*Assiut J. of Agric. Sci., 42 (Special Issue )(The 5th Conference of Young Scientists Fac. of Agric. Assiut Univ. May,8, 2011)* ***(117-135)***

# Assessment of Chemical Properties of Raw, Germinated Barley Grains, Talbina, and Biscuits Enriched with Talbina.

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**Abstract**

Talbina is a food product with high potential applications as a functional food. Talbina was prepared from two barley varieties namely: Giza126 and Giza130 by adding whole barley flour to water (1:10 w/v) and (1:5 w/v) for germinated barley then heating at 80° C for 5 minutes with continuous stirring until reaching a porridge like texture. The present investigation was carried out in an attempt to clarify the nutritional assessment of talbina as a functional food in fortifying biscuits. The study included the determination of total dietary fiber (TDF), insoluble (IDF) and soluble dietary fiber (SDF), which ranged between 12.73-23.77, 6.83-14.37 and 4.65-10.01% on dry weight basis. Moreover, talbina (cooked barley flour) recorded a noticeable increase in extractable ß-glucan content (5.9% and 12.1%). Furthermore, the present study was carried out on biscuits prepared by incorporating talbina130 and germinated talbina130 (10%, 20% and 30%) into wheat flour. The biscuits were evaluated for their physical, chemical, nutritional and sensory characteristics. In general, all the biscuits samples recorded high protein, fiber, ash and minerals contents as compared to that made from 100% wheat flour (control). Moreover, the all biscuits recorded rather slight decrease in crude fat content. Besides, biscuits incorporated with 30% germinated talbina130 recorded highest value of spread ratio (11.25) as well as spread factor (135%). The data revealed that both of biscuits enriched with10% talbina130 and biscuits enriched with10% germinated talbina130 recorded the best sensory values, which including color, texture, taste, odor and overall acceptability.

**Keywords:** Barley; Talbina; Germination; Biscuits; Minerals; physical properties.

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## 1- Introduction

Barley (*Hordeum Vulgare L.)* is regarded by many scientists as the most ancient cultivated grain. There is good evidence that it was a staple food in Egypt as early as 6000 B.C**,** it is an ancient cereal grain, which upon domestication had evolved from largely

**Received on**:2/4/2011 **Accepted for publication on**: 16/4/2011

**Referees**: Prof.Dr. Abdallah S. Abdel-Gouad Prof.Dr. Sami I. Elsayad

a food grain to a feed and malting grain (El-Farra, 1965). World production of barley was approximately 9.4% of the total world area under cereal production and ranks fifth in the world (Sharma and Gujral, 2010). Traditionally, utilization of barley for foods had been limited due to social and cultural perceptions that barley is inferior compared with other cereal crops. However, barley is an important cereal grain from a nutritional point of view due to its high dietary fiber content, particularly ß-glucans which are beneficial to human health (Newman and Newman, 1991). Moreover, Fastnaught (2001) reported that, total dietary fiber ranges from 11 to 34% and soluble dietary fiber from 3 to 20%. Hull-less or dehulled barley grain contains 11–20% total dietary fiber, 11–14% insoluble dietary fiber and 3–10% soluble dietary fiber (Marconi et al., 2000; Fastnaught, 2001 and Virkki et al., 2004). ß-glucans the major fiber constituents in barley, had been shown to lower plasma cholesterol, reduce glycemic index and reduce the risk of colon cancer (Brennan & Cleary, 2005). In addition, Lazaridou and Biliaderis, (2007) mentioned that, water-soluble fiber seems to improve blood glucose regulation and reduce serum cholesterol levels in diabetic and hypercholesterolemic subjects, respectively**.** Such beneficial health effects have been attributed to the solubility of ß-glucans in water and their capacity to form highly viscous solutions (Kahlon *et al.,* 1993). Besides*,* Wood, *et al.,* 1994 and Bhatty*,* 1992 reported that, barley ß-glucan is a linear polysaccharide consisting of ß-(1→4) and ß-(1→3) glycosidic linkages in the ratio of 2.3:1, and a large fraction of the ß-glucan from barley is soluble**.**

Actually, use of barley as a food for human beings is very limited all over the world. Formulation of food products incorporating barley offers good potential to increase the soluble fiber component. Barley being a cereal grain is suitable for use in many products e.g. breakfast cereal, pasta and baked products (Yvone *et al*., 1994).

The wife of the prophet Mohamed peace be upon him “Aisha", used to recommend Talbina for the sick and for one who is grieving over a dead person. She used to say, "I heard the Messenger (Salla Allah alayhi Wasallam) saying, "Talbina gives rest to the heart of the patient and makes it active and relieves some of his sorrow and grief" (El-Rahman, 2001). Talbina is an Arabic word made of the word laban which means milk. This may also designate in the case of barley grains when they reach the milky stage, so the inside of these grains is white and liquid resembling milk (Abdel-Hassib, 2007). Actually there is a need to explore the possibility of increasing consumption of barley and barley products for human food and value added products (Faraj *et al,* 2004). The objectives of the present study were: (1) to identification of the variability among barley, germinated form as well as the talbina due to their content of dietary fibers and ß-glucan. (2) To study the effect of talbina and germinated talbina (Giza130) content on physico-chemical, nutritional, and textural properties of biscuits were made from both of them as compared with biscuits were made from100% wheat flour.

## 2- Materials and Methods

### 2.1. Materials:

Ten kilograms of each varieties of Egyptian barley grains *(Hordeum Vulgare L.)*: Giza126 (hulled barley), and Giza130 (hull-less barley) were procured from Agricultural Research Center, Giza (ARE). 100g Commercial talbina (Giza132) was obtained from local market in Assiut Governorate. All samples were obtained in year 2008.

### 2.2. Methods:

#### 2.2.1. Preparation of samples

##### 2.2.1.1. Preparation of germinated barley:

**Soaking:** Seeds were freed from broken seeds, dust and other foreign materials, and then it soaked in water (1:5 w/v) for 12 h at 25±5°C.

**Germination:** The presoaked (12 h) seeds were spread on wet cotton in aluminum baskets. The temperature ranged from 10°C (during the first 144 h) to 25±5°C (during the last 24 h of sprouting). The germinated seeds were dried at 55°C for 24 h then at 71°C for the same period.

##### 2.2.1.2. Preparation of talbina:

Talbina was prepared by adding whole barley flour to water (1:10 w/v) according to Youssef (2008) and (1:5 w/v) for germinated barley flour then the mix was heated at 80±5°C for 5 minutes with continuous stirring until reaching a porridge like texture.

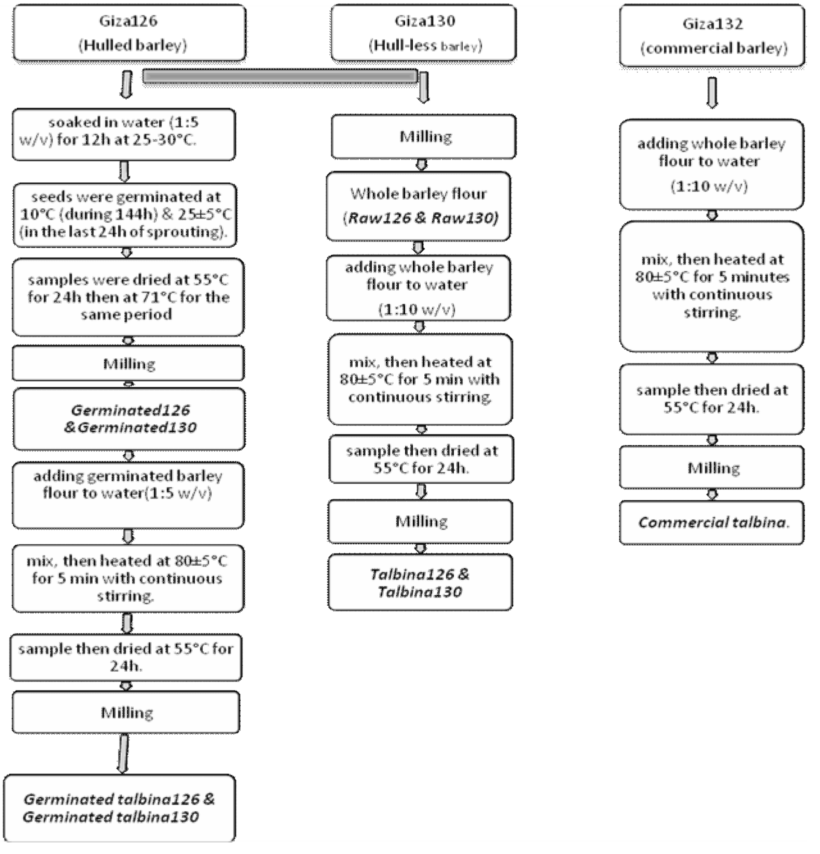



**Fig. (1): Flow sheet for the preparation of talbina products.**

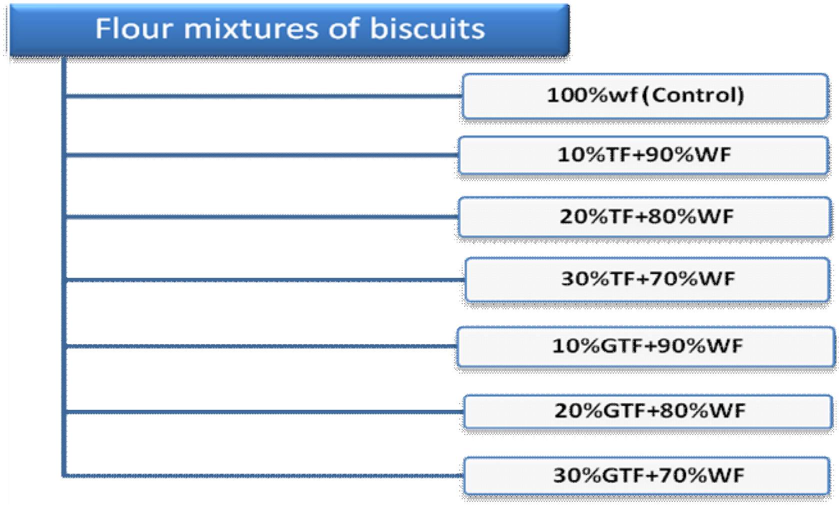
**2.2.1.3. Preparation of biscuits:**

Biscuits were prepared by using the method of Rao and Manohar (1997) as follows: Dough preparation: Sugar and fat were creamed in a mixer, for 2 min, then sodium bicarbonate, ammonium bicarbonate and sodium chloride were dissolved in water (about 16 ml as shown in Table 1) and then added to fat-sugar cream. The flour and baking powder was added to the mixture and finally mixed for 5 min to obtain homogeneous batter.

**Preparation of biscuits**: Dough was sheeted to a thickness of 3.5 mm, using a plastic platform and a frame, and by rolling with a rolling pin. Then it was shaped with a cutter and baked at 205°C for 10 min, the biscuits were cooled for 30 min and stored in plastic bags.

**Table (1): Formula of soft biscuits.**

| Ingredients | g |
|---|---|
| Flour | 100 |
| Sugar | 30 |
| Shortening | 20 |
| Sodium chloride | 1 |
| Sodium bicarbonate | 0.5 |
| Ammonium bicarbonate | 1 |
| Baking powder | 0.3 |
| Water | 16 |




**WF**: Wheat flour 72% extraction rate; **TF**: Talbina 130; **GTF**: Germinated talbina 130.

**Fig. (2):** Preparation of different blends of biscuits partially substituted with talbina and germinated talbina130.

**2.2.2. Analytical Methods**

**2.2.2.1. Determination of total, soluble and insoluble dietary fibers:**

Total dietary fiber was determined according to the method described by Prosky et al, (1985). Whereas soluble dietary fiber determined by the same procedure without addition of alcohol after digestion with termamyl protease and amyloglucosidase as recommended by Prosky et al, (1988). Soluble dietary fiber was calculated by subtraction insoluble dietary fiber from total dietary fiber.

**2.2.2.2. Extractable ß-glucan:**

Extraction of ß-glucan was carried out as reported by Temelli (1997). Whole barley flour (50g) was suspended in 500 ml distilled water; pH was adjusted to 7 with sodium carbonate (20%, w/v) and stirred vigorously for 30 min at 55°C. The mixture was centrifuged for 15 min at 15,000×g and 4°C. The supernatant was adjusted to pH 4.5 with 2 M HCl and centrifuge again (20 min at 19,000×g, 4°C). ß-Glucan was precipitated by addition of an equal volume of ethanol (98%) to the supernatant slowly with stirring. The precipitate was recovered by centrifugation (10 min at 3300×g) after allowing it to settle over night at 4°C. The sample was filtered and washed with 100 ml ethanol (98%) and air dried to a constant weight.

**2.2.2.3. Determination of gross chemical composition:**

Moisture, protein, crude fibers and ash contents were determined according to the methods described in the AOAC (1997). Fat content was determined as the ether extract according to AOCS (1994). Total carbohydrate was calculated by difference according to pellet and Sossy (1970). All determinations were performed in triplicates and the means were reported. The caloric value was calculated using values of 4 k.cal/g of protein, 4 k.cal/g of carbohydrates and 9 k.cal/g of fat according to livesy (1995).

**2.2.2.4. Determination of minerals contents:**

To extract Na, K, P, Mg, Ca, Zn, Cu, Mn and Fe, samples were drying, ashed then the ash was dissolved in hydrochloric acid (Jackson, 1973). Sodium and potassium were determined according to (Chapman and Pratt, 1961) by the flame photometric procedure (Corning instrument model 400). Determination of phosphorus was carried out according to the procedure for phosphor analysis by the sulfomolybdophosphate blue color method (Tan, 1996). Calcium and magnesium were determined by titration with versene 0.0156 N according to the method described in Soil Chemical Analysis of Jackson (1973). Iron, zinc, copper and manganese were determined using a GBC Atomic Absorption 909 AA, as described in A.O.A.C. (1997).

**2.2.2.5. Physical evaluation of biscuits:**

Height (cm), width (cm), spread ratio and spread factor were determined in five biscuits and averages were recorded. Spread ratio and spread factor were calculated according to Rao and Manohar (1997) as follow:

$$\text{Spread ratio} = \frac{\text{Width}}{\text{Hight}}$$

$$\text{Spread factor} = \frac{\text{spread ratio of sample}}{\text{spread ratio of control}} \times 100$$

**2.2.2.6. Sensory evaluation:**

Sensory evaluation for the color, texture, taste, odor and overall acceptability were determined in ten biscuits. Sensory analyses were conducted by a panel of ten judges. Larmond (1977), reported that numerical hedonic scale ranged from 1 to 10 (1 is very bad and 10 for excellent).

## 3. Results and Discussion

**3.1. Determination of dietary fiber content:**

Gill et al (2002) determined the total (TDF), insoluble (IDF) and soluble dietary fiber (SDF) contents of barley flour and cooked barley flour and they found 9.31-11.98, 4.06-4.18 and 5.25-7.8%; respectively, in barley flour, whereas cooked barley flour recorded 9.22-12.13, 4.21-4.52 and 5.01-7.61%. Likewise, in the present study the content of total (TDF), insoluble (IDF) and soluble dietary fiber (SDF) ranged between 12.73-23.77, 6.83-14.37 and 4.65-10.01% on dry weight basis. It could be seen from Table (2) that talbina126 had the highest percentage of total (TDF) and insoluble dietary fiber (IDF). High insoluble dietary fiber in barley probably due to the thicker pericarp, which is a part of the grain which is mainly composed of cellulose, insoluble hemicelluloses and lignin (Bewley and Black, 1985). Besides, Table (2) showed that talbina130 had the highest value of soluble dietary fiber (SDF). High soluble dietary fiber levels in barley might be explained by the variable amount and solubility of non-starch polysaccharide (main compounds of the soluble fraction of dietary fiber) (Englyst et al, 1982). Moreover, Faraj et al, (2004), determined soluble dietary fiber in pearled barley in two barley varieties and they found it was 4 and 6.87%, while insoluble dietary fiber was 1.87 and 2.43%. Likewise, Silva and Ciocca, (2005) determined the total dietary fiber, insoluble dietary fiber and soluble dietary fiber in some barley varieties and they found 17.41-17.79, 12.93-13.82 and 3-4 g/100g; respectively on dry weight basis.

Table (2): Total (TDF), insoluble (IDF) and soluble dietary fiber (SDF) of raw, germinated barleys and talbina products g /100g (on dry weight basis). (n=3)

| Treatments | Total dietary fiber | Insoluble dietary fiber | Soluble dietary fiber |
|---|---|---|---|
| **Raw126** | 18.9 | 11.55 | 7.35 |
| **Germinated126** | 17.13 | 12.32 | 4.81 |
| **Talbina126** | 23.77 | 14.37 | 9.4 |
| **Germinated talbina126** | 12.73 | 6.83 | 5.9 |
| **Raw130** | 22.65 | 13.97 | 8.68 |
| **Germinated130** | 13.2 | 8.55 | 4.65 |
| **Talbina130** | 20.35 | 10.34 | 10.01 |
| **Germinated talbina130** | 15.88 | 11.08 | 4.8 |
| **Commercial talbina** | 19.88 | 10.68 | 9.14 |

**3.2. Extractable ß-glucan**

Due to their cellulose-like structure, ß-glucans are only partly soluble physicochemical and functional properties in aqueous media are related to the soluble part. For example the viscosity in the small intestine caused by soluble ß-glucans is physiologically important. In the colon, the soluble and the insoluble ß-glucan fractions were more or less completely fermented by the micro flora (Huth et al, 2000).

The extractable ß -glucan ranged from 1.6% to 12.1% among the all studied treatments, and talbina130 contained highest extractable ß-glucan which was significantly higher as compared to other cultivars (Table 3). Similar results were reported by Saulnier et al. (1994); they found that ß-glucan ranged from 1.6% to 2.5% in different barley cultivars when extracted with water at 40 °C. Besides Sharma and Gujral (2010) reported that extractable ß -glucan ranged from 1.93% to 3.81% among the eight barley cultivars that they had studied. Gaosong and Vasanthan (2000), determined soluble ß-glucan of barley and they recorded values ranged from 1.0 to 3.2% and the solubility (%) was found to be between 41.52 and 70.5%. Moreover Cavallero et al (2002) determined total ß-glucan content in barley flour, and they found 4.6 g/100g, while soluble ß-glucan was 3.2 g/100g on dry basis. In addition Salem, (1997) determined total ß-glucan of some barley varieties grown in Egypt, and she reported values ranged between 3.33 and 4.56%. Whereas Erkan et al, (2006) reported that ß-glucan content was 2.8-3.38% in hulled barley and 4.25% in hull-less barley. It was reported that some barley cultivars have low ß-glucan contents and some have high (Bhatty, 1999).

Actually, Table (3) indicated that germination treatment in both varieties (Giza126 & Giza130) caused a decrease in ß-glucan content comparing with that of raw varieties. That decrease might be due to degradation of ß-glucan which occurs during germination. Besides, Chandra et al, (1999) reported that during malting, ß-glucans were degraded in both large and ale malts. Two isoenzymes of (1-3, 1-4)-ß-D-glucan, 4 glucanohydrolase (also known as lichenase) had been found to responsible for the degradation of barley ß-glucan (Woodward and fincher, 1982).

In the present study, talbina (cooked barley flour) recorded a noticeable increase in extractable ß-glucan content, which might be due to the thermal processing. In this concept Ahluwalia and Ellis (1985) showed that, the amount of water soluble ß-D-glucan increased with extraction temperature. Likewise, Dawkins and Nnanna, (1995) stated that viscosity at 61°C was slightly below than at 25°C; whereas at 100°C extracts and viscosity was much lower than that at 25 °C.

Burkus and Temelli (2005) showed that, evaporation of ß-glucan solution creates a skin-like layer if the solution is not mixed vigorously and kept in a high humidity environment. This skin- like layer probably contributed to higher viscosity readings at low shear rates. They also reported that high viscosity laboratory gum at 1% (w/w) concentration is highly pseudo plastic, while that high viscosity of ß-glucan gum may be a good fat replacer.

Table (3): Extractable ß-glucan of raw, germinated barleys and talbina products g /100g (on dry weight basis).

| Treatments | %Extractable ß-glucan |
|---|---|
| Raw126 | 1.7 |
| Germinated126 | 1.6 |
| Talbina126 | 5.9 |
| Germinated talbina126 | 4.9 |
| Raw130 | 2.5 |
| Germinated130 | 1.8 |
| Talbina130 | 12.1 |
| Germinated talbina130 | 3.1 |
| Commercial talbina | 4.9 |

### 3.3. Effect of incorporation of talbina and germinated talbina on biscuits quality:

The reasons that make barley unpopular as human food are: (i) presence of a husk that is difficult to remove, (ii) most of the barley is used up by the malting and brewing industry, (iii) barley lacks the gluten proteins therefore cannot be used in leavened bakery products and (iv) strong taste and gummy mouth feel of whole barley kernels (Sharma and Gujral, 2010). The nutritional value of food supplemented with barley depends on the level of supplementation as well as on the type of barley used.

#### 3.3.1. Gross chemical composition and caloric value of enriched biscuits with talbina:

Table (4) indicated that, moisture content in the biscuits made from 100% wheat flour was 3.25%, while that in biscuits fortified with 10%, 20% and 30% talbina 130 ranged from 2.85% to 4.88%. The moisture contents of biscuits fortified with 10%, 20% and 30% germinated talbina 130 were 3.51%, 2.27% and 5.57%; respectively. Actually, such data for moisture contents was an advantage for its microbiological stability during storage according to Soliman, (1999). Likewise, Abo-Elnaga (2002), found the moisture content of biscuits replaced with 25%, 50%, 75% and that baked from 100% barley flour was 5.27, 5.43, 5.72 and 5.87%; respectively. In addition Cronin and Preis (2000) found that moisture content of tea biscuits made from wheat flour was in the range of 4.27 to 5.61%.

It could be seen from Table (4) that, protein content in biscuits prepared by incorporating barley talbina 10%, 20%, and 30% were recorded 8.18, 8.08 and 7.97%; respectively. Likewise, Abo-Elnaga (2002), reported that, protein content of different biscuit samples replaced with barley flours was higher than that of control baked from wheat flour only. Moreover, Gupta et al, 2010, mentioned that protein content in cookies prepared by incorporating barley flour 10%, 20%, 30% and 40%, showed a decrease in protein content. In contrast, the data of this study showed that biscuits prepared by incorporating germinated barley talbina 10%, 20%, and 30% recorded 8.53, 8.58 and 9.64%, protein content; respectively which might be due to the increase in protein content during germination of barley, which was used to produce germinated talbina.

Data represented in Table (4) showed that crude fat content ranged from 8.67 to 10.42% for all fortified biscuits. The crude fat content in the same Table indicated that biscuit control baked from 100% wheat flour 72% extraction had the highest content of fat (10.74%); while fortified biscuits with 30% germinated talbina130 had the lowest crude fat content. Such data indicated that, biscuits baked from fortified wheat flour with 10%, 20%, and 30% barley talbina or germinated barley talbina recorded rather slight decrease in crude fat content comparing with biscuits control.

In the present study, crude fiber, ash and carbohydrates recorded 2.05-5.60%, 1.06-1.45% and 75.21-78.12%; respectively; for all fortified biscuits. These results indicated that the addition of talbina and germinated talbina increased the crude fiber and ash contents. This increment could be attributed to the higher contents of crude fiber and ash in barley flour and talbina. The contents of carbohydrates were low in all fortified biscuits comparing with biscuit control. Moreover, control recorded lowest value of crude fiber and ash (1.62 and 0.797%) and highest percentage in carbohydrates (80.68%). Besides, data in Table (4) showed that control had the highest value of caloric value, while fortified biscuits with 30% talbina130 had the lowest one.

Table (4): Gross chemical composition and caloric value of enriched biscuits with talbina and germinated talbina.

| Biscuits | Mois ture % | Pro-tein %* | Fat% * | Crude fi-ber%* | Ash% * | Carbo-hy-drate% ** | Caloric value% (Kcal)* |
|---|---|---|---|---|---|---|---|
| **Control (100%wheat flour72%extraction biscuits).** | 3.25 | 6.16 | 10.74 | 1.62 | 0.797 | 80.68 | 444.0 |
| **Fortified biscuits with 10%talbina130.** | 2.85 | 8.18 | 10.42 | 3.17 | 1.15 | 77.08 | 434.8 |
| **Fortified biscuits with 20%talbina130.** | 4.88 | 8.08 | 9.83 | 5.6 | 1.28 | 75.21 | 421.6 |
| **Fortified biscuits with 30%talbina130.** | 3.57 | 7.97 | 9.26 | 5.48 | 1.37 | 75.92 | 418.9 |
| **Fortified biscuits with 10%germinated talbina130.** | 3.51 | 8.53 | 10.2 | 2.09 | 1.06 | 78.12 | 438.4 |
| **Fortified biscuits with 20%germinated talbina130.** | 2.27 | 8.58 | 9.97 | 2.05 | 1.32 | 78.08 | 436.37 |
| **Fortified biscuits with 30%germinated talbina130.** | 5.57 | 9.64 | 8.67 | 2.12 | 1.45 | 78.12 | 429.07 |

* On dry weight basis, ** calculated by difference. (n=3)

**3.3.2. Minerals composition of enriched biscuits with talbina:**

In the present study calcium, magnesium, potassium, sodium, phosphor, iron, manganese copper and zinc; were ranged as follow: 204.6-211.7, 62.02-248.8, 93.02-165.9, 404.5-483.8, 134.4-245.6, 3.63-5.12, 0.486-0.815, 0.527-0.636 and 1.0-1.51 mg/100g; respectively. ***Gupta* et al. (2010)** found that cookies prepared by incorporating barley flour 10%, 20%, 30% and 40%, contained calcium, sodium, potassium, iron and zinc ranged from 9.33-35.01, 333.1-6331, 496.4-2239, 15.77-45.00 and 4.13-22.9 ppm; respectively.

In general, the results in Table (5) showed that manganese, copper, zinc, magnesium, potassium and phosphor contents were increased in fortified biscuits with talbina and germinated talbina compared with control. Besides, the results in Table (5) indicated that there was a trend to decrease the content of sodium and calcium in most fortified biscuits as the result of addition the talbina. Moreover, iron recorded variable values in fortified biscuits with talbina.

Table (5): Minerals composition (Mg/100g) of enriched biscuits with talbina and germinated talbina 130 (on dry weight basis).

| | Micro elements | | | | Macro elements | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Biscuits** | **Fe** | **Mn** | **Cu** | **Zn** | **Ca** | **Mg** | **K** | **Na** | **P** |
| **Control (100%wheat flour72%extraction biscuits).** | 3.98 | 0.486 | 0.527 | 1.0 | 206.7 | 62.02 | 93.02 | 483.8 | 134.4 |
| **Fortified biscuits with10%talbina130.** | 4.43 | 0.685 | 0.623 | 1.43 | 205.8 | 123.52 | 123.5 | 478.5 | 226.5 |
| **Fortified biscuits with 20%talbina130.** | 4.47 | 0.557 | 0.636 | 1.29 | 210.3 | 126.15 | 147.2 | 447.9 | 189.2 |
| **Fortified biscuits with 30%talbina130.** | 3.63 | 0.528 | 0.528 | 1.1 | 207.4 | 248.8 | 165.9 | 414.4 | 176.3 |
| **Fortified biscuits with10% germinated talbina130.** | 4.87 | 0.658 | 0.528 | 1.42 | 207.3 | 186.53 | 113.9 | 404.5 | 217.6 |
| **Fortified biscuits with 20%germinated talbina130.** | 5.12 | 0.696 | 0.624 | 1.51 | 204.6 | 184.18 | 143.3 | 412.1 | 245.6 |
| **Fortified biscuits with 30%germinated talbina130.** | 4.87 | 0.815 | 0.577 | 1.45 | 211.7 | 127.06 | 158.8 | 424.8 | 232.9 |

### 3.3.3. Physical properties:

Table (6) showed that the spread ratio of fortified biscuits with 10% talbina, 10% germinated talbina and fortified biscuits with 20% germinated talbina was decreased significantly and the thickness was increased as compared to biscuits made from wheat flour (control). The addition of 30% talbina or 30% germinated talbina recorded a significantly increase in spread ratio and decrease in the thickness. The fragmented starch and ß-glucan in the cooked barley flour would compete for water with native-wheat starch in the dough. This, in turn could restrict the swelling and solublisation of starch during baking and thus reduce the firmness Gill et al, (2002).

### 3.3.4. Sensory evaluation:

Table (7) indicated that, both of fortified biscuits with10% talbina130 and fortified biscuits with10% germinated talbina130 had the best color score according to judges and the surface color of these biscuits were golden brown. Fortified biscuits with 30% talbina130 had the lowest score and the color like pale cream as shown in figure (3). Moreover, Quinde et al, (2004) reported that discoloration potential of barley in food products was dependent on the class and genotype of barley. Gray and dark colors developed in pearled and cooked barley used as a rice substitute, for example in iron-fortified infant cereal (Theuer, 2002) and in various wheat-based products, which has been a concern of food manufacturers and one of the major obstacles preventing the use of barley in food products (Lagasse´ et al., 2006). The undesirable dark discoloration reported in these products, could result from enzymatic or non-enzymatic reactions (Baik and Ullrich, 2008). Moreover, Gill et al. (2002) mentioned that increasing native barley flour substitution caused a gradual decrease in brownness of the crust while increasing its paleness, also in cooked barley flour breads, its brownness progressively decreased with the increasing levels of substitution.

Table (6): Physical properties of enriched biscuits with talbina and germinated talbina 130.

| Biscuits | Width[a] (cm) | Thickness[a](cm) | Spread ratio[b] | Spread factor[c] |
|---|---|---|---|---|
| **Control (100%wheat flour72%extraction biscuits** | 4.08 | 0.49 | 8.33 | 100% |
| **Fortified biscuits with10%talbina130.** | 4.32 | 0.66 | 6.55 | 78% |
| **Fortified biscuits with 20%talbina130.** | 4.5 | 0.45 | 10 | 120% |
| **Fortified biscuits with 30%talbina130.** | 4.44 | 0.4 | 11.1 | 133.30% |
| **Fortified biscuits with10%germinated talbina130.** | 4.48 | 0.62 | 7.23 | 86.80% |
| **Fortified biscuits with 20%germinated talbina130.** | 4.56 | 0.6 | 7.6 | 91% |
| **Fortified biscuits with 30%germinated talbina130.** | 4.5 | 0.4 | 11.25 | 135% |

**a:** n= 5 **b:** width/thickness. **c:** $\frac{\text{spread ratio of sample}}{\text{spread ratio of control}} \times 100$

**Pomeranz et al, (1977)** reported that, the addition of fibrous material to wheat flour leads to dilution of wheat gluten protein, which causes weakening of cell structure; also, the fibrous materials, especially the insoluble fraction, tend to cleave the gluten strands during mixing that not only impairs the gas retention of the dough (gluten network), but also changes the texture and appearance of the baked products.

The taste of the biscuits was malty and sweet at 10%, 20% and 30% levels of germinated talbina substitution. Fortified biscuits with10% germinated talbina130 had the highest odor score (Table 7). Based on the above results biscuits containing both of 10% talbina and 10% germinated talbina were found to be most acceptable by the panel- ist

Table (7): Sensory quality of enriched biscuits with talbina and germinated talbina 130. (n=10).

| Biscuits | color | texture | taste | odor | overall acceptability |
|---|---|---|---|---|---|
| **Control (100%wheat flour72%extraction biscuits).** | 8.4 | 7.3 | 8.2 | 8.1 | 8.2 |
| **Fortified biscuits with10%talbina130** | 8.1 | 8.3 | 8 | 8.1 | 8.4 |
| **Fortified biscuits with 20%talbina130** | 7.5 | 7.3 | 7.4 | 7.5 | 7.5 |
| **Fortified biscuits with 30%talbina130.** | 6.7 | 7.3 | 7.1 | 7.1 | 7.1 |
| **Fortified biscuits with10%germinated talbina130.** | 8.1 | 8.3 | 7.8 | 8.3 | 8.3 |
| **Fortified biscuits with 20%germinated talbina130** | 7.4 | 7.9 | 7.8 | 7.8 | 7.9 |
| **Fortified biscuits with 30%germinated talbina130** | 7.7 | 7.3 | 7.7 | 7.5 | 7.9 |

**Control**

**Talbina130 (10%)**

**Talbina130 (20%)**

**Talbina130 (30%)**

**Germinated talbina130 (10%)** **Germinated talbina130 (20%)** **Germinated talbina130 (30%)**

Fig (3): control and fortified biscuits with talbina and germinated talbina**.**

In conclusion enriched biscuits with talbina proved to be a nutritious food product, which could be recommended for diabetic, hypercholesterimc and obese patients due to its both soluble and insoluble dietary fiber as well as its high content of ß-glucans. Besides, biscuits enriched with talbina had high levels of important minerals as compared to biscuits made from 100% wheat.

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*Assiut J. of Agric. Sci., 42 (Special Issue )(The 5th Conference of Young Scientists Fac. of Agric. Assiut Univ. May,8, 2011) **(117-135)***

# تقييم الخواص الكيميائية للشعير الخام والمنبت والتلبينة وكذلك البسكويت المدعم بالتلبينة

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تعتبرالتلبينة منتج غذائى يعطى احتمالات عالية للتطبيق كغذاء وظيفى، حيث تم اعداد التلبينة من صنفين من الشعيرهما جيزة 126 و جيزة130 عن طريق اضافة دقيق الشعير الكامل الى الماء بنسبة (10:1) و بنسبة (5:1) فى حالة دقيق المولت، ثم تم الطبخ على درجة حرارة 80° م لمدة 5 دقائق مع التحريك المستمر حتى الوصول الى القوام العصيدى. ان الدراسة الحالية قد تم تنفيذها فى محاولة لتوضيح التقييم الغذائى للتلبينة كغذاء وظيفى يستخدم لتدعيم البسكويت. هذا وقد اشتملت الدراسة الحالية على تقدير الالياف الغذائية الكلية و الالياف الغذائية غير الذائبة وكذلك الالياف الغذائية الذائبة والتى تقع نسبتها فى المدى73 ،12- 7 ،23 ، 83 ،6 - 37، 14 وكذلك 65، 4 - 01 ،10 % على الترتيب على اساس الوزن الجاف. علاوة على ذلك ، فان معاملة التلبينة (دقيق الشعير المطبوخ) قد سجلت زيادة واضحة فى نسبة البيتا جلوكان القابل للاستخلاص (5،9 و1، 12%).

ومن خلال الدراسة الحالية تم اعداد بسكويت عن طريق احلال التلبينة المصنوعة من الشعير الخام صنف جيزة 130 والتلبينة المصنوعة من دقيق المولت لنفس الصنف بنسب 10 و20 و 30% محل دقيق القمح. هذا وقد تم تقييم البسكويت من ناحية الخواص الطبيعية والكيميائية و الحسية. هذا وبشكل عام فان جميع انواع البسكويت المدعم قد سجلت ارتفاعا فى قيم البروتين والالياف والرماد وكذلك العناصر المعدنية مع انخفاض نسبة الدهن وذلك بالمقارنة مع البسكويت المصنع بالكامل من دقيق القمح. بالاضافة الى ذلك فان البسكويت المدعم بالتلبينة المنبتة (30%) قد سجل اعلى قيمة فى معامل و نسبة الاتساع. هذا وقد سجل البسكويت المدعم بكل من التلبينة 130 (10%) و التلبينة المنبتة 130(10%) افضل النتائج بالنسبة للخواص الحسية والتى تضمنت كلا من اللون و القوام والطعم والرائحة والقابلية العامة .