ISSN : 0974 - 7508 Volume 9 Issue 5

Natural Products

An Indian Journal

Full Paper

NPAIJ, 9(5), 2013 [180-186]

Quality and acceptability of flavored yoghurt enriched with *Red beet* extract

Mohammad Sayadi Shahraki[1], Ali Mohamadi Sani[1*], Mohammad Hojjatoleslamy[2]

[1]Department of Food Science and Technology, Quchan branch, Islamic Azad University, Quchan, (IRAN)

[2]Department of Food Science and Technology, Shahrekord branch, Islamic Azad University, Shahrekord, (IRAN)

E-mail: mohamadisani@yahoo.com

ABSTRACT

The purpose of this research was to determine the effects of red beet extract and strawberry flavor on the physicochemical and organoleptic properties of yogurt. For this purpose a total of 48 yogurt samples including yogurts flavored with strawberry flavor (1, 2 and 4%) and colored with red beet extract (1.25, 2.5 and 4%) and a control yogurt (no strawberry flavor or red beet extract) were evaluated for chemical, physical and sensory properties during 21 days of storage. Data analyzed by ANOVA using statistical analysis system (SAS, 1995). Results showed statistically significant differences ($P<0.05$) between the control and red beet-flavored yogurts in terms of viscosity and syneresis. Addition of red beet extract to yogurt resulted in an increase in the syneresis, and a decrease in the viscosity. During the storage, the values of the titratable acidity, viscosity and syneresis of experimental yogurts increased, while pH of the yogurts decreased significantly ($P<0.05$). Yogurt enriched with 2.5% red beet extract and 2% strawberry flavor was more acceptable and high scored with respect to overall acceptability value by panelists.

KEYWORDS

Flavored yogurt;
Red beet extract;
Viscosity;
Sensory properties.

INTRODUCTION

There is an increasing interest by consumers in food items recognized as beneficial for health, with regard to food that can be considered of greater nutritional value, low in fats, and rich in bioactive compounds scientifically recognized to be negatively associated with disease risk[35]. *Red beet* (Beta vulgaris) is a potential source of valuable water-soluble nitrogenous pigments, called betalains, which are composed of two main groups, the red betacyanins and the yellow betaxanthins. They are free radical scavengers and prevent active oxygen-induced and free radical-mediated oxidation of biological molecules[26]. Accordingly, this pigment mixture has been used as a natural additive for food, drugs and cosmetic products in the form of beet juice concentrate or beet powder[14]. Recently, there has been an increasing interest in the use of natural food additives and incorporation of health-promoting substances into the diet[34]. Yogurt is one of the most unique dairy product, and a functional one[17]. The consumption of yogurt has experienced significant increases and there are various types to achieve the broad consumer market. These products may vary according to the ingredients, composition, flavor, consistency, texture, caloric value, development process and nature of the process of posthatching[30]. The final product quality has great importance in its acceptance, and is influenced mainly by its consistency and viscosity. The improvement of aroma and flavor of yogurt can result in an increase in the consumption of final product. Fruit yogurt found to be more attractive organoleptically due to masking partially the excessive acetaldehyde flavor in plain yogurt[3,7]. The production and consumption of fruit yogurt is low in Iran compared to plain yogurt. Therefore, the objective of our investigation was to develop a new type of flavored Set yogurt by adding *Red beet* extract and to study the effects of *Red beet* addition on some of the qualities of the final product.

MATERIAL AND METHODS

Material

The experiment was conducted in the laboratory of the department of food technology & rural industries, Islamic azad university, branch of Shahrekord. Fresh milk was collected from dairy farm of Shimbar factory. Red beet for extract preparation, Strawberry Flavor (Farmand Co, Iran), and starter culture Chr. Hansen Co. (A/S, Horsholm, Denmark) collected from local market. Materials used in these experiments were Sodium hydroxide, methanol, sodium carbonate, methylene blue reagent, and devices used including pasteurization and Homogenizer (machine building, Iran), machine juicer (JC-17E, Japan), centrifuge 3K30 (Germany), high speed agitator (mixer 12405, Germany), Brookfield viscometer (Stoughton, USA), pH meter (D-82362, Germany), Refractometer (RX-500, Belgium).

Preparation of red beet extract

Collected red beet, was washed with clean water and the black spots were removed from red beet with the help of knife aseptically. Red beets were blended and red beet juices extracted by juicer. After blending, the extract was filtered with clean cloth (hot water washed). These were kept in plastic containers and stored at freezing temperature (-20°C) until preparation of red beet (yogurt)[18].

Manufacture of experimental yogurts

Milk was heated to boiling to destroy the pathogenic organisms at 85°C for 10 minutes. It was then transferred to a container and cooled to 39±1°C. Milk was inoculated with desirable proportion of starter culture (2.5%), which was collected from local market. For this purpose commercial starter culture Chr. Hansen Co. (A/S, Horsholm, Denmark) yogurt was used. Once the starter, was completely mixed, the red beet juice which is previously pasteurized was incorporated into yogurt at 1.25%, 2.5% and 4% level and was flavored with strawberry flavor at 1%, 2% and 4% level in different cups except control[24]. The plastic cups were pre-washed with boiled water before use. The samples were incubated at 41-43°C until the complete curd formation/coagulation of yoghurt (8-12 hrs). The yoghurt samples were stored at about 4°C at refrigeration until used.

Chemical analysis of fresh milk

Moisture, Total Solids (TS) and Ash content of the different type of milk was determined according to[4]. Fat percent was determined by Babcock method using the procedure described by Aggarwala and Sharma[1]. Acidity was determined by titration with 0.1N sodium hydroxide solution using the procedure by Aggarwala and Sharma[1]. Crude protein was determined by Kjeldahl described by Rangana[27] procedure. Total carbohydrate content of the sample was determined by subtracting the measured protein, fat, ash and moisture from 100[9]. pH was measured with the help of a pH meter (D-82362, Germany).

Sensory evaluation

The samples of yogurt prepared were evaluated organoleptically on 7 point hedonic scale by a panel of 10 judges (10 laboratory staff of Shimbar dairy factory). The samples were evaluated for body, texture, flavor and overall acceptability as Land and Shepher[21]. The judges were briefed as to the method of scoring for different quality characteristics. Descriptions about the criteria evaluated were given prior to evaluation[13].

pH measurement

Yogurt pH was measured in duplicate using a pH model (D-82362, Germany). Titratable acidity of milk and the yogurts, expressed as % lactic acid, was determined on triplicate samples following method 947.05 of the AOAC[5]. Yogurt pH and titratable acidity were measured at days 1, 7, 14, and 21.

Full Paper

Total tritatable acidity measurement

Yogurt sample (1 ml) was mixed thoroughly with 9 ml of distilled water Phenolphthalein solution (0.1%, 3 drops) was added and the yogurt suspension was titrated using 0.1 M NaoH. The mixture was stirred continuously and titrated was continued until the indicator changed to a definite pink color lasting for 30 seconds. The volume of NaOH required to neutralize the yogurt acid was recorded and used to calculate the content of titratable acids (lactic acid percentage equivalent) using the following formula:

$$LA\% = \frac{10 \times VNaOH \times 0.009 \times 0.1}{W} \times 100\% \quad (1)$$

Where 10 = Dilution factor; W = weight of sample for titration; VNaOH = Volume of NaOH used to neutralize the lactic acid and 0.1 = Normality of NaOH

Syneresis measurement

One hundred grams of yoghurt sample was placed on a filter paper resting on a top of a funnel. After 2 h of drainage at 70C, the quantity of whey collected in a 50 ml graduated cylinder was used as an index of syneresis[15]. Syneresis (%) was based on the volume of clear supernatant per 100-mL yogurt.

Viscosity measurement

Apparent viscosity was determined by using a RV Brookfield viscometer (Stoughton, USA) on 100 mL yogurt samples at room temperature. Samples were stirred for 40 sec before measurement. Readings were converted to centipoises units. All viscosity values were measured at 10 rpm with spindle #5[16].

Statistical analysis

Data were analyzed by analysis of variance (ANOVA) using the general linear model (GLM) procedure of the Statistical Analysis System[31]. The means were separated by use of the least significant difference (LSD) test. Significant differences were determined at α=0.05[32].

RESULTS AND DISCUSSION

Chemical analysis of milk

Quality of Milk used for yoghurt production was analyzed before use. Moisture, total solid, fat, protein, ash, lactose, acidity, pH, and Solid Non-Fat (SNF) were determined. Results of chemical analysis of milk are shown in (TABLE 1). The results are more or less similar to other researcher. Protein percentage of raw milk samples was 3.32, which is within the normal range of 2.3 to 4.4. Mean acidity of the experimental samples was 0.17 percent (TABLE 1) which is within the normal range.

TABLE 1: Composition of Cow milk, used for yogurt making (on as such basis)

Composition	pH	Acidity(%)	Moisture(%)	Fat(%)	Protein(%)	Ash(%)	Carbohydrate/Lactose(%)	SNF(%)
Raw Milk	6.6	0.18	87.52	4.15	3.31	0.72	4.28	8.37

Organoleptic properties of red beet- flavor yogurts

The organoleptic evaluation of the Red beet-flavored yogurt was carried out at weekly intervals for 21 days and the mean scores obtained summarized in TABLE 2. Results of organoleptic evaluation showed that significant differences were observed among Red beet-flavored yogurts (P< 0.05) except in texture, while differences were obtained statistically significant between the scores of all organoleptic properties of the flavored yogurts made by adding 1.25 and 2.5 and 4% of Red beet extracts. By adding higher amounts of red beet extract, flavor gained lower scores (P< 0.05). However, statistically significant differences were not found between the scores of samples with 1 and 2% strawberry flavor. In addition, the panelists preferred yogurt produced with 2% of red beet extract (TABLE 2).

With respect to flavor value, the red beet-flavored yogurt manufactured with 2.5% of red beet extracts and 2% strawberry flavor was more acceptable by panelists. As a result of panelists' evaluation, with respect to flavor, color, and perceived texture, significant differences were not observed between examined yogurts by adding different amounts of strawberry flavors. The perceived flavor value of 1% strawberry flavor added yogurt was found to be the lowest, while the values of the yogurts made by adding 2% strawberry flavor was highest (P < 0.05). In addition, panelists also stated that the amount of the red beet yogurt containing 1 and 4% strawberry flavor was less desirable. Yogurts produced with adding 2.5% red beet extract and 2% strawberry flavor were preferred by panelists with higher value of others red beet yogurt. Although, the result was statistically significant, the overall acceptability value of red beet-flavored yogurt with 1.25 and 4% red beet extract was slightly lower than the yogurt added 2.5% red beet extract.

TABLE 2 : Effect of red beet extract and strawberry flavor concentrations on sensory properties of yogurt

	Properties		Flavor	Texture	Color	Overall Acceptability
Different types of yogurts	0% red beet extract	CY	5.60±0.65	5.88±0.52	5.82±0.49	5.02±1.14
		S0	5.36±0.72	5.88±0.53	5.82±0.45	5.02±1.23
		S1	5.49±0.75	5.87±0.72	5.84±0.48	5.01±1.76
		S2	5.64±0.54	5.90±0.48	5.86±0.49	5.02±1.19
		S3	6.02±0.61	5.90±0.49	5.83±0.65	5.00±1.43
		ST$\bar{X}$	5.60 NS	5.89 NS	5.83 NS	5.01 NS
	1.25% red beet extract	CY	5.60±0.64	5.88±0.59	5.82±0.65	5.02±1.27
		S0	5.52±0.63	5.91±0.56	5.96±0.63	5.03±1.20
		S1	5.63±0.64	5.88±0.50	5.99±0.63	5.02±1.12
		S2	5.60±0.73	5.93±0.65	5.92±0.72	5.04±1.59
		S3	5.71±0.65	5.92±0.63	6.00±0.74	5.02±1.19
		ST$\bar{X}$	5.61 NS	5.90 NS	5.96 *	5.03 NS
	2.5% red beet extract	CY	5.60±0.65	5.88±0.48	5.82±0.56	5.02±1.83
		S0	5.43±0.71	5.89±0.62	6.02±0.59	5.04±2.04
		S1	5.77±0.73	5.92±0.54	6.05±0.54	5.04±1.98
		S2	5.80±0.64	5.94±0.59	6.09±0.53	5.05±2.01
		S3	5.86±0.69	5.93±0.63	6.14±0.66	5.06±1.88
		ST$\bar{X}$	5.69 *	5.91NS	6.03 *	5.04 *
	4% red beet extract	CY	5.60±0.52	5.88±0.61	5.82±0.53	5.02±1.45
		S0	5.60±0.64	5.92±0.65	5.86±0.59	5.02±1.53
		S1	5.65±0.76	5.89±0.64	5.90±0.69	5.03±1.34
		S2	5.57±0.68	5.91±0.57	5.91±0.65	5.04±1.49
		S3	5.69±0.65	5.94±0.71	5.84±0.71	5.05±1.57
		ST$\bar{X}$	5.62 NS	5.91NS	5.86 *	5.03 NS

CY = Control yogurt, K0 = 0% of strawberry flavor, K1 = 1% of strawberry flavor, K2 = 2% of strawberry flavor, K3 = 4% of strawberry flavor, * = significant at 5% level, NS = Non significant

Physical and chemical properties of experimental yogurt

Plain yoghurt (no Flavor and extract added) was compared with yoghurts incorporating different concentrations (1.25%, 2.5% & 4%) of extract of Red beet (R1, R2 & R3), and (1%, 2% & 4%) of Strawberry flavor (S1, S2 & S3).

Titratable acidity properties of the experimental yogurts

The lowest mean value of titratable acidity was found at the 1st day of storage, as the highest value was found at the 21st day of storage. In the range of 0.86-0.88%, for the 1st day of storage, sample S3 had the lowest mean value, for the 21st day of storage and the sample CY (control yogurt) had the highest mean value of titratable acidity. Some authors reported similar results[33]. This might be due to the acid production in the experimental yogurts during storage as a result of the fermentation of lactose by the action of the starter cultures[6].

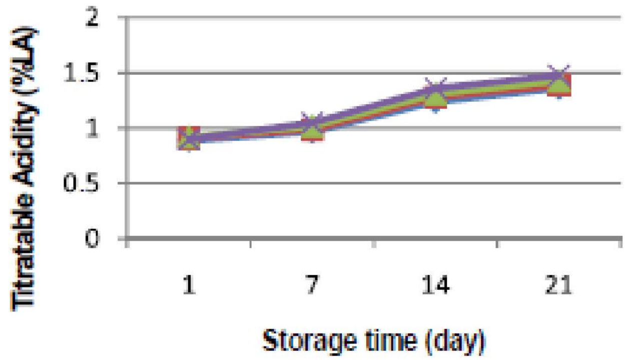

Figure 1: Effect of red beet extracts on titratable acidity of yogurts during storage at 4ºC for 21 days. *f*&: CY control and , % S1: 1.25% , ²% S2: 2.5%, and × S3: 4% red beet extract respectively

Laye et al., (1993) reported lower titratable acidity values than ours and similar results were reported by Isleten and Karagul-Yuceer[8] for non-fat yogurt. Titratable acidity of the control and red beet-flavored yogurts increased significantly during the storage period at 4ºC ($P < 0.05$). Some researchers reported that the titratable acidity of fruit-flavored yogurts increased along with storage[2]. In the red beet-flavored yogurts containing 4% red beet extract, the rapid increase in titratable acidity continued up to the end of storage (Figure 1). The titratable acidity of red beet-flavored yogurts contained 4 %red beet extract was found more than the yogurt with 1.25% red beet extract and control, while the acidity of the yogurt with 1.25% red beet extract was lower than the control (Figure 1).

pH properties of the experimental yogurts

pH measures free H^+ ion whereas the total titratable acidity measure total organic acid that present in yogurt. Both measurements are important because acidification is the key mechanism during yogurt fermentation. The declining of pH during fermentation was due to the protocooperative action of two strain of bacteria *S.thermophilus* and *L.bulgaricus*. The presence milk sugar (carbon source) and milk protein (nitrogen source) in the rich medium of milk and optimum incu-

Full Paper

bation environment (pH 7 and 41ºC) encourage the bacterial strain (*S.thermophilus*) to grow rapidly. They transform lactose acid into lactic acid, acetaldehyde, diacetyl, and formic acid. The accumulation of all these fermentation products corresponds to the increasing of acid production during fermentation. The liberation of lactic acids reflects the high metabolic activity of the lactic acid bacteria[23].

In general, the pH values of all samples decreased during storage and these differences were found to be significant (P<0.05). This can be explained by further metabolic activities of starter cultures during storage[11].

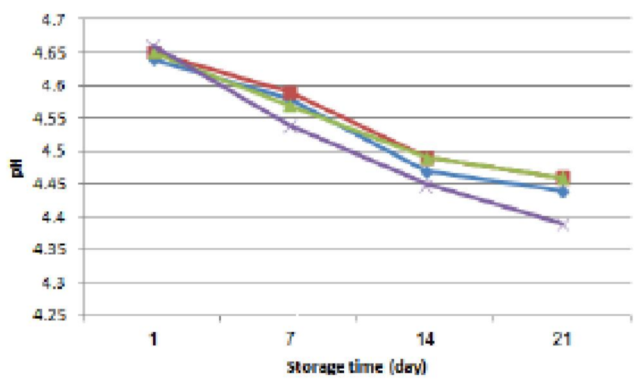

Figure 2 : Effect of red beet extracts on pH of control and red beet yogurts during storage at 4ºC for 21 days:*f&* CY: control and *%* S1: 1.25%, *²%* S2: 2.5%, and × S3: 4% red beet extract respectively.

When pH decreased, aroma and acidic taste increased as a result of decreased flavoring characteristics. Similarly, the pH of the control and red beet-flavored yogurts continued to decrease during the storage. Lower concentration of the red beet extract in the yogurt resulted in a faster decrease in the pH, while higher red beet extract concentration caused to increase in the pH. This was probably due to the nature pH of the added ingredients to the yogurts.

Syneresis properties of the yogurts

The syneresis values of yogurts were affected significantly (P<0.05) by both red beet extracts concentration and storage time and the changes are shown in (Figure 3). The highest mean value (46.06 mL/100 g) of syneresis was recorded in sample S3 and the lowest mean value (42.62 mL/100 g) in sample CY (control). As seen in Figure 3, the addition of red beet extract caused a increase of syneresis values in all samples of Red beet-flavored yogurts and the differences between the control and these samples were statistically significant (P<0.05). All yogurts with Red beet extracts showed a higher syneresis percentage compared to plain yogurt. Yogurt with 4 % (w/w) red beet extract showed the highest syneresis (52.8%). This increasing in syneresis is probably due to decreasing in water holding capacity that led to more releases of whey[27].

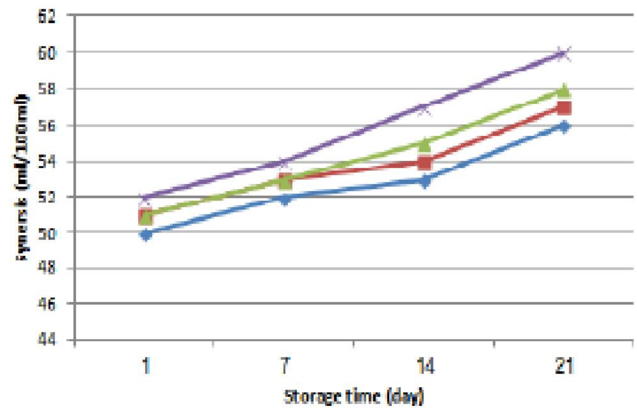

Figure 3 : Syneresis of control and red beet yogurts during storage at 4ºC for 21 days: *f&* CY: control and, *%* S1: 1.25%, *²%* S2: 2.5%, and × S3: 4% red beet extract respectively.

The introduction of red beet extracts did not increase the fiber contents in yogurt, which otherwise would hold the water and thus increase the syneresis. The watery structure of the extracts themselves may lead to more releases of whey in the red beet-flavor yogurts. The higher syneresis shown in red beet-flavor yogurt was most probably caused by higher active water content contributed by the added extracts.

Viscosity properties of the yogurts

The viscosities of the control and red beet-flavored yogurt increased rapidly up to day 7, and continued to increase slowly up to day 14 of storage and afterwards decreased slowly. Similar viscosity pattern of yogurt during gelation process was reported by Jumah et al[20]. On the other hand, the viscosities of the red beet-flavored yogurts were influenced by the rates of the extracts addition (Figure 4). The addition of the red beet extracts increased the mean viscosity values of all yogurts, and it was also found to be concentration-dependent (P<0.05).

All yogurts formulated with red beet extracts showed no significantly higher viscosity values compared to the plain yogurt (figure 4). Probably, the addition of red beet extracts reinforced the yogurt micelle matrix and the red beet fiber fragments did not interfere with the fine structure of the yogurt. Yogurt, with the highest red beet extract content (2.5%), showed the highest viscosity values. Lower levels of red beet extracts probably altered the casein micelle matrix structure of the yogurts in such a way as to have contributed to the low viscosity values. Similarly, Otero et al.[25] observed higher viscosity values when the fiber content was increased in yogurt preparation.

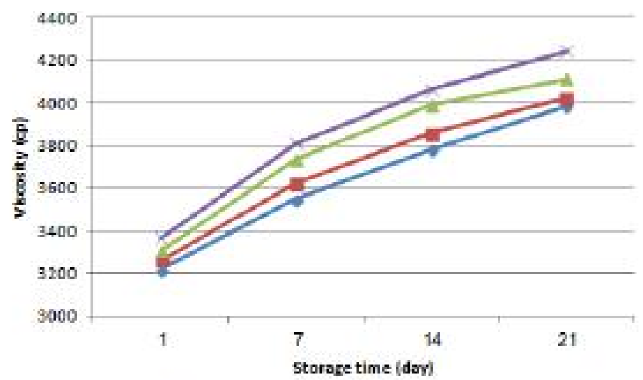

Figure 4 : Viscosity of control and red beet yogurts during storage at 4°C for 21 days: *f&* CY: control and, *%* S1: 1.25%, *²%* S2: 2.5% and × S3: 4% red beet extract respectively.

CONCLUSION

Yogurt is a functional food that has great demand due to the consumer's search for a healthier diet. The effects of the red beet extract addition on the physicochemical and organoleptic properties of yogurt were examined. The titratable acidity, pH, viscosity, syneresis, and organoleptic properties of experimental yogurts were determined at weekly intervals for 21 days. Statistically significant differences were found between the control and red beet-flavored yogurts in terms of viscosity and syneresis. The addition of the red beet extract to yogurt resulted in an increase in the syneresis, and a decrease in the viscosity. During the storage, the values of the titratable acidity, viscosity and syneresis of experimental yogurts increased, while pH of the yogurts decreased significantly ($P < 0.05$). Yogurt with 2.5% red beet extract and 2% strawberry flavor was more acceptable and high scored with respect to overall acceptability value by panelists.

REFERENCES

[1] A.C.Aggarwala, R.M.Sharma; Asia Publishing House, **(1961)**.

[2] M.S.Akin, A.Konar; Turkish J. of Agri and Forestry, **(1999)**.

[3] N.Akyüz, H.Coskun; National Productivity Centre Pub, **(1995)**.

[4] AOAC Official Methods of Analysis, Washington (DC), **(2002)**.

[5] AOAC Official Methods of Analysis, **(1999)**.

[6] I.Bakirci, A.Kavaz; Int J.Dairy Technol., **(2008)**.

[7] D.L.Barnes, S.J.Harper, F.W.Body felt, M.R.McDaniel; J.Dairy Sci., **(1991)**.

[8] M.Barzegar, F.Erfani, A.Jabbari, M.R.Hassandokit; Ital J.Food Sci., **(2007)**.

[9] J.Begum, A.Nahar, M.N.Islam, M.M.Rahman; Bangladesh Research Publications J., **(2011)**.

[10] M.Bergman, A.Perelman, Z.Dubinsky, S.Grossman; Phytochemistry, **(2003)**.

[11] G.Bonczar, M.Wszolek, A.Siuta; Food Chem., **(2002)**.

[12] A.Brabandere, J.Baerdemaeker; Int.J.Dairy Technol., **(2003)**.

[13] O.Cueva, K.J.Aryana; LWT-Food Science Technol., Dairy Sci., **(2007)**.

[14] H.Dörnenburg, D.Knorr; Crit.Rev.Plant.Sci., **(1996)**.

[15] H.Farooq, Z.U.Haque; J.of Food Engineering, **(1992)**.

[16] A.M.Gassem, F.J.Frank; J.Dairy Sci., **(1991)**.

[17] A.Guven, M.Gulmez; Kafkas Univ. Vet. Fak. Derg., **(2006)**.

[18] M.N.Hossain, M.Fakruddin, M.N.Islam; J.Food Process Technol., **(2012)**.

[19] M.Isleten, Y.Karagul-Yuceer; J.Food Quality, **(2008)**.

[20] Jumah, B.Abu-Jdayil, R.R.Shaker; International J. of Food Properties, **(2001)**.

[21] Land, A.Shepher; Elsevier Applied Sci., **(1988)**.

[22] L.Lomintski, M.Bergman, A.Nyska, V.Ben-Shaul, S.Grossman;. Nutr.Cancer., **(2003)**.

[23] A.Lourens-Hattingh, B.C.Viljoen; International Dairy J., **(2001)**.

[24] A.Nahar, M.Al-Amin, S.M.K.Alam, A.Wadud, M.N.Islam; International J. of Dairy Sci., **(2007)**.

[25] A.Otero, M.A.Diaz-Valverde, R.Amaro-Lopez; nutritional assessment, Food Chemistry, **(2000)**.

[26] M.A.Pedrenˇo, J.Escribano; J.Sci.Food Agric, **(2001)**.

Full Paper

[27] A.L.B.Penna, K.Sivieri, M.N.Oliviera; J. of Food Engineering, **(2001)**.

[28] S.Ranganna; Manual of Analysis of Fruit & Vegetable Products, **(1976)**.

[29] S.Ranganna; Tata McGraw-Hill Publ.Co.Ltd., New Delhi, INDIA, **(1976)**.

[30] J.L.Rasic, J.A.Kurmann; Technical Dairy Publ., **(1978)**.

[31] [SAS] Statistics; Version 6.0 Edition, **(1995)**.

[32] R.D.G.Steel, J.H.Torrie; A Biometrical Approach **(1980)**.

[33] Z.Tarakci, E.Kucukoner, J.Food Sci.Technol., **(2004)**.

[34] L.Varga; International Journal of Food Microbiology, **(2006)**.

[35] P.M.Waijers, E.J.Feskens, M.C.Ocké; Br.J.Nutr, **(2007)**.