J. Agric. Sci. Mansoura Univ., 25 (2): 931 - 944, 2000.

ENHANCEMENT OF SENSORY PROPERTIES, NUTRITIVE VALUE AND SHELF-LIFE OF EL-SHAMEY HOME-MADE BREAD BY USING SOME DAIRY BY PRODUCTS

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ABSTRACT

Buttermilk, a dairy by product of butter-making, was used to improve both nutritional value and shelf-life of El-Shamey bread. Dough was prepared by added Buttermilk at ratios of 25, 50, 75 and 100% (V/V) based on the required amount of mixing water . and left for 2 hrs for leavening, then baking was carried out using an automatic home bakery oven at 450-520ºC. The ingredients were analysed for Total protein, T. carbohydrates, ash, crude fat, fiber, pH and titratable acidity. Results showed that added Buttermilk improved the handling properties of the dough and improved the quality characteristics of the produced bread. The final product was stored at room temperature (25-30ºC) and at refrigerator (4-7 ºC) for 8 and 31 days respectively. The final product was investigated for firmness, elasticity, loss of moisture, cross section and eating acceptability. The results showed that there was a significant relationship between the milk ratio replacement and the sensory properties of the loaf. There was also a positive relationship between this milk ratio and both nutritive value and the shelf-life since there was significantly inhibition of fungal growth. The ratio 75% showed the best results. Generally, we can say that fermented or sweet Buttermilk as a by product could be used successfully as a fortified dairy ingredient and a cheap source of animal protein to improve nutritive value, shelf life and organoliptic properties of El-Shamey home or commercially- made bread.

INTRODUCTION

As a result of the serious problem of protein malnutrition among many Egyptians, especially those who depend mainly on cereal foods in their diets , so, many researches give a great interest to fortify bread with animal protein-rich additives. One of these additives is the dairy ingredients especially dairy by - products which represents the cheapest sources such as whey, skimmed milk, caseinates and butter milk. The latter is a byproduct of buttermaking in dairy plants and rural areas, it is the liquid that remains after the fat is removed from milk or cream by the process of churning butter. It have a superior to the whole milk nutritive value available contribution to flavour and a pleasant aroma, moreover, it is a considerable source of nutritional value (animal protein, lysine, phospholipids, milk-fat, minerals and vitamins) and flavour compounds such as diacetyl , acetaldehyde, ethanol, acetic acid and other compounds which produced by homofermentative and heterofermentative lactic acid bacteria contained naturally or concluded in starter cultures used in making butter [*Lactobacillus brevis*, *L. plantarum* and *Eenterococcus faecium* (Collar et al., 1992)] and *L. casei* and *Prop. shermanii* play an important role in the total flavour of produced bread. The later, inhibit

B. pumilus which causes bread spoilage (Marshall and Odane - Darkwah , 1994).

With reference to the historical aspects of dairy products and by - products in the past and present , we see that there are trends to increasing dairy products and by - products in the last decates nearly all over the world . Buttermilk has a considerable importance between the dairy by - products so that it recently used as a healthy beverage .

The aim of this study is to emphasis the very few studies that have done on using Buttermilk as a dairy by product in enhancement nutritional value, organoleptic properties and prolong the shelf-life of El-Shamey bread as a replacement of required mixing water in ratios of 25, 50, 75 and 100% (V/V), moreover, fermentation reduces phytic acid in bread (0.02-0.06% in white bread), (Bos et al.1997). There are many similar attempts to fortify balady bread with amino acids such as lysine, therionine, and methionine [(Hussein et al., (1973)and [Maleki and Djazayeri, (1968)] and with some protein-rich additives such as chickpea, soybean, and faba bean flours (Dalby, (1969); Finney et al., (1980)and Hallab et al., 1974).

The addition of Buttermilk improved the shelf-life owing to the presence of lactic, acetic and propionic acids that increased the sourness in the product [Javanainen & Linko (1993) and Gil et al. (1997)]. The lipids and phospholipids in Buttermilk interact as a binding substance by flour proteins during the development of the dough, this result has agreed with Carr et al. (1992). Therefore, this research is carried out to study the whether ability of using the Buttermilk as a by-product to fortify bread with the animal protein.

MATERIALS AND METHODS

I- Ingredients:-

Wheat flour 72% extraction was obtained from the cylinders blend (Delta Bakery Company) belonging to the Egyptian Baking Industry. Water was used by 600 ml/1 Kg flour for mixing and preparing the control dough. Buttermilk was either sweet (obtained from the Technology Section of Dairy Dept. of Faculty of Agriculture-Kafr El-Sheikh, Tanta Univ.), fermented Buttermilk was obtained from two sources, the first was from butter making section at Misr Milk and Food Company, Alexandria Factory. The other ingredients were obtained from some houses in rural regions that used to make butter by the traditional method used in Upper Egypt. Buttermilk was used at ratios of 25, 50, 75 and 100% based on V/V of the amount of water required for mixing the ingredients. Both Sucrose and sodium chloride were obtained from the local market and added by the ratios of 5% and 0.5% of the of flour amount respectively and dissolved in mixing water or Buttermilk . Commercially compressed baker’s yeast was used by a ratio of 2% of the flour amount.

II- Preparing the dough and baking.

All the ingredients were well mixed, with water (the control dough) or the substituant Buttermilk and left for leavening for about 1-2 hrs. Then divided into equal pecieces (150 gm) and were left for another 20 min., then

rolled and rested for another 30 min. at room temp., then the rolled dough baked in an automatic home bakery oven at 450-520°C for 2.3-3.5 min then weighted to determine the loss of moisture during baking and rested at room temp for 2 hrs, then re-weighed once again to determine the loss of moisture during cooling. After cooling the final product was packaged in clean and dry polyethylene sacks in order to keep at both room temp. and refrigerator to determine the shelf-like and the loss of moisture during storage.

III- Chemical analysis of the ingredients:-

Table (1) shows the chemical composition of the ingredients used in forming the dough . Methods used in analysis are as follow , total nitrogen in milk and flour was determined by micro-Kjeldahl and (AOAC) Official Method 960.52 (1995)and (Ling, 1963) methods, respectively, then protein content % was estimating by multiplying the nitrogen content by the conversion factor 6.38 for milk and 5.7 for flour. Total ash % was determined by (AOAC) Official Method 923.03 (1995) for both milk and flour (direct method). Total solids and moisture content were determined by air oven method according to (AOAC) Official Method 925.10 (1995). Crude fat % was determined using (Gerber method for milk (Ling, 1963) and Soxhlet method for flour (AOAC) Official Method 920.85 (1995). Crud fiber in flour was determined by (AOAC) official Method 920.86 (1995). Total carbohydrates were calculated by the formula [100-(% protein +% fat +% ash +% crude fiber +% moisture)]. pH was determined using pH meter (AOAC) Official Method 943.02 (1995) . Acidity was determined by titratable acidity for milk , flour, and yeast as lactic acid (Ling, 1963) and AOAC Official Method (1995).

Table (1). Chemical analysis of sweet and fermented butter- milk , flour and yeast.

Ingredients	**Buttermilk**	**Flour**	**Yeast**	**Daily requirements of food elements in grams*** **	
Contents	%	%	%	Male	Female
T. protein %	4.90	11.06	12.40	56.00	41.00
T. ash %	0.95	0.53	0.49	1.94	1.78
Moisture content %	89.86	13.84	75.98	-	-
Crude fat %	1.10	1.10	0.90	20.00	15.00
T. carbohydrate** %	03.19	72.40	15.93	220.00	190.00
Crude fiber %	-	1.07	1.80	-	-
T. solids %	10.14	86.18	24.02	-	-
pH	4.32	5.06	6.25	-	-
Acidity as LA **	1.20	0.08	0.05	-	-

*** Count ** L.A. = Lactic acid**

***** Source =Daily requirements of food elements (FAO and WHO, 1978)**

RESULTS AND DESCUSSION

Table (2) shows the effect of milk ratio on loss of moisture during baking and cooling in the final product. The obtained data showed that the loss of moisture decreases with the graduate increase of Buttermilk ratio replacement, on the other hand, there was a significant combination between the increased milk ratio and decreasing the firmness in bread. This was related to the presence of licithin and phospholipids in Buttermilk that has also resulted in a significant values with both loaf volume and the best

combination for decreasing the firmness in the final product which was in turn as a result of the graduate decrease in loss of moisture with increasing replaced milk ratio up to 100% that represents the best combination for this phenomenon. The minimum average values of % loss were 20.36 and 0.78 for the loss during baking and cooling respectively with the ratio of 100% milk replacement, while the same averages for the control were 24.12 and 1.67%. The later result were actually related to the lipid interaction as a binding substance by flour proteins during the development of the dough Carr et al. (1992) and Ozer & Altan (1995).

Table (3) shows the effect of milk ratio on some loaf characteristics such as loaf height and loaf volume. The results showed that these two characters increased by increasing milk ratio, this was mainly related to the carbon dioxide produced during fermentation of the dough which increases the loaf volume during baking. On the other hand, the natural or formed acidity of Buttermilk as lactic acid by the act of either the natural components of the used milk or formed lactic acid as a result of lactose fermentation which in turn reacts with the soda and produce gas causing loaf rising quickly. Results also showed that by increasing milk ratio, the final product has the best quality for the characteristics of the loaf volume, loaf height and porosity. Data showed also that both two phenomenae have increased with increasing the added milk ratio up to the maximum ratio of replacement (100%) which represents the best ratio for these two phenomenae. The average values were as follow 4.80, 5.90, 6.20, 7.60 and 8.00 for loaf volume and 8.79, 8.24, 8.90, 9.02 and 9.08 for the specific volume. These results are an agreement with that of the previous work of Jimenez et al. (1994), Ozer & Altan (1995) and Achremowicz et al. (1996).

Table (3). Effect of adding milk ratio on some loaf characteristics and baking time.

Treatments	Central value and dispersion	Loaf diameter Cm	Loaf height Cm	Loaf volume Cm^3	Specific volume Cm^3/gm	Baking time/min	Over-run %
Control	Minimum	21.00	2.30	685.00	6.12	3.20	-
	Maximum	23.50	7.00	1175.00	10.68	3.70	-
	Average	22.50	4.80	970.00	8.79	3.40	0
	SD	06.96	1.90	171.81	1.44	0.18	-
I	Minimum	21.80	5.50	575.00	5.09	3.00	-
	Maximum	23.50	7.00	1165.00	10.13	3.60	-
	Average	22.80	5.90	935.00	8.24	3.20	1.03
	SD	00.57	1.03	218.33	1.87	0.26	-
II	Minimum	20.30	3.50	574.00	4.82	2.60	-
	Maximum	23.00	7.00	1160.00	10.36	3.50	-
	Average	21.00	6.20	1018.17	8.90	2.90	2.06
	SD	01.02	0.92	203.40	1.87	0.32	-
III	Minimum	20.50	5.00	525.00	4.57	2.20	-
	Maximum	22.00	9.30	1290.00	11.23	2.90	-
	Average	21.00	7.60	1095.00	9.02	2.50	3.09
	SD	00.55	1.83	265.86	2.29	0.24	-
IV	Minimum	20.20	6.50	883.00	8.26	2.00	-
	Maximum	21.00	8.90	1280.00	10.67	2.80	-
	Average	20.80	8.00	1068.83	9.08	2.30	4.12
	SD	00.31	0.82	135.35	1.08	0.28	-

I 25 % Buttermilk replacement **II 50 % Buttermilk replacement**
III 75 % Buttermilk replacement **IV 100 % Buttermilk replacement**

The same table shows that the baking time decreased by increasing the milk ratio, the average values obtained were 3.40, 3.20, 2.90, 2.50 and 2.30 respectively. This result may related to the Millard reaction which in turn increases with the increasing the amino groups from Buttermilk. From the same table the over-run has increased by the increasing of milk ratio replacement to reach 4.12 percent compared to the control which has a zero value. This result plays an important role in reducing the coast value and in the same time increase the nutritive value. These obtained data is in agreement with those obtained by many previous workers who used the dairy ingredients in fortifing bread and other bakery products. Minkov & Ivanova (1994) and Sahloul (1997). On contrast, the same table clears that there was no significant relationship between the loaf diameter and increased milk ratio.

Table (4) discusses the effect of milk ratio on the sensory evaluation of El-Shamey home or commercially-made bread. Data obtained in this table clears that eating quality (flavour and chewing) scored the highest average values by increasing milk ratio accumulatively. The elasticity decreased with the increase of milk ratio and became less chewy compared to the control. The produced bread has a pleasant flavour which formed by volatile compounds and acids produced by lactic acid from Buttermilk and added yeast (lactic, acetic, propionic acids, ethanol, acetyl methyl carbinol and acetaldehyde from Buttermilk during baking which in turn influenced by adding sucrose and lactose (the later from Buttermilk) and Co_2 produced by yeast. Reduced sugar and amino acids concn. particularly (val., leu., and lys.), the later influences volatile synthesis during baking, since the amino acid side chain are (lysine) interaction with sugar to give typical flavours.

Table (4). Effect of adding milk ratio on the loaf quality "Sensory evaluation"

Treatment	Central value and dispersion	Eating quality		External surface	Crust character	Grain and texture	Crumb colour	Volume	Total score
		Flavour	Chewing						
		10	5	10	5	5	5	10	50
Control	Minimum	6.00	2.50	7.50	3.00	3.00	3.50	6.50	32.00
	Maximum	9.00	4.00	10.00	5.00	5.00	5.00	10.00	48.00
	Average	7.60	3.03	8.90	4.35	4.20	4.60	8.45	41.13
	SD	0.99	0.55	0.77	0.67	0.44	0.64	1.04	0.73
I	Minimum	6.50	2.00	6.50	3.00	3.00	3.50	5.50	30.00
	Maximum	9.50	4.00	9.00	4.50	5.00	5.00	9.00	46.00
	Average	7.80	3.60	8.00	3.95	4.30	3.85	7.60	39.10
	SD	0.95	0.80	0.77	0.61	0.74	0.59	1.16	0.80
II	Minimum	6.50	2.50	6.50	3.00	3.50	2.50	6.50	31.00
	Maximum	9.00	5.00	9.50	4.50	5.00	4.50	9.50	47.00
	Average	8.20	3.90	8.30	3.99	4.30	3.80	8.00	40.49
	SD	0.77	0.73	0.93	0.49	0.74	0.56	1.07	0.76
III	Minimum	8.00	3.50	8.50	3.50	3.50	3.00	8.50	38.50
	Maximum	10.00	5.00	10.00	5.00	5.00	5.00	10.00	50.00
	Average	9.50	4.10	9.65	4.60	4.75	3.85	9.55	46.00
	SD	0.55	0.54	0.46	0.47	0.59	0.73	0.50	0.55
IV	Minimum	8.50	3.00	8.50	3.00	3.00	3.50	8.00	37.50
	Maximum	10.00	5.00	10.00	5.00	5.00	5.00	10.00	50.00
	Average	9.25	4.50	9.35	4.25	4.50	4.10	9.50	45.45
	SD	0.51	0.55	0.75	0.64	0.49	0.59	0.59	0.58

I 25 % Buttermilk replacement **II 50 % Buttermilk replacement**
III 75 % Buttermilk replacement **IV 100 % Buttermilk replacement**

The maximum average value achieved with 75% milk ratio replacement for flavour and with 100% milk ratio replacement for the chewy character, these averages were 9.50 and 4.50% respectively. These results have an agreement with the results of Torner et al. (1992), Minkov and Ivanova (1994), Imhof et al. (1995), Gobbetti et al. (1995), Gelinas and Lachance (1995) and Martinez & Anaya (1996). There was also increasing in total titratable acidity with the graduate increasing milk ratio replacement. It previously proved that there was a relationship between the enzymes and bread flavour [Collar et al. (1992), Fadel & Hegazy (1993), Javanainen & Linko (1993), Gelinas et al. (1995), Vachon & Gelinas (1995) and Lerici & Nicodi (1996)].

The same table also shows that the external surface of the loaf scored the highest average values by increasing the milk ratio. The ratio 75% scored the highest average value of 9.65 per cent. This ratio of replacement had also scored a very high acceptable quality in appearance with the crust character of the loaf which described as a pleasant crust brown colour. This was related to Millard reaction. the ratio 75% replacement scored the highest value (4.60%).

As for grain and texture, the data obtained from the same Table (4) cleared that the control achieved the highest score among all sensory evaluations. The texture seemed to be more whiter and less elastic than those of the control, moreover, the reological properties of the dough affected by both glycoproteins and lipoproteins contained in Buttermilk. The tested loaves of the treatments 75 and 100% Buttermilk replacement had a very good cutting properties. The highest score of satisfactory replacement for the grain and texture was of the treatment 75%, the average value of this parameter was 4.75%.

By the same way, values for the crumb colour showed by Table (4) cleared that this phenomenon has improved with increasing the milk ratio hence, it became more whiter than that of the control. Data in this table showed that the loaf of the control has a fine crumb (elongated gas cells with thin cell walls), whereas the other treatments contain Buttermilk with graduated ratios up to 100% replacement has an open crumb (round gas cells with thick cell walls). Generally, the previous studies proved that adding different milk products make the dough harder, but using the sugar and milk fat have improved the loaf volume and crumb texture owing to the presence of lecithin, some organic compounds produced by lactic acid bacteria during fermentation. These results have an agreement with the work of Seibel et al. (1984), Kawka and Gasiorowski (1985); Srivastava & Haridas Ras (1993), Ozer & Attan (1995); Gélinas (1994) and Hansen & Hansen (1996).

The same table illustrated that the loaf volume has improved with increasing milk ratio, the ratio replacement 75% scored the highest average value for both volume character and total score. This result was related to some factors such as, added sugar, milk fat which contains lecithin and phospholipids, lipoproteins and glycoproteins, the type of flour and its content of gluten. This values are in agreement with the work of Seible et al. (1984); Kawka & Gasiorowski (1985), Srivastava & Haridas Ras (1993), Jimenez et al. (1994) and Ozer & Altan (1995).

Table (5) discusses the relationship between milk ratio and both storage period and loss of moisture during storage at room temperature in the final product.

Data obtained from this table showed that the loss of moisture content of the bread decreased clearly by the graduate increase of milk ratio by the time of storage for both room temp. and cold storage. During both two periods of storage some bread tests such as chewing, cross-section, firmness and freshness have been investigated. Results showed that the cross-section of the Buttermilk bread was better than that of the control (data are not shown), the best result was given with the ratio of 75% replacement. Firmness and freshness have gradually improved with increasing milk ratio. Since the loaf firmness decreased by the increased milk ratio (data are not shown). In contrast, freshness has a slight graduate increase in this respect hence, there were a slight remarkable or negligible change in taste and odor of Buttermilk bread by the time for room temperature storage especially ranging from the 6^{th} and 8^{th} day (by the end period of storage) (data are not shown). On the other hand, the bread freshness increased owing to the complexes of licithin with amylose that prevent the formation of crystals of partially hydrolysed amylose. Seibel et al. (1984), Lewczuk & Sobezyk (1994) and Jimenez et al. (1994). The same table illustrates that the storage periods prolonged with the graduate increase of milk ratio. The maximum average value was achieved with the treatment of 100% milk ratio replacement. On the other hand, the minimum average value was with the control. We suggest that the shelf-life of Buttermilk bread improved due to mould inhibition owing to the higher concn. of lactic, acetic, propionic acids and Co_2 produced by both hetero-and homofermenting lactic acid bacteria included Buttermilk and yeast added to the dough during fermentation. The highest average value reached to 7.17 days for storage period at room temperature and 28.80 days for cold storage at 5°C as illustrated by Table (5). These values are in agreement with the previous workers for wheat bread Kawka & Gasiorowski (1985); Kabannikova & Torgovli (1985); Javanainen and Linko (1993); Javanainen (1994); Staszewska (1994); Gelinas et al. (1995); Lerici & Nicoli (1996) and Kyoung-Haelle & Young-Chun Lee (1997).

The same table discusses also the effect of milk-ratio on the moisture content in the final product. The values of this phenomenon cleared that, with the increasing milk ratio replacement the average values of moisture content have gradually increased. This values is in agreement with those obtained by Ozer & Altan (1995). This result was also related to the type of flour and gluten network that retain higher amount of water which tends to bring about a decrease in compression force and bending values, improving shelf-life by reducing the increase in firmness over time.

Table (6) reveals the daily requirements of vitamins and minerals for both adult males and females of human origin (FAO and WHO, 1978) . The same table also illustrates Buttermilk contents of vitamins and elements for 100 gm edible portion [Dairy Council Digest 43 : 44 (1972)]

Table (7) discusses the chemical analysis of the final product made from Buttermilk and the control (EL-Shamey bread) . The ratio 100%

Buttermilk replacement has the highest value for moisture content as previously revealed in table (5) owing to the presence of both lecithin and casein. The same table also shows that the total protein and ash content increases nearly steadily with the graduate increase added Buttermilk since the later decreases baking time (as shown in table 3). This has an agreement with the previous work of (EL-Samahy and Tsen 1981). The fat content decreased in the control and increased steadily with the increasing added Buttermilk, we suppose that this was related to the increasing milk fat content and the decreasing of baking time. The table also revealed a significant correlation between the dry matter and moisture content.

On the other hand, fermentation decreases phytic acid and some other anti-nutritional factors (Bos et al .1997) . Thus, the high amount of lactic acid produced from Buttermilk had an important role in this point . From this table we see that Buttermilk shared significantly in the nutritive value of the final product.

CONCLUSION

The use of Buttermilk in El-Shamey home or commercially-made bread improved sensory properties, since it had a whiter, softer crumb and a pleasant aroma, besides increasing bread freshness. This work represents a fortification of El-Shamey bread with animal high protein source (essential amino acids) that increases its nutritive value, moreover, it contains many vitamins such as vitamin A (B-carotein, Pro-vitamin A which acts as anti-oxidant substrate), vitamin E, vitamin B_1, B_2 and B_6 at a contributable levels, it also contains minerals (macro and minors).

The fermented sugar (Lactose concluded in Buttermilk and added sucrose) with the help of both lactic acid bacteria (naturally or artificially found in Buttermilk) and added yeast plays an important role in increasing amino acids that takes part in the nutritive value of the bread. On the other hand, organic acids (lactic, acetic acids and Co_2) produced by either hetero or homofermentative lactic acid bacteria and added yeast accelerated fermentation, intensified flavour production and played a great part in destroying pathogenic microorganisms living in the intestinal tract, moreover, the bread acidity helps in the absorption of some elements such as calcium in the body and in the same time it prolongs the shelf-life of the product at both room temperature and cold storage owing to the presence of propionic acid which has the ability to inhibit mould growth.

On comparing the cost of El-Shamey commercially-made bread by the resultant product in this research. It proved that the cost of the loaf of the later product is very cheap compared to its nutritional value.

Finally, Buttermilk could be successfully used in manufacturing high quality, fortified, prolonged shelf-life and healthy El-Shamey home-or commercially-made bread.

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تأثير إضافة بعض نواتج صناعة الألبان الثانوية على القيمة الغذائية والخواص الحسية وفترة حفظ الخبز الشامي المصنع منزلياً وتجارياً

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فى هذا البحث استخدم اللبن الخض ، كأحد نواتج صناعة الزبد الثانوية إحدى منتجات الألبان الهامة وذلك بغرض تحسين القيمة الغذائية وفترة حفظ الخبز الشامى وتم إعداد العجينة بإضافة اللبن الخض السائل بنسب 25 ، 50 ، 75 ، 100% (بالحجم) كنسبة استبدال بماء العجن المستخدم فى عينة المقارنة وتركت للتخمير لمدة ساعتين ثم أجريت عملية الخبيز فى فرن الغاز الأتوماتيكى على درجة حرارة 450-520^{5}م .

تم تحليل المكونات الداخلة فى العجينة بالنسبة للبروتين الكلى ، الكربوهيدرات والرماد والدهن والألياف ودرجة الـ pH وحموضة التعادل . وأظهرت النتائج أن اللبن الخض المضاف قد حسن من خواص العجينة وكذلك الصفات الحسية وخواص الحفظ للخبز الناتج بزيادة نسبة الاستبدال .

تم تخزين المنتج النهائى على درجة حرارة الغرفة (25-30^{5}م) ، درجة حرارة الثلاجة (4-7^{5}م) لمدة 8-30يوم على الترتيب . هذا وقد تم فحص الخبز أثناء فترة التخزين بالنسبة للصلابة ، واللدانة، فقد الرطوبة أثناء التخزين ، المقطع والقابلية للأكل . وقد أوضحت النتائج المتحصل عليها أن هناك علاقة معنوية بين نسبة استبدال اللبن والصفات الحسية ، كما كان هناك أيضاً علاقة إيجابية بين هذه النسب للاستبدال وكلاً من القيمة الغذائية وفترة الحفظ حيث كان هناك تثبيط معنوى لنمو الفطر وأعطت النسبة 75% أفضل النتائج . وعموماً يمكن القول أن اللبن الخض الحلو أو المتخمر كمنتج ثانوى يمكن استخدامه كمنتج لبنى مدعم وكمصدر رخيص للبروتين الحيوانى لتحسين القيمة الغذائية وفترة الحفظ والخواص الحسية للخبز الشامى المصنع منزلياً أو على النطاق التجارى .

Table (5). Relationship between butter- milk ratio and both storage period and loss of moisture during storage at both room temperature and cold storage in the final product.

Treatments	Central value and dispersion	Moisture %	Shelf-life		% loss in moisture during storage							
			Room T.*	5°C	Room temperature				Cold storage 5°C			
					2 days	4 days	6 days	8 days	1 wk	2 wk	3 wk	4wk
Control	Minimum	25.33	2.00	17.00	0.18	0.18	-	-	0.43	0.51	0.56	0.65
	Maximum	30.67	6.00	24.00	0.45	0.52	-	-	0.59	0.68	0.76	0.85
	Average	27.95	4.00	22.00	0.38	0.40	-	-	0.49	0.56	0.64	0.72
	SD	1.79	1.47	2.63	0.11	0.13	-	-	0.06	0.07	0.08	0.08
I	Minimum	26.77	3.00	18.00	0.18	0.34	-	-	0.26	0.34	0.47	0.35
	Maximum	30.72	5.00	31.00	0.44	0.62	-	-	0.44	0.61	0.60	0.63
	Average	28.39	4.00	24.00	0.30	0.47	-	-	0.35	0.47	0.54	0.56
	SD	1.34	0.75	5.56	0.11	0.13	-	-	0.09	0.01	0.05	0.05
II	Minimum	26.52	5.00	23.00	0.17	0.17	0.18	-	0.17	0.25	0.28	0.34
	Maximum	30.67	6.00	29.00	0.26	0.35	0.36	-	0.34	0.43	0.43	0.51
	Average	28.93	5.00	26.00	0.21	0.24	0.28	-	0.24	0.34	0.37	0.45
	SD	2.01	0.49	1.96	0.04	0.07	0.06	-	0.07	0.09	0.06	0.07
III	Minimum	24.57	5.00	25.00	0.13	0.09	0.09	0.17	0.09	0.09	0.17	0.09
	Maximum	33.70	8.00	30.00	0.18	0.30	0.26	0.52	0.17	0.26	0.35	0.44
	Average	29.14	6.00	27.00	0.16	0.19	0.21	0.34	0.13	0.19	0.29	0.31
	SD	3.06	1.17	3.04	0.02	0.09	0.07	0.14	0.04	0.07	0.07	0.15
IV	Minimum	23.25	6.00	26.00	0.09	0.09	0.04	0.04	0.09	0.13	0.17	0.17
	Maximum	34.43	8.00	31.00	0.17	0.17	0.26	0.28	0.13	0.17	0.26	0.35
	Average	29.87	7.00	29.00	0.11	0.14	0.15	0.16	0.10	0.16	0.24	0.28
	SD	2.33	0.89	1.74	0.03	0.03	0.08	0.09	0.02	0.02	0.04	0.07

*** Room temperature ranges from 25-30°C.**

I 25 % Buttermilk replacement II 50 % Buttermilk replacement III 75 % Buttermilk replacement IV 100 % Buttermilk replacement

Table (6): Vitamins and minerals content of butter milk, flour and yeast the daily requirements for both adult male and female of human origin.

Nutrient Compound Unites		Vitamins										Elements						
		Thiamin mg	Nisin mg	Riboflavin mg	Folic acid mg	V.B 6 mg	V.B12 mg	V.C Mg	V.A Iu	V.D Ug	V.E mg	Ca mg	P. mg	Mg mg	K mg	Fe mg	Zn mg	Na mg
Daily Requirement*	male	1.50	20.00	1.80	200.00	2.00	3.00	30.00	1000.00	2.50	9.00	800.00	800.00	300.00	150.00	10.00	10.00	-
	female	1.10	14.00	1.30	200.00	1.50	3.00	30.00	800.00	2.50	6.00	700.00	700.00	250.00	40.00	14.00	9.00	-
Butter milk**	sweet	0.15	0.25	0.45	-	-	-	2.50	72.50	-	-	121.00	95.00	14.00	140.00	Trace	-	130.00
	Fermented***	0.14	0.27	0.95	-	-	-	2.00	120.00	-	-	114.00	88.00	13.00	154.00	0.10	-	96.00
Flour		0.66	0.54	0.33	-	-	-	zero	zero	-	-	20.00	109.00	-	119.00	3.60	-	3.00
Yeast		0.13	1.00	0.02	-	-	-	35.20	4720.00	-	-	249.20	69.20	-	-	-	-	12.70

***Source = Daily requirements of food elements (FAO and WHO, 1978).**

****The amount of Elements for 100 gm edible portion (Dairy council Digest 43:4(1972).** *****Elements for Bulgarian Buttermilk .**

Table (7): Chemical analysis of the final product of Buttermilk bread.

Treatments	Moisture content %	Total protein %	Total fat %	Total Ash %	Total carbohydrates %	Dry matter %
Control	27.95	12.46	0.65	2.42	56.52	72.05
I	28.39	13.53	0.77	3.03	54.28	71.61
II	28.93	14.61	1.02	3.44	52.00	71.07
III	29.14	15.73	1.40	4.05	49.66	7.86
IV	29.87	16.76	1.90	4.76	46.71	70.13

I 25 % Buttermilk replacement II 50 % Buttermilk replacement III 75 % Buttermilk replacement IV 100% Buttermilk replacement

Table (2). Effect of adding milk ratio on loss of moisture during baking and cooling in the final product.

Treatment	Control				I				II				III				IV			
Central value and dispersion	Min.	Max.	Aver.	SD	Min.	Max.	Aver.	SD	Min.	Max.	Aver.	SD	Min.	Max.	Aver.	SD	Min.	Max.	Aver.	SD
Loss % During baking	20.00	26.67	24.12	2.05	21.33	25.33	23.07	1.44	10.82	24.67	21.47	2.09	20.00	23.67	21.45	1.18	18.82	22.00	20.36	1.10
Loss % During cooling	0.67	2.67	1.67	0.74	0.65	2.00	1.47	0.50	0.68	1.34	1.00	0.33	0.64	1.31	0.89	0.31	0.67	1.00	0.78	0.16

I 25 % Buttermilk replacement **II 50 % Buttermilk replacement**
III 75 % Buttermilk replacement **IV 100% Buttermilk replacement**