of various stabilizers on pH during storage of yoghurt samples at 10°C is shown in Table 1, which reveals that optimum pH was found 4.248 and 4.236 in case of cornstarch and gelatin respectively at initial day of storage as compared to other treatments which ranged from 4.143 to 4.170. The less decrease in pH was observed in case of samples treated with cornstarch, gelatin and pectin during storage as compared to guargum, CMC, carrageenan and sodium alginate. Thus cornstarch, gelatin and pectin had better effect on pH change as compared to other stabilizers. The maximum decrease was observed in pH change in case of control after 15 days storage. These observations agreed with the results reported by Jawalekar *et al*. (1993). As revealed from data pH decreased throughout the storage period. The decrease of pH was due to the formation of lactic acid by certain bacteria of yoghurt (Abraharnsen, 1978). It was also reported earlier that pH decrease with increase in the storage period (Oh *et al.,* 1991). Statistical analysis of data showed highly significant effect of storage period and stabilizers and their interaction on pH of yoghurt samples.

Acidity: The effect on the development of acidity during storage of yoghrut samples under various stabilizers treatment are presented in Table 2. The mean values of acidity of yoghurt treated with guargum, CMC, carrageenan and sodium alginate along with control were 0.893, 0.886, 0.882, 0.883 and 0.890% after complete processing of yoghurt but it increased to 1.457, 1.407, 1.463, 1.447 and 1.555% after 15 days storage respectively. The initial mean values for the treatment of cornstarch (0.755%) gelatin (0.781%) and pectin (0.881%) were found which increased to 1.267, 1.303 and 1.390% after 15 days storage respectively. A gradual increase in acidity in all the treatment was observed along with control during storage of yoghurt samples. Maximum

increase was recorded in control sample as compared to other treated samples. Less acidity was developed in samples treated with cornstarch, gelatin and pectin. Statistical analysis of the data showed highly significant effect of storage and stabilizers and their interaction on the acidity of the samples. These results were in confirmation with findings of Salji and Ismail (1983) who observed similar changes in the acidity of yoghurt during storage.

Lactose: The data regarding the changes in lactose content of yoghurt during storage are presented in Table 3. The mean lactose content in guargum, CMC, carrageenan, sodium alginate and control were 3.939, 3.931, 3.958, 3.938 and 3.881% on initial day of storage which decrease to 3.737, 3.710, 3.757, 3.710 and 3.668% on final day of observation respectively. The initial mean values of lactose content in case of pectin, gelatin and cornstarch stabilized samples were 4.010, 3.953 and 4.050% which showed a decrease in lactose content after 15 days 3.853, 3.737 and 3.903% respectively. The data are in line with observation reported by Goodenough and Kleyn (1976). Comparison of results for seven stabilizers revealed that decrease in lactose content was less in cornstarch stabilized yoghurt samples as compared to other six yoghurt samples treated with stabilizers. It might be due to reason that cornstarch is composed of 86.4% carbohydrate (Woods, 1907), so the lactic acid producing bacteria utilized CH_2O present in cornstarch along with lactose thus decrease in lactose content was lower in cornstarch as compared to pectin, guargum, CMC, carrageenan, gelatin and sodium alginate treated yoghurt samples. The results also indicated that decrease of lactose content in control was more pronounced. This decrease might be due to the action of micro-organism which break the lactose to lactic acid. The results were in agreement with of Gendrel *et al*. (1990). The statistical analysis showed highly significant effect of treatment and storage period on change of lactose contents. These results coincided with the findings already reported by Gendrel *et al*. (1990) and Oh *et al*. (1991).

Syneresis/Whey Separation: The results for the effect of various stabilizers and storage period on syneresis are shown in Table 4. The untreated yoghurt samples showed a higher increase in syneresis as compared to the yoghurt samples treated with various stabilizers. The mean for syneresis in case of untreated samples were 1.933 nil and 21.09 ml at 0 day of storage and 15 days respectively. As far as stabilizers are concerned, it is clear from data that effect of stabilizers on the syneresis is well pronounced. The performance of cornstarch was better than all other stabilizers used in this study. This confirmed the findings of Anonymous (1996), Bassett (1983), Christensen and Trudose (1980) and Keogh and O'Kennedy (1998). Statistical analysis revealed that the results were also highly significant for storage period and treatment with various stabilizers. In each case including control, the syneresis increased with increasing storage time. The average value for all treated yoghurt samples also increased with time. The results are in line with the findings already reported by Foley and Mulcahy (1989).

It was concluded on the basis of yoghurt made under this study that there was a gradual decrease in pH and increase in acidity in all yoghurt samples. However, there was more rapid development of acidity in control samples as compared to samples treated with stabilizers. Similar effect was observed in the decrease of lactose content in yoghurt samples. Among different stabilizers used in this study, cornstarch, gelatin and pectin showed better results than rest of the treatments. It can be inferred that use of stabilizers can help to retard/reduce syneresis arid give better quality yoghurt.

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