USING OF ACIDIC WHEY AND BUTTERMILK TO ENRICH THE PEASANT'S BREAD

1. Evaluating of Physiochemical and Sensory Characteristics

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ABSTRACT

The acidic whey and buttermilk produced in rural regions during Karieish cheese and butter making (by the traditional methods) were used here as a source of animal proteins and other nutrients at levels of 25, 50, 75 and 100% (V/V) of the required mixing water for preparing the peasant's bread dough.

The final product was evaluated for loss of moisture during baking and cooling and for some loaf characteristics (loaf height and loaf volume), baking time and over-run; more over, it was investigated for the listed sensory parameters. The handling properties of the dough have improved by using the two dairy by– products. There was also a considerable decrease in loss of moisture during baking and cooling with increasing added whey or buttermilk up to the ratio of 100 % replacement. The loaf height and volume were also remarkably increased up to the level 50% replacement of added whey or buttermilk. With respect to the baking time, it has obviously decreased with increasing the two replacers up to the level 100 % replacement, while the over–run has increased nearly steadily with increasing the added whey or butter milk up to the ratio 100 % replacement.

The sensory evaluation revealed that, both flavour and chewness have possessed the heighest values with the ratio 75% of buttermilk and 50% of whey. The external surface and crust colour also improved up to the ratio 50% replacement of whey or buttermilk, while both grain and texture and the crumb colour improved with the increasingly replacement of both buttermilk or whey up to the ratio 75% replacement. Moreover, the ratio 75% replacement of buttermilk achieved the heighest total score, while this result has been achieved with whey at the level of 50% replacement.

INTRODUCTION

With refer to the historical aspects of dairy products and by–products in the past and present; there are trends to increase the use of these ingredients in the last decades nearly all over the world in bakery products to improve these products. Sour buttermilk and kareish cheese whey had a

considerable importance between these dairy products and by–products that recently used as healthy beverages and fortificant ingredients improving the sensory properties scoring the highest values with the flavor. On the other hand, diminishing the protein malnutrition among those who depend mainly on cereal foods in their diets especially in the countryside, there was a though of the current work to benefit of these animal nutrient dairy by products in fortification and enhancing the sensory properties of the white bread in the Egyptian countryside where there is a considerable amounts of acidic whey and buttermilk as a result of the traditional making of kareish cheese and butter in these rural regions of Egypt as the cheapest sources of animal protein and concluding considerable amounts of essential amino acids, phospholipids, milk fat, minerals and vitamins. Moreover, nearly all whey proteins are concluded in the two previous by-products; also a considerable amounts of volatile compounds such as diacetyl, acetaldehyde, ethanol and other organic acids, acetic, lactic propionic acids are produced by homo-heterofermentations of these ingredients by lactic acid bacteria contained naturally in these fermented by products ; ***Lactobacillus brevis, Lac.plantarium*** and ***Enterococcus facium***, **Collar *et al.*, (1992)**. The cultured buttermilk containes a clean acid background taste; the important flavor compounds in buttermilk are acetaldehyde, dimthylsulphide, acetic acid, lacitic acid and diacetyle **(Marshall, 1982)** .

On the other hand, fermentation process reduced the antinutritional factors; phytic acid up to 0.02 – 0.06 % in white bread **(Bos *et al* ., 1997)**. Buttermilk contains lecithin at a level ranging from 0.114 – 0.126% **(Rai, 1985)**. Moreover, fermented kariesh cheese whey and buttermilk contains nearly all whey proteins that contribute at a highly level in the daily requirements of the adults from the essential amino acids and ash, above all the presence of lactoalbumins at a high level share in increasing the loaf volume and height and interrupting the humidity in the loaf structure that in turn takes part in improving the bread chewiness and increasing the loaf weight and the over-run; there is also a great health benefit from the cholesterol supporting factor which is found in the whey fraction and not in the casein. **(Cook *et al.*, 1951).**

MATERIALS AND METHODS

Dough preparing and bread making:

Wheat flour 72 % extraction obtained from El-Safa Milling Company and sifted maize flour obtained from the local market were used. The control dough was prepared by adding mixing water at level of 700 ml/kg

flour (80% wheat flour and 20% maize flour). Buffalo's acidic buttermilk and kariesh cheese whey obtained from some houses at the countryside used to make butter and kariesh cheese by the traditional methods used in Upper Egypt.

Acidic buttermilk or kareish cheese whey was used at levels of 25, 50, 75 and 100% replacement (V/V) of mixing water for the treatments. Other ingredients (Commercially compressed yeast, salt and sucrose) were obtained from the local market and added at levels of 1%, 0.5% and 3%, respectively based on the flour amount after dissolving both sugar and salt in mixing water or its replacers of acidic buttermilk or whey.

Yeast, sugar and salt were dissolved in water are added to the flour and well mixed manually for 5 min. The same procedure was done with the treatments after dissolving the minor ingredients in buttermilk or whey. Each dough was left to ferment for an hour. Then cut into equal pieces (150 gm) and left for another 15 min. The pieces were rolled, rested for 30 min for leavening and baked in the home bakery oven at 300 – 350 °C. The loaves were then weight to determine the loss of moisture during baking and left for an hour at room temp. to cool and reweighed to determine the loss of moisture during cooling and then packaged in a clean dry polyethylene bags and sealed .

Chemical Compositions of the Main Ingredients:

The total protein, fat, moisture and ash in both buttermilk and whey were determined according to **ling (1963)**, while these components and the crude fibers in flours were determined according to the methods listed in **(AOAC)** Official Methods **(1995)**. The total carbohydrate and energy were estimated by calculations, the acidity were determined as lactic acid by the titratable acidity. The contribution of the main ingredients of the daily requirement for the adults were calculated.

Statistical analyses:

Were determined as the average values of the central value and dispersion.

Physiochemical evaluation:

Loss of moisture Per 100 g of the dough during baking and cooling were determined by the deference between the weight of loaves before and after baking and cooling for one hr. at room temperature. The loaves were placed in an oven at 149° C for ten min. to be firmed according to **El-Samahy and Tsen (1981)**; the volume's measurements have been done by seed displacement while both loaf height and diameter were measured by

cm. The baking time was determined by stop-watch finally, the over-run % was calculated according to the formula:

$$\text{Over} - \text{run} = \frac{Wt - Wc}{Wc} \times 100$$

Where : Wt = The weight of the loaves of treatments
Wc = The weight of the loaves of control

Sensory evaluation :

Eight Persons (4 males and 4 females) judged the sensory characteristics of the produced bread according to **El-Nemr (1976)** with some modifications.

RESULTS AND DISCUSSION

Table (1) demonstrated that the main ingredients contribute at a considerable levels of protein requirement from both wheat and maize flours, buttermilk and kareish cheese whey; these levels of contribution were, 18.49, 16.83, 6.11 and 1.62% respectively of the daily requirements of protein for adult male with total contribution reached 43.05% for males and these contribution of the required protein reached 23.30, 21.30, 7.70 and 2.04% respectively with total contribution 54.24 % for females. The same table illustrated that the used main ingredients contribute at higher levels of the required ash reached 21.21, 60.61, 36.36 and 27.78 respectively, with total contribution of 145.96 for males; the same contributions were 21.99, 62.83, 37.70 and 28.80% respectively with total contribution reached 151.32% for females superiored that for males.

Contributable levels of energy as evaluated are also revealed by Table (1). Both wheat and maize flours contribute at contributable levels of the daily required energy for both male and female of all ingredients; this contribution represents 30.12% and 40.66% as total contribution respectively.

Table (2) demonstrated that the loss of moisture during baking and during cooling of the produced bread has obviously decreased by using acidic buttermilk or kareish cheese whey up to ratio of 100% replacement. The moisture retention increase in both types of bread related to the concluded components (gluten, casein, whey proteins and lecithin) which help the interruption of both water and gas. The presence of lecithin and phospholipids in buttermilk resulted in a significant values of loaf volume and the best combination for increasing the softness in the produced bread these results have an agreement with the work of **He and Hoseney (1992)**.

Table (1) Chemical Analyses of Major Ingredients Used in Making Peasent's Bread and Their Contribution of the Daily Requirements for the Adults.

Items	Main ingredients				Male	Contribution to the daily requirement					Female	Contribution to the daily requirement				
	Wheat flour	Maize flour	Acidic Butter -milk	Acidic kariesh cheese whey		* Contr. % .Per 100 gm of Wheat lour	Contr. %.Per 100 gm of maize flour	Contr..% Per100 gm of buttermilk	Contr.. % Per 100 gm of kariesh cheese whey	T. contr. % Per 100 gm of ingredient		* Contr. % .Per 100 gm of Wheat lour	Contr. %.Per 100 gm of maize flour	Contr..% Per100 gm of buttermilk	Contr.. % Per 100 gm of kariesh cheese whey	T. contr. % Per 100 gm of ingredient
** T. protein %	11.65	10.60	3.85	1.02	63.00	18.49	16.83	6.11	1.62	43.05	50.00	23.30	21.20	7.70	2.04	54.24
T. ash %	0.42	1.20	0.72	0.55	1.98	21.21	60.61	36.36	27.78	145.96	1.91	21.99	62.83	37.70	28.80	151.32
Fat %	1.20	4.60	1.30	0.5	-	-	-	-	-	-	-	-	-	-	-	-
Moisture %	12.21	9.80	89.53	93.83	-	-	-	-	-	-	-	-	-	-	-	-
*** T. carbohydrates %	73.15	72.50	4.60	4.10	-	-	-	-	-	-	-	-	-	-	-	-
Crude fibers %	0.45	1.30	-	-		-	-	-	-	-	-	-	-	-	-	-
Acidity %	0.08	0.2	0.60	0.80	-	-	-	-	-	-	-	-	-	-	-	-
Energy Kcal/100gm	358.61	382.57	46.48	25.54	2.700	13.28	14.17	1.72	0.95	30.12	2.000	17.93	19.13	2.32	1.28	40.66

* Contribution per / 100 gm. ** Total protein *** Calculated.

On the other hand, **(Jane Bower, 1992)** suggested that the pre – heated acid whey of kareish cheese plays an important role in the retention of moisture because of the denaturation process caused to the whey proteins. Lactose–containing baking formulations from buttermilk or whey support yeast leavened products and give sponge dough fermentation **(Morrison, 1985).**

Figure 1 (a, b and c) demonstrated the effect of replacing water by fermented buttermilk or kareish cheese whey on the loss of moisture during baking and during cooling of the peasant bread. The same fig. illustrates the effect of adding butter milk or whey on the percentage of over-run.

Table (2) Effect of Replacing Mixing Water by Fermented Buttermilk or Kareish cheese Whey on the Loss of Moisture During Baking and During Cooling and Moisture Content of the Peasant's bread.

Treatments		Loss of moisture during baking %		Loss of moisture during cooling %		Moisture content %	
Water %	Buttermilk or whey %	Butter-milk	whey	Butter-milk	whey	Butter-milk	whey
100	0	29.12		0.86		23.91	
75	25	27.52	27.98	0.65	0.72	24.35	24.40
50	50	25.49	27.04	0.68	0.72	24.99	24.53
25	75	24.17	26.30	0.55	0.61	25.02	24.55
0	100	23.50	25.53	0.32	0.57	24.52	24.53

* The numbers are the average values of three replicates.

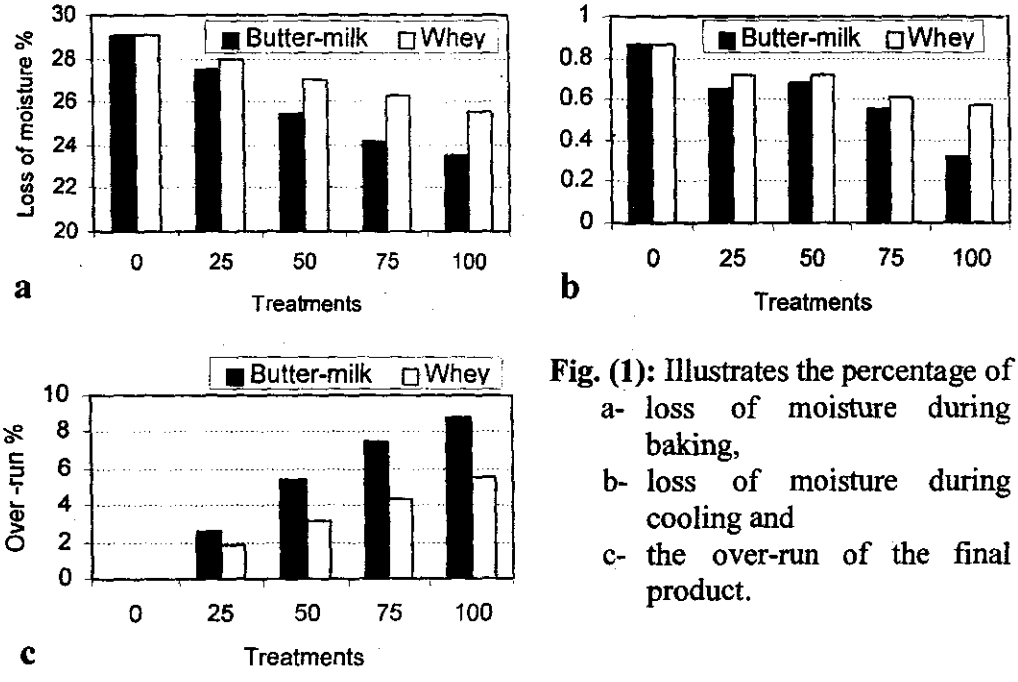

Fig. (1): Illustrates the percentage of
a- loss of moisture during baking,
b- loss of moisture during cooling and
c- the over-run of the final product.

Table (3) demonstrated that the loaf height achieved considerable values with the increase of adding the acid ingredients and achieved the heighest values with the ratio 50% replacement and the kareish cheese whey achieved a higher value than the other (8.10 and 7.87 cm) respectively. The same table showed that the loaf volume increased constantly up to the ratio 50% replacement of both acidic buttermilk or kareish cheese whey and then decreased for both ingredients up to the ratio 100%. These values were 1071.00 and 1082.67 cm^3 for the ratio 50% and 1060.00 and 1059.00 cm^3 for the ratio 100% respectively

The specific volume behaved the same behavior and the ratio 50% achieved 8.73 and 8.88 cm^3/gm; while the ratio 100% achieved 8.47 and 8.64 cm^3/gm respectively. This increase in the loaf volume, specific volume and the loaf height may be due to the action between the soda and the formed lactic acid either naturally or as a result of lactose fermentation of both buttermilk and kariesh cheese whey which accelerated fermentation, dimensioned leavening time and concentrate of CO_2 in the dough; the latter increased in volume by nearly 15 – 20% **(Minkov and Ivanova, 1994)**. This action produces gas causing loaf raising quickly Lecithin and phospholipids from buttermilk play a great part in increasing the loaf volume; the laboratory trials of **(Jimenez *et al.*, 1994) and (Lewczuk, 1994)** have agreed with these results.

Concerning, baking time it illustrated a significant decrease with the increasing of replaced mixing water by both buttermilk or whey and the latter showed a progressive decrease ranged from 3.40 to 2.20 min. up to the ratio 100% replacement. This result may be related to the relationship between lactose content and acidity of buttermilk or whey which play an important role in accelerating Milliard reaction and increasing the acidity with the increasing of added buttermilk or whey up to the ratio 100% of replacement that in turn, demonstrated that the baking time as an economical benefit share in reducing the production cost in addition to the over-run.

The percentage of over–run also has been demonstrated by Table (3) which revealed that using buttermilk achieved nearly higher over-run than the other replacer with the commulative increase of replacement since the ratio 100% possessed the highest value of this parameter in the final product (8.80%) while this value was 5.53% with kareish cheese whey when

Table (3) Effect of Added Fermented Buttermilk or Kareish cheese Whey on Some physiochemical, Characteristics, Baking Time and the Over-run of the Peasant's Bread.

Treatments		Loaf height cm		Loaf diameter cm		Loaf volume cm^3		Specific volume cm^3/gm		Baking time min.		Over-run %	
Water	Butter-milk or whey	butter-milk	whey	butter-milk	whey	butter-milk	whey	butter-milk	Whey	butter-milk	whey	butter-milk	whey
100	0	* 7.00		20.67		1009.00		8.59		3.40		0.00	
75	25	7.17	7.33	20.17	20.67	1047.33	1056.70	8.70	8.80	3.34	3.20	2.57	1.82
50	50	7.87	8.10	20.50	20.00	1071.00	1082.67	8.73	8.88	3.00	2.80	5.45	3.17
25	75	6.80	6.87	19.83	19.77	1059.67	1058.67	8.66	8.71	2.50	2.40	7.51	4.38
0	100	7.07	6.80	19.17	19.50	1060.00	1059.00	8.47	8.64	2.40	2.20	8.80	5.53

* The numbers are the average values of three replicates.

calculated as a wet weight. The same ratio achieved 7.92% and 4.67% respectively when calculated as dry matter (data are not shown). These results explain the great role of the used dairy by-products in enhancing the peasant's bread.

On the other hand, this parameter plays a great part in lowering the cost of production of bread. These results have agreed with the previous work of **Mikov & Lavnova (1994) and Sahloul (1997).**

Table (4) revealed some organoleptic properties of the peasant's bread. Flavor of the fresh bread scored the highest score with the ratio 75% replacement of buttermilk (9.17 degrees) while the ratio 50% replacement of kareish cheese whey scored 8.30 degrees; the drop of flavor with the increasing added whey may be related to the huge amounts of ethanol by yeast as stated by **(Shilpa Vijand and Gandhi 1993).** The pleasant flavor formed by volatile compounds and acids produced by lactic acid bacteria from both buttermilk or kareish cheese whey and added yeast (lactic, acetic, propionic acids, ethanol, acetyl methyl carbinol, CO_2 and acetaldehyde. These compounds release at considerable amounts from buttermilk than kareish cheese whey and concentrate in dough with different treatments than in control dough made with water only. On the other hand, reduced sugar and amino acid conc. particularly **(Val., Leu., and Lys.)**; the latter influences volatile synthesis **(Torner *et al.*, 1992), (Minkov and Ivanova, 1994), (Imhof *et al.*, 1995), (Gobbetti *et al.*, 1995), (Gelinas and Lachance, 1995) and (Martinze and Anaya, 1996).** The previous work proved also that some lactic acid bacteria such as ***(Lac. plantarium Lac. delbrueckii or Lac. sanfrancisco*** produce a higher content of 2 or 3 – methyl 1-1 – butanol than of control **(Hansen, A. and Hansen, B. 1996).** The related researches also found that the sour aroma and pleasant taste of buttermilk or whey bread was related to the combination of enzymes naturally present or formed by lactic acid bacteria/yeast fermentation (proteinases, amylases, lipoxygenases, carbohydrate fermentation, metabolism of N compounds and other substrates, bread baking) **(Martinez–Anaya, 1996).** By increasing the added buttermilk or whey; the acidity increased and superior the pH degree (3.5 – 4.5); the excessive acidification gives the pungent bread aroma that decrease the acceptability of the produced bread **(Salovaara and Spicher, 1987).**

Another phenomena, eating quality; the chewness of the bread which improved at a highly degree with the increasing of buttermilk or whey replacement up to the ratio 50% replacement for both buttermilk or whey

Table (4): Effect of Added Fermented Buttermilk or Kareish cheese Whey on the Sensory Properties of the Peasant's Bread.

Treatment		Flavor (10)		Chewing (5)		External surface (10)		Crust color (5)		Grain and texture (5)		Crumb color (15)		Total score (50)	
Water %	butter-milk or whey %	butter-milk	whey	butter-milk	whey	butter-milk	whey	butter-milk	whey	butter-milk	whey	butter-milk	whey	butter-milk	whey
100	0	8.00		3.17		8.00		5.00		3.83		12.00		40.00	
75	25	8.33	7.50	4.00	3.33	8.33	7.67	4.33	4.50	4.17	3.33	12.00	13.00	41.16	39.3
50	50	9.00	8.30	4.33	4.17	8.33	6.67	4.83	4.67	4.67	3.67	13.50	13.50	44.66	39.3
25	75	9.17	7.50	4.17	3.50	8.00	5.33	4.50	3.33	4.83	3.50	14.50	13.33	45.17	36.4
0	100	7.33	6.67	3.83	3.33	6.33	3.17	3.33	2.33	4.00	3.00	14.67	11.00	39.32	29.5

(4.33 and 4.17 respectively) compared to control. With increasing buttermilk or whey; there was a crumbly chewing with the ratio 100% of buttermilk and sour taste was highly appeared especially with kareish cheese whey.

Tabulated data showed that external surface was improved clearly by increasing the added buttermilk or whey up to the ratio 50% of buttermilk and 25% of kareish cheese whey; they scored 8.33 and 6.67 degree respectively. By the further increasing of added buttermilk or kareish cheese whey, there was a decrease in the scored degrees up to the ratio 100% replacement. The pleasant crust brown colour and the highest acceptable quality in appearance of the loaf was obtained with the ratio 50% replacement for the two added ingredients; they scored 4.83 and 4.67 degree respectively. These results may be related to the Milliard reactions, which increased with the kareish cheese whey than with buttermilk. This result has agreed with the work of **Gueriviere and Dela (1982)**. The texture as an important parameter illustrates by Table (4) which revealed that the increasing of acidic buttermilk or kareish cheese whey improved this parameter up to the ratio 75% replacement of buttermilk. This ratio possessed the highest score of all treatments (4.83 degree) while this highest score with the kareish cheese whey was lower than that of the buttermilk since it scored 3.67 degree with the ratio 50% replacement. On the other hand, the reological properties of the dough improved with the addition of acidic buttermilk and whey alike, while the bread firmness improved with the graduate addition of the two acid ingredients up to the ratio 75% of the first and to the ratio 50% of the latter (data are not shown but investigated sensorically); this was correlated with the results of **Gelinas *et al.*, (1995)**. The same table demonstrated the important character of the sensory evaluation of buttermilk or whey peasant's bread. Data obtained from this table illustrate that there is a progressive improvement in the crumb color with increasing the added buttermilk up to the ratio 100% replacement, it became whiter than that of the control and up to the ratio 75% with kareish cheese whey, then decreased clearly up to the ratio 100% where the crumb became darker more than of the former ratios and the control. The latter had a fine crumb which has an elongated gas cells with a thin cell walls but with the increasing of added buttermilk it turns to an open crumb which has a round gas cells with thick cell walls.

In general, the porosity of the crumb and the color were improved clearly with the treatments compared to the control. These results with the work of **(Srivastava & Haridas Ras, 1993)** and **(Ozer and Altan, 1995)**.

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الملخص العربى

استخدام الشرش واللبن الخض الحمضى لتدعيم الخبز الريفى
I- تقييم الخواص الفيزوكيميائية والصفات الحسيه

أم السعد اسماعيل الجمال

كلية الإقتصاد المنزلى - قسم علوم وتكنولوجيا الأغذية
جامعة الأزهر - طنطا

استخدم فى هذا البحث الشرش الحامضى واللبن الخض والتى تعتبر مخلفات ونواتج ثانوية من صناعة الجبن القريش والزبد المصنع بالطرق التقليدية كمصدر للبروتين الحيوانى والمغذيات الأخرى وذلك بمستويات استبدال ٢٥، ٥٠، ٧٥، ١٠٠% بالحجم من كمية الماء اللازم لعجن الخبز الريفى.

تم تقييم المنتج النهائى بالنسبة لفقد الرطوبة أثناء الخبيز وأثناء التبريد وكذلك بالنسبة لبعض خواص الرغيف الناتج (ارتفاع الرغيف - حجم الرغيف - زمن الخبيز والريع) ، علاوة على ذلك فقد تم دراسة المتغيرات الحسية الموضحة. وقد أوضحت البيانات المتحصل عليها أن هناك تحسن واضح فى خواص تداول العجينة باستخدام هذه النواتج الثانوية لمنتجات الألبان، وكان هناك أيضا انخفاض كبير فى فقد الرطوبة أثناء الخبيز وكذلك أثناء التبريد بزيادة كمية الشرش أو اللبن الخض المضاف حتى نسبة استبدال ١٠٠%، وهذا النقص كان أقل قليلا فى حالة الأول عن الثانى. وفيما يتعلق بوقت الخبيز فقد انخفض هذا المتغير بوضوح بزيادة نسبة الاستبدال بالنسبة للمواد المستخدمة فى عملية الاستبدال حتى مستوى ١٠٠% من الاستبدال.

وقد حقق كل من الطعم وخاصية المضغ أعلى قيم فى التحكيم الحسى حتى نسبة استبدال ٧٥% بالنسبة للبن الخض ، ٥٠% بالنسبة للشرش أما المظهر الخارجى وشكل القشرة فقد تحسن على مستوى ٥٠% من نسبة استبدال اللبن الخض أو الشرش على حد سواء فى حين تحسن كل من التركيب ومظهر اللب بزيادة نسبة الإستبدال من اللبن الخض أو الشرش حتى نسبة ٧٥%. علاوة على ذلك فقد حققت النسبة ٧٥% من اللبن الخض أعلى مجموع قيم فى التحكيم الحسى فى حين تحققت هذه النتيجة على مستوى ٥٠% بالنسبة لاستبدال الشرش.