J. of Food and Dairy Sci., Mansoura Univ., Vol. 14 (7):155 - 162, 2023

Journal of Food and Dairy Sciences

Journal homepage & Available online at: www.jfds.journals.ekb.eg

Antioxidant Activity and Quality Characteristics of Yogurt Supplemented with Raw and Germinated Barley Flour Storage

Abd-Alla, A. A.[1]; E. A. Mahmoud[2] and Walaa kobacy*[2]

Cross Mark

[1] Dairy Science Department, Faculty of Agriculture, Sohag University, Egypt
[2] Food Science and Nutrition Department, Faculty of Agriculture, Sohag University, Egypt

ABSTRACT

This work aimed to produce supplemeted yogurt with using three different concentrations of 1, 3, and 5% from raw and germinated (R&G) barley flour. The alterations in the chemical structure, antioxidant activity, color value, microbiological and sensory evaluation of yogurt samples were determined through two weeks of storage at 4 °C. Result obtained indicated that increasing amounts of added barley flour (R&G) led to a significant increase in the total solids (TS), protein, ash contents, and acidity. On the other hand, TS, protein, fat, ash, acidity, and syneresis increased during storage at 4 °C for 2 weeks. Moreover, DPPH antioxidant activity was higher in the yogurt samples supplemented with barley flour from (R&G) than in control yogurt samples, slightly increased with the storage, and declined on the 14th day of storage. The lightness (L) of yogurt supplemented with barley flour was lower, and the values of (a) and (b) were high compared with control samples yogurt. The value of (L) and (a) increased slightly with the storage and declined on the 14th day in all stored yogurt samples. By increasing the percentage of barley flour R&G in yogurt, the total bacterial count and *Streptococci*, *Lactobacilli*, yeast and mould were significantly elevated. In sensory evaluation, yogurt containing 1% germinated barley flour scored the highest total acceptability score. Thus the quality of stored barley yogurt was comparatively reasonable. Based on the current findings, it can be established that supplementing yogurt with barley flour from R&G enhanced the yogurt's quality and antioxidant activity.

***Keywords*: Barley, yogurt, physiochemical, antioxidant activity, sensory evaluation**

INTRODUCTION

Food production is now intended to satisfy hunger, offer essential and necessary nutrients, avert nutrition-linked disorders and diseases and enhance customers' physical and mental well-being, as reported by Roberfroid (2000). Consumers' interest in adding healthful foods to their diets is growing (Hekmat and Reid, 2006). Fermented food is an integral part of many people's diets since fermentation is a low-cost method that preserves food, boosts nutritive value, and improves desirable characteristics (Gadaga *et al.*, 1999). Fermented dairy has been the focus of extensive investigation during the last few decades. Yogurt is a renowned fermented dairy nutrition widely enjoyed worldwide, and customer acceptance is greatly influenced by its sensory qualities (Saint-Eve *et al.* (2006). Yogurt is often made from cow's milk, with or without adding some ordinary milk derivatives, and it involves the formation of a gel structure as a result of the coagulating of milk proteins by the impact of the lactic acid produced by both *Streptococcus thermophilus* and *Lactobacillus bulgaricus* bacteria (Robinson, 2003). There has recently been a surge in attention to using common food additives and incorporating health-promoting fundamentals into the diet, as reported by (Varga, 2006). As the approval of desirable yogurt products grows, manufacturers continuously look for value-added requirements such as prebiotics and probiotics to induce health-conscious clients. Yogurt's nutritional attributes and health benefits have attracted customers' attention (Cakmakci *et al.*, 2014). Yogurt is a fermented dairy meal consumed globally with immunological and digestive benefits and anticancer properties (Helal and Tagliazucchi, 2018). The antioxidant peptides produced through milk fermentation contribute to yogurt's remarkable oxidative stability (Farvin *et al.*, 2010). According to recent research, as interest in functional qualities and food quality has grown, so has the number of studies studying the fortification of dairy foods with natural substances. Thus, adding natural components like grains might boost yoghurt's nutritional content while potentially increasing its biological activity. Cereals can also be employed as a source of non-digestible carbohydrates, which, in addition to encouraging a variety of favorable physiological benefits, can specifically encourage the development of the beneficial *Lactobacilli* and *Bifidobacteria* in the human colon and performance as prebiotics, as reported by (Charalampopoulos *et al*., 2002).

Because of its nutritional health advantages, easy availability, fair cost, and processing qualities of products such as beer, barley drinks, and baked goods, the barley (*Hordeum vulgare* L.) plant is an important cereal crop worldwide. Based on the grain structure of barley, it is high lysine, high ß-glucan, and proanthocyanidin-free, as reported by (Lee *et al.*, 2010). Furthermore, barley is well-known for its high levels of dietary fiber, such as ß-glucan, but it also includes other essential chemicals, such as antioxidant activity, tool, and phenolic compounds, as reported by

*** Corresponding author.**
E-mail address: walaakobasy@gmail.com
DOI: 10.21608/jfds.2023.212656.1108

Holtekjølen *et al.* (2008). Barley may be handled into many tasty, nutritious food products, which has sparked growing research attention in its usage in various food requirements (Bilgi and Celik, 2004). Barley flour has recently been utilized in several traditional Arabic, Kurdish, Persian, and Turkish food dishes, and it is appropriate for many food applications. Historically, barley was a significant food source throughout Asia and Northern and Eastern Europe (Newman and Newman, 2006). Vitamins A, C, B1, B2, folic acid, and B12, as well as calcium (Ca), iron (Fe), potassium (K), and chlorophyll, are all abundant in barley (Bawazir, 2010; Yamaura *et al.*, 2012). It offers all nine of the necessary amino acids, unlike other plants. It has the flavones C-glycoside and saponarin and is one of the richest sources of high antioxidants. Therefore, this study aimed to create fortified fermented milk (yogurt) acceptable to consumers by adding nutritional and functional items such as barley flour derived from R&G grains.

MATERIALS AND METHODS

Materials:

Fresh cow's milk used in this study was obtained from the flok of the Experimental Animal Farm of the Animal Production Department at the Faculty of Agriculture, Sohag University, Sohag. The barley grains (Hull-less barley) used in this study was obtained from local market.

Chemicals:

All pure chemicals used in this study were bought from the Sigma company- located at Aldrich, St. Louis, MO, United States of America.

Methods:

Preparation of barley flour from raw grain samples:

The parched barley grain was manually cleaned of broken grains, dust and dirt, and other extraneous components before being ground into fine flour in a laboratory grinder. The powdered barley flour samples were stored in sealed plastic pages and kept in a deep freezer at -22 °C until the performance of the analysis.

Preparation of barley flour from germinated grain:

Clean barley grain samples were steeped in distilled water (DW) for 12 hours and left at room temperature (the DW was altered every six hours). The grain/water ratio used was (1:5, w/v). Soaked grains were then located on moistened laboratory paper and immediately covered in germination trays with capillary water flow. Then the trays were placed in a scientific research germinator for 48 hours at 20-25 °C until complete barley grain germination. The barley grains were washed every 12 h with a 0.3% NaOCl solution to suppress the contaminated microbial growth. Afterward, the barley germinated grain was dried at 55 °C in an oven for a day, then at 71 °C for the same applied period (a constant weight), and then crushed into a finely ground powder using an electric grinder. The powdered germinated grain samples were maintained in sealed fine plastic pages after keeping them in a deep freezer at -22°C until further study analysis according to the procedures and methods described by Abdel-Gawad (1991) and Cevallos-Casals and Cisneros-Zevallos (2010).

Yogurt manufacture:

The yogurt base mix was made from milk and was separated into sex treatments and control with added barley by different percent. The first part was not treated with additives and was a control. At the same time, the other sex parts were immediately enriched by adding the flour of R&G grains of barley to obtain a final concentration of 1, 3, and 5%, respectively. The yogurt mixtures were heated for 10 min in a water bath at 90 °C, quickly cooled to 42 °C, and then inoculated with 1.5% (w/w) active yogurt starter culture. Afterward, the inoculated milk was placed into plastic cups (250 ml) with covers and incubated at 42 °C until complete coagulation (approx. 3-5 hours). After incubation, treated yogurts were allowed to cool at laboratory room temperature before being kept at 4 °C for 14 days. The analyses were conducted entirely within a day of the yogurt fermentation being accomplished. The physicochemical analyses in this study were conducted after storing for 1, 7, and 14 days. All experiments in this study were conducted using replicates of all tested treatments.

Analytical methods:

The samples ' gross chemical composition of studies moisture, crude fat, protein, fiber, and ash (barley grains) were determined according to the methods and procedures recommended by AOAC (2012), and the difference has calculated the total carbohydrate. All study analyses were used in three replicates, and the study means were then reported. The determined caloric value was calculated according to the formula described by Nwabueze (2007) as follows:

$$[(9 \times \text{fat}) + (4 \times \text{carbohydrates}) + (4 \times \text{protein})].$$

Physiochemical analysis:

In this study, the chemical analysis included total solid (TS), total nitrogen (TN), soluble nitrogen (SN), fat, ash content, and titratable acidity (TA) of all treated yogurt samples were determined according to the methods described by AOAC (2010). Syneresis of all yogurt products tested was determined using the drainage whey (mL/100 mL tested yogurt) following the method previously described by Tarakci and Kucukoner (2003) and Achanta *et al.* (2007). All study measurements of chemical analysis were also done using three replicates for each treatment.

Color measurement:

The color was measured using a colorimeter (Model PCE Instrument – CSM 4, UK) and standardized before measurements using a standard white plate supplied with the device. Lightness (L*), redness (a*), and yellowness (b*) values were measured three times in each tested yogurt sample and then were averaged.

Determination of antioxidant activity:

The 2, 2-diphenyl-l-picrylhydrazyl (DPPH) test was measured according to the procedure described by Lee *et al.* (2003). The scavenging activity as an antioxidant activity was then calculated as follows:

$$\text{DPPH radical scavenging activity (\%)} = [(\text{Abs control} - \text{Abs sample}) / \text{Abs control}] \times 100$$

Where Abs is the absorbance value measured at 515 nm.

Microbiological analysis:

The total bacteria was determined using the standard plate count technique as colony-forming units (CFU) described by Marshall (1992). Also, *Lactobacillus* count was determined on the MRS selective medium recommended for the bacteria *Lactobacilli*, and *Streptococci* count was also determined using the M17 agar medium recommended for the bacteria *Streptococci* as described by IDF (1997).

Sensory evaluation

The sensory evaluation for the tested yogurt samples was assessed by seven staff members of the Food and Dairy Science Department, Faculty of Agriculture, Sohag University. Sensory evaluation of the yogurt samples consisted of flavor (50 points), body & texture (30 points), appearance, and color (20 points) according to the method described by Kebary and Hussein (1999) with some modifications.

Statistical analysis:

All obtained data in this study was statically analyzed of variance by ANOVA using a SAS statistical analysis system for Windows (SAS, 2008). The least significant difference (L.S.D.) at $p \leq 0.05$ was applied to detect differences among the means of the tested yogurt samples (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Gross chemical composition of raw and germinated barley flour:

The effect of the germination process for 2 days on the proximate chemical composition and antioxidant activity of local market Hull-less barley grains, raw and after germination, were studied. Table (1) shows the alteration percentages of the chemical structure in studied raw and treated yogurt samples. The result showed that crude fiber and protein contents increased slightly during germination compared with raw samples. In contrast, crude fat, total carbohydrate, and ash contents decreased after germination. These results parallel with those Senhofa *et al.* (2016) and Dancîte *et al.* (2021) reported. This rise in protein content in germinated barley grains could be due to the loss in dry weight during the respiration of the germination process. Consequently, the germinated grains on a unit weight basis would have more grain mass, and therefore, the germinated barely grains had more nitrogen content than the raw material (Tian *et al.*, 2010). In contrast, a decrease in fat occurs since fat and fatty acids are continuously oxidized to carbon dioxide and water, leading to generating energy for grain germination (Hahm *et al.*, 2008).

The decrease in ash content indicates mineral loss owing to rootlet and washing of the barley in water to reduce sourness during gran germination (Tatsadjieu *et al.*, 2004). Therefore, a negative correlation between grain carbohydrates and barley protein contents could be detected. Such the correlation mentioned above has been detected in the current study. Data also showed that raw barley recorded a higher caloric value (391.37 Kcal) than germinated barley (390.02 Kcal). In this respect, these findings are similar to those reported by Youssef *et al.* (2013).

Total antioxidant activity (DPPH %) of raw and germinated barley flour:

Data in Table (1). exhibit the effect of the germination process on the antioxidant activity in local market Hull-less barley grains. Germinated barley (57.24%) has higher antioxidant activity contents than raw samples (34.80%). The 48-hour germination process resulted in a considerable rise in antioxidant activity. In the control sample, the growing level was 64.5% of its beginning value. These results align with those mentioned by (Ha *et al.,* 2016; Abid Aljanabi and Al Abdullah, 2018). These findings are predicted since the plant creates defense components against environmental stress during the germination phase; however, antioxidant activity and phenolic phytochemicals have such properties (Kaukovirta-Norja and colleagues, 2004). These findings are unsurprising given that non-germinated extract had the lowest total antioxidant activity, whereas 48 h germinated grains extract had the highest total antioxidant activity, phenolic and flavonoid content, etc. In our investigation, it was clearly proven that these bioactive substances exhibit antioxidant action. Moreover, the total phenolic and flavonoid content of the 48-hour water extract of barley germination was substantially greater, resulting in increased overall antioxidant activity.

Table 1. Gross chemical composition, caloric value, and antioxidant activity raw and germinated barley flour.

Treatment	Moisture %	Protein %*	Ash %*	Fiber %*	Fat %*	Free Nitrogen Extract %**	Caloric value (Kcal)	Total Antioxidant activity (DPPH%)*
Raw	11.37±0.08[a]	10.85±0.5[b]	2.46±0.18[a]	3.759±0.06[b]	3.25±0.05[a]	79.66±0.18[a]	391.37± 0.32[a]	34.80±0.95[b]
Germinated 48 h	8.57±0.15[b]	12.08± 0.21[a]	2.08± 0.10[a]	4.026±0.11[a]	2.88±0.15[b]	78.92±0.21[b]	390.02±1.49[a]	57.24±0.77[a]
L.S.D. $_{0.05}$	0.49	0.56	0.61	0.2	0.26	0.39	4.44	0.62

***On a dry weight basis ** Calculated by difference Means± standard deviation (SD) on a dry weight basis. [a–b] Values in the same column with different superscript letters differ significantly at a 0.05 significance level.**

Physiochemical analysis:

The TS, protein, and fat contents of yogurt supplemented with barley flour from raw and germinated barley flour during 14 days storage period at 4 °C were studied. The yogurt sample fortified with 5% raw barley flour and 5% germinated barley flour had the highest total solids, 21.97 and 21.65, respectively. The TS content slightly increased in all yogurt samples during 14 days of storage. The total protein was also increased in barley fermented milk products by increasing the barley flour percentage of raw and germinated barley flour added because of barley's protein content, which is 10.85% in raw barley and 12.08% in germinated barley grains. Protein content was slightly increased in all yogurt samples during 14 days of storage. However, the fat percentage did not affect markedly by adding barley flour from both R&G grains. These results are mainly consistent with reports of Abbas *et al.* (2013) and Ismail *et al.* (2018). Table (2) shows that increasing the barley flour percentage from R&G grains added to the formulated yogurt significantly increased total solids, total protein and fat.

The acidity, ash, and syneresis of yogurt supplemented with flour of raw and germinated barley flour during 14 days of storage at 4 °C were investigated. The percentage of titratable acidity (T.A %) significantly increased in the enriched yogurts than in the yogurt control (Table 3). This activity might be attributed to the high lactose content, which boosted the activity of lactic acid bacteria, or to the fact that some additives may favorably impact bacteria activity. The titratable acidity (T.A%) enormously increased as the quantity ratio of R&G grains added to the barley flour increased. The highest titratable acidity value was observed in a yogurt sample enriched with raw barley at 5%. The titratable acidity was generally increased with an advanced storage period. The acidity of lactic acid bacteria caused by milk protein encouraging the development of the yogurt starter culture was predicted to rise over the storage period. This acidity is a well-known condition caused by acidifying bacteria activity. The same Table also demonstrates that adding barley flour of R&G grains to yogurt recipes dramatically enhanced the ash level compared with the yogurt control. The ash concentration in yogurt recipes increased with higher R & G grains of barley additions. Results showed that as storage time increased, the ash level of all yoghurt samples marginally rose. These results are also mainly consistent with reports of Gouda *et al.* (2013) and Mabrouk and Effat (2020). The syneresis values of yoghurt treated with raw and germination-stage barley during storing at 4 °C for 14 days are shown in Table (3). Comparing control yoghurt to other prepared samples, it consistently provided the highest syneresis.

Table 2. Effect of addition barley flour (R&G) on TS, protein, and fat contents of yogurt during storage for 14 days at 4°C.

Treatment		Storage Period	Total solids	Protein	Fat
Sample	Conc.%	(days)	%	%	%
Control		0 (Fresh)	17.34±0.96^{e}	4.35±0.44^{d}	7.10±0.30^{b}
		7	17.57±0.93^{e}	4.43±0.48^{c}	7.13±0.25^{b}
		14	17.90±0.87 ^{e}	4.58±0.40^{c}	7.20±0.30^{b}
Raw barley flour	1%	0 (Fresh)	18.21±0.86^{d}	4.41±0.35 ^{d}	7.13±0.29^{b}
		7	18.52±0.94^{d}	4.47±0.36^{c}	7.20±0.35^{ab}
		14	18.87±0.90^{d}	4.54±0.37^{c}	7.27±0.32^{ab}
	2%	Fresh	20.09±0.97^{c}	4.65±0.45^{bc}	7.20±0.17^{a}
		7	20.60±0.73^{c}	4.82±0.37^{b}	7.27±0.06^{ab}
		14	20.84±073^{c}	4.89±0.33^{b}	7.37±0.15^{ab}
	3%	0 (Fresh)	21.97±1.02^{a}	5.02±0.41^{a}	7.30±0.17^{a}
		7	22.35±1.06^{a}	5.25±0.39^{a}	7.33± 0.21^{a}
		14	23.03±1.00^{a}	5.40±0.30^{a}	7.43±0.21^{a}
Germinated barley flour	1%	0 (Fresh)	18.14±0.88^{d}	4.54±0.40^{dc}	7.10±0.17^{b}
		7	18.37±0.85^{d}	4.68±0.41^{b}	7.10±0.17^{b}
		14	18.79±0.91^{d}	4.82±0.45^{b}	7.33±0.21^{ab}
	2%	0 (Fresh)	19.82±0.1.15^{c}	4.80±0.25^{b}	7.13±0.21^{b}
		7	20.11±1.05^{c}	4.74±0.25^{b}	7.20±0.10^{ab}
		14	20.41±1.10^{c}	4.95±0.34^{b}	7.27±0.06^{ab}
	3%	0 (Fresh)	21.65±0.92^{b}	5.19±0.24^{a}	7.20±0.17^{b}
		7	21.91±0.92^{b}	5.32±0.25^{a}	7.23±0.21^{ab}
		14	22.36±0.97^{b}	5.37±0.34^{a}	7.40±0.06^{a}
L.S.D			0.12	0.06	0.05

Means± SD on a dry weight basis. $^{a-e}$ Values in the same column with different superscript letters differ significantly at 0.05.

By adding more barley flour from R&G grains to the yogurt, the ability of the yogurt to expel whey was significantly reduced. Syneresis and total solid content had a negative connection. Results showed that the syneresis concentration of all yoghurt samples marginally rose as storage time increased. These findings have confirmed the work of other investigators, Akalin *et al.* (2012) and Abd El-Khair *et al.* (2018), who worked on the same materials.

Table 3. Effect of addition barley flour (R&G) on Acidity, ash, and syneresis of yogurt during storage for 14 days at 4°C.

Treatment		Storage Period	Titratable acidity	Ash	Syneresis
Sample	Conc.%	(days)	%	%	(%)
Control		0 (Fresh)	0.83±0.08^{d}	0.87±0.08^{e}	34.3±3.51^{a}
		7	0.97±0.14^{c}	0.90±0.06^{e}	38.3±3.06^{a}
		14	1.12±0.12^{c}	0.91±0.06^{f}	41.0±3.61^{a}
Raw barley flour	1%	0 (Fresh)	0.89±0.08^{d}	0.92±0.06^{cd}	31.7±3.79^{bc}
		7	1.12±0.06^{c}	0.94±$^{0.05d}$	33.7±3.05^{b}
		14	1.20±0.18^{c}	1.02±0.04^{cd}	37.7±3.06^{b}
	2%	Fresh	1.04±0.06^{b}	0.97±0.05^{b}	30.3±3.21^{bc}
		7	1.28±0.06^{b}	1.01±0.04^{b}	34.0±4.36^{b}
		14	1.430.13^{b}	1.05±0.03^{c}	36.0±4.36^{b}
	3%	0 (Fresh)	1.16±0.03^{a}	1.05±0.04^{a}	23.3±3.21^{e}
		7	1.47±0.10^{a}	1.10±0.04^{a}	26.7±2.08^{c}
		14	1.65±0.19^{a}	1.17±0.03^{a}	27.3±1.53^{c}
Germinated barley flour	1%	0 (Fresh)	0.85±0.08^{d}	0.89±0.06^{ed}	33.0±4.36^{ab}
		7	0.98±0.10^{c}	0.92±0.05^{de}	35.3±4.93^{b}
		14	1.15±0.11^{c}	0.96±0.05^{e}	37.0±5.29^{b}
	2%	0 (Fresh)	0.96±0.06^{c}	0.93±0.07^{c}	29.7±3.79^{d}
		7	1.19±$^{0.10b}$	0.95±0.06^{cd}	31.3±4.04^{b}
		14	1.40±0.18^{b}	0.98±0.06^{de}	34.03.61^{b}
	3%	0 (Fresh)	1.10±0.07^{ab}	0.98±0.07^{b}	21.3±3.21^{f}
		7	1.32±0.12^{b}	0.98±0.07^{bc}	23.0±2.65^{c}
		14	1.48±0.19^{b}	1.09±0.0.3^{b}	24.7±2.08^{c}
L.S.D			0.04	0.01	0.81

Means± SD on a dry weight basis. $^{a-f}$ Values in the same column with different superscript letters differ significantly at 0.05.

Changes of color values of the yogurt supplemented with barley flour from R&G grains during 14 days of storage at 4 °C. Color contribute to evaluating food quality, which fascinates the consumer, and color from ordinary sources is determined by management or processing (Hallagan *et al.*, 1995). Therefore, the effect of barley flour on the color change of yogurt during the storage period was studied. Variations in the color value of yogurt-supplemented barley flour are shown in Table 4. The values of L (brightness), a (redness), and b (yellowness) were measured in all yogurt samples. Data in the same Table showed that yogurt's L (lightness) value decreased gradually by increasing the barley flour level of R&G grains in yogurt. There was a significant decrease (at 5% significance) for the lightness attribute of yogurt with barley flour of R&G

grains at all levels compared with the control sample. Compared with the control yogurt sample, the (L) value of the yogurt product supplement with barley flour was lower, and the (a) and (b) values were higher. This change can be attributed to the increased amount of barley flour added. The more you add it, the clearer it becomes. The findings obtained agree well with those previously reported by Lee *et al.* (2013); Lee *et al.* (2022). In this regard, Lee and Lee (2014) reported that adding barley flour decreased the lightness of yogurt. During the storage period, a change in the color of the yogurt samples occurred. The data revealed that the values (L) and (a) were slightly increased with the yogurt storage period and declined on the 14th day of storage in all yogurt samples, but the decrease of the values (L) and (a) was smaller in R&G barley grains yogurt than in the control yogurt, While the (b) value decreased with increasing storage period in yogurt supplement with yogurt. These results agree with those reported by Lee *et al.* (2013); Lee *et al.* (2015); Lee *et al.* (2022).

Table 4. Effect of addition of barley flour (R&G) on color value of yogurt during storage for 14 days at 4 °C.

Treatment		Storage Period	L	b	a
Sample	**Conc.%**	**(days)**			
Control		0 (Fresh)	84.78±0.18[a]	10.51±0.04[f]	-1.0±0.021[f]
		7	86.12±0.10[a]	11.76±0.05[e]	-0.88±0.0043[g]
		14	84.08±0.66[a]	9.24±0.96[e]	- 1.05±0.15[f]
Raw barley flour	1%	0 (Fresh)	81.51±0.01[b]	12.78±0.05[d]	0.52±0.003[e]
		7	82.94±0.05[b]	12.21±0.04[c]	0.73±0.032[e]
		14	82.24±0.23[ab]	11.92±0.29[cd]	0.46±0.03[e]
	2%	Fresh	76.91±0.01[d]	14.43±0.05[b]	3.87±0.05[b]
		7	77.78±0.03[c]	13.96±0.02[b]	4.01±0.005[c]
		14	77.15±1.53[c]	13.51±0.67[b]	3.62±0.18[b]
	3%	0 (Fresh)	76.01±0.02[e]	16.36±0.04[a]	4.71±0.061[a]
		7	76.88±0.04[cd]	15.82±0.05[a]	4.93±0.032[a]
		14	76.62±2.32[d]	15.27±0.24[a]	4.36±0.14[a]
Germinated barley flour	1%	0 (Fresh)	79.91±0.01[c]	11.41±0.03[e]	0.46±0.008[e]
		7	80.65±0.03[b]	10.37±0.05[e]	0.65±0.025[f]
		14	80.36±1.09[b]	9.44±0.53[e]	0.38±0.05[e]
	2%	0 (Fresh)	75.73±0.10[e]	12.76±0.04[d]	2.63±0.014[d]
		7	76.84±0.05[cd]	12.01±0.01[d]	3.32±0.020[d]
		14	76.47±0.46[cd]	11.54±0.43[d]	1.08±0.18[d]
	3%	0 (Fresh)	74.21±0.98[f]	13.88±0.08[c]	3.46±0.052[c]
		7	75.51±0.04[d]	12.98±0.01[bc]	4.22±0.017[b]
		14	74.75±0.83[d]	12.71±0.69[c]	2.21±0.13[c]
L.S.D			0.41	0.31	0.42

Means± SD on a dry weight basis. [a-g] Values in the same column with different superscript letters differ significantly at 0.05.

For the DPPH % of the total antioxidant activity of yogurt supplemented with barley flour from R&G grains during the storage period of 14 days at 4 °C, the effect of barley flour added on the total antioxidant activity of treated yogurt during the storage period was investigated. Table (5) results revealed that antioxidant activity content ranged between 16.94-57.47% in all yogurt samples. The highest total antioxidant activity was recorded in the yogurt sample enriched with barley flour of germinated grains at level 5% (60.16%) (Storage period 7 days). Our research indicated that the DPPH value of antioxidant activity was higher in the barley-added yogurt, slightly increased with the storage period, and decreased on the 14th day of storage. However, the reduction in antioxidant activity was lesser in R&G barley grains yogurt than in the yogurt control. The results obtained align with those reported by Lee *et al.* (2015); Lee *et al.* (2022).

Data also show that antioxidant activity increased gradually by increasing the barley flour level of yogurt's R&G grains. There was a significant increase (at 5% significance) for yogurt's total antioxidant activity attribute with barley flour derived from R&G grains at all levels compared with the control sample. These findings are in line with those reported by Lee *et al.* (2013), Lee *et al.* (2015), Ismail *et al.* (2018), and Lee *et al.* (2022).

The increasing level of total antioxidant activity was higher by adding Germinated barley flour in yogurt than raw barley flour, which might be due to the rise in the total antioxidant activity content during barley germination. These findings are predicted since the plant creates defense components against environmental stress (Antioxidant Activity) during the germination phase, and phenolic phytochemicals have such properties (Kaukovirta-Norja et al., 2004).

Table 5. Effect of addition of barley flour (R&G) on total antioxidant activity (DPPH %) of yogurt during storage for 14 days at 4 °C.

Treatment		Storage Period	Total antioxidant
Sample	**Conc.%**	**(days)**	**activity (DPPH %)**
Control		0 (Fresh)	16.94±0.63[g]
		7	19.22±0.18[g]
		14	17.48±0.33[g]
Raw barley flour	1%	0 (Fresh)	23.93±0.37[f]
		7	27.15±0.14[f]
		14	25.57±0.71[f]
	2%	Fresh	31.55±0.46[d]
		7	34.54±1.03[d]
		14	33.12±0.12 [d]
	3%	0 (Fresh)	43.66±0.46[b]
		7	51.12±0.456[b]
		14	47.41±25[b]
Germinated barley flour	1%	0 (Fresh)	26.15±0.42[e]
		7	29.12±0.81[e]
		14	27.95±0.65[e]
	2%	0 (Fresh)	36.40±0.46[c]
		7	39.11±0.32[c]
		14	37.60±0.74[c]
	3%	0 (Fresh)	55.48±1.01[a]
		7	60.16±0.55[a]
		14	57.47±0.100[a]
L.S.D			0.59

Means± SD on a dry weight basis. [a-g] Values in the same column with different superscript letters differ significantly at a 5% significance level.

Microbiological characteristics of yogurt supplemented with raw and germinated barley flour during 14 days of storage at 4° C.

The overall bacterial count of yoghurt samples from all treatments was noticeably higher than the control, as shown in Table (6). The overall bacterial count was markedly raised by increasing the flour of R&G barley rains added. The yoghurt samples containing 1% germinated barley had the highest overall bacterial count. The total number of bacteria in the various samples ranged from 6.25 to 7.81 log CFU/g. Moreover, all yoghurt samples' total bacterial counts from all treatments were marginally reduced during storage. The same Table demonstrates that increasing the flour percentage of R&G barley grains added dramatically raised the *Lactobacilli* count. The yoghurt samples from all treatments experienced a slight reduction in lactobacilli count after storage. Data also shows that the *Streptococci* count was expressively increased by increasing the flour percentage of R&G barley grains added. *Streptococci* count samples from all treatments slightly decreased in all tested yogurt samples during storage. Moreover, the same data demonstrates that increasing the flour percentage of R&G barley grains added caused a considerable increase in yeast and mould and that during storage, all yoghurt samples showed a minor decrease in yeast and mould from all tested treatments. These findings are consistent with those previously reported by Abbas *et al.* (2013), Gouda *et al.* (2013), and Ismail *et al.* (2018).

Table 6. Microbiological properties (log CFU/g) of yogurt supplemented with barley flour from R&G grains during storage for 14 days at 4°C.

Treatment		Storage Period	Total bacterial	Lactobacilli count	Streptococci count	Yeast and mould
Sample	Conc.%	(days)	count			
Control		0 (Fresh)	6.25±0.015^{g}	5.11±0.015^{b}	6.01±0.031^{e}	1.05±0.010^{a}
		7	6.11±0.021^{f}	5.01±0.036^{g}	5.84±0.020^{f}	1.22±0.015^{f}
		14	6.05±0.015g	4.77±0.021f	5.73±0.021f	2.02±0.026d
Raw barley flour	1%	0 (Fresh)	7.25±0.042d	6.22±0.042ab	6.84±0.021c	1.11±0.021a
		7	6.98±0.067^{d}	6.11±0.015^{e}	6.61±0.015^{c}	1.28±0.015^{e}
		14	6.43±0.026^{e}	6.01±0.021^{d}	6.44±0.021^{c}	2.11±0.015^{cd}
	2%	Fresh	6.98±0.015^{f}	6.11±0.015^{ab}	6.71±0.021^{d}	1.08±0.021^{a}
		7	6.47±0.0.010^{e}	5.81±0.015^{f}	6.52±0.010^{d}	1.11±0.021^{g}
		14	6.11±0.015^{f}	5.31±0.021^{e}	6.41±0.015^{d}	2.07±0.021^{d}
	3%	0 (Fresh)	7.05±0.030^{e}	6.74±0.030^{a}	6.81±0.020^{d}	1.42±0.030^{a}
		7	7.11±0.015^{c}	6.52±±0.015^{d}	6.42± 0.015^{e}	1.89±0.010^{a}
		14	6.91±0.010^{c}	6.43±0.010^{c}	6.31±0.020^{e}	2.23±0.124^{a}
Germinated barley flour	1%	0 (Fresh)	7.81±0.035^{a}	6.81±0.035^{a}	6.91±0.051^{b}	1.22±0.12^{a}
		7	7.05$^{0.038c}$	6.72±0.031^{c}	6.71±0.010^{b}	1.41±0.015^{c}
		14	6.47±0.010^{d}	6.41±0.015^{c}	6.53±0.010^{b}	2.17±0.010^{bc}
	2%	0 (Fresh)	7.43±0.044^{c}	7.01±0.044^{ab}	6.85±0.021^{c}	1.17±0.010^{a}
		7	7.22±0.038^{b}	6.84±0.020^{b}	6.61±0.035^{c}	1.35±0.015^{d}
		14	7.23±0.015^{a}	6.65±0.010^{b}	6.52±0.015^{b}	2.11±0.010^{cd}
	3%	0 (Fresh)	7.61±0.026^{b}	7.11±0.026^{a}	7.41±0.012^{a}	1.31±0.010^{a}
		7	7.43±0.010^{a}	6.89±0.015^{a}	7.22±0.010^{a}	1.58±0.030^{b}
		14	7.11±0.015^{b}	6.74±0.015^{a}	7.31±0.020^{a}	2.24±0.010^{ab}
L.S.D			0.27	0.11	0.08	0.11

Means± SD on a dry weight basis. $^{a-g}$ Values in the same column with different superscript letters differ significantly at 0.05.

Sensory evaluation of yogurt:

Table (7) indicated that the inclusion of raw and germinated barley flour impacted the sensory qualities of yoghurt. The control sample initially attained the highest score for total acceptability. While in barley yogurt, yogurt containing 1% germinated gained the highest score for total acceptability, followed by those made by adding 3% and 5% germinated barley, respectively. Yogurt containing 1% raw barley total acceptability scores higher than those containing 3%, and 5 raw barley, respectively. The 1% germinated barley grains yoghurt received the highest rating for overall acceptability, followed by the 3% and 5% germinated barley yoghurts, respectively. Yogurt with 1% raw barley content has a higher overall acceptance rating than yoghurt with 3% and 5% raw barley, respectively germinated barley-based yoghurt 5% samples had the lowest flavor rating. Several yoghurt samples received flavor values ranging from 48 to 38. 5% germinated barley-based yoghurt samples had the lowest flavor rating. Several yoghurt samples received body and texture values ranging from 29 to 24.5% of germinated barley flour yoghurt samples with the lowest texture rating. The grades for the appearance and color of various yoghurt samples ranged from 19 to 17. Yogurt samples manufactured with 5% germinated barley flour received the lowest rating for color and appearance.

Table 7. Sensory evaluation of yogurt supplemented with barley flour from R&G grains during storage for 14 days at 4 °C.

Treatment						
Sample	Conc. %	Storage Period (days)	Flavor (50)	Body & Texture (30)	Appearance & Color (20)	Total acceptability (100)
Control		0 (Fresh)	48	29	19	96
		7	45	28	18	88
		14	40	25	15	82
Raw barley flour	1%	0 (Fresh)	45	25	18	88
		7	41	22	15	78
		14	38	20	13	71
	2%	Fresh	43	23	16	82
		7	38	21	12	71
		14	35	19	12	66
	3%	0 (Fresh)	41	23	15	79
		7	39	19	13	71
		14	37	17	10	64
Germinated barley flour	1%	0 (Fresh)	47	27	19	93
		7	45	26	16	87
		14	41	22	14	77
	2%	0 (Fresh)	45	25	17	87
		7	43	24	14	81
		14	40	20	12	72
	3%	0 (Fresh)	38	24	17	79
		7	34	23	13	70
		14	33	19	11	63

CONCLUSION

According to the study, adding barley flour from raw and germinated barley flour to yoghurt produced a functional fermented dairy product that could have positive health effects. Generally, adding raw, germinated barley to yoghurt has a significant interest in increasing functionality and producing beneficial foods with health advantages. The 1% germinated barley yoghurt received the highest rating for overall acceptability, followed by the 3% and 5% germinated barley yoghurt, respectively. In conclusion, adding barley flour from R&G grains to yogurt enhances its production quality, antioxidant activity, and desirable properties.

REFERENCES

Abbas, M.; Gouda, E.; Farag, M. (2013). Some chemical and physical properties of cereal fermented milk product. Alexandria Sci. Exchange J., 34:181–188.

Abd El-Khair, A. A.; Abd-Alla, A. A.; Amany Gaber.(2018). Influence of Incorporation of different dried dairy ingredients and inulin on the physicochemical properties of non-fat set yogurt. J. of Sohag Agri. Sci. (JSAS), (1): 79-93.

Abdel-Gawad, A.S. (1991). Effect of germination and fermentation on phytate and some mineral contents of sunflower meal. Fourth Arab Conf. of Food Sci. and Technol., 5 - 9 JAN., Cairo – Egypt, NULL, 521-541.

Abid Aljanabi, M.I.; Al Abdullah, B.Y. (2018). The effect of processing operations on antioxidant activity measured by three methods of some grains and their treatments. Annals of Agric. Sci., Moshtohor, 56(2): 613 – 628. Retrieved from https://aasj.bu. edu.eg/ index.php.

Achanta, K.; Aryana, K.J.; Boeneke, C.A. (2007). Fat free plain set yogurts fortified with various minerals. Lebensm. Wiss. Technol., 40:424–429.

Akalin, A.S.; Unal, G.; Dinkci, N.; Hayaloglu, A.A. (2012). Microstructural, textural, and sensory characteristics of probiotic yogurts fortified with sodium calcium caseinate or whey protein concentrate. J. Dairy Sci., 95 (7): 3617-3628.

AOAC (2010).Official Methods of Analysis of Association of Official Chemists.18th Ed., Washington, D.C., USA.

AOAC. (2012). Official Methods of Analysis of AOAC International. 19th Ed. Dumes Method. No.968.06, Chapter 4, pp. 25-26.

Bawazir, A.E. (2010) Investigations on the chronic effect of Talbina (barley water) on hormone (cortisol and testosterone), reproductive system and some neurotransmitter contents in different brain areas of male Albino rats. Am-Eurasian J. Sci. Res., 5:134:142.

Bilgi, B.; Çelik, S. (2004). Solubility and emulsifying properties of barley protein concentrate. European Food Res. Tech., 218:437–441. 10.1007/s00217-004-0895-4.

Cakmakci, S.; Tahmas-Kahyaoglu, D.; Erkaya, T.; Cebi, K.; Hayaloglu, A. A. (2014). "*β*-carotene contents and quality properties of set type yoghurt supplemented with carrot juice and sugar," *J.* of Food Processing and Preservation, 38 (3); 1155–1163.

Cevallos-casals, B.A.; Cisneros-Zevallos, L. (2010).Impact of germination on phenolic content and antioxidant activity of 13 edibile seed species. Food Chem., 119(4): 1485-1490. DOI: 10.1016/j.food chem. 2009. 09.030.

Charalampopoulos, D.; Wang, R.; Pandiella, S. S; Webb, C.(2002). Application of cereals and cereal components in functional foods: A Review. Int. J. Food Microbiol., 79: 131-141.

Dancîte, D.; Zagorska, J.; Íince, T.; Vita Đterna, V. (2021). Application Of Hull-Less Barley Variety 'Kornelija' Grains For Yogurt Development. Proceedings of the latvian academy of Sci. Section B, 6 (735): 432–437. DOI: 10.2478/prolas-2021-0064.

Farvin, K. H.; Baron, C. P.; Nielsen, N. S.; Jacobsen, C. (2010). "Antioxidant activity of yoghurt peptides: part 1-in vitro assays and evaluation in x-3 enriched milk." *Food Chem.*, 123(4):1081–1089.

Gadaga, T. H.; Mutukumira, A. N.; Narvhus, J. A.; Feresu, S. B. (1999). A review of traditional fermented foods and beverages of Zimbabwe. Int. J. Food Microbiol., 53:1-11.

Gomez, K.A.; Gomez, A.A. (1984). Statistical procedures for agricultural research. John Wiley & Sons, USA.

Gouda, E.; Abbas, M.; Farag, M. (2013). Preparation of bio yogurt cereal fermented milk. Alexandria Sci. Exchange J., 34:170-180.

Ha, K. S.; Jo, S.H.; Mannam, V.; Kwon, Y.I.; Apostolidis, E. (2016). Stimulation of Phenolics, Antioxidant and α-Glucosidase Inhibitory Activities during Barley (*Hordeum vulgare* L.) Seed Germination. Plant Foods Hum Nutr., 71:211–21.

Hahm, T.; Park, S.; Lo, Y.M. (2008).Effects of germination on chemical composition and functional properties of sesame (*Sesamum indicum*L.) seeds. Bioresource Technol.,100:1643-1647. DOI: 10.1016/j.biortech.2008. 09.034.

Hallagan, J. B.; Allen, D. C.; Borzelleca, J. F. (1995). The safety and regulatory status of food, drug and cosmetics colour additives exempt from certification. Food Chem. Toxic., 33:515-528.

Hekmat, S.; Reid, G. (2006). Sensory properties of probiotic yogurt is comparable to standard yogurt. Nutr. Research, 26:163-166.

Helal, A.; Tagliazucchi, D. (2018). "Impact of in-vitro gastropancreatic digestion on polyphenols and cinnamaldehyde bioaccessibility and antioxidant activity in stirred cinnamon fortified yogurtin-vitro gastro-pancreatic digestion on polyphenols and cinnamaldehyde bioaccessibility and antioxidant activity in stirred cinnamon-fortified yogurt." LWT-Food Sci. and Technol., 89: 164–170.

Holtekjølen, A. K.; Bævre, A. B.; Rødbotten, M. ; Berg, H. ; Knutsen, S. H.(2008). Antioxidant properties and sensory profiles of breads containing barley flour. Food Chem., 110:414-421.

IDF (1997). Yoghurt. Enumeration of characteristic microorganisms. Colony count technique at 37°C. FIL-IDF 117B Int. Dairy Federation Brussels, Belgium.

Ismail, M.M.; Hamad, M.F.; ; Elraghy, E.M.(2018). Using Goat's Milk, Barley Flour, Honey, and Probiotics to Manufacture of Functional Dairy Product. Probiotics & Antimicrob. Prot., 10:677-691. DOI 10.1007/s12602-017-9316-4.

Kaukovirta-Norja, A.; Wilhelmson, A.; Poutanen, K. (2004). Germination: a means to improve the functionality of oat. Agri. Food Sci., 13:100–112. https://doi.org/10.2137/ 1239099041838049.

Kebary, K. M. K.; Hussein, S. A. (1999). Manufacture of low fat Zabady using different fat substitutes. ActaAlimentaria, 28: 1-14.

Lee, N.; Lee, M.J. (2014). Effect of Colored Barley Flours on Quality Characteristics of Fermented Yogurt by *Lactobacillus spp*. Korean J.Crop Sci., 59(1): 66-72. DOI: http://dx.doi.org/10.7740/kjcs.2014.59.1.066.

Lee, M.J. ; Kim, Y.K.; Kim, K.H.; Lee, N.Y.(2015). Quality Characteristics of Whole Barley Flour Added to Yogurt During Storage.Food Eng. Prog.,19, (1): 8-13. DOI http: // dx. doi. org/10.13050/foodengprog.2015.19.1.8.

Lee, M.J.; Kim, H.Y.; Yang, J.Y.; Song, SY. ; Seo, W.D.; June-Yeol Choi, JY.(2022). Quality Characteristics and Antioxidant Activity of Oat-added Curd Yogurt. Korean J. Food Nutr., 35(5): 324-331. https://doi.org/10.9799/ksfan.2022.35.5.324.

Lee, M.J.; Kim, K.S.; Kim, Y.K.; Park, J.C. ; Kim, H.S.; Choi, J.S.; Kim, KJ. (2013).. Quality Characteristics and Antioxidant Activity of Yogurt Added with Whole Barley Flour. Korean J. Food Sci. Technol., 45 (6): 721-726. http://dx.doi.org/10.9721/KJFST.2013.45.6.721.

Lee, S.C.; Kim, J.H.; Jeong, S.M.; Kim, D.R.; Ha, J.U.; Nam, K.C.; Ahn, D.U.(2003).Effect of far-infrared radiation on the antioxidant activity of rice hulls. J Agri. Food Chem., 51: 4400 4403. DOI: 10.1021/jf0300285.

Lee, N. Y.; Kim, Y. K.; Choi, I.; Cho, S. K.; Hyun, J. N.; Seong, J. S.; Park, K. H.; Kim, K. J.; Lee, M. J. (2010). Biological activity of barley (*Hordeum vulgare* L.) and barley byproduct extracts. Food Sci. Biotechnol., 19:785-791.

Mabrouk, A.; Effat. B. (2020). Production of high nutritional set yogurt fortified with Quinoa flour and probiotics. Int. J. of Environment, Agri. and Biotechnol., 5(6):1529-1537.

Marshall, R. T. (1992).Standard methods for the examination of dairy products, 16th ed. American Public Health Association, Washington, D.C.

Newman, C.W.; Newman, R.K. (2006). A brief history of barley foods. Cereal Foods World. 51: 4-7. https://doi.org/ 10.1094/ cfw-51-0004.

Nwabueze, T.U. (2007). Nitrogen solubility index and amino acid profile of extruded African breadfruit (*T. Africana*) blends. Nig. Food, J., 25: 35–36. DOI: 10.4314/nifoj.v 25i1.33651.

Roberfroid, M.B. (2000). An European consensus of scientific concepts of functional foods. Nutr., 16:689- 691. https: //doi.org/10. 1016/s0899-9007(00)00329-4.

Robinson, R. K. (2003). Yogurt types and manufacture, In: Roginski H, Fuquay JW, Fox PF editor. Encyclopedia of dairy sci., Academic Press, Inc., Massachusetts, USA, 2: 1055-1058.

Saint-Eve, A.; Levy, C.; Martin, N.; Souchen, I. (2006). Influence of proteins on the perception of flavored stirred yoghurt. J. Dairy Sci., 89: 922-933.

SAS (2008). Statistical Analysis System, Version 9.2. Cary, USA: SAS Institute Inc. S.

Senhofa, S.; Ķince, T.; Ruta; Galoburda; Cinkmanis, I.; Sabovics, M.; Sturite, I. (2016). Effects of Germination on Chemical Composition of Hull -Less Spring Cereals. Food Sci.,1:91-97. Retrieved from https://www. semanticscholar.org.

Tarakci, Z.; Kucukoner, E. (2003). Physical, chemical, microbiological and sensory characteristics of some fruit-flavored yoghurt. YYU Vet Fak Dergisi., 14:10–14.

Tatsadjieu, N.L.; Etoa, F.X.; Mbofung, C.M.F. (2004). Drying Kinetics, physicochemical and Nutritional Characteristics of "Kindimu", a Fermented Milk- Based-Sorghum-Flour. The J. of Food Technol. in Africa, 9(1):17-22. Retrieved from https://www. ajol.info/index. php/jfta/article/view/19320.

Tian, B.; Xie, B.; Shi, J.; Wu, J.; Cai, Y.; Xu, T.; Xue, S.; Deng, Q. (2010). Physicochemical changes of oat seeds during germination. Food Chem., 119: 1195-1200. DOI:10. 1016/j. foodchem.2009.08.035.

Varga, L. (2006). Effect of acacia (*Robinia pseudo-acacia* L.) honey on the characteristic microflora of yogurt during refrigerated storage. Int. J. Food Microbiol., 108:272-275.

Yamaura, K.; Nakayama, N.; Shimada, M.; Bi, Y.; Fukata, H.; Ueno, K. (2012). Antidepressant-like effects of young green barley leaf (*Hordeum vulgare* L.) in the mouse forced swimming test. Pharmacognosy Res., 4:22–26. https://doi.org/10.4103/0974-8490. 91030.

Youssef, M.K.E.; El-Fishawy, F.A.E.; Ramadan, E.A.E.;Abd El-Rahman, A.M. (2013.) Nutritional assessment of barley, talbina and their germinated products. Front Sci., 3:56-65.

خصائص الجودة والنشاط المضاد للأكسدة للزبادي المضاف له دقيق الشعير الخام والمنبت أثناء التخزين

عبد اللاه عبد اللطيف عبد الله[١]، السيد علي محمود [٢] و ولاء قبيصي[٢]

[١] قسم علوم الألبان ، كلية الزراعة ، جامعة سوهاج ، مصر
[٢] قسم علوم الاغذية والتغذية ، كلية الزراعة ، جامعة سوهاج ، مصر

الملخص

يهدف هذا العمل إلى إنتاج زبادي مدعم بدقيق الشعير باستخدام ثلاث تركيزات مختلفة (١ ، ٣ و ٥٪) من دقيق الشعير الخام (R) والمنبت (G). تم تقدير التغيرات في التركيب الكيميائي والنشاط مضادات الأكسدة وقيمة اللون والتقييم الميكروبي والحسي للعينات سواء الكنترول اوالعينات المضاف لها كلا من الشعير الخام والمنبت خلال اسبوعين من التخزين عند ٤ درجات مئوية. أظهرت النتائج أن زيادة كمية دقيق الشعير الخام والمنبت المضاف أدى ذلك إلى زيادة في محتوى المواد الصلبة الكلية ، البروتين ، الحموضة ، والرماد ، ولكن التشريش انخفض.كما وجد زيادة في المواد الصلبة الكلية والبروتين والدهن والرماد والحموضة و التشريش أثناء التخزين. وجد ان نشاط مضادات الأكسدة (DPPH) أعلى في الزبادي المضاف إليه الشعير الخام والمنبت ، وزاد بشكل طفيف مع فترة التخزين وانخفض في اليوم الرابع عشر من التخزين. كانت قيمة السطوع (L) في الزبادي المدعم بدقيق الشعير أقل ، بينما كانت قيم (a) و (b) أعلى مقارنة بعينة الزبادي الكنترول. وزادت قيم (L) و (a) بشكل طفيف خلال فترة التخزين وانخفضت في اليوم الرابع عشر من التخزين في جميع عينات الزبادي. عند زيادة نسب دقيق الشعير الخام والمنبت المضاف في جميع المعاملات ، ادي ذلك الي ارتفاع العدد الكلي للبكتيريا ، وعدد *streptococci* ، وبكتريا حمض اللاكتيك ، وعدد الخمائر والفطريات معنوياً. في زبادي الشعير ؛ حيث حصلت عينة الزبادي التي تحتوي على ١٪ دقيق الشعير المنبت على أعلى درجة للقبول الحسي. وبذلك كانت جودة تخزين زبادي الشعير جيدة نسبيًا. بناءً على هذه النتائج ، يمكن الاستنتاج بأن الزبادي الذي يحتوي على دقيق الشعير الخام والمنبت يظهر جودة محسنة ونشاط مضاد للأكسدة.