

CHEMICAL AND RHEOLOGICAL STUDIES ON TALBEENA AS A TRADITIONAL HEALTHY BEVERAGE

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ABSTRACT

This study aims to examine the possibility of producing Talbeena, using whole barley and malt flours with skimmed milk or full-cream milk compared with a reference control treatment (with water only). Chemical investigation included β -glucan determination, minerals content (Na, K, Ca, P, Fe, and Zn), beside the other basic nutritional components in both raw materials and corresponding products was done. Viscosity was measured as an important rheological property and a strong indicator on β -glucan functionality. All treatments were examined organolytically. Obtained results showed that barley flour gave the highest content of ash, crude fiber and fat compared to malt flour. Moreover, barley flour Talbeena gave the highest content of the minerals (Na, K, Ca, P, Fe, and Zn) compared with malt flour talbeena. β -glucan results showed that malt flour treatments scored the lowest content while, β -glucan solubility increased by malting. Skimmed milk treatments registered the highest content of carbohydrates, protein and ash as well as minerals (Na, K, Ca, P, and Zn) compared with full-cream milk, which was higher in iron content. Viscosity was higher in control and skimmed milk barley flour Talbeenas compared with others. Sensory evaluation of samples showed superiority of malt with full cream milk talbeena than other treatments. . Presented Content of β -Glucan in barley flour talbeena, meet the recommended daily needs to achieve the health benefits attributed to barley β -gucan.

INTRODUCTION

The increasing prevalence of public health problems related to a sedentary life style has been widely discussed (*WHO, 2003*). The challenge for consumers is to gather a diet from the individual products available on the market, although the nutritional goals are satisfied overall diet. The noticeable development of health promoting diet called Functional Foods has been on the focus. A key perspective to understand the role of functional foods is to emphasis the role of functional foods as a socially and culturally shaped phenomenon instead of mere products to be accepted or rejected (*Niva, 2007*). That why we should search in our heritage and local environment for more healthy substitutes.

As a healthy food, there has been a growing research interest for the utilization of barley in a wide range of food applications (*Erkan et al., 2006*). Apart from having a nutritive value, barley is unique among cereals for its healthy effects. Barley is the main cereal grain for the development of functional foods, as it contains high concentrations of many components of strong healthy interest. Consuming barley lowers the levels of blood cholesterol and attenuates postprandial glucose response (*Cavallero et al., 2002 and lyly, 2006*). Consumption of barley-containing foods and the

associated soluble fiber significantly improved several cardiovascular disease risk factors. The mixed linkage (1-3)(1-4)- β -D-glucans (β -glucan) from the endosperm of barley grains are valuable industrial hydrocolloids and have been shown to be important, physiologically active dietary fibre components. Cereals especially oat and barley are rich in β -glucan. (Wood et al., 2000). The highest β -glucan intake resulted in the greatest reduction in total and LDL-cholesterol concentrations and total HDL cholesterol, especially in postmenopausal women and men as reported by (Behall, 2004). The Food and Drug Administration had allowed foods containing barley to claim that they reduce the risk of coronary heart disease. provide at least 0.75 grams of soluble fiber per serving (FDA, 2006) which may have a positive impact on the consumption of this grain, that consumption level may start rising in the near future. Talbeena-like beverage in the Tibet is called *tsangpa* it is roasted hulless barley grain flour. It can be added to tea, skim milk, or even cold water and consumed as a beverage. Many people mix it with sugar and eat it directly (Nyima, 2005). It is important to refer to that Prophet Muhammad (PBUH) recommended barley and used it in various forms such as barley bread and Talbeena as mentioned by *Ibn Al Qayyim Al Jawziyyah* (1957).

So, the present study was designed to investigate the possibility of producing healthy, high quality traditional Talbeena using hulless barley flour (87.2%) and malt flour and how these healthy foods are influenced chemically and organoleptically by the addition of milk (skimmed or full cream). Also, to investigate how modifications affect the perceived rheological, and nutritional quality as well as health functional properties. On the way to produce a feasible strategy for involving such a healthy food in our traditional staple foods.

MATERIALS AND METHODS

Materials:

Raw materials:

Barley grains, the six rowed naked barley cultivar (*Hordeum vulgare vulgare L.*) Giza 130 grains were obtained from Barley Research Department, Crop Research Institute, Agriculture Research Center, Giza, Egypt. Dry Skimmed and full cream milk were purchased from local markets.

Methods:

Milling process: Hull-less barley was milled into flour using Brabender pilot automatic mill (mill senior Brabender, Mod. No.8802, Germany), with a milling yield of 63.7%. The fine bran was re-mixed with the flour again, and then sieved through 0.5 mm sieve to produce flour 87.2%.

Malting: Malt was produced from barley grains as described by (Aly, 1997).

Talbeena: Popular Traditional beverage "Talbeena" was prepared according to (Ibn Al Qayyim Al Jawziyyah, 1957) using some modifications to improve sensory and nutritional quality as follows: 100 ml water, 4gm flour (barley, or malt), 6 gm sugar, with or without 10 gm dried milk (skimmed or full cream "Nido") were mixed vigorously, then stirred for 5 min over moderate stove.

After that, still hot samples were subjected to the sensory and rheological analyses.

Chemical Analyses:

Moisture, ash, protein, crude fiber, and fat contents were determined according to the methods described by (A.O.A.C, 2000).

-Determination of minerals content: Sodium, potassium and Calcium were determined using flame photometer according to (Hesse, 1971). Phosphorus compound was determined using the spectrophotometric method (Jackson, 1967). Iron and zinc contents were determined according to (Puspa et al., 1994).

Determination of total β -glucan: β -glucan was determined by a non enzymatic method according to (Madacsi et al 1983).

Determination of solubility of β -glucan samples: The solubility of β -glucan (unpurified) in the native flour was determined according to the method of GaoSong and Vasanthan (2000).

Viscosity measurement: viscosity of Talbeena samples was measured with Brookfield RVDV-II+ viscometer (Brookfield, United Kingdom) including the temperature of samples at the time of measurement (40 degrees Celsius), with angular speed of 10 rpm and spindles between numbers 5 and 7. Viscosities measured at shear rate 50 s⁻¹. The shear rate was chosen as it has been shown to correlate with sensory sliminess and thickness in mouth feel as stated by (Lyly et al, 2004).

All samples evaluated sensorically by panelists were measured. Two replicate measurements per sample were conducted; and the average value of the apparent viscosity (reported as the mean shear rate of the measurement taken at 50 s⁻¹) measurements was used in the statistical analysis.

Sensory evaluation of Talbeena: Samples of Talbeena were committed to the sensory evaluation by 20 panelists from staff members of Food technology Dept., Faculty of Agriculture, Suez Canal University. Talbeena hot samples were evaluated for taste, appearance, mouth feel, and odor. The characteristics were scored on a scale of 1 to 10 as described by Lyly (2006).

RESULTS AND DISCUSSION

Chemical composition of Talbeena:

The compared determination of the proximate analysis of Talbeena raw materials shown in table (1), illustrated that, barley flour had higher protein, ash, fat, and crude fiber than malt flour; this is because of the hydrolysis during germination which characterized with high enzymatic activity. In the same table, likewise, skimmed milk had higher ash, protein, and total carbohydrates contents than full cream milk while, the later was superior in its fat content. .Proximate composition Of skimmed milk and full cream milk were confirmed by (Eckles et al, 1951). These results were in agreement with (Assem et al, 2002) who found that, chemical composition of whole barley flour showed protein content 12.9%, ash 2.95%, crude fiber 3.9% , lipids 2.43%, and total carbohydrates 76.71%. The increases in

protein and fat contents may due to that; they used whole 100% flour, beside genotype and environmental variations. Moreover, (Tamime et al, 1997) reported 2.4% ash, 12.8% protein, and 3.5% fat in barley grains.

Table (1): Chemical composition of Talbeena ingredients (gm\ 100 gm) on dry weight basis:-

Components	Moisture%	Crude Protein	Crude Fat	Ash	Crude fiber	Total Carbohydrate	Energy (kcal/100g)
Raw materials							
Barley flour	10.70 ^a ±0.16	10.89 ^a ±0.30	1.94 ^a ±0.08	2.39 ^a ±0.04	2.23 ^a ±0.11	82.55 ^a ±0.36	391.22 ^a ±13.1
Malt flour	3.31 ^b ±0.26	11.91 ^a ±0.09	1.74 ^a ±0.36	2.00 ^b ±0.03	2.01 ^b ±0.03	82.29 ^a ±0.72	392.46 ^a ±2.12
LSD / Sign (P ≤ 0.05)	0.585**	1.103 ^{N.S}	0.589 ^{N.S}	0.078**	0.016**	1.290 ^{N.S}	3.337 ^{N.S}
Skimmed milk	4.92 ^b ±0.34	32.06 ^a ±0.39	0.90 ^b ±0.08	7.96 ^a ±0.11	N.D	08.07 ^a ±0.32	373 ^b 0.61
Full cream milk	7.40 ^a ±0.32	20.40 ^b ±0.23	28.48 ^a ±0.09	6.23 ^b ±0.06	N.D	39.89 ^b ±0.22	018 ^a ±0.62
LSD / Sign (P ≤ 0.05)	0.750**	0.717**	0.193**	0.208**	--	0.631**	1.309**

Values in the same column with different letters (a & b) are significantly different (P ≤ 0.05).

All values are means of three replicates ± SD on dry weight basis.

Table (2) showed the chemical analysis of Talbeena samples for each 100 ml wet basis. Unsurprisingly, chemical composition of Talbeena samples made with barley flour high significantly differed from that made from malt flour. The crude protein, total carbohydrates and ash contents increased with the addition of skimmed milk than full cream milk, the later increased significantly fat content. Reasonably, differences were due to type of added milk, not to the type of flour. It is worthy to note that, all treatments had the same added amount of sugar.

Minerals content:

Minerals content of ingredients of Talbeena given in table (3). Concerning flour type, it could be observed that, Na, K, Ca and Zn content was higher in barley flour than malt, while there were non significant differences in the content of Fe between two flours. Differences between flour types may be due to malting process effects. Soaking in Water (steeping) leads to loss of water-soluble components especially minerals. In this concern (Tamime et al, 1997) detected lower contents in three barley varieties for Na (6.5- 7.5 mg\100g), Ca (46.5- 47.5 mg\100g), P (388- 406 mg\100g), and Zn (1.97- 2.87 mg\100g). However, higher K content (486-550 mg\100g) was detected, and nearly similar Fe content (2.34- 3.17 mg\100g), compared with these results.

Data presented also in table (3) data illustrated high significant differences in all minerals content between the skimmed and full cream milk. skimmed milk was superior in its content of all minerals than full cream milk, except Fe, which reflected higher nutritional value related to the addition of skimmed milk.

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Minerals contents of Talbeena :

Minerals content of Talbeena is given in table (4). Among flour types (control, with skimmed milk, and with full cream milk) there were non significant differences in Na, P, and Fe contents. On the contrary, differences in K, and Ca content was high significant, also, Zn showed significant difference. Treatments showed more comparative differences which is due to milk types. It could be stated that, Talbeena treatments with full cream milk were much higher in Fe content. Meanwhile, skimmed milk treatments excelled in Na, K, Ca, P, and Zn content. Control treatments were distinguished with lesser nutritional value. Barley flour was more nutritional than malt flour.

Table (4) : Minerals contents of Talbeena (mg/100ml):

Component	Macro Elements						Micro Elements		
	Na	K	Ca	P	Na/ K	Ca/ P	Fe	Zn	
Barley flour Talbeena	1	0.59 ±0.04 ^c	15.55 ±0.12 ^c	3.31 ±0.06 ^c	12.97 ±0.14 ^c	0.038 ±0.002 ^c	0.256 ±0.008 ^c	0.093 ±0.001 ^c	0.195 ±0.002 ^c
	2	40.28 ±0.86 ^a	130.24 ±2.77 ^a	127.7 ±3.82 ^a	110.73 ±3.16 ^a	0.309 ±0.008 ^a	1.153 ±0.004 ^b	0.159 ±0.002 ^b	0.781 ±0.013 ^a
	3	26.66 ±1.17 ^b	112.69 ±0.18 ^b	95.27 ±0.61 ^b	67.79 ±1.29 ^b	0.237 ±0.011 ^b	1.406 ±0.038 ^a	0.344 ±0.009 ^a	0.423 ±0.010 ^b
LSD / Sign (P ≤ 0.05)		2.66	1.47	3.53	4.74	0.02	0.07	0.02	0.03
Malt flour Talbeena	4	0.49 ±0.07 ^c	13.12 ±0.12 ^c	2.66 ±0.04 ^c	12.32 ±0.14 ^c	0.038 ±0.006 ^c	0.216 ±0.001 ^c	0.093 ±0.002 ^c	0.223 ±0.003 ^c
	5	40.19 ±0.89 ^a	127.82 ±0.77 ^a	127.04 ±1.81 ^a	110.07 ±2.16 ^a	0.315 ±0.009 ^a	1.154 ±0.001 ^b	0.159 ±0.002 ^b	0.809 ±0.011 ^a
	6	26.57 ±1.12 ^b	110.27 ±0.18 ^b	94.61 ±0.62 ^b	67.14 ±1.94 ^b	0.241 ±0.011 ^b	1.409 ±0.032 ^a	0.345 ±0.008 ^a	0.451 ±0.007 ^b
LSD / Sign (P ≤ 0.05)		2.65	1.48	3.51	4.55	0.03	0.06	0.03	0.04
Type of flour	Ns	**	**	Ns	Ns	Ns	Ns	*	
Type of liquid	**	**	**	**	**	**	**	**	
Interaction	Ns	**	**	*	*	*	Ns	*	

Values in the same column with different letters (a, b, c and d) are significantly different (P ≤ 0.05).

All values are means of three replicates ± SD.

1 = control barley flour (made with water).

2 = barley flour with Skimmed milk.

3 = barley flour with full cream milk.

4 = control malt flour (made with water).

5 = malt flour with Skimmed milk.

6 = malt flour with full cream milk.

Insoluble, Soluble and Total β-Glucan contents of Talbeena :

The β-glucan content (insoluble, soluble & total) is given in table (5). It could be observed that, the differences between barley and malt flours β-Glucan contents were high significant.

There was a noticeable decrease from 6.093% in barley flour, to 4.432% in malt flour in total β-glucan. In the same concern, insoluble β-Glucan was obviously higher in barley flour than malt flour. In contrast, soluble β-Glucan was higher in malt flour than barley flour. This is attributed mainly to the activity of β-Glucanase in β-Glucan degradation during malting process, which causes β-Glucan to break down, resulting in molecules that are more soluble and lesser total content. Data presented in table (5) could

be read as percentage of solubility as follow, the highest β -Glucan solubility% was recorded in malt flour 68.43%, while barley flour was 33.97%. Insoluble β -Glucan showed higher percentage in barley flour 66.03% than malt flour 31.57%. Concerning β -Glucan content in Talbeena treatments, data is shown in the second part of the same table. Similar trends were noticed. The similar solubility percentages of both raw flour and product might be due to the reversible effect of heating on β -Glucan physical properties (*Dawkins and Nnanna, 1995*). Differences in Solubility of β -Glucan between the two flours could be attributed to due to the hydrolysis during malting. This was in match with (*Andersson et al, 2004*) who reported that, the whole-meals fractions of barley content of β -glucan ranged between 4.2–5.8%, the water-extractability of β -glucan was also 55–63%.

Table (5): Insoluble, Soluble & Total β -Glucan contents of Talbeena (gm/ 100 ml):-

Components		Insoluble β -Glucan	Soluble β -Glucan	Total β -Glucan	% Insoluble β -Glucan	% Soluble β -Glucan
* Raw materials	Barley flour	4.023 ± 0.097	2.069 ± 0.007	6.093 ± 0.104	66.03 ± 0.47	33.97 ± 0.47
	Malt flour	1.399 ± 0.206	3.033 ± 0.049	4.432 ± 0.186	31.57 ± 1.25	68.43 ± 1.25
LSD / Sign ($P \leq 0.05$)		0.278**	0.061**	0.261**	4.02**	4.02**
•Treatments	Barley flour	0.161 ± 0.004	0.083 ± 0.001	0.244 ± 0.004	65.98 ± 0.47	34.01 ± 0.47
	Malt flour	0.056 ± 0.008	0.121 ± 0.002	0.177 ± 0.007	31.64 ± 1.25	68.36 ± 1.25
LSD / Sign ($P \leq 0.05$)		0.011**	0.003**	0.011**	4.02**	4.02**

Values in the same column with different letters (a & b) are significantly different ($P \leq 0.05$).

* All values are means of four replicates \pm SD on dry weight basis.

• All values are means of four replicates \pm SD (gm/ 100 ml).

Also, these findings are in agreement with (*Bathgate et al, 1974*) who suggested that the initial release of β -glucans was affected by endo- β - (1, 3)-glucanases, which are found in steeped barley. Carboxypeptidases (β -glucan solubilases) are also involved in the release of β -glucans (*Bamforth, 1981*). Since β -glucans are associated with proteins and phospholipids proteases and phospholipidases may also be involved in the release of β -glucans from the endosperm cell walls (*Palmer, 1975*). That explains why the United States Food and Drug Administration (FDA) authorized use of a health claim for the role of β -Glucan soluble fiber from barley in reducing the risk of coronary heart diseases, while didn't approve malt products to be eligible for the claim (*FDA, 2006*).

Concerning malting in the recent study, it is worthy note that the chemical composition of β -glucan from partially modified (2-day germination) malt is similar to that of β -glucan extracted from barley, but the physical properties and the enzyme susceptibilities are not similar. β -glucan extracted from malt germinated for 2 days is more viscous and "retrogrades" from solution to gels or precipitates more readily, because of prolonged degradation of macromolecules, while, the extended germination time

glucans as a function of concentration (Lyly, 2006). However, it is difficult to separate the pure effect of β -glucan viscosity from other exist hydrocolloids, as flour contain proteins, starch and other minor carbohydrates, on the measured viscosity. Partially, it could be correlated to the recorded differences in β -glucan content of flours. The viscosity of β -glucan temporarily decrease with increased temperature (Dawkins and Nnanna, 1995), but the effect of temperature on viscosity of β -glucan is reversible. Similarly, Burkus and Temelli (2005) observed reversible drop in viscosity with temperature in laboratory prepared barley β -glucan solutions. Thus, it is possible to use hot beverages as a carrier of health benefits of barley β -glucan without negatively affecting its properties by processing, as the product would have decreased temperature during drinking.

It is important to remember that health benefits of barley β -glucan are linked to its viscosity. As the higher viscous β -glucan gel, the higher cholesterol blood glucose lowering effectiveness (Wood et al, 2000). Therefore, instrumental viscosity is crucial for achieving the healthy effects claimed to barley products. Thus, we can state that, Talbeena made from barley flour had the health functions claimed for barley β -glucan.

Sensory evaluation of Talbeena:

From table (7), it is evident that, barley flour Talbeena was better than that of malt flour. Concerning color, appearance and .Color in Malt flour characterized with darker color that is due to browning reactions during drying step of malt .Malt flour was higher than barley flour Talbeena in taste, mouth feeling and odor.

Table (7): Sensory evaluation of Talbeena:

Characteristics Treatments		Color (20)	Odor (20)	Taste (20)	Mouth feel (20)	Appearance (20)	Overall (100)
Barley flour	1	13.00 ±1.02	13.42 ^c ±1.27	12.00 ^c ±1.41	12.43 ^c ±1.87	13.57 ^c ±1.71	64.42 ^c ±2.99
	2	16.71 ^b ±1.38	15.28 ^b ±1.11	14.50 ^b ±1.71	16.28 ^b ±1.75	16.43 ^b ±1.83	79.22 ^b ±3.33
	3	18.50 ^a ±0.96	17.85 ^a ±1.35	16.85 ^a ±1.21	18.43 ^a ±1.97	18.71 ^a ±1.11	90.36 ^a ±3.81
LSD / Sign (P ≤ 0.05)		1.27	1.41	1.82	2.03	1.43	5.60
Malt flour	4	12.93 ^c ±1.36	13.78 ^c ±0.96	13.78 ^c ±1.23	14.07 ^c ±1.31	13.14 ^c ±1.46	67.71 ^c ±4.61
	5	15.50 ^b ±1.97	15.64 ^b ±1.05	15.86 ^b ±1.03	15.14 ^b ±1.63	15.71 ^b ±1.65	77.86 ^b ±3.61
	6	17.36 ^a ±1.49	18.42 ^a ±1.13	18.28 ^a ±1.11	18.71 ^a ±1.13	17.92 ^a ±1.83	90.71 ^a ±3.46
LSD / Sign (P ≤ 0.05)		1.84	1.65	1.26	1.64	1.59	5.69
Type of flour		Ns	Ns	**	Ns	Ns	Ns
Type of liquid		**	**	**	**	**	**
Type of flour* liquid		Ns	Ns	*	Ns	Ns	Ns

Values in the same column with different letters (a, b, c and d) are significantly different (P ≤ 0.05).

All values are means of 15 replicates ± S on dry weight basis D.

1 = control barley flour (made with water).

2 = barley flour with Skimmed milk.

3 = barley flour with full cream milk.

4 = control malt flour (made with water).

5 = malt flour with Skimmed milk.

6 = malt flour with full cream milk.

This could be explained by considering the effect of malting and drying processes on the formation and release of aroma compounds. In all treatments overall acceptability was significantly improved by the addition of full cream milk, due to its high content of fatty acids and other components responsible for aroma, followed by skimmed milk.

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دراسات كيميائية وريولوجية علي التلبينة كمشروب تقليدي صحي
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تهدف هذه الدراسة إلى بحث إمكانية إنتاج التلبينة باستخدام دقيق الشعير الكامل ودقيق المولت مع حليب منزوع الدسم، أو الحليب كامل الدسم، مقارنة مع الكونترول (بالماء فقط). تمت دراسة المحتوى الكيميائي بجانب محتوى وذوبانية البيتا جلوكان والمحتوى المعدني (الصوديوم، البوتاسيوم، الكالسيوم، الفوسفور، الحديد، والزنك)، في كل من المواد الخام والمنتج. وتم قياس اللزوجة كخاصية ريولوجية هامة ومؤشرا قويا على خواص β -glucan الوظيفية. تم تقييم جميع المعاملات حسيًا. وأظهرت النتائج التي تم الحصول عليها أن دقيق الشعير أعطى أعلى محتوى من الرماد، الألياف الخام والدهون مقارنة بدقيق المولت. وعلاوة على ذلك، أعطت التلبينة المصنعة من دقيق الشعير أعلى محتوى من العناصر المعدنية مقارنة مع تلبينة المولت. وأظهرت النتائج أن المولت ومعاملاته سجل أدنى محتوى للبيتا جلوكان في حين زادت نسبة الذوبانية فيه مقارنة بدقيق الشعير ومعاملاته. تلبينة الحليب منزوع الدسم سجلت أعلى محتوى من الكربوهيدرات والبروتين والرماد محتوى فضلا عن محتوى العناصر المعدنية مقارنة مع تلبينة الحليب كامل الدسم، والذي كان أعلى في محتوى الحديد فقط. قياس اللزوجة اظهر اعلي قيم للتلبينة المصنعة من دقيق الشعير الكونترول وكذلك مع اللبن الفرز، بينما سجلت معاملات المولت اقل قيم للزوجة. التقييم الحسي لعينات التلبينة اظهرت تفوق التلبينة المصنوعة من دقيق المولت واللبن كامل الدسم علي جميع المعاملات الاخرى. وبمراعاة محتوى وحدة التقديم من كل معاملة من البيتا جلوكان يمكن القول إن تلبينة دقيق الشعير تغطي الاحتياجات اليومية المطلوبة لتحقيق الفوائد الصحية المنسوبة لبيتا جلوكان الشعير.

