The Effects of the Addition of Baker's Yeast on the Functional Properties and Quality of Tarhana, a Traditional Fermented Food

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Abstract

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As a fermented product, tarhana is the dry form of yogurt-cereal mixture and represents an important part of the diets of many people in different countries including Turkey. In the present study, the effects of the addition of baker's yeast on the quality and functional properties of tarhana were investigated. Tarhana was produced under laboratory conditions (uncontrolled and controlled conditions) using two formulas. Some physicochemical, functional, and sensory properties of the samples were analysed. An increase was found in the acidity value of all samples during the fermentation period. The addition of baker's yeast affected the functional properties (water absorption capacity, foaming capacity, foaming stability, emulsifying activity) of the samples ($P < 0.05$). The tarhana samples produced by the addition of yeast and under controlled conditions had shorter fermentation times and better sensory properties. This research suggests that the addition of baker's yeast and the employment of controlled conditions can be recommended in the production of the commercial type of tarhana.

Keywords: soup; fermentation; tarhana; yeast; flour

Tarhana, a popular traditional fermented food product in Turkey, is prepared by mixing yoghurt, wheat flour, and a variety of vegetables and spices (tomatoes, onions, salt, mint, and paprika) followed by fermentation (Siyamoglu 1961; Maskan & Ibanoglu 2002). After the fermentation, tarhana has an acidic and sour taste with a strong yeasty flavour, and it can be readily reconstituted for soup making. It is a good source of proteins, vitamins, and minerals, and therefore it is used largely for feeding children and elderly people (Ibanoglu & Ibanoglu 1999a). The products similar to Turkish tarhana are known as trahana in Greece, kishk in Egypt, kushuk in Iraq, and tahonya/talkuna in Hungary and Finland (Youssef 1990; Ibanoglu & Ibanoglu 1998, 1999b). There are four types of tarhana in Turkey, namely "flour tarhana", "goce tarhana", "semolina tarhana" and "mixed type tarhana" (Anonymous 1981). The technique of tarhana production is nearly the same in every country. There are only some differences in the formulas according to the traditions and habits (Ibanoglu & Ibanoglu 1998).

Tarhana is a dried product, which can be easily prepared and stored. Lactic acid bacteria and yeasts present in the spontaneous microflora of tarhana ingredients are the main microorganisms responsible for the fermentation and leavening effects. Throughout fermentation, lactic acid bacteria and yeast give characteristic taste, flavour, and some functional properties of tarhana by producing lactic acid, ethanol, carbon dioxide, and some other organic compounds as a result of carbohydrate and protein consumption (Temiz & Pirkul 1990).

Acid fermentation occurs together with the volatile acids and ethanol production. Although these compounds are removed by the drying process, they contribute to the formation of the desired taste and flavour of tarhana. Tarhana fermentation also causes some protein break-down to a limited extent, possibly due to the proteolytic activity of lactic acid bacteria and baker's yeast (Steinkraus 1983).

Sourdough is used as a yeast source during home-made (traditional) production. Tarhana types of different quality can be produced due to the complex microflora of sourdough. For this reason, the investigation of the effect of baker's yeast will be useful to avoid the fermentation risks and reduce the fermentation time. Thus, the objective of this research was to study the effects of the yeast addition on the functional properties and quality of tarhana. Changes were analysed during fermentation of acidity, ash, viscosity, and other functional properties such as water absorption capacity, foaming capacity, or foam stability of dried samples. Finally, tarhana soup was prepared and panel tests were made.

MATERIAL AND METHODS

Materials. Commercial wheat flour type 550 with the moisture content of 13%, protein content of 11%, and ash content of 0.53%, on dry basis, was used. The yoghurt used was full fat (4% wet basis) made from cow's milk. Compressed baker's yeast in wet form, onion, tomato, green and red peppers, dry mint, and salt were purchased from local markets in Denizli, Turkey. The ingredients used in tarhana are given in Table 1.

Table 1. Ingredients of tarhana

Ingredient	% (w/w)
Flour	35
Yoghurt	25
Onion	12
Tomato	10
Red pepper	6
Green pepper	5
Dry mint	5
Salt	2

Preparation of tarhana. The flow sheet of the production of tarhana is given in Figure 1. In addition to the ingredients given in Table 1, 1% of yeast was used in the formula of the tarhana mixture containing yeast. Tomato, green pepper, and onion were chopped into pieces before their addition to the tarhana mixture. All ingredients except flour and yeast were first mixed, and the mixture was left for a day under the room conditions to become sour. At the end of that day, wheat flour was added and mixed in. To get the formulas containing either yeast or no yeast, the tarhana mixture was divided into 2 pieces. The halves of the samples which either contained yeast or did not contain yeast were fermented at 23°C under controlled conditions while the other halves were fermented under uncontrolled conditions (Ozbilgin 1983). Fermentation was continued for 15 days. The

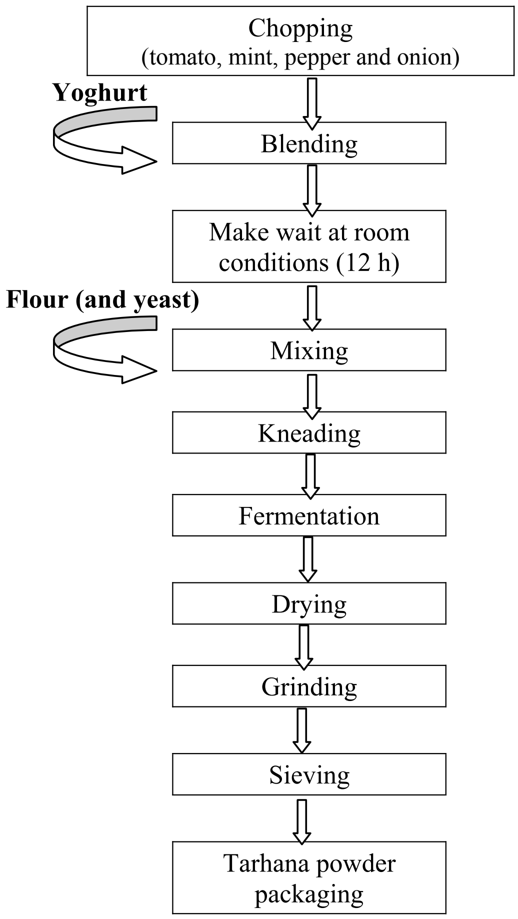


Figure 1. Flow sheet for the preparation of tarhana

samples were dried after the fermentation. The samples fermented under controlled conditions were dried at 50 ± 2°C in an incubator and the samples fermented under uncontrolled conditions were dried under the room conditions. The dough was divided into pieces of 1–2 cm thickness for drying; to make the drying easier, those small pieces were sometimes broken into smaller pieces during drying. The drying process was continued until the moisture content decreased to 15%. The samples were then milled in a hammer mill to the size of 190 microns to standardise the sizes. Then, samples were put into polyethylene packing materials and stored at 20°C.

Determination of ash content and acidity value. 1 g of the dried sample was incinerated at 550 ± 15°C in a muffle furnace until the constant weight was obtained. The acidity value analysis was made by the method given by the Turkish Standard Institute (TSE 2282 – Anonymous 1981). The acidity value was determined by neutralising the acids dissolved in 67% ethyl alcohol with 0.1M NaOH (Anonymous 1981).

Determination of viscosity. 10 g of tarhana was dispersed in distilled water, stirred for 10 min, and then cooked for 10 min to permit complete starch gelatinisation. Viscosity was measured at 30, 45, and 60°C using the Brookfield rotational viscometer (model R.V.D. V ++ Brookfield Engineering Laboratories, Stoughton, Mass, USA) using No. 4 spindle at 20 rpm. Two readings were recorded for each sample (Hayta *et al*. 2002).

Determination of water absorption capacity. 5 g of tarhana was thoroughly mixed with distilled water (25 ml) in a 50 ml centrifuge tube. The dispersion was stirred at 15 min intervals over a 60 min period and then centrifuged at 4000 × g for 20 min. The water absorption capacity values were expressed as grams of water absorbed per gram of tarhana (Hayta *et al*. 2002).

Determination of foaming capacity and foam stability. 10 g of tarhana was dispersed in distilled water and stirred for 20 min. The mixture was centrifuged at 4000 × g for 20 min. The supernatant obtained was filtered (Whatman No. 1) and transferred to a Waring blender and whipped for 2 min at high-speed setting. The solution was slowly poured into a cylinder, and the volume of the foam was recorded after 10 s. The foaming capacity was expressed as the volume (ml) of gas incorporated into 1 ml of solution. The foam stability was recorded in the course of time until a half of the original foam volume had disappeared (Hayta *et al*. 2002).

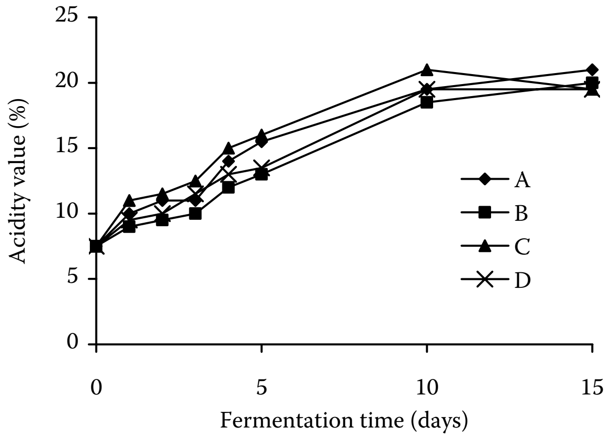
Determination of emulsifying activity. 10 g of tarhana was dispersed in distilled water and stirred for 20 min. The solution was centrifuged at 4000 × g for 20 min. Equal volumes of the supernatant and sunflower oil were mixed and homogenised for 5 min at low-speed setting in a Waring blender. The homogenised mixture was transferred into a measuring cylinder. The emulsifying activity was expressed as the percentage of the volume of the emulsified layer in the total volume of the mixture (Hayta *et al*. 2002).

Sensory analysis. Tarhana soup was prepared by dissolving one part of tarhana sample in seven parts of warm water and boiling it (Ozbilgin 1983). Eight panellists from the Department of Food Engineering evaluated the sensory properties of the cooked tarhana samples (tarhana soup) using a hedonic scale. The panel consisted of the staff of the department (three females, five males), who enjoyed eating tarhana soup. The panellists were in the age range of 23–40 years. The samples were tempered to approximately 60°C and labelled with randomly selected three-digit numerical codes. The samples were presented in a randomised balanced block design. The panellists evaluated each treatment in duplicates. In performing the test, the panellists were instructed to rinse their mouths with water, and to eat bread without salt between the samples. The assessments were made in partitioned booths equipped with daylight. The panellists gave scores on a nine-point scale from 1 (dislike extremely) to 9 (like extremely) for taste, odour, texture, colour, and acceptance of the prepared soups. The replication was achieved with four different tarhana samples evaluated by eight panellists (Penfield & Campbell 1990; Celik *et al*. 2004).

Statistical analysis. The data were statistically analysed using the analysis of variance (ANOVA). The least significant differences (LSD) test was used to determine the significant differences between the means at the significance level of $P < 0.05$ (Anonym 1985). All experiments and analyses were completed in duplicates.

RESULTS AND DISCUSSION

For tarhana to obtain its proper taste and flavour, its acidity value must be minimum 15% at the end of fermentation (Anonymous 1981). All tarhana samples tested gave appropriate acidity values according to the Turkish Standards. In addition, the tarhana sample containing no yeast and prepared under uncontrolled conditions gave the highest acidity value, its value being 21%. It was found that the acidity of samples containing yeast increased more slowly during the first 5 day period (Figure 2). This slow increasing can be explained by the competition between yeast and acid producing (lactic acid, acetic acid, etc.) bacteria for the carbohydrate sources. The acidity of samples containing yeast increased quickly during the second 5-day period and reached the acidity values of the samples containing no yeast on the 10th day. The samples provided more constant and proportional increase in acidity under controlled fermentation conditions. Under these conditions, the acidity had the maximum value on the 10th day of incubation; it reached equilibrium at the last 5-day period. On the other hand, under uncontrolled conditions, the maximum acidity value was measured on 15th day (Figure 2). And similarly to the samples prepared under controlled conditions, this acidity value could reach equilibrium according to the relationship between substrate-acid producing bacteria on the following days of fermentation.



A – uncontrolled conditions; B – uncontrolled conditions + 1% yeast; C – controlled conditions; D – controlled conditions + 1% yeast

Figure 2. Changes in acidity value during fermentation of tarhana samples

Maximum ash content (4.395%) was found in the samples containing no yeast and prepared under uncontrolled conditions. The minimum value (3.971%) was measured in the samples containing yeast and prepared under controlled conditions. According to other researchers, the ash content ranges between 1.4% and 14.2%, average 6.2% (reviewed in Daglioglu 2000). The ash content determined in our study is in this range but below the average. This can be explained by the differences in the tarhana formulas produced in different regions of Turkey. It was assumed that the controlled conditions decreased the ash content; this decrease was also supported by the addition of yeast (Table 2). This can be explained by the optimum fermentation conditions for microflora that use mineral materials effective as growth factors.

The water absorption capacity (WAC) is considered as an important functional property in viscous foods, such as sauces dough and baked products (Hayta *et al.* 2002). In our study, it was found that the addition of yeast to the samples decreased WAC values. These results are significantly important in statistics at the level of $P < 0.05$ (Table 2). The decrease in WAC values can be explained by structural changes in starch and proteins present in tarhana ingredients according to proteolytic and zymase enzyme activities of yeast (Pyler 1982).

The yeast addition affects the foaming capacity (FC) and foam stability (FS) of the tarhana samples (Table 2). Under controlled and uncontrolled

Table 2. Some functional properties of tarhana samples*

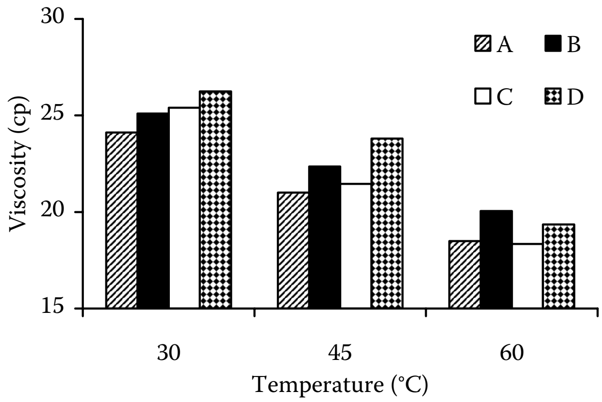
Samples	Ash content (%)	Water abssorption capacity (ml/g)	Foaming capacity (ml/ml)	Foam stability (min)	Emulsifying activity (%)
Uncontrolled conditions	4.395^a	0.79^a	0.53^b	3.22^a	91.5^a
Uncontrolled conditions + 1% yeast	4.220^a	0.76^b	0.32^c	2.25^b	89.0^b
Controlled conditions	4.017^b	0.80^a	0.62^a	3.07^a	93.5^a
Controlled conditions + 1% yeast	3.971^b	0.76^b	0.37^c	2.35^b	89.0^b

*Mean values indicated by different superscript in the same column are significantly different at $P < 0.05$

conditions, the yeast addition reduced FC and FS significantly ($P < 0.05$) as compared to the samples containing no yeast. Tarhana contains milk proteins (casein, globulin, and albumin) and wheat proteins (glutenin and gliadin) originating from yogurt and flour used for the tarhana preparation (Metin 1996; Elgun & Ertugay 1997; Daglioglu 2000). Some food proteins are capable of forming good foams and their capacity to form and keep stable foams depends on the type and concentration of proteins, the degree of denaturation, pH, ions, temperature, and processing methods (Isik & Gokalp 1996; Daglioglu 2000). Differences in FC and FS between the samples may reflect structural changes of proteins in tarhana during fermentation and drying. The decrease in FC and FS can be explained by the proteolytic activity of yeast, which leads to the weakness in the gas absorption property of proteins present in the tarhana formula.

The emulsifying activity (EA) depends on the area of stabilised oil droplets on the interface. Therefore, it is a function of the oil content, protein concentration, and the type of equipment used to produce the emulsion (Hayta *et al.* 2002). Lower EA values were found in the samples containing yeast. Similarly as explained with FC and FS, the proteolytic activity of yeast could also be effective in this decrease in EA.

The effects of the addition of baker's yeast on the viscosity of tarhana soups are shown in Figure 3. In all the samples, viscosity decreased with the increase in temperature. Heating may rupture the molecular entanglement and bonds, stabilising the molecular structure and resulting in a decrease in viscosity. As the temperature increases, destabilisation of protein-protein and protein-water interactions occur, which leads to a decrease in viscosity (Hayta *et al.* 2002). It was also found that the addition of baker's yeast to the formulas caused a small increase in viscosity.



A – uncontrolled conditions; B – uncontrolled conditions + 1% yeast; C – controlled conditions; D – controlled conditions + 1% yeast

Figure 3. Changes in viscosity value of tarhana samples at different temperatures

The results of the sensory analysis are given in Table 3. While the samples containing yeast revealed the best scores in texture, taste, and odour, the sample containing no yeast and produced under uncontrolled conditions obtained the worst score. And while the sample containing yeast and prepared under controlled conditions was given the highest score in acceptance, the sample containing no yeast and produced under uncontrolled conditions obtained the worst score, again.

The results show that the use of yeast in the tarhana formula had a positive effect on the sensory properties. This shows that yoghurt bacteria and yeast together produce lactic acid, ethyl alcohol, carbon dioxide, and other fermentation products, which give tarhana its characteristic taste and flavour (Koca *et al.* 2002).

CONCLUSIONS

Several kinds of yeasts can grow naturally during the fermentation of tarhana. However, different

Table 3. Sensory evaluation of tarhana samples* (1 – disliked extremely; 9– liked extremely)

Samples	Colour	Texture	Taste	Odour	Acceptance
Uncontrolled conditions	6.0^c	5.0^d	5.8^d	6.8^d	5.8^d
Uncontrolled conditions + 1% yeast	6.8^a	6.8^b	8.0^a	7.8^a	7.2^b
Controlled conditions	6.6^b	6.4^c	6.8^c	7.2^c	6.7^c
Controlled conditions + 1% yeast	6.8^a	7.4^a	7.8^b	7.6^b	7.4^a

*Mean values indicated by different superscript in the same column are significantly different at $P < 0.05$

species of these yeasts cause the production of non-standard quality of tarhana products. In our study, shorter fermentation times and better sensory properties were obtained if tarhana samples were produced with the addition of baker's yeast and under controlled conditions to reach standard quality. As a consequence, the addition of baker's yeast and the use of controlled conditions can be recommended in the production of the commercial type of tarhana which is widely consumed in different countries of the world including Turkey. We think that the use of well defined yeasts should be necessary to standardise the acid forming microflora.

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