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UTILIZATION OF TARHANA AS A PRO - AND PREBIOTIC FOOD IN EGYPT

BY

Hemat, E. Elsheshetawy* and Nessrien, M.N. Yasin*

* Food Science Dep., Fac. of Agric, Ain Shams Univ., Shoubra El- Kheima, Cairo, Egypt

ABSTRACT

Tarhana, commonly consumed as a soup, is a traditional Turkish fermented food made from cereal, various vegetables with using yoghurt bacteria and baker's yeast as a fermentation culture. This study is a trial to use this product as a pro - and prebiotic material in food diets in Egypt. Barley, wheat / barley (1:1) and wheat were used to produce tarhana samples with relatively high β-glucan contents. Physico-chemical, microbial and sensory properties of tarhana samples were investigated and compared with the traditional wheat tarhana. The use of barley significantly ($p < 0.01$) affected the tristimulus color properties of dried tarhana samples. The lactic acid bacteria count was increased with the addition of barley to wet tarhana formula. However, the overall sensory analysis results indicated that the utilization of barley alone or combined with wheat resulted in significant ($p < 0.01$) acceptable tarhana chicken soup sensory properties.

Key words: Tarhana – probiotic food – prebiotic food – fermentation – color measurements - LAB bacteria.

INTRODUCTION

Fermented food played an important role in the diets of many people in the Middle East. One such product, tarhana is widely consumed in Turkey and forms a significant part of the diet especially for infants and young children as well as for elderly. Tarhana is a traditional Turkish fermented cereal food product both commercially and in homes. It's mainly used in the form of a thick and creamy soup consumed at lunch or dinner and is easily digested as mentioned by Siyamoglu (1961) and Bilgiçli and Elgün (2005).

Tarhana dough (wet tarhana) is prepared by mixing wheat flour, yoghurt, salt, baker's yeast, various vegetables and spices; followed by lactic and alcoholic fermentation for 1-7 days and the dough was then dried in the sun or by oven to obtain dry tarhana. Finally, it is ground into powder, smaller than 1mm (Erbaş *et al.*, 2006). The nutritional properties, aroma and flavor of tarhana dough can be improved by fermentation since lactic acid bacteria from the yoghurt also aid in absorption of nutrients which would otherwise be indigestible or poorly digestible so, it is a good source of lactic acid bacteria. Also, it has an acidic and sour taste with a yeasty flavor, in the same time it has low moisture content and low pH so it can be stored for 2-3 years without any sign of deterioration as published by Ibanoğlu and Ibanoğlu (1999) and has a bacteriostatic effect on pathogenic microorganisms (Dağlioğlu *et al.*, 2002). Similar products are known as tarhana in Greece, kishk in Egypt, kushuk in Iraq and "tahanya/talkuna" in Hungary and Finland (Farnworth 2003, Hayta, *et al.*, 2002 and Köse and Çağindi, 2002). Tarhana is a good source of vitamins such as thiamine, riboflavin and vitamine B12 (Ibanoğlu *et al.*, 1995), while ascorbic acid, niacin, pantothenic and folic acid are also present (Ekinci, 2005).

Probiotic food (contained lactic acid bacteria) has been reported to play therapeutic roles by modulating immunity, lowering serum cholesterol, improving lactose tolerance and preventing cancer (Kailasapathy and Chin, 2000). Lactic acid bacteria is a normal component of the intestinal microflora in both humans and animals and has been associated with various health-promoting properties. For this reason, there has been much interest in developing food products containing this bacterial group as dietary adjunct (Young, 1998 and Naidu *et al.*, 1999).

In general, tarhana is produced with white-wheat flour. A part from having a nutritive value comparable to white - wheat, barley is unique among cereals containing high concentrations of β-glucan which is known to have a cholesterol lowering effect (McIntosh *et al.*, 1991), regulating blood glucose level and insulin response in diabetics (Jacobs *et al.*, 1998). Although barley is the fourth most important cereal in the world in terms of total production after wheat, rice and corn (Jadhav *et al.*, 1998), taste and appearance factors along with its poor baking quality have limited its use in human food. However, in recent years there has been a growing research interest for the utilization of barley in a wide range of food applications as mentioned by Erkan *et al.* (2006).

Finally, there was a lack of or no literature on the production and utilization of tarhana as a pro and prebiotic product in Egypt, so, the main objective of this study was to produce a probiotic (containing yoghurt LAB), prebiotic (containing β-glucan and fibers) fermented product called tarhana with investigation of its properties as well as the use of its dried form to enrich a food product like chicken soup.

MATERIALS AND METHODS

1-Materials

Wheat flour, yoghurt, dried baker's yeast, tomato paste, green as well as red pepper, onion, and salt were purchased from local markets in Cairo. Barley (*Hordium vulgare L.)* whole meal used in this study was obtained from barley research section, Field Crops Research Institute, Agric. Research Center, Giza, Egypt. Wheat flour was used to prepare common tarhana and barley whole meal was used to prepare barley tarhana. In addition, wheat flour/barley tarhana was prepared using the wheat flour and barley whole meal at the ratio of 1:1. Chicken soup base called Knorr was purchased from local market in Cairo with these ingredients (salt–food enhancer-flavors–vegetable fat–sugar-maltodextrin-dehydrated onion-parsely-caramel- curcuma-oleoresin).

2-Preparation of tarhana

Tarhana samples were prepared accor-ding to the method of Erkan *et al.* (2006) with omit of paprika to ingredients of tarhana as mentioned in Table (1). To prepare tarhana samples, onions, green and red peppers were chopped in a food processor (Toshiba). Tomato paste and salt were added and the mixture was blended. Flour, yoghurt and baker's yeast were added to the mixture and blended until complete homogenization. The resulting mixture was filled into covered containers and fermented at 30°C for 7 days. Samples were taken at the end of fermentation for the determination of acidity, pH and microbiological analysis. After fermentation, the tarhana was dried at 30 °C for 24 h and then was ground. Dried samples were analyzed for: chemical composition, β- glucan content, color measurements and its content of LAB.

Table (1): Recipe used for preparation of tarhana samples

Ingredients	Amount (g)
Flour*	750
Yoghurt (from cow's milk)	600
Tomato paste	112
Green pepper	75
Red pepper	75
Onion	180
Baker,s yeast	15
Salt	60

*Wheat, wheat /barley (1:1), barley.

3-Physico-chemical analysis

Moisture, ash, crude fat and protein contents of tarhana samples were determined according to AACC Methods (AACC, 2000). pH was determined at the end of fermentation by blending tarhana sample with distilled water (1:10) and the pH values of the suspensions were determined with pH meter (HANNA- Instrument, USA). Acid formation at the end of fermentation was determined by titration using 0.1 N NaOH and expressed as lactic acid percent (Kirk and Sawyer, 1991). β- Glucan contents of tarhana samples were determined by McCleary and Codd (1991). Color parameters of the tarhana powders were determined according to tristimulus color system described by Frandis, (1983) using a Spectrophotometer (MOM, 100 D, Hungary). Co or coordinates X, Y and Z were converted to corresponding Hunter L, a, b color coordinates according to formulas given by the manufacture. Hue angle (which represent the dominating color) was calculated from arctan (b/a) and chroma values were calculated from $(a^2+b^2)^{1/2}$ and total color intensity $(a^2+b^2+c^2)^{1/2}$.

4-Microbiological analysis

At the end of fermentation eleven gm of each tarhana sample, was added to 99ml sterile peptone water, then appropriate dilutions of sample were prepared in sterile peptone water blank and plated in duplicate on the following growth media and incubation conditions: a) de Man Rogosa Sharpe (MRS) agar at 30 °C/ 48-72h for lactic acid bacteria (LAB), b) nutrient agar at 30°C / 48h for total viable count (TVC), c) dextrose and potato agar at 25°C / 48h for yeasts. In the same pattern 11 ml sample of each chicken tarhana soup, after sensory evaluation (15 min), was diluted and used to determine the count of LAB. The results were expressed as log cfu/g sample.

5- Sensory evaluation:

Chicken soup samples were prepared by adding tap water to 6% dried soup base. These soup samples were heated gently, while stirring, until they boiled, then they were simmered for 5 min and finally cooled to 40°C. Each dried tarhana sample was added by 40g to 500ml of chicken soup at 40°C to maintain lactic acid bacteria. The soup samples were coded with letters and 100 of each was poured into coded bowels whose volumes were approximately 150ml each. The attribute descriptor ranges were taste, odor, color, flavor, sourness, powderness and overall acceptability. The soups were evaluated by a panel group of 10 members, randomly selected from the staff members of the Food Science Dep., Fac. of Agric., Ain Shams University, Cairo, Egypt. The acceptability of each sample was scored on 10-point hedonic scale (1= extremely disliked, 10= extremely liked) (Erkan, *et al.*, 2006).

6-Statistical analysis

Experimental data were analyzed for variance (ANOVA) and significant differentces among the means were determined by Duncan's multiple - range test using the Statistical Analysis System (SAS, 1996) computer program.

RESULTS AND DISCUSSION

Chemical characteristics of tarhana samples:

Chemical characteristics of dried tarhana samples are presented in Table (2). The moisture content of dried tarhana samples varied between 13.78 and 17.47%. Barley dried tarhana had the highest moisture content which reached 17.47% followed by wheat/ barley tarhana (1:1) being 15.2%. This may be due to existence of higher fiber contents in barley grain. It was previously reported that the variation in moisture content of tarhana samples was due to the properties of ingredients used in the formulation and drying method (Temiz and Pirkul, 1991).

Wheat tarhana had the lowest protein content (12.37%) while the barley tarhana had the highest significant ($p < 0.01$) protein content (14.94%). Since the type and amount of yoghurt samples used in this study were the same for all tarhana samples, it can be concluded that the reason for the variation of protein contents is due to the type of flour used in tarhana preparation. These results are in accordance with those of Erkan *et al.* (2006) who stated that barley has the highest protein content being 13.4% while it was only 11.6% in wheat flour. The percentage of fat in barley tarhana was considerably higher (4.95%) than that in both of wheat/ barley (4.08%) and wheat tarhana (3.56%). This could be attributed to the source of the fat content of barley, wheat flours and in yoghurt (Rasic and Kurmann, 1978). The ash contents of tarhana samples ranged from 1.79 to 2.56%. Wheat tarhana sample had the lowest ash content while the barley tarhana had the highest value as expected from the ash contents of whole barley grain. These results go in parallel with those of Erkan *et al.* (2006).

The acidity values of wet tarhana samples ranged between 2.11 and 3.18%. Wheat / barley wet tarhana had the highest significant (p < 0.01) acidity value, whereas there was no significant difference between the acidity of wheat tarhana and barley tarhana. Wet tarhana samples used in this research had pH values between 4.63 and 4.95. Both bacteria and yeast in yoghurt and wheat flour are the main factors of fermentation and production the organic acids which reduced the pH values as mentioned by Ekinci, (2005). So, it could be stated that, different tarhana samples have a bacteriostatic effect towards pathogenic microorganism because of its low pH (Dağlioğlu, 2000; Dağlioğlu *et al.*, 2002 and Bilgiçli *et al.*, 2006).

Table (2): Proximate chemical composition (mean ± SE) on dry basis of tarhana samples:

Tarhana samples made with	Chemical composition					
	Moisture%^{A}	Protein%^{A}	Fat%^{A}	Ash%^{A}	pH^B	Acidity^B
Wheat	13.78^b ±0.41	12.37^c ±0.27	3.56^c ±0.404	1.79^b ±0.92	4.63^a ±0.04	2.11^b ±0.10
Wheat / barley	15.20^a ±0.90	13.07^b ±0.40	4.08^b ±0.361	1.89^b ±0.82	4.78^b ±0.06	3.18^a ±0.36
Barley	17.47^a ±0.77	14.94^a ±0.66	4.95^a ±0.404	2.56^a ±0.66	4.95^c ±0.03	2.48^b ±0.24

Means with the same superscript letter within the same parameter are not significantly different (p > 0.01).
A: parameters were determined on dried tarhana.
B: parameters were determined at the end of fermentation.

ß- Glucan contents of dried tarhana samples:

There are statistically significant (p< 0.01) differences between ß- glucan contents of tarhana samples (Table 3). Wheat tarhana sample had the lowest ß- glucan content (0.33%) while the barley tarhana had the highest value (3.59%). Aman and Graham (1987) and Storsely *et al.* (2003) stated that hull - less barley is a good source of non – starchy poly saccharides especially ß- glucan content which ranged between 4 and 10% (Bhatty, 1999), while Erkan *et al.* (2006) found that it was only 0.43% in wheat flour. So, a parallel relationship exists between the ß- glucan contents of flour samples and those of tarhana samples. On the other hand, ß-glucan contents of tarhana samples were lower than those of flour samples. It was reported that there was obvious decrease in total and soluble ß- glucan contents of cereal flours during fermentation. The main reason for decrease in ß- glucan content has been thought to be the degradation of ß- glucan by lactic acid bacteria during fermentation (Skrede *et al.* 2002 and Skrede *et al.*, 2003). As found from the results, barley is a good source of ß-glucan and could be considered a prebiotic food as published by Seidel *et al.* (2007).

Table (3): ß- Glucan contents (%) of different dried tarhana samples

Dried tarhana samples	ß- Glucan contents (%)
Wheat tarhana	0.33^{c}
Wheat / barley tarhana	2.63^{b}
Barley tarhana	3.59^{a}

Means with the same small superscript letter are not significantly different ($p > 0.01$).

Color measurements of different dried tarhana:

The color of different dried tarhana samples are presented in Table (4), from these results it could be found that there were significant differences ($p < 0.01$) between color values of tarhana samples. Lightness (L-values) were significantly ($p < 0.01$) increased by incorporating barley in the manufacture of tarhana. On the other hand, use of barley only in the process resulted in a significant ($p < 0.01$) decrease in lightness of the product. Accordingly, the use of barley changed the a-value of the tarhana products to be less greenish and more yellow (higher b–values). Furthermore, the hue angle and the chroma of the product moved to the significant ($p < 0.01$) increased yellow / white color shade. Total color intensity of the barley tarhana was significantly ($p < 0.01$) lower than those processed from either barley or wheat flour.

In conclusion, partial substitution of wheat with barley enhanced the tristimulus color parameters of the end fermented product. The obtained results agree with those reported by Erkan *et al.* (2006).

Table (4): Tristimulus color analysis of different dried tarhana samples:

Tarhana samples made with	Tristimulus color parameters					
	L*	a*	b*	Hue angle	Chroma	Total color intensity
Wheat	79.16^{b}	6.2^{a}	20.1^{c}	72.75^{c}	21.05^{c}	81.91^{a}
Wheat / barley	81.73^{a}	4.15^{b}	25.04^{a}	80.59^{a}	25.38^{a}	85.58^{a}
Barley	71.21^{c}	4.6^{b}	22.0^{b}	78.19^{b}	22.48^{b}	74.67^{b}

*L, whiteness; a, redness, greenness; b, yellowness and blueness

Means with the same small superscript letter within the same parameter are not significantly different ($p > 0.01$).

Microbiological analysis:

1-Wet tarhana samples:

Lactic acid fermentation was utilized primarily to increase the shelf life of food products. Results illustrated in Fig (1) and Table (5) clearly show that the lowest number of (LAB) was observed at the end of fermentation of wheat tarhana sample being 11.9 log cfu/g. Lactic acid bacteria (LAB) count was increased by 7.3% reaching 12.78 log cfu/g when wheat / barley tarhana was used, while, it was only 3.36% with barley tarhana. A little increase was observed in the total viable count of wheat / barley tarhana being 9.7 log cfu/g with an increase percentage than that of wheat tarhana by 3.2%, while the same count was detected even in wheat tarhana and wheat / barley tarhana.

On contrary, yeast showed a lower growth in barley tarhana (5.92 log cfu/g) while the higher number was observed with wheat tarhana (6.88 log cfu/g) followed by wheat/barley tarhana (6.5 log cfu/g) with an increment percentage of 16.22 and 9.8%, respectively as compared with barley tarhana.

From the previous results, it could be concluded that lactic acid bacteria growth was much better with barley rather than with that of wheat tarhana, while yeast grow well with wheat tarhana.

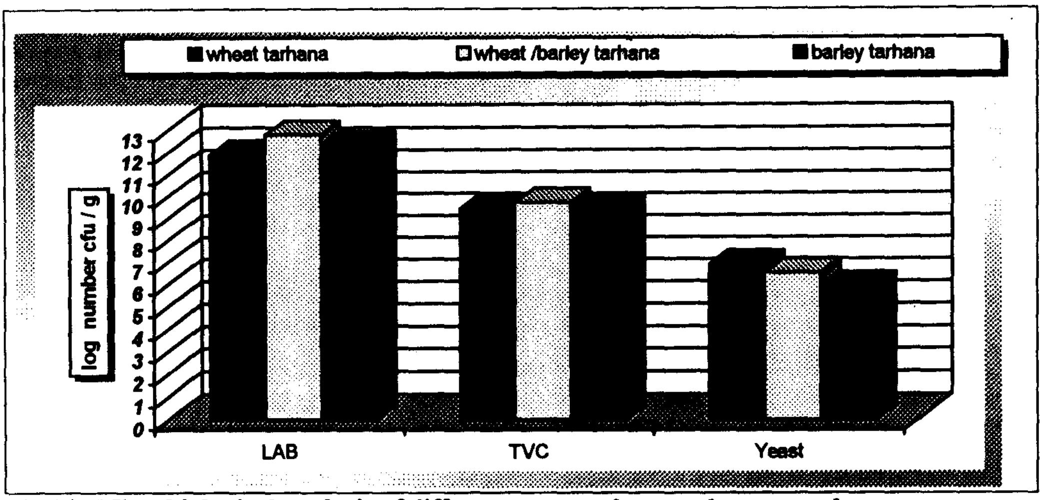

Fig (1): Microbiological analysis of different prepared wet tarhana samples

2- Dried tarhana samples:

It is established that drying of tarhana samples affects lactic acid bacterial activity. Results presented in Table (5) clearly exhibited a negative relation between the number of LAB and the drying of tarhana samples. The highest decrement percentage was observed in dried wheat tarhana being 47.23%, while the lowest one was observed in dried wheat / barley tarhana being 38.97%.

Table (5): Effect of drying on the survival of lactic acid bacteria

Tarhana samples made with	Log number of lactic acid bacteria (cfu / g)		Decrement %
	Before drying	after drying	
Wheat	11.90	6.28	47.23
Wheat / barley	12.78	7.80	38.97
Barley	12.30	7.00	43.09

3- Chicken soups enriched with dried tarhana samples:

It could be noticed that, the number of LAB was 5.45, 6.64 and 6.26 log cfu/g for wheat, wheat / barley and barley tarhana chicken soups, respectively (Fig, 2). The high number of LAB in tarhana soups made with barely alone or in combination with wheat could be due to the presence of β-glucan which acts a prebiotic substance for LAB. For this reason wheat / barley or barley tarhana chicken soups could be used as a pre - and probiotic food.

Sensory characteristics of different chicken soups enriched with dried tarhana samples:

Chicken soups enriched with different tarhana samples were sensory evaluated. The mean of score values are presented in Table (6). Taste of the tarhana soups had values between 8.3 and 9.7. Odor of the tarhana soups varied between 7.6 and 9.1. Soup enriched with barley tarhana gave a significant ($p < 0.01$) lower color score (6.2). The effect of different flours on both flavor and sourness values of tarhana soups showed a low significant difference. On other words, all of the soups were comparable in terms of taste, odor, flavor and sourness values. The results of the overall sensory analysis showed that utilizetion of wheat/ barley in tarhana prepa-ration resulted in acceptable soup properties in terms of all the sensory properties. These results are in accordance with those of Erkan *et al.* (2006).

The lowest score for overall acceptability of chicken soup (control) could be attributed to the lake of this soup to the taste, odor, color, flavor and sourness found in different tarhana soups.

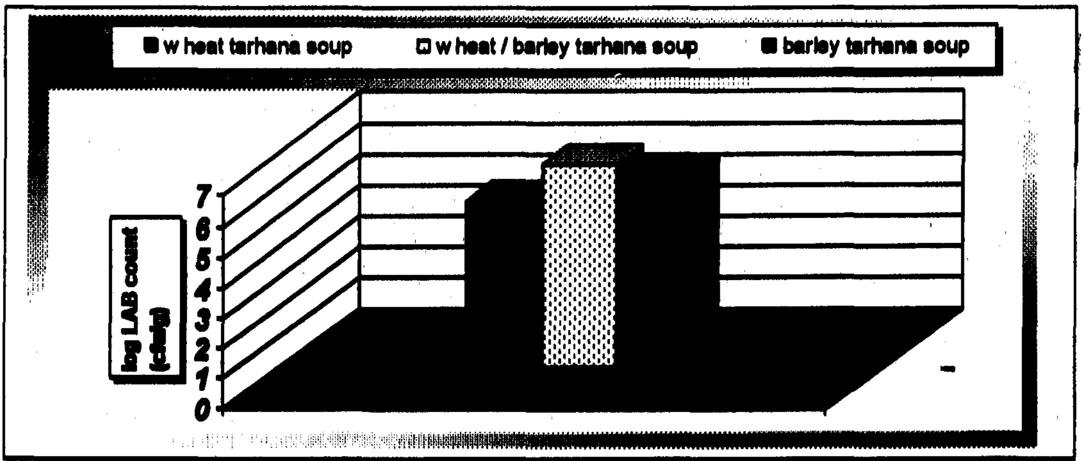

Fig (2): Number of lactic acid bacteria in different tarhana chicken soups

Table (5): Sensory evaluation scores of different chicken soups enriched with tarhana

Soups	Taste	Odor	Color	Flavor	Sourness	Powder-ness	Overall acceptability
Chicken (control)	7.6^{c} ±0.52	7.5^{b} ±0.53	5.3^{c} ±0.46	5.6^{c} ±0.64	5.9^{c} ±0.74	9.5^{a} ±0.53	8.0^{c} ±0.82
Wheat tarhana	8.3^{b} ±0.68	7.7^{b} ±0.82	8.1^{b} ±0.74	7.5^{b} ±1.08	7.9^{b} ±0.88	8.5^{b} ±0.53	8.7^{b} ±0.48
Wheat / barley tarhana	9.7^{a} ±0.48	8.6^{a} ±0.52	9.5^{a} ±0.53	8.5^{a} ±0.53	9.4^{a} ±0.52	9.5^{a} ±0.53	9.8^{a} ±0.42
Barley tarhana	8.8^{b} ±0.92	9.1^{a} ±0.73	6.2^{c} ±0.63	8.2^{a} ±0.42	8.1^{b} ±0.88	7.6^{c} ±0.52	8.5^{bc} 0.85

Means with the same small superscript letter within the same parameter are not significantly different ($p > 0.01$).

CONCLUSION

Barley tarhana is not only used as a prebiotic food, but also it could be used as a probiotic food by fortification with yoghurt. Barley whole meal was utilized in tarhana production as a source of β-glucan and in the same time yoghurt LAB, was used in tarhana formula, as a probiotic. Barley could be used alone or together with wheat in tarhana production. The level of β-glucan content was higher in barley tarhana sample than that in wheat tarhana sample. The overall sensory analysis showed that utilization of barley in tarhana preparation resulted in more acceptable chicken soup properties than control soup (without tarhana).

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إستخدام التارهانا كغذاء بروبيوتيك وبريبيوتيك في مصر

همت الششتاوى الششتاوى ، نسرين محمد نبيه يسن
قسم علوم الأغذية– كلية الزراعة – جامعة عين شمس – شبرا الخيمة – القاهرة – مصر

يعتبر التارهانا منتج شعبي تركى متخمر ويستهلك كحساء ويصنع من الحبوب وبعض الخضراوات مع إستخدام بكتريا الزبادى وخميرة الخباز كمزرعة للتخمير. وهذه الدراسة عبارة عن محاولة للإستفادة من هذا المنتج وأستخدامة كمنتج بروبيوتيك وبريبيوتيك هنا فى مصر. تم إستخدام مجروش الشعير مع خليط من دقيق القمح ومجروش الشعير بنسبة (١:١) لإنتاج التارهانا لتكون مرتفعة نسبيا من محتواها من بيتا – جلوكان. تم أختبار الخصائص الفيزيوكيميائية والميكروبية وكذلك الحسية لعينات التارهانا المختلفة وقورنت بتلك المصنعة من دقيق القمح العادية وأيضا تم تقدير المحتوى من البيتا – جلوكان لعينات التارهانا المختلفة.

أظهرت النتائج أن إستخدام مجروش الشعير قد أثر بمعنوية على صفات اللون لعينات التارهانا المجففة وكذلك أعداد بكتريا حمض اللاكتيك قد ازدادت مع هذه الزيادة وذلك لعينات التارهانا الرطبة ودلت التحليلات للصفات الحسية أن إستخدام مجروش الشعير بمفردة أوكخليط مع دقيق القمح فى الخلطة قد أثر بمعنوية فى زيادة تقبل عينات شوربة دجاج التارهانا.