



## **Impacts of Adding Rye, Sorghum and Their Mixtures on the Quality of Untraditional Egyptian Kishk**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author JBA designed the study, managed the analysis of the study and performed the statistical analysis. Author TTES managed some analysis of the study, wrote the protocol and wrote the first draft of the manuscript. Author AFAS managed some analysis of the study. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Kishk is a dried mixture of fermented milk and cereal, widely consumed in Upper Egypt. The aim of this study was to study the effect of rye, sorghum with wheat grains compared with traditional wheat kishk (control) on physical properties, chemicals composition, microbiological and sensory analysis. Untraditional kishk was prepared with rye, sorghum and four groups of mixtures Mix1 (50% wheat and 50% rye), Mix 2 (50% wheat and 50% sorghum), Mix3 (50% rye and 50% sorghum) and Mix4 (mixed of wheat, rye and sorghum in ratio of 1:1:1) compared with traditional wheat kishk. The chemical composition analysis of different untraditional kishk was in the following ranges: moisture content of kishk samples ranged from 8.00 to 12.72% for M 2 and M 1, respectively. M 2 had the highest total solid of untraditional kishk samples value 84.66% while Mix 1 had the lowest value 76.18%. For protein content, wheat had the highest protein 27.11% followed by M 1 (26.02%), while sorghum (22.90%) had the lowest protein content. On other hand nitrogen free extracts (NFE) % range from 65.76% (rye) to 80.55% (wheat). Additionally Sorghum had lower fat (2.50%) than other samples and wheat was lower in ash content 6.64% in completely in other untraditional kishk. The results of fiber showed that rye had significant highest value of 8.12% while wheat had lowest value of 1.80%. M 3 was the lowest total caloric values 325.13% of kishk samples and tannic acid was under detection safe limit 0.185%. Data also indicated that as a

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result of pH of different prepared kishk samples. Microbiological analysis of kishk from wheat, rye, sorghum and their mixture were determined. M1 kishk is white and yellow colored than other untraditional kishk samples. Differences in sensory attributes were associated with different grain kishk and their mixed but there were no significant differences between wheat kishk control and M 1 in mouth feeling, and consistency. Sensorial, M1 kishk is more acceptability than other treatment after the traditional kishk control.

**Keywords:** Rye; sorghum and their mixed; traditional; untraditional kishk.

## 1. INTRODUCTION

Cereals are considered one of the most important sources of food [1], which have contributed to human nutrition for millions of years. The major cereal crops grown in worldwide are wheat, rice, maize/corn, barley and other cereals include millet, sorghum, rye, oat and triticale [2]. Wheat is one of the oldest of all cultivated plants. Most of wheat varieties presently cultivated are grouped under the soft bread wheat (*Triticum aestivum*), which account for approximately 95% of world production, and durum wheat (*Triticum durum*), which often used for pasta production [3].

Rye (*Secale cereale*) is a cereal grain which looks like wheat but is longer and more slender and its color varies from yellowish brown to grayish green. Hopefully more people discover rye's nutritional benefits and its unique taste profile, it will assume a more important role in our diets which have exceptionally high water-binding capacity and quickly give a feeling a fullness and satiety, making rye bread a real help for anyone trying to lose weight [4]. Whole grain rye has a high level of lignan, an insoluble fiber that also functions as a phytoestrogen. The amount of amino acids is higher in rye than in wheat, etc., [5]. The rye grains are high fiber content and its high amount of phytochemicals, which are known to increase the bioactivity of rye. The phenolic compounds significantly influence the rye like flavor [6].

Sorghum (*Sorghum bicolor*) is one of the most important crops in Africa, Asia and Latin America. More than 35% of sorghum is grown directly for human consumption. The rest is used primarily for animal feed, alcohol production and industrial products [7] and [8]. Selection of varieties meeting specific local food and industrial requirements from this great biodiversity is of high importance for food security [9]. Sorghum while playing a crucial role in food security in Africa, it is also source of income of house-hold [10]. Sorghum is the fifth

most important cereal crop after wheat, rice, maize, and barley in terms of production [11]. Sorghum is a valuable staple food, for its content of protein, pro-vitamins (carotenoids) and vitamins, fat-soluble (D, E and K) and of B group (except for B12) and minerals, such as iron, phosphorus and zinc.

Fermentation is one of the old food processing techniques that have been used to improve the nutritional values, flavors, and storage period of foods.

Fermentation of cereals is inexpensive way to increasing nutritional value, sensory properties and functional qualities of cereal flour might lack some basic components e.g. essential amino acids [12]. The purpose of fermentation was to give food safety and it plays other roles such as: improving the diet flavor, nutritional value and texture; preservation of food by lactic acid and acetic acid; detoxification of undesirable substances present in raw foods like phytates, tannins and polyphenols during food fermentation processing [13,14]. Most fermented foods are based on cereals such as millet, sorghum, maize, and wheat.

The main ingredients of Egyptian kishk are laban zeer with boiled, dried and crushed whole wheat grains. It is rich in nutritive constituents and a source of many vitamins, growth factors and other nutrients [15,16]. Kishk flavor influenced by the type of lactic acid bacteria used to ferment the milk, but the survival rate may be irrelevant because these products are heated after rehydration [17]. Because of its keeping quality under ambient conditions and high nutritional value [18], kishk may preserve milk protein from spoilage, increase its nutritional value and improve its sensory properties [12].

However, in Sudan a closely related dried fermented milk product (Um-Kushuk) is made with de-hulled sorghum [19], and laboratory-made kishks using soya milk and chickpea our have been evaluated in Egypt [20].

Differences in the traditional methods employed during the manufacture of kishk and the cereal base used can influence the compositional, nutritional properties and microbiological characteristics of the product [21]. However, Kishk related products have been produced or developed by researchers in many countries using different flours (e.g. malted, chick pea, rice or maize), de-hulled sorghum or soybeans [20,22].

Thus the aim of this study was to investigate the impact of using rye, sorghum and their mixtures for producing untraditional kishk compared to wheat grains as traditional source of kishk on physical, chemical, color parameters, microbial criteria, minerals, vitamins, amino acids contents and sensory properties.

## 2. MATERIALS AND METHODS

### 2.1 Materials

Imported rye grains (Rye Berries), (*Secale cereale*) was obtained from U.S.A which was obtained from (Alexandria) Government. Egyptian yellow sorghum grains (Sakha 80), (*Sorghum bicolor*) was obtained from El-Ghrbia and Egyptian wheat grains (Giza 144), (*Triticum aestivum*) was obtained from Giza, Egypt. They were taken from three different Companies since 2019. Cow milk was obtained from the Technology Center of Agriculture Production, Faculty of Agriculture, Cairo University. Direct Vat Set (DVS) containing *Streptococcus thermophiles* and *Lactobacillus delbruckii sub sp. bulgaricus* (YCX31) was obtained from Chr. Hansen's laboratories; Denmark and salt were obtained from the local market, Egypt.

Media and reagents: the following solutions and media were used for mold enumeration and identification: Peptone water, Rose Bengal chloramphenical agar (Biolife, Italy). The reagents used for the chemical analyses were of analytical grade.

### 2.2 Methods

#### 2.2.1 Preparation of grains

A thirty kg of each grain samples used in this investigation were stored at temperature  $25 \pm 1^\circ\text{C}$  and relative humidity less than 62% according to the methods described in [23]. Grains samples were cleaned mechanically to remove dirt,

dockage, imparters and other strange grains by Carter Dockage Tester according to the methods described in [24]. The samples were milled by Laboratory mill 3100 Perten according to the methods described in [25].

#### 2.2.2 Preparation of kishk samples

Different kishk samples were prepared from cow yoghurt with wheat, rye or sorghum and their mixtures grains in the laboratory according to the method described by Tamime et al. [26] with some modifications in ratio of added salt to 2%, illustrated by Fig. 1. The formulas of different kishk samples are shown in Table 1.

#### 2.2.3 Analytical methods

##### 2.2.3.1 Physical properties

Cleanliness, dockage, shrunken and broken, thin, sound, foreign materials, total damaged kernels and total defects of studied grains were separated and determined manually (hand picking). Test weight pound per bushel, Test weight P/B = (Kg/Hectoliter)  $\div 1.278$  according to USDA [23]. A thousand kernel weights were determined by counting the kernels in a 10 g wheat sample [25].

##### 2.2.3.2 Chemical properties

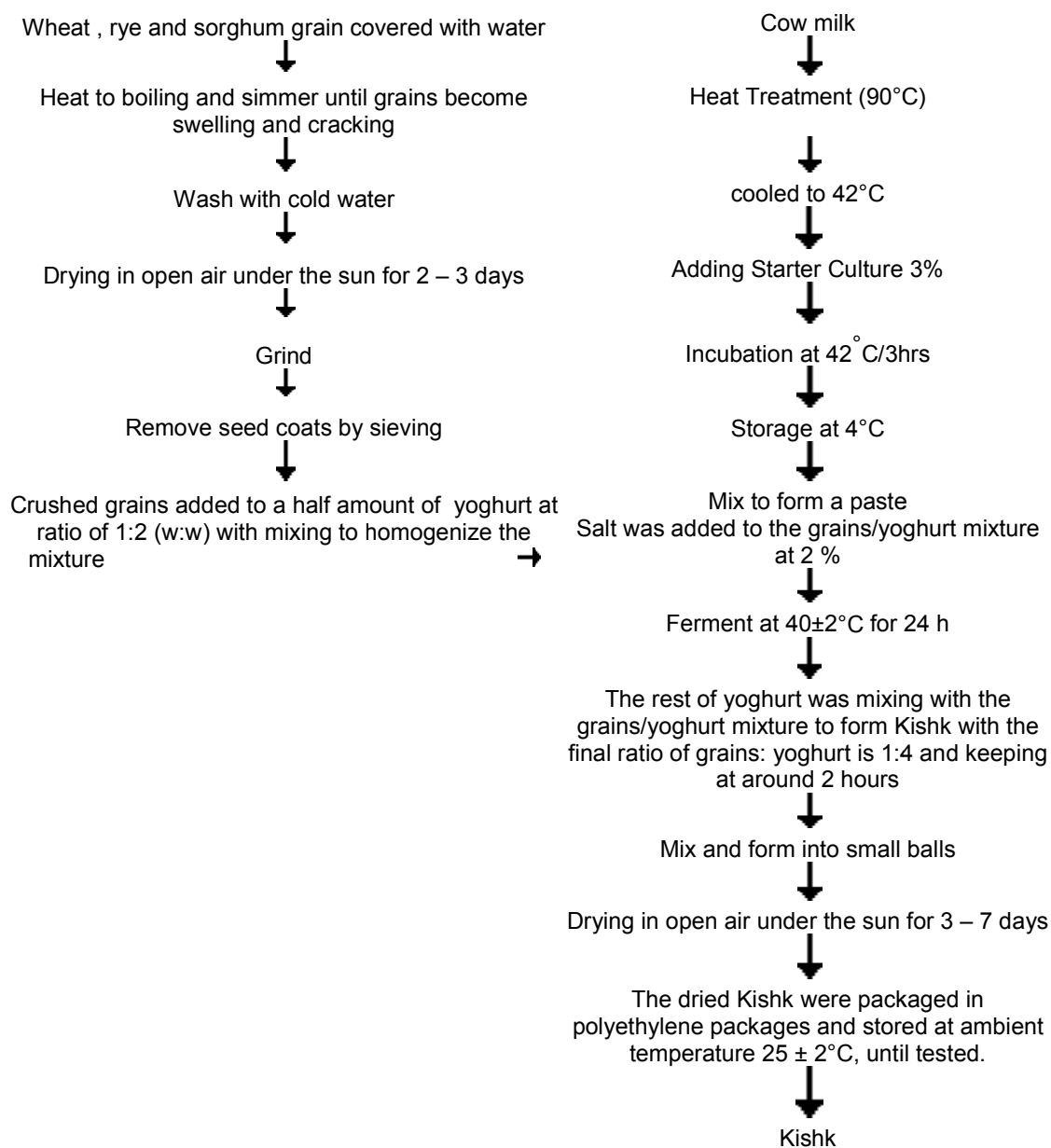
Chemical composition (Moisture, crude protein, ash, crude fiber, TS, and fat), also vitamins, amino acid, minerals of selected grains and kishk samples were determined according to AOAC [27] and grains moisture according to [23]. The nitrogen free extract (NFE) was calculated by difference. Total caloric values of kishk were calculated according to Dougherty et al. [28] as follows:

$$E = 4(\text{protein \%} + \text{carbohydrates \%}) + 9 \times \text{fat \%}$$

Estimation of Aflatoxins content, Ochratoxin, Zearalenone and Fumonisin were determined by HPLC using the method of AOAC [29].

##### 2.2.3.3 PH and titratable acidity

The pH of prepared kishk samples were measured according to the method of Adeleke and Odedeji [30] using a pH meter (HANNA, HI 9025) already standardized with buffer solutions of pH 4.0 and 7.0. Kishk samples were analyzed for their acidity as reported by Tamer et al. [31].



**Fig. 1. Flow diagram for the preparation of kishk**

**Table 1. Formulation of Kishk samples from different grains and their mixtures**

<b>Kishk code</b>	<b>Raw materials used in Kishk samples</b>
W	Wheat kishk (control) (100% wheat)
R	Rye kishk (100% rye)
S	Sorghum kishk (100% sorghum)
M 1	50% Wheat + 50% Rye
M 2	50% Wheat + 50% Sorghum
M 3	50% Sorghum + 50% Rye
M 4	Wheat + Rye+ Sorghum (1:1:1)

#### 2.2.3.4 Color determination of prepared kishk samples

Determination of kishk samples color was done by using Minolta Color Reader CR-400, (Minolta Co. Ltd. and Japan) according to the method described in [32].

#### 2.2.3.5 Microbiological analysis

For microbiological analysis, Kishk samples were prepared according to the method recommended by [33] and analyzed for total bacterial count [34]. Total bacterial count were carried out using plate count agar and incubated for 24 h at 37°C. Sabouraud agar medium was used for total molds and yeasts enumeration according to APHA [35]; fungal identification was performed for isolated fungi in Food Safety Lab, Regional Center for Food & Feed, Agriculture Research Center and identified according to Pitt and Hocking [36].

#### 2.2.3.6 Sensory analysis

The sensory evaluation of kishk soup was determined by the department of centre laboratory for Food and feed. Kishk samples were evaluated for appearance (10), color (10), aroma (10), taste (20), mouth-filling (20), consistency (20), presence of bran (10) and overall acceptability (100) according to the method described by Abou-Donia et al. [37].

#### 2.2.3.7 Statistical analysis

Data of three replicates were determined by Statistical Analysis System software package. Analysis of variance was performed by ANOVA procedures. Significant differences between means were determined by Duncan's multiple range tests at a level of  $P=0.05$  [38].

### 3. RESULTS AND DISCUSSION

#### 3.1 Chemical and Physical of Grains and Their Flours

Chemical composition of different grains used in this study is given in Table 2 that grains moisture content of different varieties ranged from 10.20 to 11.60% for all studied samples. Sorghum had the highest value while rye and wheat had lowest value. As regards protein content, rye had the highest protein 12.30% followed by wheat 12.20%, while sorghum 10.40% had the lowest protein content. Additionally sorghum was lower fat 1.50% than other samples. The ash content of flour is related to the amount of bran in the flour

and therefore to flour yield [39]. The results of fiber showed that rye and sorghum had significant highest value 8.22%, 6.50%, respectively, while wheat had lowest value 1.90%. On other hand nitrogen free extracts (NFE) % range from 64.98% for rye to 82.30% wheat. Rye was the lowest total caloric values 329.82% and tannic acid was under detection safe limit 0.185% in sorghum.

#### 3.2 Minerals for Different Grains

Data in Table 2 showed that the macro, Micro and heavy metals, it can be noticed that macro element Mg ranged from 2.68 to 175.0 mg/100g for all samples, where sorghum had the highest Mg 175.0 mg followed by wheat and rye which have the lowest Mg 2.68 mg. Additionally for micro element it can be noticed no have trend for micro element which range between highest and lowest for all micro element. Moreover can be observed some micro element have the highest range for Ca, P and K than those stander values. The same trend are noticed in heavy metals for all samples of grains with the highest Na and Fe than stander value in all samples whereas rye, sorghum and wheat had lowest than the stander value Na, Fe and K in sorghum, wheat and rye are 39.47, 363.0 and 264.0 mg, receptivity. This Standard value is applied to the grain of soft and durum wheat to be used for food and non-food purposes, and for export. Wheat division into types which represented indices, characteristics, and quality norms of wheat according to classes; obligatory requirements for wheat grain, which guarantee human, animal and environmental safety and health (condition, odour and colour of grain, infectiousness), (toxic elements, mycotoxins and pesticides), (safety and industrial sanitation requirements) and (natural environment protection) approved by the [40]. These results agree with result obtained by Nagarajan [41].

Vitamins of different grains cultivars used in this study are given in Table 2 that thiamine (B1) of different grains ranged from 18.0 to 33.0% for all studied samples. Wheat had the highest value while rye had lowest value among all samples. As regards riboflavin (B2), rye had the highest (B2) 22.0% followed by wheat 10.0%, while sorghum 6.0% had the lowest (B2). On other hand Niacin (B3) % ranges from 36.0% wheat to 12.0% rye. Additionally sorghum was lower pantothenic (B5) 4.0% than other samples and lowers in pyridoxine (B6) 22.0% in completely in other grains. However, highest foliate (B9) was

observed in wheat 10.0%. Vitamin K of flour is related to the amount of bran in the flour and therefore to flour yield. The results of vitamin E showed that wheat had significant highest value 7.0%. These results agree with result obtained by FAO [42] and recommended by WHO [43].

### 3.3 Physical Properties for Different Grains

Mean value of physical properties of different grains are presented in Table 3. It can be concluded that the test weight for all samples which ranged from 52.44 to 60.10 pound per bushel. The same trend were observed in test weight where wheat the highest and followed by sorghum and rye. More ever the foreign material among all samples ranged from 0.20 to 0.40 and the highest one was rye either wheat had highest percentage of shrunken and broken kernels and

the thin of rye was 0.72% while the highest the foreign material and broken kernel was sorghum 1.09%. For damage kernels which contest of heat damage and total damage, specially wheat which had highest total damage kernels percentage 1.50%, while sorghum had lowest percentage of total damage kernels 1.32%. It can be noticed that all grains hadn't heat damage. More over from the same table noticed that all sample are free from insect and odor. The Egyptian stander no. 1601/1986 and it's modification on 23/4/2002 [44] has obligation that the dockage % (first separated from sample) not exceed 1%, foreign material % not exceed 1%, total damage kernels % (heat damage ,sprout damage, insect damage and mould damage kernels) not exceed than 4%. However that difference between wheat samples, all wheat samples had graded one according to USDA [45].

**Table 2. Chemical analysis, minerals and vitamins for different grains**

Chemical composition %	Grains		
	Wheat	Rye	Sorghum
Moisture	10.40 <sup>b</sup>	10.2 <sup>b</sup>	11.60 <sup>a</sup>
Protein	12.20 <sup>a</sup>	12.30 <sup>a</sup>	10.40 <sup>b</sup>
Fat	1.90 <sup>ab</sup>	2.30 <sup>a</sup>	1.50 <sup>b</sup>
Ash	1.70 <sup>a</sup>	2.0 <sup>a</sup>	1.79 <sup>a</sup>
Fiber	1.90 <sup>b</sup>	8.22 <sup>a</sup>	6.50 <sup>a</sup>
NFE	82.30 <sup>a</sup>	64.98 <sup>c</sup>	68.21 <sup>b</sup>
Total caloric values	395.90 <sup>a</sup>	329.82 <sup>c</sup>	332.74 <sup>b</sup>
Tannic acid	Free	Free	0.185
Minerals Mg/100g			
Mg	126.0 <sup>b</sup>	2.68 <sup>c</sup>	175.0 <sup>a</sup>
Zn	2.65 <sup>a</sup>	3.73 <sup>a</sup>	2.5 <sup>a</sup>
Mo	-	-	0.06
Ca	29 <sup>b</sup>	33.0 <sup>a</sup>	15.0 <sup>c</sup>
P	288 <sup>c</sup>	374.0 <sup>b</sup>	758.0 <sup>a</sup>
Cu	-	0.45 <sup>a</sup>	0.7 <sup>a</sup>
Mn	3.985 <sup>b</sup>	121.0 <sup>a</sup>	1.15 <sup>c</sup>
K	363 <sup>a</sup>	264.0 <sup>b</sup>	39.47 <sup>c</sup>
Na	5.61 <sup>a</sup>	6.0 <sup>a</sup>	2.0 <sup>b</sup>
Fe	3.19 <sup>a</sup>	2.67 <sup>a</sup>	3.95 <sup>a</sup>
Al	-	-	-
Cr	-	-	0.017
Se	0.070 <sup>a</sup>	0.035 <sup>a</sup>	0.122 <sup>a</sup>
Vitamins %			
Thiamine (B1)	33.0 <sup>a</sup>	18.0 <sup>c</sup>	22.0 <sup>b</sup>
Riboflavin (B2)	10.0 <sup>b</sup>	22.0 <sup>a</sup>	6.0 <sup>c</sup>
Niacin (B3)	36.0 <sup>a</sup>	12.0 <sup>c</sup>	23.0 <sup>b</sup>
Pantothenic (B5)	19.0 <sup>a</sup>	-	4.0 <sup>b</sup>
Pyridoxine(B6)	23.0 <sup>a</sup>	-	22.0 <sup>b</sup>
Folate (B9)	10.0 <sup>a</sup>	4.3 <sup>b</sup>	-
Vit. E	7.0 <sup>a</sup>	1.0 <sup>b</sup>	2.0 <sup>b</sup>
Vit. K	2.0	-	-

Means with the same letter in the same row are not significantly different at ( $P = 0.05$ ). NFE = Nitrogen free extracts, (-) = Not determined

**Table 3. Physical properties and grading of different grains**

Grading	Grains		
	Wheat	Rye	Sorghum
T.W P/B	60.10 <sup>a</sup>	56.6 <sup>b</sup>	52.44 <sup>c</sup>
F.M%	0.20 <sup>ab</sup>	0.4 <sup>a</sup>	-
BNFM	-	-	1.09
Sh.& B.N%	1.10	-	-
Thin	-	0.72	-
H.D	Zero	Zero	Zero
T.D	1.50 <sup>a</sup>	1.33 <sup>b</sup>	1.32 <sup>b</sup>
Odor	Ok	Ok	Ok
Insect	Free	Free	Free
Grade	1	1	1
Weigh per 1000 kernels gm	33.5 <sup>a</sup>	24.1 <sup>b</sup>	33.0 <sup>a</sup>
Hardness%	61 <sup>a</sup>	60 <sup>b</sup>	59 <sup>c</sup>
Colour	white	White	yellow

Means with the same letter in the same row are not significantly different at ( $P = 0.05$ ). T.W = Test weight, P/B= Pound per Bushel (American unit), F.M = Foreign Material, Sh. & B.N = Shrunken & Broken kernels, H.D = Heat Damage, T.D = Total Damage, (-) = Not determined

**Table 4. Amino acids for different grains**

Amino acids g/100 g	Grains		
	Wheat	Rye	Sorghum
Aspartic	5.46 <sup>b</sup>	7.2 <sup>a</sup>	0.743 <sup>c</sup>
Alanine	3.5 <sup>b</sup>	4.4 <sup>a</sup>	1.033 <sup>c</sup>
Arginine	4.79 <sup>a</sup>	4.9 <sup>a</sup>	0.355 <sup>b</sup>
Cystine	2.19 <sup>a</sup>	1.7 <sup>b</sup>	0.127 <sup>c</sup>
Glutamic	31.25 <sup>a</sup>	23.7 <sup>b</sup>	2.439 <sup>c</sup>
Glycine	6.11 <sup>a</sup>	4.5 <sup>b</sup>	0.346 <sup>c</sup>
Leucine	6.71 <sup>a</sup>	5.9 <sup>b</sup>	1.491 <sup>c</sup>
Lysine	2.82 <sup>b</sup>	3.8 <sup>a</sup>	0.229 <sup>c</sup>
Methionine	1.29 <sup>b</sup>	2.9 <sup>a</sup>	0.169 <sup>c</sup>
Histidine	2.04 <sup>a</sup>	2.3 <sup>a</sup>	0.246 <sup>b</sup>
Isoleucine	4.34 <sup>a</sup>	3.3 <sup>b</sup>	0.433 <sup>c</sup>
Phenylalanine	4.94 <sup>a</sup>	4.0 <sup>b</sup>	0.546 <sup>c</sup>
Proline	10.44 <sup>a</sup>	8.9 <sup>b</sup>	0.852 <sup>c</sup>
Serine	4.61 <sup>a</sup>	4.2 <sup>a</sup>	0.462 <sup>b</sup>
Threonine	2.88 <sup>b</sup>	3.7 <sup>a</sup>	0.346 <sup>c</sup>
Tryptophan	1.24 <sup>b</sup>	2.2 <sup>a</sup>	0.124 <sup>c</sup>
Tyrosine	3.74 <sup>a</sup>	1.5 <sup>b</sup>	0.321 <sup>c</sup>
Valine	4.63 <sup>a</sup>	3.3 <sup>b</sup>	0.561 <sup>c</sup>

Means with the same letter in the same row are not significantly different at ( $P = 0.05$ ). (-) = Not determined

### 3.4 Amino Acids for Different Grains

In Table 4 that aspartic acid of different grains ranged from 0.743-7.2% for all samples. Rye had the highest value while sorghum had lowest value among all samples. And the same trend with alanine acid ranged from 4.4- 1.033%. Then arginine of different grains ranged from 0.355 to 4.90% for all studied samples. Rye and wheat had the highest value while sorghum had lowest value among all samples. As regards cystine, wheat had the highest value 2.19% while sorghum had the lowest value 0.127%. At the

same trend with glutamic, glycine and leucine acid ranged from 31.25-2.439%, 6.11-0.346%, 6.71-1.491%. On other hand Lysine range from 3.8% for rye to 0.229% sorghum. Additionally sorghum was lower methionine 0.169% than other samples and lower in histidine 0.246% in completely in other grain. However, highest isoleucine, phenylalanine and proline were observed in wheat 4.34, 4.94 and 10.44%, receptivity. The results of serine and threonine showed that sorghum had significant lowest value 0.462-0.346%, receptivity.

The results of tryptophan showed that rye had significant highest value 2.2% while sorghum had lowest value 0.124. The results of tyrosine and valine showed that wheat had significant highest value while sorghum had lowest value. These results agree with result obtained and recommended by several authors [42,43].

### 3.5 Isolated Fungal Species for Different Grains

Result of isolated fungal species for grains wheat, rye and sorghum are present in Table 5. Data show that total mold count ranged between 1.80 to 3.50 log cfu/g sorghum had highest total mold count, wheat and rye had lowest total mold count. From the same table, it can be noticed that isolated fungi species are different between all samples which some of isolated fungal species found in some samples and no found in other. In [46] which reported that the dominant genus was *Aspergillus*, predominantly *A. flavus*, *A. niger* and *A. versicolor*. The other isolated species were *A. ochraceus*, *A. alliaceus*, *A. carbonarius*, *A. terreus*, *A. fumigatus*, *A. candidus* and *Aspergillus spp.* The occurrence and the levels of the genus *Penicillium*, *Fusarium*, *Alternaria* and *Mucor* were substantially lower than those of *Aspergillus*. The storage in silos shows high levels of *Aspergillus spp.* ranged 66 to 84%, especially *A. flavus*, but *A. niger* and other fungi were isolated at relatively low percentages [46].

Mycotoxins content for different grains: Results in Table 5 show that aflatoxin content in grains. It can be noticed that all samples had lowest aflatoxin content before storing under detection limit 0.5ppb for aflatoxin, ochratoxin, zearalenone, fumonisin. More ever it can be concluded that all sample Wheat, rye and sorghum under detection limit (0.5ppb) of the stander Egyptian maximum (B1=10ppb and total aflatoxin =20ppb). Aflatoxin content was valet within the safe limit 50ml/kg recommended by FAO [42].

### 3.6 Chemical Properties of Prepared Kishk Samples

Chemical composition of different kishk samples in this study is given in Table 6 that untraditional kishk moisture content of different varieties ranged from 8.00 to 12.72% for all studied samples. M 1 kishk had the highest value while M 2 kishk had lowest value among all samples.

The total solid of kishk samples ranged between 84.66% and 76.18%. M 2 kishk had the highest value of total solid while M 1 kishk had the lowest value, respectively. As regards protein content, wheat kishk (control) had the highest protein 27.11% followed by M 1 kishk 26.02%, while sorghum kishk 22.90% had the lowest protein content. Additionally sorghum kishk was lower fat 2.50% than other samples and wheat kishk control was lower in ash content 6.64% in completely in other untraditional kishk.

The ash content of kishk is related to the amount of bran in the kishk. However, highest ash content was observed in M 1 kishk 8.67% while ash content of mixed kishk was found quite close to each other. The results of fiber showed that rye had significant highest value 8.12% while wheat kishk control had lowest value 1.80%. On other hand nitrogen free extracts (NFE) % ranged from 65.76% for rye kishk to 80.55% for wheat kishk sample. M 3 kishk was the lowest total caloric values 325.13 and tannic acid was under detection safe limit 0.185%.

The low moisture content and acidic pH of the final product makes it safe against the growth of pathogenic micro-organisms [47]. The difference in proteins content could be linked to the amount of dairy solids added to Bourghol [48]. Also, the higher fat content in kishk could be explained by the single addition of strained yoghurt. In addition, the traditional process of daily mixing and kneading may cause some loss of fat as lumps stick on utensils and tools [49].

Kishk is a highly nutritious food, having a protein content of about 23.5%. It is of a high digestibility, and high biological value. These include tocopherols, phenolics and types of cereals (such as rice, wheat, corn or sorghum) are phytosterols as well as soluble and insoluble fibers; well known in many parts of the world [50].

### 3.7 Minerals for Different Kishk

Data in Table 6 showed that macro, micro elements and heavy metals, it can be noticed that macro element ranged from Mg 6.84 to 185.0mg/100g for all samples, where Sorghum kishk had the highest Mg 185.0 mg followed by M 2 kishk and rye kishk which have the lowest Mg 6.84 gm. But M 4 had the highest Zn 14.85 mg in all samples. Additionally for micro element it can be noticed that no trend for micro element which range between highest and lowest for all



micro element. More ever, it can be observed some micro element have the highest range for Ca, P and K than those stander minerals. The same trends are noticed for all samples of kishk with the highest Na and Fe than stander value in all samples whereas rye, sorghum and wheat had lowest than the stander value for Na. But K in sorghum are the lowest value 109.47 and M 4 has the highest value 461.2. However, it can be noticed that rye had the highest Mn 121.1 mg and sorghum kishk which have the lowest Mn 1.17 gm, but sorghum which have the highest Se 3.002. This Standard value is applied to the grain of soft and durum wheat to be used for food and non-food purposes, and for export.

### 3.8 Vitamins of Different Kishk

Used in this study is given in Table 6 that Thiamine (B1) of different grains ranged from 17.68 to 37.00% for all studied samples. Wheat had the highest value while M 1 had lowest value

among all samples. As regards Riboflavin (B2), rye had the highest value 32.0% followed by M 3 kishk 21.8%, while sorghum 13.61% had the lowest (B2). On other hand Niacin (B3) % ranges from 37.0% wheat to 13.0% rye. Additionally M 3 was lower Pantothenic (B5) 1.2% than other samples and rye had lower in Pyridoxine (B6) 5.0% in completely in other kishk. However, highest Folate (B9) was observed in wheat 11.0%. The results of vitamins E and K showed that wheat had significant highest value 7.2%, 2.8%. Vitamin K of flour is related to the amount of bran in the flour and therefore to flour yield. In addition, kishk is rich in nutritive constituents of many vitamins and growth factors associated with the microbial fermentative processes [15]. Kishk is a balanced food with excellent preservation quality, richer in B vitamins than either wheat or milk, and well adapted to hot climates by its content of lactic acid [51,52,53]. These results agree with result obtained by FAO [42] and recommended by WHO [43].

**Table 5. Isolated fungal species and mycotoxins content from different grains**

Isolated species	Grains		
	Wheat	Rye	Sorghum
<i>Mucor hiemalis</i>	+	+	-
<i>Rhizopus oryzae</i>	+	-	+
<i>Asp. Candidus</i>	-	+	-
<i>Asp. Flavus</i>	-	+	+
<i>Asp. Ochraceus</i>	-	+	-
<i>Asp. Terrus</i>	+	+	-
<i>Asp. Ustus</i>	+	+	+
<i>Fus. Proliferatum</i>	-	-	-
<i>Asp. Niger</i>	-	+	-
<i>Pen. Citrinum</i>	+	-	+
<i>Acremonium butyri</i>	+	+	-
<i>Alternaria allesnara</i>	+	-	+
<i>Asp. Parasiticus</i>	-	+	-
<i>Cladosporium macrocarpum</i>	+	+	+
<i>Emericella nidulans</i>	+	-	+
<i>Fus. Oxysporum</i>	-	+	-
<i>Pen. Variable</i>	-	+	+
Total Mold Count log cfu/g	1.80 <sup>b</sup>	2.0 <sup>b</sup>	3.50 <sup>a</sup>
Mycotoxins ppb			
Ochratoxin	*	*	*
Zearalenone	*	*	*
Fumonisin	*	*	*
Aflatoxin			
B1	*	*	*
B2	*	*	*
G1	*	*	*
G2	*	*	*
Total	*	*	*

Means with the same letter in the same row are not significantly different at ( $P = 0.05$ ). \* = under detection limit (0.50 ppb)

Table 6. Chemical analysis for different kishk

Chemical composition %	Traditional			Untraditional kishk			
	Wheat	Rye	Sorghum	M 1	M 2	M 3	M 4
Moisture	10.84 <sup>b</sup>	10.25 <sup>d</sup>	10.48 <sup>c</sup>	12.72 <sup>a</sup>	8.00 <sup>g</sup>	9.15 <sup>f</sup>	10.03 <sup>e</sup>
TS	89.16 <sup>f</sup>	89.74 <sup>d</sup>	89.52 <sup>e</sup>	87.28 <sup>g</sup>	92.00 <sup>a</sup>	90.85 <sup>b</sup>	89.97 <sup>c</sup>
Protein	27.11 <sup>a</sup>	25.11 <sup>d</sup>	22.90 <sup>e</sup>	26.02 <sup>b</sup>	25.65 <sup>c</sup>	26.06 <sup>b</sup>	25.62 <sup>c</sup>
Fat	3.0 <sup>ab</sup>	3.30 <sup>a</sup>	2.50 <sup>c</sup>	2.72 <sup>bc</sup>	2.53 <sup>bc</sup>	2.61 <sup>bc</sup>	2.93 <sup>abc</sup>
Ash	6.64 <sup>e</sup>	6.75 <sup>d</sup>	6.76 <sup>d</sup>	8.67 <sup>a</sup>	6.23 <sup>f</sup>	8.14 <sup>b</sup>	7.61 <sup>c</sup>
Fiber	1.80 <sup>f</sup>	8.12 <sup>a</sup>	6.20 <sup>c</sup>	5.13 <sup>d</sup>	4.21 <sup>e</sup>	7.12 <sup>b</sup>	5.37 <sup>d</sup>
NFE	63.45 <sup>a</sup>	58.93 <sup>c</sup>	57.43 <sup>d</sup>	57.46 <sup>d</sup>	61.38 <sup>b</sup>	56.07 <sup>e</sup>	58.47 <sup>c</sup>
Total caloric values	381.24 <sup>a</sup>	357.02 <sup>f</sup>	360.66 <sup>d</sup>	358.40 <sup>e</sup>	370.89 <sup>b</sup>	352.01 <sup>g</sup>	362.73 <sup>c</sup>
Tannic acid	Free	Free	0.10 <sup>a</sup>	Free	0.030 <sup>a</sup>	0.027 <sup>a</sup>	0.011 <sup>a</sup>
Minerals mg/100g							
Mg	136.0 <sup>c</sup>	6.84 <sup>g</sup>	185.0 <sup>a</sup>	72.02 <sup>f</sup>	160.2 <sup>b</sup>	95.02 <sup>e</sup>	109.2 <sup>d</sup>
Zn	2.82 <sup>b</sup>	3.90 <sup>b</sup>	2.75 <sup>b</sup>	3.31 <sup>b</sup>	2.79 <sup>b</sup>	3.31 <sup>b</sup>	14.85 <sup>a</sup>
Ca	64.5 <sup>c</sup>	66.5 <sup>a</sup>	57.5 <sup>g</sup>	65.3 <sup>b</sup>	61.0 <sup>f</sup>	61.7 <sup>e</sup>	62.83 <sup>d</sup>
P	355.5 <sup>g</sup>	444.0 <sup>e</sup>	825.0 <sup>a</sup>	395.8 <sup>f</sup>	590.2 <sup>c</sup>	632.22 <sup>b</sup>	541.33 <sup>d</sup>
Mn	4.01 <sup>f</sup>	121.1 <sup>a</sup>	1.17 <sup>g</sup>	62.41 <sup>d</sup>	2.42 <sup>f</sup>	105.87 <sup>b</sup>	72.30 <sup>c</sup>
K	409.0 <sup>b</sup>	404.0 <sup>b</sup>	109.47 <sup>e</sup>	406.1 <sup>b</sup>	246.0 <sup>d</sup>	256.21 <sup>c</sup>	461.2 <sup>a</sup>
Na	40.61 <sup>a</sup>	41.0 <sup>a</sup>	37.0 <sup>d</sup>	40.5 <sup>a</sup>	38.2 <sup>c</sup>	39.02 <sup>bc</sup>	39.21 <sup>b</sup>
Se	1.090 <sup>c</sup>	2.005 <sup>b</sup>	3.002 <sup>a</sup>	1.05 <sup>c</sup>	2.001 <sup>b</sup>	2.050 <sup>b</sup>	2.032 <sup>b</sup>
Vitamins%							
Thiamine(B1)	37.0 <sup>a</sup>	20.0 <sup>df</sup>	24.0 <sup>cd</sup>	17.68 <sup>e</sup>	30.58 <sup>b</sup>	21.1 <sup>de</sup>	26.1 <sup>bc</sup>
Riboflavin(B2)	17.8 <sup>cd</sup>	32.0 <sup>a</sup>	13.61 <sup>e</sup>	18.30 <sup>c</sup>	15.71 <sup>de</sup>	21.8 <sup>b</sup>	20.13 <sup>bc</sup>
Niacin(B3) 1	37.0 <sup>a</sup>	13.0 <sup>e</sup>	24.0 <sup>c</sup>	16.31 <sup>de</sup>	30.24 <sup>b</sup>	18.3 <sup>d</sup>	23.66 <sup>c</sup>
Pantothenic(B5)	19.2 <sup>a</sup>	-	4.0 <sup>e</sup>	7.0 <sup>d</sup>	11.38 <sup>b</sup>	1.2 <sup>f</sup>	8.72 <sup>c</sup>
Pyridoxine(B6)	25.0 <sup>a</sup>	5 <sup>e</sup>	24.0 <sup>a</sup>	9.4 <sup>d</sup>	16.53 <sup>b</sup>	13.65 <sup>c</sup>	17.25 <sup>b</sup>
Folate (B9)	11.0 <sup>a</sup>	5.3 <sup>b</sup>	1.01 <sup>d</sup>	5.1 <sup>bc</sup>	3.01 <sup>cd</sup>	2.95 <sup>cd</sup>	4.89 <sup>bc</sup>
Vit. E	7.2 <sup>a</sup>	1.1 <sup>c</sup>	2.1 <sup>bc</sup>	2.7 <sup>b</sup>	2.1 <sup>bc</sup>	1.2 <sup>c</sup>	2.91 <sup>b</sup>
Vit. K	2.8 <sup>a</sup>	0.5 <sup>b</sup>	0.6 <sup>b</sup>	0.83 <sup>b</sup>	0.69 <sup>b</sup>	0.45 <sup>b</sup>	1.02 <sup>b</sup>

<sup>a</sup> Symbols as in Table 1. <sup>b</sup> Means with the same letter in the same row are not significantly different at ( $P = 0.05$ ). NFE = Nitrogen free extracts, (-) = Not determined, TS = Total solid

**Table 7. Amino acids for different traditional and untraditional kishk**

Amino acids g/100	Traditional			Untraditional kishk			
	W	R	S	M 1	M 2	M 3	M 4
Aspartic acid	10.50 <sup>c</sup>	13.84 <sup>a</sup>	1.42 <sup>g</sup>	12.14 <sup>b</sup>	5.26 <sup>f</sup>	7.32 <sup>e</sup>	8.45 <sup>d</sup>
Alanine	6.73 <sup>a</sup>	6.86 <sup>a</sup>	1.61 <sup>c</sup>	6.71 <sup>a</sup>	3.56 <sup>b</sup>	4.02 <sup>b</sup>	6.16 <sup>a</sup>
Arginine	5.00 <sup>a</sup>	5.11 <sup>a</sup>	0.37 <sup>d</sup>	5.00 <sup>a</sup>	2.10 <sup>c</sup>	2.51 <sup>c</sup>	3.36 <sup>b</sup>
Cystine	2.50 <sup>a</sup>	1.94 <sup>b</sup>	0.13 <sup>e</sup>	2.00 <sup>b</sup>	1.05 <sup>cd</sup>	0.89 <sup>d</sup>	1.51 <sup>bc</sup>
Glutamic	32.8 <sup>a</sup>	24.87 <sup>abc</sup>	2.50 <sup>e</sup>	27.83 <sup>ab</sup>	16.58 <sup>cd</sup>	13.24 <sup>d</sup>	20.0 <sup>bcd</sup>
Glycine	5.70 <sup>a</sup>	4.19 <sup>b</sup>	0.32 <sup>d</sup>	3.99 <sup>b</sup>	2.75 <sup>c</sup>	2.02 <sup>c</sup>	2.86 <sup>c</sup>
Leucine	11.10 <sup>a</sup>	9.76 <sup>b</sup>	2.47 <sup>e</sup>	9.65 <sup>b</sup>	6.11 <sup>cd</sup>	5.32 <sup>d</sup>	6.98 <sup>c</sup>
Lysine	5.90 <sup>b</sup>	7.95 <sup>a</sup>	0.48 <sup>e</sup>	6.23 <sup>b</sup>	3.10 <sup>d</sup>	3.95 <sup>c</sup>	4.32 <sup>c</sup>
Methionine	1.90 <sup>c</sup>	4.27 <sup>a</sup>	0.25 <sup>e</sup>	2.87 <sup>b</sup>	1.00 <sup>d</sup>	2.06 <sup>c</sup>	2.03 <sup>c</sup>
Histidine	4.10 <sup>a</sup>	4.62 <sup>a</sup>	0.50 <sup>d</sup>	3.92 <sup>ab</sup>	2.10 <sup>c</sup>	2.51 <sup>c</sup>	2.96 <sup>bc</sup>
Isoleucine	6.20 <sup>a</sup>	4.71 <sup>b</sup>	0.62 <sup>d</sup>	4.96 <sup>b</sup>	3.12 <sup>c</sup>	2.61 <sup>c</sup>	3.25 <sup>c</sup>
Phenylalanine	8.10 <sup>a</sup>	6.55 <sup>b</sup>	0.90 <sup>e</sup>	7.32 <sup>ab</sup>	4.31 <sup>cd</sup>	3.70 <sup>d</sup>	4.96 <sup>c</sup>
Proline	16.20 <sup>a</sup>	13.81 <sup>c</sup>	1.32 <sup>g</sup>	15.00 <sup>b</sup>	3.56 <sup>f</sup>	6.85 <sup>e</sup>	10.22 <sup>d</sup>
Serine	6.70 <sup>a</sup>	6.10 <sup>a</sup>	0.67 <sup>d</sup>	6.10 <sup>a</sup>	3.26 <sup>c</sup>	3.21 <sup>c</sup>	4.32 <sup>b</sup>
Threonine	5.60 <sup>bc</sup>	7.19 <sup>a</sup>	0.67 <sup>e</sup>	5.98 <sup>ab</sup>	3.31 <sup>d</sup>	3.61 <sup>d</sup>	4.38 <sup>cd</sup>
Tryptophan	1.90 <sup>b</sup>	3.37 <sup>a</sup>	0.19 <sup>c</sup>	3.89 <sup>a</sup>	0.98 <sup>bc</sup>	1.54 <sup>b</sup>	1.87 <sup>b</sup>
Tyrosine	4.80 <sup>a</sup>	1.92 <sup>c</sup>	0.46 <sup>d</sup>	3.20 <sup>b</sup>	2.23 <sup>c</sup>	1.13 <sup>d</sup>	2.29 <sup>c</sup>
Valine	8.30 <sup>a</sup>	5.91 <sup>c</sup>	1.01 <sup>g</sup>	7.02 <sup>b</sup>	3.68 <sup>e</sup>	2.64 <sup>f</sup>	5.07 <sup>d</sup>

<sup>a</sup> Symbols as in Table 1. <sup>b</sup> Means with the same letter in the same row are not significantly different at ( $P = 0.05$ ).  
(-) = Not determined

### 3.9 Amino Acids for Different Kishk

In this study are given in Table 7 that highest Aspartic was observed in rye kishk 13.84%. Then lowest alanine was observed in sorghum kishk 1.61% and highest ammonia was observed in rye kishk 4.61%. Arginine of kishk ranged from 0.37 to 5.11% for all studied samples. Rye kishk had the highest value then wheat kishk 5.00% while sorghum kishk had lowest value among all samples. As regards Cystine, Wheat kishk had the highest value 2.50% while sorghum kishk 0.13% had the lowest value. However, Glutamic, Glycine, Leucine, wheat had the highest value 32.8-5.70-11.10%, respectively. On other hand Lysine range from 0.48% sorghum kishk to 7.95% rye kishk. Additionally sorghum was lower Methionine 0.25% than other samples and lower in Histidine 0.50% in completely in other kishk. Then, Isoleucine, Phenylalanine, Proline, wheat had the highest value. But, Serine and Threonine, sorghum had the lowest value 0.67-0.67%, respectively. The results of Tryptophan showed that M 1 had significant highest value 3.89% while sorghum had lowest value 0.19. Tyrosine and Valine, wheat had the highest value. Kishk is good source of the amino acids composition of the protein, selenium and dietary [49]. These results agree with result obtained by FAO [42] and recommended by WHO [43].

### 3.10 pH Values and Titratable Acidity for Different Kishk

The pH values and titratable acidity (% as lactic acid) of prepared kishk samples were determined and the data illustrated by Figs. 2 and 3. Kishk prepared from wheat had the highest pH value 5.00 and lowest acidity 0.185% compared to other treatments, but rye kishk had lowest pH value 4.60. The low pH values and high acidity contents of kishk samples caused by release the organic acids generated due to fermentation, lead to a bacteriostatic effect of pathogenic microorganisms, in which shelf life increases of final product. These results agree with result obtained by Tamime et al. [55].

Titratable acidity increased, from 0.170%, in the sorghum kishk, to a maximum level of 0.375% in M 2 kishk (Fig. 3). During the fermentation stage, lactic and other organic acids such as acetic acid [49] were formed, causing a decrease in the pH, with a simultaneous increase in acidity.

The length of the conditioning period influenced the "acid" character of Kishk [54]; which is particularly appreciated by consumers. For this, many Kishk producers extend on purpose the fermentation period. In addition to the flavor, the organic acids produced during fermentation exhibit inhibitory activities against a wide range

of pathogens [56], thereby enhancing the safety of the end product.

### 3.11 Microbiological Analysis

The results of microbiological analysis of different kishk samples were presented in Table 8. It could be noticed that total bacterial count ranged from  $20 \times 10^5$  to  $30 \times 10^6$  cfu/g, total fungi ranged from  $4 \times 10^3$  to  $5 \times 10^4$  cfu/g and thus total yeasts of different kishk samples were ranged from  $5 \times 10^3$  to  $2 \times 10^4$  cfu/g. These results were agreement with those reported by Tamime et al. [55], as they reported that, coliforms, yeasts and molds were not recovered from any of the prepared kishk samples at the level tested. And El-Aide et al. [57], who regarding the coliform counts, all samples were free while mold and yeast counts were less than  $10 \log 10 \text{ CFU mL}^{-1}$  during storage at room temperature for 120 days. Also, the spore forming load of all experimental products was low. In [55], the microbial load (i.e. total viable, coliforms and aerobic spore formers) of all laboratory-made kishk were influenced by used cereal type and dairy base, but were similar to microbiological specifications of skimmed milk powder.

### 3.12 Color Parameters of Different Kishk

Color of foods is an important characteristic, which depends on the color and properties of raw materials as well as processing conditions. The white/yellow values of prepared untraditional kishk samples were determined and obtained results are tabulated in Table 9. The values of the primary colours (white and yellow) showed

that all dried kishk samples as ranged 1.56 – 19.62 and 15.42 – 48.02, respectively. It could be noticed that the M 1 was high significant increase in whiteness 19.62 when compared to other samples. kishk prepared from rye exhibited significant decrease in white being 1.56 but kishk prepared from sorghum showed significant decrease in (yellowness) 15.42 compared to other samples. After cooked rye grains in making kishk sample, its color changed to creamy color. These results are agreement with [57].

### 3.13 Sensory Quality of Different Traditional and Untraditional Kishk

In differences in the sensory quality of untraditional kishk soup perceived from wheat, rye, sorghum and their mixture were assessed by panelists using 12 discriminate attributes, and results are depicted in Table 10. The highest score of appearance 9.0 was given by kishk samples prepared from wheat and M 3. In wheat kishk, higher scores were awarded by the panelist for color, aroma and taste characters in all samples. In wheat and M 1 kishk, higher scores were awarded by the panelist for mouth feel characters. These mouth feel characters could be influenced as a consequence, the broken/gelatinized starch either leached or degraded by amylases during the secondary fermentation period. The mouth-feel were associated with grain type and the type of acidulate affected the sensory of the product [58]. The highest score of consistency 18.5 and 18.0 was given by kishk samples prepared from M 1 and wheat, respectively.

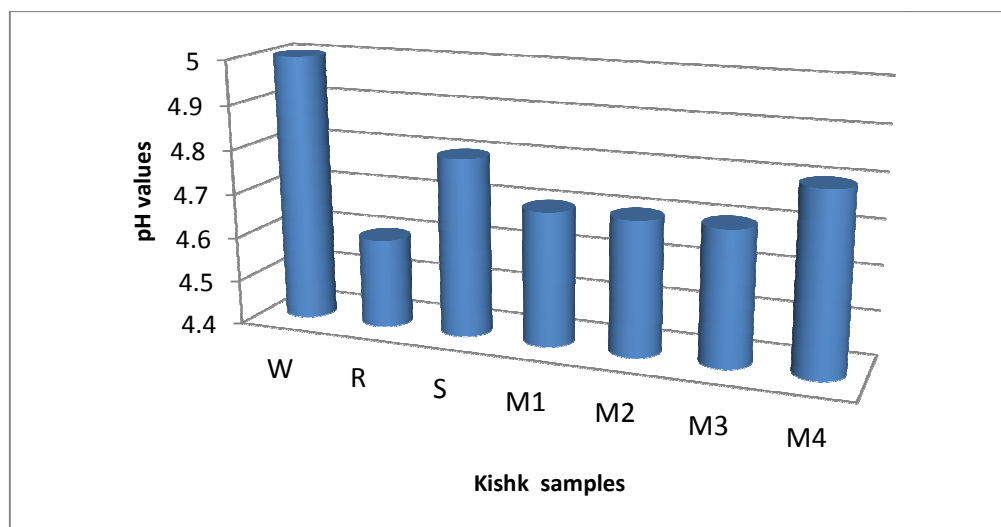


Fig. 2. pH values of different kishk

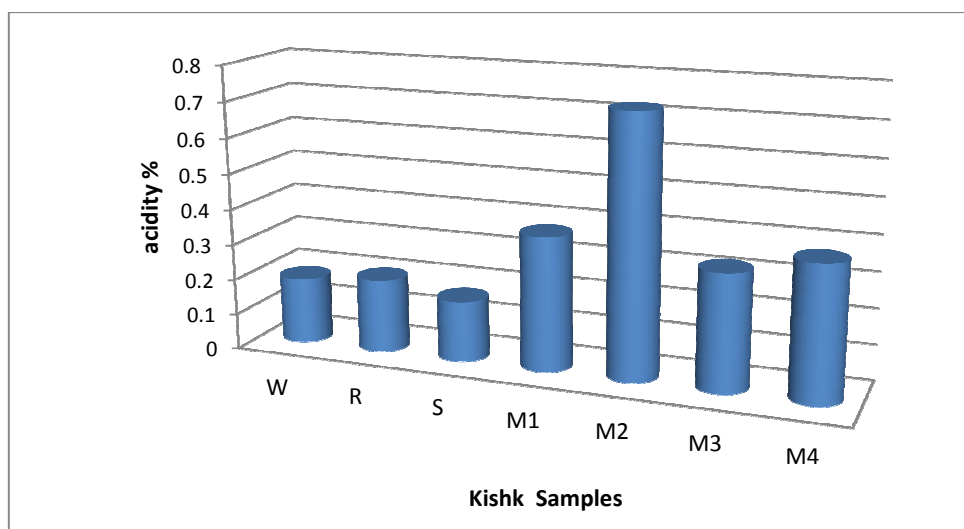


Fig. 3. Acidity (%) of different kishk

Table 8. Microbiological analysis of different traditional and untraditional kishk

Microbiological analysis(cfu/g) samples	T.B.C	T.F	T.Y
W	20x10 <sup>6b</sup>	20x10 <sup>3a</sup>	6x10 <sup>3ab</sup>
R	20x10 <sup>5a</sup>	4x10 <sup>3cd</sup>	8x10 <sup>3a</sup>
S	16x10 <sup>6b</sup>	5x10 <sup>3c</sup>	9x10 <sup>3a</sup>
M 1	30x10 <sup>6b</sup>	4x10 <sup>4d</sup>	5x10 <sup>3ab</sup>
M 2	14x10 <sup>6b</sup>	5x10 <sup>4d</sup>	2x10 <sup>4b</sup>
M 3	13x10 <sup>6b</sup>	3x10 <sup>4d</sup>	2x10 <sup>4b</sup>
M 4	8x10 <sup>6b</sup>	11x10 <sup>3b</sup>	2x10 <sup>4b</sup>

<sup>a</sup> Symbols as in Table 1. <sup>b</sup> Means with the same letter in the same column are not significantly different at (P = 0.05). T.B.C: Total bacterial count. T.F: Total Fungi. T.Y: Total yeasts

Table 9. Color parameters of different kishk

Kishk Samples	Color attributes	
	White	Yellow
W	16.66 <sup>b</sup>	19.58 <sup>f</sup>
R	1.56 <sup>g</sup>	24.18 <sup>e</sup>
S	14.92 <sup>d</sup>	15.42 <sup>g</sup>
M 1	19.62 <sup>a</sup>	48.02 <sup>a</sup>
M 2	10.56 <sup>e</sup>	34.18 <sup>c</sup>
M 3	9.12 <sup>f</sup>	33.2 <sup>d</sup>
M 4	15.7 <sup>c</sup>	41.4 <sup>b</sup>

<sup>a</sup> Symbols as in Table 1. <sup>b</sup> Means with the same letter in the same column are not significantly different at (P= 0.05)

Concerning to overall acceptability, the highest score was recorded by kishk prepared from wheat, M 1 then rye, M 3 kishk were 92.0, 88.0, 85.0, 84.0 respectively and the lowest score was M 4, sorghum were 76.5 and 79.0, respectively. However this difference was not perceptible by sensory panelists. Kishk soup possesses a characteristic pleasant aroma and flavor and bears the slightly acidic taste of the fermented

buttermilk and is a highly nutritious food, having a protein content of about 23.5% [53]. Similar findings regarding color [58,59], stickiness, grainy, and slimy characteristics [26] were ascribed to the cereal type and grain characteristics e.g. whole or white meal. These results may be because wheat grains consider the traditional source of kishk processing, thus the panelists accustomed with this taste.

**Table 10. Sensory characteristics of different traditional and untraditional kishk**

Kishk samples	Sensory characteristics							Overall acceptability (100)
	Appearance (10)	Color(10)	Aroma(10)	Taste (20)	Mouth feeling (20)	Consistency (20)	Presence of bran (10)	
W	9 <sup>a</sup>	9.5 <sup>a</sup>	9.0 <sup>a</sup>	19.0 <sup>a</sup>	19.0 <sup>a</sup>	18.0 <sup>a</sup>	8.5 <sup>a</sup>	92.0 <sup>a</sup>
R	8.5 <sup>ab</sup>	8.0 <sup>b</sup>	8.0 <sup>ab</sup>	17.5 <sup>bc</sup>	17.5 <sup>b</sup>	17.5 <sup>ab</sup>	8.0 <sup>ab</sup>	85.0 <sup>abc</sup>
S	8.0 <sup>ab</sup>	7.5 <sup>b</sup>	8.0 <sup>ab</sup>	16.5 <sup>cd</sup>	15.5 <sup>d</sup>	16.0 <sup>c</sup>	7.5 <sup>ab</sup>	79.0 <sup>bc</sup>
M 1	8.0 <sup>ab</sup>	8.0 <sup>b</sup>	8.0 <sup>ab</sup>	18.5 <sup>ab</sup>	19.0 <sup>a</sup>	18.5 <sup>a</sup>	8.0 <sup>ab</sup>	88.0 <sup>ab</sup>
M 2	7.5 <sup>b</sup>	8.0 <sup>b</sup>	7.5 <sup>b</sup>	16.5 <sup>cd</sup>	17.0 <sup>b</sup>	16.5 <sup>bc</sup>	7.5 <sup>ab</sup>	80.5 <sup>bc</sup>
M 3	9.0 <sup>a</sup>	8.0 <sup>b</sup>	8.0 <sup>ab</sup>	17.5 <sup>bc</sup>	17.0 <sup>b</sup>	16.5 <sup>bc</sup>	8.0 <sup>ab</sup>	84.0 <sup>bc</sup>
M 4	7.5 <sup>b</sup>	7.0 <sup>b</sup>	8.0 <sup>ab</sup>	16.0 <sup>d</sup>	15.5 <sup>c</sup>	15.5 <sup>c</sup>	7.0 <sup>b</sup>	76.5 <sup>c</sup>

<sup>a</sup> Symbols as in Table 1. <sup>b</sup> Means with the same letter in the same column are not significantly different at ( $P = 0.05$ )

#### 4. CONCLUSION

Kishk is rich in nutritive constituents and a source of many vitamins, growth factors and other nutrients. Generally, we obtained results which revealed that there are grains such as rye and sorghum and their mixed used in untraditional kishk. These grains and their mixtures might help to produce untraditional kishk with high nutritional quality. The results of our experiment showed that the dried untraditional kishk had lower moisture content as compared to the traditional kishk wheat. But the untraditional mixed kishk higher titratable acidity and protein content, which suggesting it is better nutritional and good quality. The addition of all dairy solids in a single step gave a lighter color and higher acceptability of untraditional kishk. And the M 1 kishk is more whitish in colour than the traditional kishk. Sensorial, M 1 kishk is more acceptability than other treatment followed by the traditional kishk.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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