Improvement of the Nutritional Value of Cereal Fermented Milk: 1- Soft Kishk Like

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Abstract

Soft Kishk like products were produced from whole wheat, barley and freek burghul with reconstituted skim milk (15% T. S) and addition of different Starter cultures. Physico-chemical, bacteriological and organoleptic properties of soft kishk like samples have been evaluated during 14 days of storage at 5 ± 1°C. The main effect on Soft Kishk like products characteristics was due to the used cereal type more than the started culture. Containing wheat burghul showed the highest pH values, Crude protein content were almost similar between all treatments as a result of the similarity of protein content in the selected seeds. Freek burghul treatment showed higher total solids and carbohydrates whereas, lower content of ash, crude fiber, fat and crude protein contents compared to the other treatments. The c.f.u on MRS medium (mainly *Bifidobacteria*) sensitive than other starter microorganisms (mainly lactic acid bacteria) for storage. Cereal fermented dairy products containing Freek; gained the highest scores in the organoleptic properties followed by wheat. While the addition of whole barley burghul had the lowest total score at the end of storage. Therefore, a functional and nutritional Kishk like products have been successfully produced using different cereals and probiotic starter cultures.

Keywords: Fermentation; Cereal; Probiotic bacteria; Kishk; Milk

Introduction

There is a currently growing interest in certain strains of lactic acid bacteria that have been suggested or shown to provide specific health benefits when consumed as food. The history of those observations had started in the early 1900’s, when Élie Metchnikoff noted the longevity of people living in the Balkans, and attributed this to their high consumption of fermented milk products [1].

Following those early observations, scientists reported that yogurt and other fermented milk products contain lactic acid bacteria that are capable of establishing and colonizing the gut, this group of bacteria referred to as probiotic bacteria [2]. Probiotics are live microbial food supplements, which beneficially affect the host animal by improving its intestinal microbial balance [3]. Recently, some foods, as called functional foods that have positive health promoting effects are already on the global market, and especially in the markets of Japan, Europe, and United states. Functional foods are defined broadly as foods that provide more than simple nutrition; they supply additional physiological benefits to the consumer. Yoghurt and other fermented milks containing probiotics may be considered the first functional foods [2-4].

Cereals are providing dietary fibers, proteins, energy, minerals and vitamins required for human health. The possible applications of cereal constituents in functional food formulations could be summarized: (a) as dietary fiber promoting several beneficial health or physiological effects; (b) as prebiotics due to their content of specific non digestible carbohydrates; and (c) as encapsulation materials for probiotics in order to enhance their stability [5]. However, the nutritional quality of cereals and the sensorial properties of their products are sometimes poor or inferior in comparison with milk and milk products. Milk proteins have high nutritional value compared to other proteins because of their relatively high content of essential amino acids and good digestibility [6].

During fermentation of dairy products like cheese and yoghurt release bioactive peptides upon enzymatic hydrolysis of milk proteins [7]. Fermentation may be the most simple and economical way of improving nutritional value, sensory properties and functional qualities of the dairy products [8]. Lactic acid fermentation of different cereals has been found effectively to reduce the amount of Phytic acid, tannins and improve protein availability [9]. Increased amounts of riboflavin, thiamine, niacin and lysine due to the action of LAB in fermented blends of cereals where also reported [10]. The traditional foods manufactured from grains usually lack flavor and aroma. Fermentation improves the sensorial value, which is very much dependent on the amounts of lactic acid, acetic acid and several aromatic volatiles such as higher alcohols, aldehydes, ethyl acetate and di-acetyl, produced via the homo-fermentative or hetero-fermentative metabolic pathways [11]. This work aimed to produce probiotic cereals fermented milk supplemented. The cereals were as wheat, barley and Fereek (green wheat), in order to introduce a diet with nutritionally balanced that needed for sensitive or elderly persons.

Materials and Methods

Cereals

Three different cereals; namely: Dry Wheat (Triticum spp.), Barley (Hordeum spp.) and Green Wheat or Fereek (Triticum spp.), were purchased from local market (Alexandria, Egypt). Dried skim milk was obtained from Alexandria market.

Starters

Three commercial freeze-dried DVS were used. They were a Yoghurt starter (YC-X11) (*Streptococcus thermophilus* + *Lactobacillus delbruckii* subsp. *bulgaricus*); Bio-yoghurt starter (ABT–2) (CHR HANSEN) + Yoghurt starter (1:2) and *Lactobacillus plantarum* + Yoghurt starter (1:2) with potential probiotic properties (From Chr.

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were mixed thoroughly before adding. The resultant paste was filled in polystyrene cups and covered then incubated at (43°C for W1, B1 and F1) and (37°C for W2, W3, B2, B3, F2 and F3) to 6 hours. After that, the fermented paste was stored at 5 ± 1°C (refrigerator temperature) (Figure 1).

**Chemical Analysis**

**Dairy base analysis**

Dried skim milk is analyzed for total solids (TS), Protein, Ash, titratable acidity, pH and Total carbohydrate content according to the Association of Official Analytical Chemists [12] (Table 1).

**Cereals analysis**

Cereals were analyzed for total solids (TS), Fat, Protein, Ash, Total carbohydrate and crude fiber content according to AACC [13] (Table 2).

**Kishk like analysis**

The samples were analyzed in triplicates for pH, titratable acidity as lactic acid, and Total solids in the fresh products and after 7 and 14 days of storage at 5 ± 1°C, whereas, total protein, carbohydrate, ash, crude fibers and the fat content were determined only in the fresh products.

Total solids content, total protein, fat, ash and crude fibers were determined as described by AOAC [12]. pH values were measured using a pH-meter model HANNA HI9321 microprocessor with a standard, combination glass electrode. Titratable acidity was estimated as percentage of lactic acid according to [14]. The carbohydrate content was calculated in the product according to the following equation:

\[
\text{Carbohydrate} \% = 100 - (\text{Protein} \% + \text{Ash} \% + \text{Fat} \% + \text{Fiber} \%)
\]
Preparation of the samples: Eleven grams of each sample were weighted and transferred thoroughly under condition to sterilized flasks, contained 99 ml 2% sodium citrate solution. The necessary serial dilutions using sterilized distilled water were carried out. The samples were incubated at 37°C for 48 hours.

Lactic acid bacterial count (LAB): Using de Man Rogosa Sharpe (MRS) medium as described by APHA [16]. The plates were incubated at 37°C for 24 hours.

Coliform count: Coliform bacteria were enumerated using Violet Red Bile Agar (VRBA) medium according to Difco [17]. The plates were incubated at 37°C for 24 hours.

Yeasts and moulds count: Sabouraud dextrose agar medium (Oxoid) was used for enumerating yeasts and moulds according to APHA [16]. The plates were incubated at room temperature (20°C-25°C) for 5-7 days.

Lactobacillus acidophilus count: Lactobacillus acidophilus was counted on MRS agar (Oxoid) supplemented with L-cystein according to Lapierra et al. [18].

Proteolytic bacteria: Proteolytic bacteria count was enumerated on nutrient agar (NA) according to APHA [16]. The plates were incubated at 32°C for 38-48 hrs.

Spore forming bacterial count: Representative sample was heated at 80°C for 20 min in water bath and then cooled at the room temperature, the same technique as previously mentioned was followed for enumeration the spore formers but using manitol salt agar medium (MSA) Incubation was done at 32°C for 24 hrs [16].

Statistical analysis
Statistical analysis was performed by applying three ways ANOVA and multiple comparisons of means of each treatment (cereals, starter cultures and storage time) using the Least Significant Difference (LSD) test at the confidence level of 95%. Analysis of data was carried out with SAS [19].

Results and Discussion
Chemical composition
Chemical properties of cereal fermented dairy products are presented in Tables 3 and 4. The results (Table 3) revealed that the effect of cereal type on the chemical composition of the resultant cereal fermented dairy products was more pronounced (P ≤ 0.05) than that of type of starter culture used. There are significant differences (P ≤ 0.05) in pH values and acidity percentages between different cereals fermented dairy products, depending on the type of cereal or starter culture. Data in Table 3 show that the pH values of all samples were decreased gradually till 14 days of the storage, whereas the titratable acidity values were increased at the same period of cold storage. These expected results due to the starter activity similar results were obtained by Hussein [20]. The cereal fermented dairy products containing wheat (W1, W3 and W2, Respectively) were characterized by higher

Table 1: Experimental treatments.

| Composition | Raw material |
|-------------|--------------|
| Cereals     | Skim Milk Powder | Whole Barley Burghul | Whole Wheat Burghul | Freek Burghul | Vanillin |
| Whole Wheat Burghul (W) | 35.8 ± 0.20 | 4.95 ± 0.10 | 3.81 ± 0.20 | 3.62 ± 0.40 |
| Whole Barley Burghul (B) | 0.81 ± 0.20 | 0.7 ± 0.50 | 0.63 ± 0.15 | 0.65 ± 0.20 |
| Freek Burghul (F) | 52.08 ± 0.55 | 35.99 ± 0.90 | 31.6 ± 0.50 | 27.91 ± 0.55 |
| Re-constituted Skim milk (15%) | 7075 ± 0.25 | 60.87 ± 0.50 | 4.95 ± 0.10 | 0.7 ± 0.50 |
| % Total protein | 5005 ± 0.45 | 60.87 ± 0.50 | 27.91 ± 0.55 |
| % Ash | 4005 ± 0.45 | 60.87 ± 0.50 | 27.91 ± 0.55 |
| % moisture | 1900 ± 0.45 | 60.87 ± 0.50 | 27.91 ± 0.55 |
| % Crude fiber | 2100 ± 0.45 | 60.87 ± 0.50 | 27.91 ± 0.55 |

1: Total Protein % = N × 6.38; 2: Total Protein % = N × 5.33; 3: Calculated by the difference. 4: Not determined.

Table 2: Characteristics of the raw materials used in manufacture of Kishk like.

Sensory evaluation
Organoleptic evaluation was carried out according to the scheme of Clark et al. [15]. The samples were subjected to organoleptic analysis by well-trained members of the Dairy Science and Technology Department (Fac. Agric. Alexandria Univ., Egypt). The sensory attributes evaluated were: The Flavor (1-10 points), Body and Texture (1-5 points) and appearance and Colour (1-5 points).
pH as compared with their containing of Barely (B1, B3 and B2) and Freek (F1, F3 and F2, Respectively). However, samples of cereal fermented dairy products that fermented with only Yoghurt starter culture (1) were characterized with higher pH than that fermented with mixed cultures contain Yoghurt and Bio-Yoghurt starter (2) and mixed cultures of Yoghurt starter culture and Lactobacillus plantarum (3), respectively. During values of the storage at 5 ± 1°C for 14 days, significant differences (P ≤ 0.05) were recorded in pH of different cereal fermented dairy products. Moreover, a gradual decrease in pH could be observed in all samples of cereal fermented dairy products, with extending the cold storage period. The decrease in pH could be attributed to a limited growth of different bacterial starter cultures and the slow fermentation of residual lactose [20,21].

The fermentation activity can be observed by acidity and/or pH measurements [22]. During fermentation of cereal fermented dairy products, the amount of organic acids other than lactic acid production were small and neglected in acidity calculations [23]. Unlike pH, it is normal expected that the higher acidity rates would lead to lower pH values. The rates of acidity were higher in barley samples than other samples of Wheat and Fereek [24-27]. The higher acidity of cereal fermented dairy products made with mix of Yoghurt starter culture and Lactobacillus plantarum culture can be attributed to the high activity of yoghurt starter for splitting lactose into glucose and galactose as the first step of fermentation [28].

Table 3 illustrates the percentages of total solids, carbohydrates, ash, crude fiber, fat and crude protein of cereal fermented dairy products. There were no significant differences (P < 0.05) in the crude protein for all samples, but significant (P ≤ 0.05) in the carbohydrates, ash, crude fiber and fat contents between samples depending on type of cereals usage. The cereal fermented dairy products containing Freek were characterized with higher total solids and carbohydrates whereas, lower content of ash, crude fiber, fat and crude protein contents, compared with the other treatments. Also, depending on the type of starter culture, the cereal fermented dairy products fermented with only Yoghurt starter showed very slight increase in the crude protein and carbohydrate contents, but decrease in moisture content than that fermented with mixed starter cultures except moisture content at (S. B. 1) treatment. As expected the crude fibers were higher in barley products than other samples because of its higher percent of crude fiber which reached 2.51%. Also, it ranged from 0.702% to 0.709% in whole barley burghul fermented with reconstituted skim milk, but unlike contain whole wheat burghul and Freek products that ranged between

### Table 3: Changes in pH values and acidity % of different cereal fermented dairy products during storage at 5 ± 1°C for 14 days.

| Samples   | Storage Period (days) | Acidity as lactic acid | pH   |
|-----------|-----------------------|------------------------|------|
| S.W.1     | 1                     | 0.630FG                | 4.87E |
|           | 7                     | 0.843FG                | 4.64E |
|           | 14                    | 0.943BC                | 4.52D |
| S.W.2     | 1                     | 0.676AM                | 4.80AB|
|           | 7                     | 0.883GF                | 4.48D |
|           | 14                    | 0.966ABC               | 4.38D |
| S.W.3     | 1                     | 0.658AM                | 4.83AB|
|           | 7                     | 0.863FG                | 4.53A |
|           | 14                    | 0.950ABC               | 4.40D |
| S.B.1     | 1                     | 0.690AE                | 4.80BC|
|           | 7                     | 0.850BG                | 4.55AH|
|           | 14                    | 0.930BC                | 4.48AH|
| S.B.2     | 1                     | 0.760G                 | 4.73KG|
|           | 7                     | 0.896HA                | 4.51HK|
|           | 14                    | 0.986A                 | 4.44HHK|
| S.B.3     | 1                     | 0.750G                 | 4.76KD|
|           | 7                     | 0.886GF                | 4.53RF|
|           | 14                    | 0.994A                 | 4.42SM|
| S.F.1     | 1                     | 0.550IJ                | 4.72OD|
|           | 7                     | 0.673L                 | 4.65GE|
|           | 14                    | 0.796NF                | 4.52J |
| S.F.2     | 1                     | 0.603IH                | 4.70ED|
|           | 7                     | 0.776JF                | 4.52J |
|           | 14                    | 0.850G                 | 4.35J |
| S.F.3     | 1                     | 0.583IK                | 4.72ED|
|           | 7                     | 0.730JK                | 4.62GH|
|           | 14                    | 0.816L                 | 4.51HK|
| R-Square  |                       | 0.908                  | 0.012 |
| Coeff. Var.|                      | 1.884                  | 0.467 |

S.W. = Soft kishk like manufactured from fermented Whole Wheat Burghul Skim milk.
S.B. = Soft kishk like manufactured from fermented Whole Barley Burghul Skim milk.
S.F. = Soft kishk like manufactured from fermented Freek Burghul Skim milk.

### Table 4: Chemical properties of cereal fermented dairy products

| Sample   | Total Solids % | Carbohydrates % | Ash % | Crude Fiber % | Fat content % | Crude protein % |
|----------|----------------|-----------------|-------|---------------|---------------|-----------------|
| S.W.1    | 26.66<sup>AI</sup> | 19.099<sup>AS</sup> | 0.96<sup>AB</sup> | 0.386<sup>AS</sup> | 0.240<sup>AB</sup> | 5.243<sup>AB</sup> |
| S.W.2    | 26.40<sup>BC</sup> | 19.687<sup>B</sup> | 0.96<sup>AB</sup> | 0.383<sup>B</sup> | 0.234<sup>B</sup> | 5.143<sup>B</sup> |
| S.W.3    | 26.27<sup>C</sup> | 19.603<sup>A</sup> | 0.95<sup>AB</sup> | 0.38<sup>B</sup> | 0.223<sup>BC</sup> | 5.126<sup>BC</sup> |
| S.B.1    | 25.76<sup>D</sup> | 18.930<sup>C</sup> | 0.86<sup>B</sup> | 0.708<sup>C</sup> | 0.196<sup>C</sup> | 5.18<sup>C</sup> |
| S.B.2    | 25.83<sup>D</sup> | 18.631<sup>D</sup> | 0.87<sup>C</sup> | 0.705<sup>C</sup> | 0.196<sup>C</sup> | 5.13<sup>C</sup> |
| S.B.3    | 25.67<sup>E</sup> | 18.815<sup>D</sup> | 0.84<sup>B</sup> | 0.702<sup>C</sup> | 0.196<sup>C</sup> | 5.11<sup>C</sup> |
| S.F.1    | 26.69<sup>F</sup> | 20.203<sup>E</sup> | 0.76<sup>B</sup> | 0.285<sup>C</sup> | 0.183<sup>DE</sup> | 5.08<sup>BC</sup> |
| S.F.2    | 26.37<sup>BC</sup> | 20.165<sup>F</sup> | 0.74<sup>B</sup> | 0.283<sup>C</sup> | 0.183<sup>DE</sup> | 5.00<sup>BC</sup> |
| S.F.3    | 26.38<sup>BC</sup> | 20.164<sup>F</sup> | 0.75<sup>B</sup> | 0.282<sup>C</sup> | 0.180<sup>C</sup> | 5.00<sup>BC</sup> |
| SED      | 0.053           | 0.088            | 0.007 | 0.001         | 0.001          | 0.057           |
| R-Square | 0.955           | 0.950            | 0.985 | 0.999         | 0.980          | 0.517           |
| Coeff. Var.| 0.353           | 0.783            | 1.50  | 0.441         | 1.502          | 1.940           |

S.W. = Soft kishk like manufactured from fermented Whole Wheat Burghul Skim milk.
S.B. = Soft kishk like manufactured from fermented Whole Barley Burghul Skim milk.
S.F. = Soft kishk like manufactured from fermented Freek Burghul Skim milk.

**S.E.D:** standard Error of Difference.
0.381-0.388 and from 0.282% to 0.285%, respectively. These differences of the chemical properties of cereal fermented dairy products, due to its chemical composition of cereal burghul and blends. It was reported that the type of starter culture used in the fermentation did not affect in the Total solids, fat and crude protein of yogurt, bio-yogurt [20-29]. Also, Salama [30] noticed that the stirred fermented milk made by ABT-4 culture (Lb. acidophilus, Str. thermophilus and B. bifidum) observed slight decrease in crude protein than made by used YO-FLEX yogurt culture (Lb. delbruektii spp. lactis, Lb. delbruektii spp. bulgaricus and, Str. thermophilus); this may be due to the limited proteolysis of milk protein by lactic acid bacteria.

Suitability of heat treatments, good hygiene and microbiological analysis of characteristics of different blends

Table 5 illustrates the changes in the viable cell counts appeared on MRS medium for fresh and 14 days stored of cereal fermented dairy products at 5 ± 1°C. Slight decrease were observed after 14 days of storage. Generally, the decreasing values were about 0.45 (c.f.u × 10³ g⁻¹). On the other hand, it can be noticed that the decline on MRS+L-Cysteine medium were less than that obtained in the case of MRS medium. The decreasing in values was 0.32, 0.43 and 0.44 (c.f.u × 10³ g⁻¹) for S.W. 2, S.B. 2 and S.F. 2 treatments, respectively. All the samples did not contain any growth in 0.1 gm on SDA, VRBA, NA and MSA media in either fresh or stored products through the storage period. These results are revealed the good hygiene sanitation during manufacture different products. From the above results, it could be concluded that the c.f.u on MRS medium (mainly Bifidobacteria) sensitive than other starter microorganisms (mainly lactic acid bacteria) for storage.

| Samples | Storage Period (Days) | Media | MRS | MRS+L-Cysteine | NA | SDA | VRBA | MSA |
|---------|----------------------|-------|-----|----------------|----|-----|------|-----|
| S.W.1   | 1                     | 2.80  | ---- | 2.68           | ---- | 2.40 | ---- | ---- |
|         | 7                     | 2.80  | 2.56 | ----           | ---- | 2.44 | ---- | ---- |
|         | 14                    | 2.80  | 2.46 | ----           | ---- | 2.24 | ---- | ---- |
| S.W.2   | 1                     | 2.84  | ---- | 2.72           | ---- | 2.44 | ---- | ---- |
|         | 7                     | 2.84  | ---- | 2.56           | ---- | 2.44 | ---- | ---- |
|         | 14                    | 2.84  | ---- | 2.46           | ---- | 2.24 | ---- | ---- |
| S.W.3   | 1                     | 2.88  | ---- | 2.72           | ---- | 2.44 | ---- | ---- |
|         | 7                     | 2.88  | ---- | 2.56           | ---- | 2.44 | ---- | ---- |
|         | 14                    | 2.88  | ---- | 2.46           | ---- | 2.24 | ---- | ---- |
| S.B.1   | 1                     | 2.80  | ---- | 2.68           | ---- | 2.46 | ---- | ---- |
|         | 7                     | 2.80  | ---- | 2.56           | ---- | 2.44 | ---- | ---- |
|         | 14                    | 2.80  | ---- | 2.46           | ---- | 2.24 | ---- | ---- |
| S.B.2   | 1                     | 2.84  | ---- | 2.68           | ---- | 2.44 | ---- | ---- |
|         | 7                     | 2.84  | ---- | 2.56           | ---- | 2.44 | ---- | ---- |
|         | 14                    | 2.84  | ---- | 2.46           | ---- | 2.24 | ---- | ---- |
| S.B.3   | 1                     | 2.80  | ---- | 2.68           | ---- | 2.46 | ---- | ---- |
|         | 7                     | 2.80  | ---- | 2.56           | ---- | 2.44 | ---- | ---- |
|         | 14                    | 2.80  | ---- | 2.46           | ---- | 2.24 | ---- | ---- |
| S.F.1   | 1                     | 2.72  | ---- | 2.68           | ---- | 2.44 | ---- | ---- |
|         | 7                     | 2.72  | ---- | 2.56           | ---- | 2.44 | ---- | ---- |
|         | 14                    | 2.72  | ---- | 2.46           | ---- | 2.24 | ---- | ---- |
| S.F.2   | 1                     | 2.84  | ---- | 2.68           | ---- | 2.44 | ---- | ---- |
|         | 7                     | 2.84  | ---- | 2.56           | ---- | 2.44 | ---- | ---- |
|         | 14                    | 2.84  | ---- | 2.46           | ---- | 2.24 | ---- | ---- |
| S.F.3   | 1                     | 2.76  | ---- | 2.68           | ---- | 2.44 | ---- | ---- |
|         | 7                     | 2.76  | ---- | 2.56           | ---- | 2.44 | ---- | ---- |
|         | 14                    | 2.76  | ---- | 2.46           | ---- | 2.24 | ---- | ---- |

S.W. = Soft kishk like manufactured from fermented Whole Wheat Burghul Skim milk.
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S.F. = Soft kishk like manufactured from fermented Freek Burghul Skim milk.

| Media | NA | SDA | VRBA | MSA |
|-------|----|-----|------|-----|
|       | ---- | ---- | ---- | ---- |

Table 5: Changes in viable microbial counts (c.f.u × 10⁻³ g⁻¹) in cereal fermented dairy products during storage at 5 ± 1°C.
ph and the concentration of lactic and acetic acid in fermented cereal product in relation to the properties of each specific probiotics strain have to be investigated in order to maximise the viability during storage for practical application; a pH value of the final product must be maintained above 4.6 to prevent the decline *Bifidobacteria* population [35].

**The sensory evaluation**

The sensory evaluation is the main factor affecting the consumption of the products and its acceptance. It was realized that the sensory evaluation could contribute pertinent, valuable information related to marketing consequences and simultaneously provide direct actionable evaluation could contribute pertinent, valuable information related to organoleptic properties of cereal fermented dairy products at the end of storage.

At the end of storage time, whole wheat burghul treatments had the highest total scores and then Freek burghul samples, while the addition of barley burghul had the lowest total score because of lowering the total score. General acceptability of the cereal fermented dairy products containing of Freek were characterized with perfect flavor, body and texture as well as whiteness appearance and colour. On the other hand, the pronounced malt flavor and light brown color or the decline of color to un-natural, were noticed in cereal fermented dairy products containing of barely; especially at (S.B.2) treatment, these results are in agreement with [20]. During storage at 5 ± 1°C for 14 days, Sensory evaluation was decreased for all products due to the acidity increased in all samples gradually and effect on organoleptic properties and decreased its total score. Vijayalakshmi et al. [36] found that during storage of cereal based low fat fruit yogurt, acidic or malt flavor, firm or ropy body and texture, shrunken or free whey appearance, as well as light brown color were increased in different cereal fermented dairy products at the end of storage.

Table 6: Organoleptic properties of cereal-based fermented dairy products, during storage at 5 ± 1ºC for 14 days.

| Sample   | Storage Period (days) | Flavor (10) | Body/texture (5) | Appearance and color (5) | Total (20) |
|----------|-----------------------|-------------|------------------|--------------------------|------------|
| S.W.1    | 1                     | 7.83ABC     | 4.00a            | 4.33a                    | 16.16a     |
|          | 7                     | 7.86H       | 3.83H            | 3.83H                    | 15.32H     |
|          | 14                    | 6.00DEF     | 3.66*            | 3.66*                    | 13.68C     |
| S.W.2    | 1                     | 7.86H       | 4.50a            | 4.33a                    | 16.49a     |
|          | 7                     | 7.00ABC     | 4.00a            | 3.59C                    | 14.99a     |
|          | 14                    | 6.16ABCDEF  | 3.83a            |                         | 13.28a     |
| S.W.3    | 1                     | 7.33ABC     | 4.33a            | 4.33a                    | 15.99a     |
|          | 7                     | 7.00ABC     | 3.83a            | 4.16a                    | 14.99a     |
|          | 14                    | 5.83ABCDEF  | 3.66a            | 3.83 BC                  | 13.28a     |
| S.B.1    | 1                     | 6.00DEF     | 3.66a            | 3.5a                     | 13.16a     |
|          | 7                     | 5.50ABC     | 3.66a            | 2.5a                     | 11.16BC    |
|          | 14                    | 4.33C       | 3.00             | 2.33BC                   | 9.66D      |
| S.B.2    | 1                     | 5.66ABCDEF  | 3.66a            | 3.16AC                   | 12.48BC    |
|          | 7                     | 5.00ABC     | 3.66a            | 2.5a                     | 11.66BC    |
|          | 14                    | 4.00        | 2.66             | 2.33BC                   | 9.33CD     |
| S.B.3    | 1                     | 6.33ABCDEF  | 4.00a            | 3.5a                     | 13.83BC    |
|          | 7                     | 5.50ABC     | 3.66a            | 2.5a                     | 11.66BC    |
|          | 14                    | 4.00        | 3.00             | 2.00                     | 9.00D      |
| S.F.1    | 1                     | 8.33a       | 4.00A            | 4.33a                    | 16.66a     |
|          | 7                     | 6.33ABCDEF  | 4.00A            | 4.33a                    | 14.66a     |
|          | 14                    | 5.66ABCDEF  | 3.83a            | 3.5a                     | 12.99a     |
| S.F.2    | 1                     | 7.83a       | 4.00a            | 4.33a                    | 16.16a     |
|          | 7                     | 6.33ABCDEF  | 3.66a            | 4.09a                    | 13.99a     |
|          | 14                    | 5.10ABCDEF  | 3.00             | 3.66AC                   | 11.82BC    |
| S.F.3    | 1                     | 7.83a       | 4.00a            | 4.33a                    | 16.16a     |
|          | 7                     | 7.00ABC     | 4.00a            | 3.66AC                   | 14.66a     |
|          | 14                    | 6.00DEF     | 3.33a            | 3.5a                     | 12.83a     |
| SED      |                       | 0.420       | 0.340            | 0.343                    | 0.883      |
| R-Square |                       | 0.805       | 0.383            | 0.679                    | 0.754      |
| Coeff. Var. |                   | 11.686     | 15.81            | 16.93                    | 11.34      |

S.W. = Soft kishk like manufactured from fermented Whole Wheat Burghul Skim milk.
S.B. = Soft kishk like manufactured from fermented Whole barley Burghul Skim milk.
S.F. = Soft kishk like manufactured from fermented Freek Burghul Skim milk.

**Conclusion**

From the above results it could be concluded that either Whole...
Wheat Burghul, Whole Barley Burghul and Whole Freek Burghul can be used to produce an acceptable product as functional foods suitable for elderly persons or infants weaning foods. This formula has a high nutritional value and fiber content beside the presence probiotic bacteria with a lot of health benefits.

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