

Physico-Chemical And Microbiological Quality Of Some Consumer Preferred Plain Set Yoghurts Sold In Matara Municipal Area Of Sri Lanka

K.K.G.U Hemamali, V.S Jayamanne, S.M. Amarathunge

Abstract: As yoghurt is a health food, assessment of quality of commercialized yoghurt during storage period in refrigerator is needed. Lack of data on quality parameters of yoghurt brands in Sri Lanka is impediment to consumer health. This study is an attempt to fill that gap by providing data on evaluation of the changes of physico-chemical and microbiological parameters of some plain set yoghurt sold in Matara municipal area of Sri Lanka. Five different brands of plain set yoghurt samples were collected on the basis of consumer preference for the present study. From each brand, fifteen samples were analyzed by means of their physico-chemical (syneresis effect, pH, titratable acidity, total protein content) and microbiological composition (total plate count, total yeast and mould count) by using three replicates of each sample at 4, 7, 14, 21 and 28 days intervals from production date under refrigerated condition (4 °C) and compared against local and international standards. All microbiological parameters and total protein content of all plain set yoghurt brands were not within the permissible range for local and international standards. Titratable acidity was only in the permissible range of local standards. All the physico-chemical parameters and microbiological parameters of collected samples were significantly affected by storage period. Good quality yoghurt of physico-chemical and microbiological parameters with hygiene conditions during processing and storage should be encouraged for consumption.

Index Terms: consumer preference, international standards, local standards, microbiological parameters, physico-chemical parameters, plain set yoghurt, storage period.

1 INTRODUCTION

CONSUMPTION of yoghurt in Sri Lanka has increased over the last decade. Yoghurt is not only used as a diet food but also a health food because of its therapeutic value. Hence, to ensure its health benefits and microbial safety as well as to retain its consumer acceptance and preference yoghurt must be produced according to the recommended Sri Lankan Standards (SLS) and World Health Organization (WHO) standards. Therefore it is important to evaluate characteristics of the yoghurt sold in Sri Lankan markets to assess their quality [8]. According to Food and Agricultural Organization [3], "Yoghurt is a coagulated milk product obtained by lactic acid fermentation of milk through the action of *Streptococcus salivarius* subsp. *thermophilus* and *Lactobacillus delbrueckii* subsp. *Bulgarcicus* with or without addition of whole milk powder or skim milk powder or whey powder. The desirable microorganisms in the final product must be viable and abundant".

1.1 Standards for plain set yoghurt- International standards for yoghurt

Yoghurt contains symbiotic starter cultures of *Streptococcus salivarius* subsp. *thermophilus* and *Lactobacillus delbrueckii* subsp. *Bulgarcicus* for fermentation [2].

TABLE 1.

International Standards For Yoghurt By The Codex Alimentarius Commission Of The Food And Agriculture Organization (Fao) And World Health Organization (Who) In The Codex Standards For Fermented Milks (2003).

Parameters	WHO standards
Milk protein (% m/m) ^(a)	Min.2.7%
Milk fat (%m/m)	Less than 15%
Titratable acidity as % lactic acid (% m/m)	Min 0.6%
Sum of microorganism constituting the starter culture (CFU's/g, in total)	Min 10 ⁷
Labeled microorganism (CFU's/g, total) ^(b)	Min 10 ⁶

(a) Protein content is 6.38 multiplied by the total kjeldahl nitrogen method.

(b) Applies where a content claim is made in the labeling that refers to the presence of a specific microorganism that has been added as a supplement to the specific starter culture.

1.2 Standards for plain set yoghurt- National standards for yoghurt

Sri Lanka Standard Institution (SLSI) is the apex body in Sri Lanka engaged in standardization activities, such as formulation of national standards, implementing these standards, testing and evaluation of food products. Also they describes officially recognized levels of quality, safety, composition, packaging, and labeling regulation of food products that are appropriate for the Sri Lankan market [13]. SLSI gives the certification of the quality of products for local consumption or export [10].

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TABLE 2. Requirements For Yoghurt

Standard No.	Characteristics	Yoghurt
1)	Milk fat, percent by mass	3.0 min.
2)	Milk solids not fat, percent by mass	8.0 min
3)	Titrateable acidity as lactic acid, percent by mass	0.8 to 1.25

Table 3. Microbiological Limits

Test organism	Limit
<i>Escherichia Coli.</i>	Not more than 1 per g
Yeasts	Not more than 1000 per g
Moulds	Not more than 1 per g

2 MATERIALS AND METHODS

2.1 Site selection

Matara municipal area of Sri Lanka (approximately 21000 km²) was purposively selected as study area due to higher population size. As the selected study area was limited to Matara municipal area of Sri Lanka, eight sites were selected for the preliminary survey; Walgama, Polhena, Pamburana, Nupe, Broad way, Gabada weediya, Matara and Meddawaththa.

2.2 Preliminary survey

Two super markets were selected from each selected site and preliminary survey was done by giving a questionnaire to the customers.

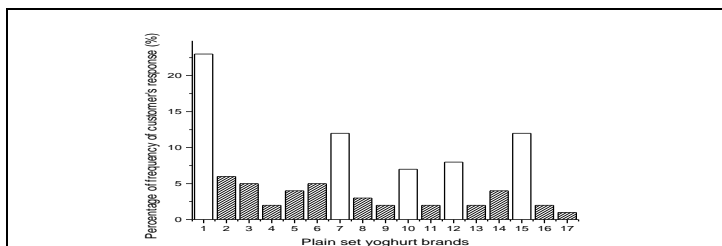


Fig 1. The graph of percentage of frequency of customer's response versus different plain set yoghurt brands

According to the fig. 1., the popularity of the commercialized brands of plain set yoghurt in Matara municipal area of Sri Lanka was in a decreasing order as follows; Brand 1, Brand 15, Brand 7, Brand 12, Brand 10.

2.3 Sample collection

Seventy five plain set yoghurt samples were purchased from super markets in Matara municipal area of Sri Lanka. All samples were transported in an ice box at 4 °C to laboratory of Department of Botany, Faculty of Science, University of Ruhuna, Matara. Fifteen samples from each brand were examined from five batches.

2.4 Physico-chemical and microbiological analysis

Following parameters were checked for each sample during the storage period as 4th, 7th, 14th, 21st and 28th days from production day. The pH of yoghurt was measured using a pH-meter after calibration. Titrateable acidity of yoghurt was

determined by 0.1N NaOH titration. Protein was determined by using Kjeldahl method according to AOAC methods [6]. Syneresis effect was determined by measuring drained whey according to the method proposed by Olson and Aryana [7]. Total plate count of yoghurt was determined by pour plate method by using Nutrient Agar (NA). Yeast and mould count was determined by pour plate method using Sabouraud's Dextrose Agar (SDA). The data were analyzed statistically using Completely Randomized Block Design by calculating data with mean values and standard deviations in triplicate trials. The value of total bacteria and total yeast and mould counts were transformed into log values. The analysis of variance (ANOVA) tests were carried out by using the general linear model procedure of the SPSS (Version 17.0). The means were separated by Tukey HSD. Significant differences were determined at p-value = 0.05.

3 RESULTS

3.1 Comparison of physico-chemical and microbiological parameters with SLS and WHO standards

TABLE 4.

Physico-Chemical And Microbiological Parameters Compared To SIs And Who Standards

Parameter	Mean	Standard deviation
pH	4.3844	0.19055
Titrateable acidity (%)	0.5777 ^b	0.05741
Total protein content (%)	3.4700 ^a	0.00974
Syneresis effect (mL)	3.1827	1.79868
Total plate count (log ₁₀ CFU's g ⁻¹)	7.1788 ^a	1.19600
Total yeast and mould count (log ₁₀ CFU's g ⁻¹)	5.0272 ^a	1.17371

a- Below accepted SLS and WHO standard levels

b- Below accepted WHO standards level and above accepted SLS standard level

3.2 Physico-chemical parameters of selected plain set yoghurt brands

TABLE 6.

The Effect Of Storage Period (Days) On Chemical Compositional Quality Of Plain Set Yoghurt Samples Collected From Matara Municipal Area Of Sri Lanaka

Parameter	Storage period (days)				
	4 days	7 days	14 days	21 days	28 days
pH value	4.50667 ^a (±0.00577)	4.45 ^b (±0.01)	4.35 ^c (±0.01)	4.34333 ^d (±0.00577)	4.24333 ^e (±0.00577)
Titrateable acidity (%)	0.50333 ^a (±0.00577)	0.51 ^b (±0.01)	0.58333 ^c (±0.00577)	0.61667 ^d (±0.00577)	0.63 ^e (±0.01)
Total protein content (%)	3.54 ^a (±0.01)	3.51667 ^b (±0.00577)	3.43667 ^c (±0.00577)	3.42333 ^d (±0.00577)	3.42 ^e (±0.01)

abcde means in the same row followed by the same letter(s) do not differ significantly at (p-value > 0.05) (mean +-SD) From the Table 6, it is clear that the pH value and total protein content decrease significantly (p-value < 0.05) from day 4th to day 7th, 14th, 21st, 28th while titratable acidity increase significantly (p-value < 0.05) from day 4th to day 7th, 14th, 21st, 28th. No significant variation report for calcium concentration (p-value > 0.05) during the storage period.

TABLE 7.

The Effect Of Storage Period (Days) On Synereisi Effect Of Plain Set Yoghurt Samples Collected From Matara Municipal Area Of Sri Lanaka

Parameter	Storage period (days)				
	4 days	7 days	14 days	21 days	28 days
Syneresis effect (mL)	0.99593 ^a (±0.00276)	3 ^b (±0.00577)	3 ^c (±0.00153)	7 ^d (±0.00277)	1.9969 ^e (±0.0013)

abcde means in the same row followed by the same letter(s) do not differ significantly at (p-value > 0.05) (mean +-SD)

3.3 Microbiological parameters of selected plain set yoghurt brands

TABLE 8.

The Effect Of Storage Period (Days) On Microbiological Quality Of Plain Set Yoghurt Samples Collected From Matara Municipal Area Of Sri Lanaka

Parameter	Storage period (days)				
	4 days	7 days	14 days	21 days	28 days
Total plate count (log10 CFU's g ⁻¹)	7.3899 ^a (±0.03057)	7.4586 ^b (±0.20816)	7.4740 ^c (±0.30552)	7.8664 ^d (±0.44900)	8.6685 ^e (±0.55694)
Total yeast and mould count (log10 CFU's g ⁻¹)	3.3814 ^a (±0.05710)	4.2546 ^b (±0.18596)	5.1225 ^c (±0.28556)	5.1272 ^d (±0.39489)	5.8808 ^e (±1.17371)

abcde means in the same row followed by the same letter(s) do not differ significantly at (p-value > 0.05) (mean +-SD)

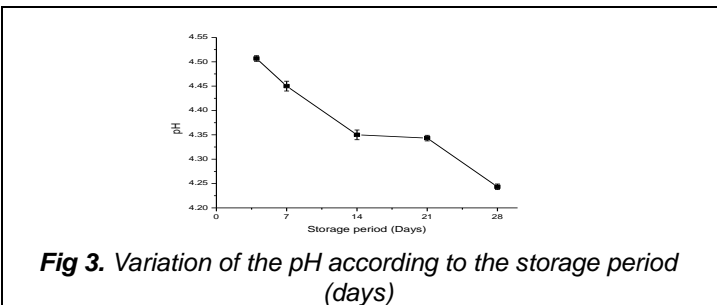


Fig 3. Variation of the pH according to the storage period (days)

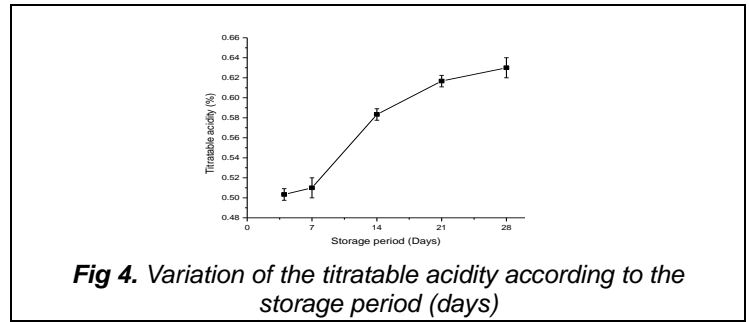


Fig 4. Variation of the titratable acidity according to the storage period (days)

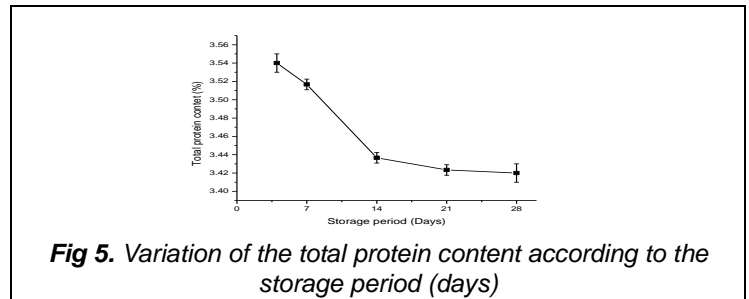


Fig 5. Variation of the total protein content according to the storage period (days)

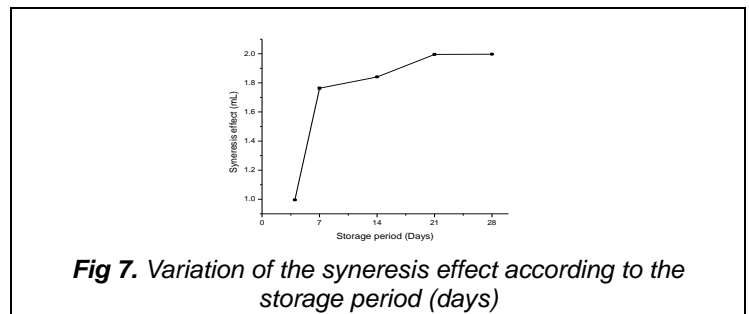


Fig 7. Variation of the syneresis effect according to the storage period (days)

Storage period significantly (P-value < 0.05) differ for pH (Fig 3.), titratable acidity (Fig 4.) and syneresis effect (Fig 7.) while it is significantly do not differ (P-value > 0.05) for total protein content (Fig 5.) during each analyzed day of storage in each plain set yoghurt brand.

4 DISCUSSION

According to Rathnayaka and Silva [8], total plate count, total yeast and mold count of some commercial set yoghurt samples were not within the SLS standards. Total plate count and total yeast and mold count of all set yoghurts in the current study were not according to the SLS and WHO standards. So, the investigated plain set yoghurts are not in good condition of microbiological quality. Montagna *et al.*, [5] cited that the moulds, in commercial yoghurt generally correspond to poor cleaning practices and the use of unhygienic techniques or inadequate transformation processes and/or packaging, storage, transport and sale. According to Rathnayaka and Silva [8], titratable acidity and total protein content of most of the commercial set yoghurt samples were within the SLS standards. In the present study, we observed that some physic-chemical parameters were not within the SLS standards and WHO standards (Table 4). That can happen due to the usage of low quality milk or different milk sources [13]. Therefore, in order to improve the market demand, we can improve the quality of those products up to the SLS standards.

4.1 Comparison with storage time

Decrease of pH (Fig. 3) of plain set yoghurt during storage period may be due to production of more lactic acid by breakdown of lactose by lactic acid bacteria with the help of a sugar source [4]. Yoghurt quality is, therefore, affected by microbial growth [1]. Growing more rapidly at the beginning, *Streptococcus salivarius* subsp. *thermophilus* lowers the redox potential and slightly acidifies the milk. These conditions are stimulatory for *Lactobacillus delbrueckii* subsp. *Bulgarcus* that acidifies the milk even more [11]. Increase of titratable acidity (Fig. 4) of plain set yoghurt during storage period may be due to the completely non stopped activity of *Streptococcus salivarius* subsp. *thermophilus* and *Lactobacillus delbrueckii* subsp. *Bulgarcus* during post-acidification period which produces lactic acid [4]. Decrease of total protein content (Fig. 5) of plain set yoghurt during storage period may be due to the proteolytic activity of lactic acid bacteria, which hydrolyses proteins (caseins) into peptides and amino acids during storage and leading to formation of soluble compounds [12]. Increase of the physical property of plain set yoghurt during storage period, syneresis effect (Fig. 7) may be due to acidity of the product [9].

5 CONCLUSION

The results of the current study showed that almost all physico-chemical and microbiological parameters of plain set yoghurts were not within acceptable national and international standards. Some selected physico-chemical and microbiological quality of plain set yoghurts changed during storage period and among brands. Overall picture of yoghurt quality assessment needs emphasis on quality control during processing and storage

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