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PHYSICAL AND CHEMICAL QUALITY APPRAISAL OF COMMERCIAL YOGHURT BRANDS SOLD AT LAHORE

Khalid Khan[1], Shabir Ur Rehman[2], Muhammad Athar Khan[3], Farhan Anwar[1], and Sher Bhadar[1]
[1]Directorate of Veterinary Research Institute, Peshawar, Pakistan
[2]Pakistan Dairy Development Company
[3]University of Veterinary and Animal Sciences, Lahore, Pakistan
E-mail: khalidvet75@yahoo.com

ABSTRACT

Physical and chemical quality appraisal of different commercial brand yoghurts available in the Lahore market was studied during the year 2006 and study included yoghurt samples of Guormet's, Moon Dairies, Nestle and Nirala sweets to analyse for acidity, pH, protein, total solids, solids not fat, and carbohydrate/lactose. It was recorded that Nestle yoghurt had 1.00±0.01% acidity, 5.44±0.01 pH, 4.00±0.06% protein, 15.84±0.10% total solids, 13.08±0.11% solids not fat, and 8.47±0.12% carbohydrate/lactose. Yoghurt of Gourmet's had 1.19±0.01% acidity, 5.50±0.01 pH, 3.73±0.08% protein, 11.35±0.09% TS, 10.86±0.09% SNF, and 6.27±0.10% carbohydrate/lactose. Moon Dairies yoghurt had 1.20±0.02% acidity, 5.43±0.01 pH, 3.85±0.08% protein, 11.53±0.14% TS, 11.00±0.13% SNF, and 6.35±0.14% carbohydrate/lactose. Nirala yoghurt contained 1.15±0.01% acidity, 5.42±0.01 pH, 4.16±0.06% protein, 12.36±0.09% TS, 11.82±0.09% SNF, and 6.93±0.11% carbohydrate/lactose. Nestle yoghurt was found to be superior in term of syneresis as compared to the yoghurt being marketed by Gourmet's , Moon Dairies, and Nirala sweets.

Keywords: yoghurt, quality, physical, chemical, properties, commercial brands.

INTRODUCTION

Yoghurt is one of the traditional cultured milk products, best known in almost all corners of the world. It originated in Bulgaria, where it is known as "Yourt". However, in many other countries it has their own names like Lebon in Lebanon including some Arabian countries, Zababy in Egypt and Sudan, Dahi or Curd in Pakistan and India (Williams, 2004). It plays an important role in human nutrition, health maintaining, therapeutic and dietetic functions. Good quality dahi has a desirable organoleptic properties and uniform consistency with specific lactic flavour. It has been an article of diet and refreshing beverage for majority of the population of Pakistan, and stands second in consumption to fresh milk. Beside this some commercial brands of yoghurt have been introduced in various big cities of Pakistan recently.

The quality of industrial yoghurt varied greatly with chemical composition of yoghurt milk, method of production, type of flavor added and the nature of post-incubation processing. Technology of yoghurt, microbiology of starter culture and quality appraisal is the prime importance of any type of yoghurt. In this respect, many studies and reviews are reported in great detail in the world (Hui 1993, Yadav *et al* 1993). However, in Pakistan, particularly very limited work has been done. Keeping the above views in mind the present study was designed to appraise the quality of commercial brands yoghurt sold at Lahore.

MATERIALS AND METHODS

Four commercial brands of yoghurt available at Lahore, Food/Dairy Shops were selected for the present study. A total of 100 yoghurt samples, 25 from each branch were collected and brought to the laboratory of Dairy Technology, University of Veterinary and Animal Sciences Lahore, for the analysis of physical and chemical quality characteristics of yoghurt.

Acidity %, Total Solids Content % and were determine according the method as described by the Association of Official Analytical Chemist. (AOAC, 2000 a, b and c, respectively). pH values were recorded using pH meter (Hanna instruments, HI 8417, Italy). Lactose/Total Carbohydrate % and SNF content % were determined by difference as per following formulas:

Lactose %age = TS % - (Protein% + Fat% +Ash %)
SNF %age = TS % - Fat %

RESULTS

The study was carried on quality appraisal of different commercial brands of yoghurt available in the Lahore market during the year 2006-07. The yoghurt samples were collected from Gourmet's, Moon Dairies, Nestle and Nirala Sweets, and analyzed for physico-chemical properties such as acidity, pH, protein content, total solids, solids not fat and lactose. The results thus finalized on each parameter are interpreted and presented as follows:

Acidity percentage

The yoghurt samples collected from various commercial brands (Table-1) showed significant ($P<0.01$) differences in their acidity levels. It was observed from the results that the minimum-maximum acidity range in yoghurt of Gourmet's was 1.10-1.40 percent, while in yoghurt of Moon Dairies it was 1.00-1.50, where as in Nestle brands acidity ranged 0.90-1.10 and in yoghurt of Nirala sweets the minimum-maximum acidity range was 1.00-1.40 percent. Mean acidity percentage in commercial brands yoghurt of Gourmet's was 1.19±0.01, Moon

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Dairies 1.20±0.02, Nestle 1.00±0.01 and Nirala sweets 1.15±0.01 percent.

The statistical analysis results suggested that the differences in acidity percentage in yoghurt of Gourmet's and Moon Dairies were non-significant at (P>0.05), while differences between Nirala sweets v/s, Gourmet's and Moon Dairies v/s Nirala sweets yoghurt were significant at (P<0.05) level. However, the difference were statistically high significant (P<0.001) for acidity between the yoghurt of Gourmet's v/s Nestle Moon Dairies v/s Nestle and Nestle v/s Nirala Sweets product.

Table-1: Acidity (%age) of commercial brands yoghurt sold at Lahore.

Source of yoghurt samples	**Acidity** (%age)			
	Minimum	**Maximum**	**Mean**	**SE (±)**
Gourmet's	1.10	1.40	1.19	0.01
Moon Dairies	1.00	1.50	1.20	0.02
Nestle	0.90	1.10	1.00	0.01
Nirala sweets	1.00	1.40	1.15	0.01
Significance:				
Gourmet's v/s Moon dairies			n.s	
Gourmet's v/s Nestle			***	
Gourmet's v/s Nirala Sweets			*	
Moon Dairies v/s Nestle			***	
Moon Dairies v/s Nirala sweets			*	
Nestle v/s Nirala sweets			***	

Significance: * P < 0.05, *** P < 0.001, n.s P > 0.05.
SE: Standard Error of mean

pH value

The yoghurt samples of different commercial brands collected from Lahore Market were analyzed for pH value and results are presented in (Table-2). It was observed from the results that the minimum-maximum pH range in yoghurt of Gourmet's was 5.50-5.70, while in yoghurt of Moon dairies, was 5.30-5.60, in Nestle brands 5.30-5.60 where as in yoghurt of Nirala sweets showed minimum-maximum pH value between 5.30-5.50. The mean pH value in commercial brands yoghurt supplied by Nirala sweets, Lahore was minimum (5.42±0.10), and Gourmet's was maximum (5.50±0.01). However pH value of yoghurt marketed by Moon Dairies with mean pH value averaged 5.43±0.01 and Nestle brands yoghurt 5.44±0.01.

While comparison was made between different commercial brands of yoghurt marketed at various stores, it was observed that the differences in pH value in yoghurt of Gourmet's v/s Nestle were moderate significant (p<0.01) and in yoghurt of Moon Dairies v/s Moon Dairies and Moon Dairies v/s yoghurt manufactured by Nirala sweets were statistically highly significant (P<0.001) while differences were non-significant (P>0.05) when yoghurt of Moon Dairies was compared with Nestle and Nirala sweets and Nestle v/s Nirala sweets.

Table-2: pH values of commercial brands yoghurt sold at Hyderabad.

Source of yoghurt samples	**pH values**			
	Minimum	**Maximum**	**Mean**	**SE (±)**
Gourmet's	5.50	5.70	5.50	0.01
Moon dairies	5.30	5.60	5.43	0.01
Nestle	5.30	5.60	5.44	0.01
Nirala sweets	5.30	5.50	5.42	0.01
Significance:				
Gourmet's v/s Moon dairies			***	
Gourmet's v/s Nestle			**	
Gourmet's v/s Nirala Sweet,s			***	
Moon Dairies v/s Nestle			n.s	
Moon Dairies v/s Nirala sweets			n.s	
Nestle v/s Nirala sweets			n.s	

Significance: ** P < 0.01, *** P < 0.001, n.s P > 0.05.
SE: Standard Error of mean
Data are the average of 25 samples and duplicate for each.

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Protein content (%age)

The results of protein contents of different samples of yoghurt collected from Lahore are depicted in (Table-3). According to these results the protein content from the sample of commercial brands yoghurt of Nirala Sweet's store Lahore was in the range of 3.10 to 4.90 percent, while yoghurt sample of Nestle contained protein contents from 2.60 to 4.40 percent, whereas protein content of yoghurt sample of Moon Dairies ranged between 2.90-4.90 percent and Gourmet's 2.60-4.40 percent. The average protein content in commercial brands yoghurt supplied by Nirala Sweets was maximum (4.16±0.06), followed by yoghurt marketed by Nestle and Moon Dairies with mean protein contents of 4.00±0.06 and 3.85±0.08 percent, respectively. However, the protein content was lowest (3.73±0.08 percent) in commercial brand yoghurt sample of Gourmet's Lahore.

It is further evident from the results that statistically differences between Gourmet's yoghurt v/s yoghurt of Moon Dairies, and Nestle v/s Nirala sweets were non-significant ($P>0.05$) and significant ($P<0.05$) between Moon Dairies v/s Nestle and moderate significant ($P<0.01$) between Moon dairies v/s Nirala sweets and highly significant ($P<0.001$) between Gourmet's v/s Nirala sweets.

Table-3: Protein content (%age) of commercial brands yoghurt sold at Lahore.

Source of yoghurt samples	Protein content (%age)			
	Minimum	Maximum	Mean	SE (±)
Gourmet's	2.60	4.40	3.73	0.08
Moon Dairies	2.90	4.90	3.85	0.08
Nestle	2.60	4.40	4.00	0.06
Nirala sweets	3.10	4.90	4.16	0.06
Significance:				
Gourmet's v/s Moon Dairies			n.s	
Gourmet's v/s Nestle			***	
Gourmet's v/s Nirala Sweets			***	
Moon Dairies v/s Nestle			*	
Moon Dairiesv/s Nirala sweets			**	
Nestle v/s Nirala sweets			n.s	

Significance: *P < 0.05, ** P < 0.01, *** P < 0.001, n.s P > 0.05.
SE: Standard Error of mean
Data are the average of 25 samples and duplicate for each.

Total solids content (%age)

The yoghurt samples of various commercial brands were purchased from Lahore market to analyze for total solids content (Table-4). It was observed from the results that the total solids content in the commercial brands yoghurt of Nestle was in the range of 13.00 to 17.00 percent, while yoghurt sample of Nirala sweets in the range of 11.00 to 13.00 percent, yoghurt of Moon Daireis in the range of 9.10 to 13.00 percent and yoghurt of Gourmet's , in the range of 10.00 to 12.80 percent. The mean total solids content in commercial brands yoghurt supplied by Nestle was maximum (15.84±1.00) followed by yoghurt marketed by Nirala sweets and Moon Dairies, Lahore with mean total solids contents of 12.36±0.09 and 11.53±0.14 percent, respectively. However, the total solids content was lowest (11.35±0.09 percent) in commercial yoghurt of Gourmet's, Lahore.

The comparison of the results regarding total solids content in different commercial brands of yoghurt revealed that the total solids content on average in yoghurt of Nestle was relatively greater than the yoghurt of all other commercial branches and statistically the differences were significant ($P<0.001$) between all the brands, with the exception of yoghurt of Gourmet's and Moon Dairies where differences were statistically non-significant ($P>0.05$).

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Table-4: Total solids content (%age) of commercial brands yoghurt sold at Lahore.

Source of yoghurt samples	Total solids content (%age)			
	Minimum	Maximum	Mean	SE (±)
Gourmet's	10.00	12.80	11.35	0.09
Moon Dairies	9.10	13.00	11.53	0.14
Nestle	13.00	17.00	15.84	0.10
Nirala sweets	11.00	13.00	12.36	0.09
Significance:				
Gourmet's v/s Moon dairies			n.s	
Gourmet's v/s Nestle			***	
Gourmet's v/s Nirala sweets			***	
Moon Dairies v/s Nestle			***	
Moon Dairies/s Nirala sweets			***	
Nestle v/s Nirala sweets			***	

Significance: *** P < 0.001, n.s P > 0.05.
SE: Standard Error of mean
Data are the average of 25 samples and duplicate for each.

Solids not fat content (%age)

The yoghurt samples of different commercial brands were computed in the present study and results are depicted in (Table-5). The results illustrated that the solids not fat content in the commercial brands yoghurt of Nestle were in the range of 11.40 to 14.50 percent, yoghurt of Nirala sweets in the range of 10.40 to 12.60 percent, yoghurt of Moon Dairies in the range of 8.60 to 12.70 percent and while the yoghurt of Gourmets were in the range of 9.70 to 12.50 percent. The mean solids not fat content in commercial brands yoghurt supplied by Nestle were maximum (13.08±0.11), followed by yoghurt marketed by Nirala sweets and Moon Dairies with mean solids not fat contents 11.82±0.09 and 11.00±0.13 percent, respectively. However, the solids not fat content were lowest (10.86±0.09 percent) in commercial yoghurt of Gourmet's.

The comparison of the results regarding solids not fat in different commercial brands of yoghurt revealed that the solids not fat content on an average in yoghurt of Nestle was relatively greater than the yoghurt of all other commercial brands and statistically the differences were highly significant (P<0.001) between all the brands, with the exception of yoghurt of Gourmet's v/s Moon Dairies where differences were statistically non-significant (P>0.05).

Table-5: Solids not fat content (%age) of commercial brands yoghurt sold at Lahore.

Source of yoghurt samples	Solids not fat content (%age)			
	Minimum	Maximum	Mean	SE (±)
Gourmet's	9.70	12.50	10.86	0.09
Moon dairies	8.60	12.70	11.00	0.13
Nestle	11.40	14.50	13.08	0.11
Nirala sweets	10.40	12.60	11.82	0.09
Significance:				
Gourmet's v/s Moon dairies			n.s	
Gourmet's v/s Nestle			***	
Gourmets y v/s Nirala sweets			***	
Moon Dairies v/s Nestle			***	
Moon Dairies v/s Nirala sweets			***	
Nestle v/s Nirala sweets			***	

Significance: *** P < 0.001, n.s P > 0.05.
SE: Standard Error of mean
Data are the average of 25 samples and duplicate for each.

Total carbohydrate/lactose content (%age)

The samples of different commercial brands yoghurt obtained from Lahore market were analyzed for total carbohydrate/lactose contents (Table-6). The results showed that the total carbohydrate/lactose content in the commercial brands yoghurt of Nestle was in the range of 6.40 to 10.20 percent, Nirala sweets 5.40 to 8.90 percent, Moon Dairies, Lahore 4.40-8.70 percent and Gourmet's,

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5.00 to 8.60 percent. The mean total carbohydrate/lactose content in commercial brands yoghurt supplied by Nestle were maximum (8.47±0.12) percent, followed by commercial yoghurt sample produced by Nirala super store (6.93±0.11) Moon Dairies (6.35±0.14) and Gourmet's (6.27±0.10 percent).

The statistical analysis further illustrated that the total carbohydrate/lactose content in different commercial brands of yoghurt varied considerably, and statistically the differences were moderate significant (P<0.01) when yoghurt of Gourmet's was compared with Nestle yoghurt, and the differences were highly significant (P<0.001) when the yoghurt of Gourmet's was compared with Moon Dairies and Nirala and non-significant (P>0.05) when yoghurt of Moon Dairies was compared with Nestle and Nirala sweets or when Nestle yoghurt was compared with yoghurt of Nirala sweets.

Table-6: Total carbohydrate/lactose content (%age) of commercial brands yoghurt sold at Lahore.

Source of yoghurt samples	**Total carbohydrate /lactose content (%age)**			
	Minimum	**Maximum**	**Mean**	**SE (±)**
Gourmet's	5.00	8.60	6.27	0.10
Moon Dairies	4.40	8.70	6.35	0.14
Nestle	6.40	10.20	8.47	0.12
Nirala Sweets	5.40	8.90	6.93	0.11
Significance:				
Gourmet's, v/s Kaka			***	
Gourmet's v/s Nestle			**	
Gourmet's v/s Nirala sweets			***	
Moon Dairies v/s Nestle			n.s	
Moon Dairies v/s Nirala sweets			n.s	
Nestle v/s Nirala sweets			n.s	

Significance: ** P < 0.01, *** P < 0.001, n.s P > 0.05.
SE: Standard Error of mean
Data are the average of 25 samples and duplicate for each.

Syneresis

Commercial yoghurts available at different Lahore markets were purchased and subjected to analyze for syneresis (Table-7). The results illustrated that the whey syneresis in the commercial brands yoghurt of Nestle was in the range of 0.50 to 1.00 ml $2h^{-1}$, Nirala sweets in the range of 2.80 to 3.60 ml $2h^{-1}$, Moon Dairies in the range of 2.80-3.80 ml $2h^{-1}$ and Gourmets in the range of 2.00-3.80 ml $2h^{-1}$. The mean whey syneresis was minimum (0.87±0.03 ml $2h^{-1}$) in commercial brands yoghurt marketed by Nestle maximum (333±0.03 ml $2h^{-1}$) in commercial yoghurt of Moon Dairies . However, Nirala and Gourmet's Lahore evident with mean whey syneresis of 3.20±0.03 ml $2h^{-1}$ and 3.22±0.07 ml $2h^{-1}$, respectively.

The comparison of results regarding whey syneresis in commercial yoghurts marketed in Lahore city illustrated that the differences for syneresis between Gourmets v/s Moon Dairies and Gourmet's v/s Nirala sweets were non-significant (P>0.05), while the differences were highly significant (P<0.001) when comparison for whey syneresis was made among Gourmet's v/s Nestle, Moon Dairies v/s Nestle, Moon Dairies v/s Nirala sweets and Nestle v/s Nirala sweets.

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Table-7: Syneresis (ml $2h^{-1}$) of commercial brands yoghurt sold at Hyderabad.

Source of yoghurt samples	Syneresis (ml $2h^{-1}$)			
	Minimum	Maximum	Mean	SE (±)
Gourmet's	2.00	3.80	3.22	0.07
Moon Dairies	2.80	3.80	3.33	0.03
Nestle	0.50	1.00	0.87	0.03
Nirala Sweets	2.80	3.60	3.20	0.03

Significance:	
Gourmet's v/s Moon Dairies	n.s
Gourmet's v/s Nestle	***
Gourmet's v/s Nirala sweets	n.s
Moon Dairies v/s Nestle	***
Moon Dairies v/s Nirala sweets	***
Nestle v/s Nirala Sweets	***

Significance: *** $P < 0.001$, n.s $P > 0.05$.
SE: Standard Error of mean
Data are the average of 25 samples and duplicate for each.

DISCUSSIONS

Acidity

It was noted that the acidity percentage was significantly ($P<0.01$) higher in yoghurt supplied by the local stores at Lahore as compared to the yoghurt marketed by Nestle and Nestle yoghurt had remarkably less acidity percentage. However, the maximum acidity in locally supplied commercial yoghurts at Lahore shops possessed significantly high percentage of acidity than the provided limit for human consumption. However, the average acidity percentage in yoghurt of all the commercial brands was within the provided limits for human consumption. These results are partially supported by Inoue *et al*. (1998) who reported no appreciable change in acidity during storage of yoghurt.

pH value

The results revealed that the pH value was relatively higher in yoghurt of Gourmets Lahore as compared to the commercial yoghurt marketed by Nestle, Moon Dairies and Nirala sweets. While comparison was made between different commercial brands yoghurts marketed at various stores.

It was observed that the differences in pH value in yoghurt of Gourmets v/s Moon Dairies, Gourmet's v/s Nestle and Gourmet's v/s yoghurt manufactured by Nirala sweets were statistically highly significant ($P<0.001$) while differences were non-significant ($P>0.05$) when yoghurt of Moon Dairies was compared with Nestle and Nirala sweets and Nestle v/s Nirala sweets . Similar results have also been reported by Inoue *et al*. (1998) who recorded pH values 4.5, 5.0, 5.5 and 6.5 during storage of yoghurt for six months and these values are well comparable with the findings of the present research. Moreover, the results reported by Mandokhel (1996) are in contrast to the findings of the present research, who found non-significant differences in pH values of different yoghurt samples.

Protein content (%age)

The results argued that the protein content was remarkably higher (4.16 %) in the commercial yoghurt of Nirala sweets as compared to the yoghurts supplied by Nestle, Gourmet's and Moon Dairies Lahore. It is further evident from the results that statistically differences between Gourmets yoghurt v/s yoghurt of Moon Dairies and Nestle v/s Nirala sweets were non-significant ($P>0.05$) and significant between Gourmet's v/s Nestle, Gourmets v/s Nirala sweets , Moon Dairies v/s Nirala sweets. ($P<0.01$) and Moon Dairies v/s Nestle ($P<0.05$). The results of the present study are in concurrence with the findings of Seckinkomal (2004), who mentioned that protein contents in yoghurt increased during different processes and storage period and during removal of lactose, while Modler (2000) also experienced significant effect on protein content in storage yoghurt samples.

Total solids content (%age)

The results illustrated that the total solids content was comparatively higher (15.84 %) in the commercial yoghurt of Nestle as compared to the yoghurts supplied by Nirala sweets, Gourmet's and Moon Dairies Lahore. The comparison of the results regarding total solids in different commercial brands of yoghurt revealed that the total solids content on an average in yoghurt of Nestle was relatively greater than the yoghurt of all other commercial brands and statistically the differences were significant ($P<0.01$) between all the brands, with the exception of yoghurt of Gourmet's v/s Moon Dairies where differences were statistically non-significant ($P>0.05$). Similar results have also been reported by Ayub and Siddiq (2003), who were of the opinion that the total solids in all samples significantly increased during storage.

Solids not fat content (%age)

The solids not fat content was relatively higher (13.08 %) in the commercial yoghurt of Nestle as compared to the yoghurts supplied by Nirala sweets, Moon

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Dairies and Gourmet's, Lahore. The comparison of the results regarding solids not fat content in different commercial brands of yoghurt revealed that the solids not fat content on an average in yoghurt of Nestle was relatively greater than the yoghurt of all other commercial brands and statistically the differences were highly significant (P<0.001) between all the brands, with the exception of yoghurt of Gourmet's and Moon Dairies where differences were statistically non-significant (P>0.05). The findings of the present investigation are in line to those of Ayub and Siddiq (2003), who found varied SNF in samples of yoghurt collected at different storage periods.

Lactose content (%age)

Lactose content was comparatively higher (8.47%) in the commercial yoghurt of Nestle as compared to the yoghurts supplied by Nirala sweets, Moon Dairies and Gourmet's Lahore. The statistical analysis further illustrated that the total carbohydrate/lactose content in different commercial brands of yoghurt varied considerably, and statistically the differences were significant (P<0.01) when yoghurt of Gourmet's was compared with Moon Daiires, Nestle and Nirala sweets, and non-significant (P>0.05) when yoghurt of Moon Dairies was compared with Nestle and Nirala sweets or when Nestle yoghurt was compared with yoghurt of Nirala sweets. Results of the author are further supported by similar results have also been reported by Ayub and Siddiq (2003), who found that lactose content decreased in all samples significantly with increasing storage periods.

Syneresis

Syneresis was significantly (P<0.05) higher (3.33±0.034 ml $2h^{-1}$) in the commercial yoghurt of Moon Dairies, Lahore as compared to the yoghurts supplied by Gourmets , Nirala sweets and Nestle commercial brands yoghurt, Lahore. It was observed that yoghurt marketed by Gourmets and Moon Dairies and Nirala sweets had higher whey syneresis levels than commercial yoghurt of Nestle, which reflected that Nestle yoghurt was better in quality as compared to the yoghurts of rest companies investigated. The comparison of results regarding whey syneresis in commercial yoghurts marketed in Lahore city illustrated that the differences for syneresis between Gourmet's v/s Moon Dairies and Gourmet's v/s Nirala sweets were non-significant (P>0.05) while, the differences were highly significant (P<0.01) when comparison was made among Gourmet's sweets v/s Nestle, Moon Dairies v/s Nestle, Moon Dairies v/s Nirala sweets and Nestle v/s Nirala sweets. Schmidt and Bledsoe (1995) who found considerable differences for syneresis and water holding capacity in yoghurt of different commercial brands, while Modler *et al*. (2000) who found that with increase in protein in yoghurt the syneresis was decreased.

CONCLUSIONS

It was concluded from the present study that commercial brands of yoghurt sold at Lahore market varied widely in the physical as well as chemical quality. Quality of Nestle brand yoghurt in term of syneresis was supperior in contrast to Gourmet's, Moon Dairies and / or Nirala Sweets yoghurt.

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