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Journal of Food Engineering 77 (2006) 680–686
JOURNAL OF FOOD ENGINEERING
www.elsevier.com/locate/jfoodeng

Effect of wheat germ/bran addition on the chemical, nutritional and sensory quality of tarhana, a fermented wheat flour-yoghurt product

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Available online 15 September 2005

Abstract

Tarhana is a dried soup base made from yoghurt and wheat flour. Wheat flour used in tarhana production was replaced with wheat germ and wheat bran up to 50% (based on the wheat flour used) to improve the nutritional status of tarhana. The chemical, nutritional and sensory properties of enriched tarhana samples were evaluated and compared with a control sample. Increasing wheat germ/bran level in tarhana sample resulted in an expected increase in the crude protein and mineral content of samples ($p < 0.05$). Phytic acid content of wheat germ and wheat bran added to tarhana were significantly reduced by tarhana fermentation ($p < 0.05$). Total antioxidant capacity of the samples decreased upon the addition of wheat germ/bran, whereas there was an increase in the total phenolic compounds in the samples ($p < 0.05$). Addition of wheat germ/bran resulted in darker samples in colour with reduced cooked viscosity of tarhana soup. Tarhana sample with 10% wheat germ and the sample with 25% wheat bran had high scores from the taste panellists.

Keywords: Antioxidants; Cooked viscosity; Phenolic compounds; Phytic acid; Soup

1. Introduction

Fermented foods may be defined as those foods which have been subjected to the action of microorganisms (bacteria, moulds and yeasts) and enzymes for a period so that the final products have often undergone favourable changes (Adams, 1990; Hesseltine, 1979). Generally, fermentation serves the purpose of preparing low cost products which are highly acceptable, palatable, safe and often very nutritious (Economidou & Steinkraus, 1983).

Tarhana, a traditional fermented cereal product, is prepared by mixing wheat flour, yoghurt, yeast, vegetables and spices, followed by fermentation, drying and grinding (Hesseltine, 1979). It is mainly used in the form of a thick soup after reconstituting with water followed by simmering. There are some other food products similar to tarhana such as kishk and kushuk in the Middle East, trahana in Greece and atole in Scotland (Tamime, Muir, Khaskheli, & Barclay, 2000). Methods for preparation for such products may vary from one place to another, but cereals and fermented milk are always the major component. The practical nutritional importance of cereal-fermented milk mixtures is the improvement of the basic protein diet by adding animal protein in a highly acceptable form (Hesseltine, 1979).

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doi:10.1016/j.jfoodeng.2005.07.030

Some researchers fortified, supplemented or replaced wheat flour and/or yoghurt in tarhana by adding cereals and/or legumes to raise the biological value of tarhana and tarhana-like products (Hafez & Hamada, 1984; Hamad & Fields, 1982; Koçtürk, 1966; Öner, Tekin, & Erdem, 1993; Özbilgin, 1983; Tamime et al., 2000). There have been some works also regarding the production methods of tarhana-like products with improved functional properties (Berghofer, Schwaiger-Nemirova, & Conrad, 1990; İbanoğlu, 1999; İbanoğlu & İbanoğlu, 1998; İbanoğlu, Ainsworth, & Hayes, 1996; Youssef, 1990). The purpose of this study was to incorporate wheat germ and wheat bran into tarhana formulation (up to 50%, w/w, based on the wheat flour used) and investigate the proximate chemical composition (i.e., protein, ash, acidity, minerals), nutritional properties (i.e., in vitro protein digestibility, phytic acid content, total antioxidant capacity, total phenolic compounds) and sensory properties of tarhana samples enriched with wheat germ/bran.

2. Materials and methods

2.1. Materials

The ingredients used in tarhana preparation were obtained from local markets in Konya, Turkey. The wheat flour used was commercial flour with a crude protein content of 11.60% (Nx5.7, w/w, dry basis). The yoghurt used was full-fat concentrated set yoghurt (pH 4.5) made of cow's milk and had a solids and fat content of 21.3% and 3.6% (w/w), respectively. Tomato paste was double concentrated (32% total dry solids). The yeast used was compressed active baker's yeast. Medium sized dry onions were used. The spices used were in powder form (i.e., salt, paprika).

Wheat germ used was obtained from a commercial mill in Kenya, Turkey and had a moisture, ash, protein and fat content of 10.8, 4.18, 26.5 and 8.56% (w/w, db), respectively. The wheat bran used had a moisture, ash, protein and fat content of 13.9%, 4.32%, 13.6% and 4.6% (w/w, db), respectively.

2.2. Methods

2.2.1. Preparation of tarhana with only wheat flour (control)

To prepare tarhana at laboratory conditions, wheat flour (400.0 g), yoghurt (160.0 g), tomato paste (40.0 g), chopped onions (20.0 g), paprika (8.0 g), table salt (4.0 g) and baker's yeast (10.0 g) were mixed using a Hobart mixer for 5 min at the highest speed without any external water added. The resultant mixture was placed in sealed plastic container (25 × 30 cm) to a depth of 20 cm and incubated at 30 °C for 72 h to ferment. The fermenting mixture was mixed manually every 12 h. The moisture content of the mixture before fermentation was 43.0% (w/w, db). Fermented mixture was divided into ~2 cm diameter pieces by hand, placed on aluminium trays and dried at 55 °C for 48 h to 9–12% moisture content (w/w, db) in an air convection oven (Özköseoğlu PFS-9, Turkey). The dried samples were ground into granulated form in a hammer mill equipped with 1 mm opening screen. Tarhana samples were kept in closed glass containers at room temperature until used. This tarhana sample was used as control sample.

2.2.2. Preparation of tarhana with wheat germ/bran

Tarhana supplemented with wheat germ and wheat bran were prepared as described above, with addition of 10%, 25% and 50% (w/w) wheat germ or wheat bran, based on the weight of the wheat flour used. The particle size of the wheat germ and wheat bran used was 1.3 and 0.6 mm, respectively. This produced seven samples including the control sample.

2.2.3. Determination of proximate chemical composition

The moisture (method 44–12), ash (method 08–03) and protein (method 46–12) contents of the ingredients used and tarhana samples were determined using standard methods (AACC, 1990). The total titratable acidity of the samples was calculated as lactic acid as described by Kirk and Sawyer (1991). The pH was measured by a digital pH meter (WTW pH 315) after mixing a five gram sample with 100 ml distilled water. The mineral content of the samples were determined by spectroscopic method using a ICP-AES (Vista series, Varian International AG, Switzerland) as described by (Bubert & Hagenah, 1987). The crude fat contents of the samples were determined by the method 30–25 of AACC (1990).

2.2.4. Determination of in vitro protein digestibility (IVPD), phytic acid content, total antioxidant capacity and total phenolic compounds

The IVPD of the samples were determined by the modified methods of Hsu, Vavak, Satterlee, and Miller (1977) and Dahlin and Lorenz (1993). Fifty millilitres of aqueous protein suspension having 6.25 mg protein/ml was mixed for 60 min at 5 °C. Then, the samples were placed in a 37 °C water bath and the pH was adjusted to 8.00 using 0.1 N NaOH and/or 0.1 N HCl, while stirring. Lyophilized, crystallized trypsin (Sigma Chemical Co., St Louis, Mo) at a concentration of 1.6 mg/ml was maintained in an ice bath and the pH was adjusted to 8.00 with 0.1 N NaOH and/or 0.1 N HCl. Five ml of enzyme solution were then added to the protein suspension, which was being stirred at 37 °C. The trypsin had an activity of 13766 BAEE units/mg protein. A rapid decline in pH was observed. The pH drop was recorded 15 s after enzyme addition and at one minute intervals for 10 min. Triplicate analysis was performed for each