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A Preliminary Study on the Use of Protein Isolate Produced From Trout in Tarhana Soup

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Abstract

The aim of this study is to use protein isolate that produced from fillet trout by pH shifting (acid) processes, in tarhana soup as protein enrichment. Three different soup groups were prepared; control (C): without isolate; 3.5% protein isolate added (T1) and 7% protein isolate added (T2). For sensory characteristics of soups, groups were compared by using color and sensory analysis by panelists. According to the sensory analysis results, the highest texture, odor and general acceptability values (7.38; 7.50 and 7.50, respectively) were reported in T1 while, these values were the lowest in C (6.50, 7.13 and 7.13, in order). When the results were evaluated in general, it was determined that there was no significant difference in terms of general acceptability in both isolate-added soup groups compared to the C. Test score of T1 is higher than T2 in terms of texture, it was determined that the isolate added groups were better than the C. With this preliminary study, it was determined that the fish protein isolate did not have a negative effect on the sensory properties of tarhana. More research is needed to establish the impact of additional fish protein isolate on the functional and biochemical quality of tarhana.

Introduction

In parallel with rapid population growth in our country as well as in the world, food requirement of people is increasing. Therefore, increasing available animal protein sources and processing them with different methods for human consumption are very important. Recent scientific studies conducted to find solutions for nutrition problems have been investigated how it can be utilized marine resources, particularly fish, in better ways.

Alternative animal and plant origin proteins and their derivatives generally take role in enrichment of foods as functional ingredients in the preparation of protein-rich diets. Milk derivatives, edible insects, fish derivatives, legumes, cereals, and other sources are routinely utilized in a variety of forms, including flours, powders, protein concentrates, protein isolates, and protein hydrolysates. These protein sources may boost nutritional content while also providing health advantages (Dhen et al., 2018; Karimi et al., 2021; Prieto-Vázquez del Mercado et al., 2022). Texture, color, and nutrition are all physiochemical qualities that may modified by the incorporation of protein isolates. Protein isolate with high protein content and functional characteristics can improve the rheology and specific volume, which can affect texture and mouthfeel (Hansmeyer et al., 1976; Wouters et al., 2016; Huang et al., 2023; Pořízka et al., 2023).

Tarhana is a fermented dry food produced traditionally. In Türkiye, tarhana soup is prepared mostly of yogurt, wheat flour, herbs, tomato, pepper, onion, and other ingredients. There are several researches conducted on the effect of variety production techniques, flours, and additives on the structure and nutritional properties of tarhana. Some of the flours are; corn flour, potato starch, taro flour and Jerusalem artichoke flour, quinoa: rice flour combinations, rice flour, and whole wheat and chickpea flours (Türker and Elgün, 1995; Yalcin et al. 2008; Demir, 2014; Kumral, 2015; Özdemir et al. 2018; Çalışkan and Özçıra, 2019; Anil et al., 2020; Cankurtaran et al., 2020; Köten, 2021; Gohari, 2022). However, there is a lack of literature determining the effect of the different types of proteins originating from animals on the properties of tarhana.

According to our knowledge, despite the fact that several additives have been attempted in the literature, there has not been enough research on the effect of fish protein isolate addition on the sensory qualities of tarhana.

In the present study, it focused on evaluation the acceptability of tarhana soup, which was added fish protein isolate at different ratios, by consumers in terms of sensory properties.

Material and Methods

Trout, which was used as raw material in the study, was obtained from market and transferred to Central Fisheries Research Institute. The samples taken were brought to the Food Technology Laboratory of the Central Fisheries Research Institute by applying cold chain and were stored at -30ºC to be used in the experiments. Production studies of protein isolate by pH adjustment (acid) method were carried out from fillet trout (Figure 1). Commercial organic tarhana powder was used in the study was obtained from market (Fanus Food and Organic Products, Trabzon, Türkiye). Ingredients of commercial tarhana powder are organic fresh red pepper, organic strained yoghurt, organic whole-wheat flour, organic onion, organic mint, organic sourdough and sea salt.

Protein Recovery from Trout and Preparation

At the beginning of the research, acid and alkaline methods were compared for protein recovery during the production of isolates. Because of high recovery obtained on acid isolate this method was applied for the study (Hultin and Kelleher, 2001).

Trout fillets were cut into small pieces, mixed with cold distilled water at 1:6 ratio (g: ml) and homogenized for 1 min on a Waring blender (Waring Products, Torrington, Connecticut, USA). The pH of the homogenate was adjusted to 2-3 by 2 M HCl and centrifuged at 10,000 *g* at 4 °C for 20 min using a laboratory centrifuge (Hermle Z446K, Germany). Three layers occurred in centrifuge tubes; fish oil on the top, protein solution in the middle and bones, skin, scale, etc. at the bottom. A double layer of cheesecloth was used for the filtration of the middle phase. To precipitate the proteins in the middle phase, the pH of the solution was increased to the isoelectric point of 5.5 with 2 M NaOH and centrifuged for 20 minutes at 10,000 *g* at 4 °C. After the second centrifuging step, precipitated and de-watered fish protein, which called as fish protein isolates (FPI), was collected. The produced fillet protein isolates were freeze-dried.

Preparation of Tarhana Soup

Tarhana soup was prepared by the procedure given on the package. In the study, three different soup groups were formed. Accordingly, control group (C): without isolate; 3.5% protein isolate added (T1) and 7% protein isolate added (T2) groups. For sensory qualities of soup groups were compared using color analysis and sensory analyzes by panelists.

Color Analysis

Color analysis was performed using Konica Minolta CR 410 (Tokyo, Japan) color analyzer and L*, a* and b* values of the samples were determined. L*, a* and b* values were determined according to the criteria given by the International Commission on Illumination CIELAB (Commision Internationalele de I'E Clairage), which is based on three-dimensional color measurement. According to this; L*; L*= 0, black; L*=100, white (darkness/lightness); a*; +a*= red, -a*=green and b*; +b*=yellow, -b*= blue color intensities (Amanatidou et al., 2000, Gobantes et al., 1998).

Proximate Analysis

Standard methods were used for crude protein and lipid analysis (AOAC, 1995). The amount of crude protein was calculated by multiplying the amount of N % obtained by a factor of 6.25 (AOAC, 1995). Crude lipid with Soxhlet extraction with diethyl ether. The moisture

Figure 1. Production of trout protein isolate powder

content of the samples was determined according to Ludorff and Meyer (1973). Ash analysis was conducted according to Mattissek et al. (1988).

Sensory Analysis

For sensory analysis, eight panelists evaluated the products in terms of color, odor, taste, texture and general acceptability. In evaluation, a hedonic scale ranging from 1 to 10 was used (Paulus et al., 1979). Evaluation score criteria; 10-9 very good, 8-7 good, 6-5 fair, 4-3 bad, 1-2 very bad.

Statistical Analysis

Data were analyzed by one-way analysis of variance (ANOVA) test. MedCalc 20.0 for Windows was used for this purpose. Results were regarded significant according to ($P<0.05$) significance level. Analysis applied in three parallels.

Results and Discussion

The chemical composition and color values of commercial tarhana powder and protein isolate powder are demonstrated in Table 1.

Accordingly, while the protein value of commercial powder tarhana was 10.92%, the protein value of trout protein isolate was determined as 85.74%.

Çalışkan Koç ve Özçıra (2019) investigated the influence of different ratios of wheat germ addition in the formulation of tarhana. The authors reported that increasing wheat germ percentage results in increasing protein, ash, and cellulose contents. In their study, the protein value of the control group was 14.04 %. Gohari (2022) determined the functional, rheological, and sensory aspects of tarhana samples by replacing wheat flour (72%) with different ratios of chickpea flour, white quinoa flour, and chickpea flour and white quinoa flour mixture. The protein content of control was calculated 11.46%. These results are similar with present study. The differences could be caused from different production ratios of ingredients and processes.

Color is one of the major qualitative features in customer acceptability of food. The color of tarhana samples was determined; the L*, a* and b* values are indications of lightness, redness, and yellowness, respectively. In present study L*, a* and b* values of commercial tarhana were 45.12; 15.31, and 27.12, respectively. Gohari (2022) measured the L*, a* and b* values of control group of tarhana as 81.07; 6.11, and 31.17. Bilgiçli and İbanoğlu (2007) monitored changes in the pH, total titratable acidity, PA and color of tarhana enriched with wheat germ/bran over a three-day fermentation period. The researchers found the L*, a* and b* values of control group of tarhana powder as 94.6; 0.5, and 13.7, respectively.

As given above, there are different varieties of tarhana made by substituting different components and ratios. Because of these differences, the color values of tarhana samples have a wide range of color qualities. The color of commerical tarhana powder used in present study showed differences with previous studies.

Chemical composition of trout protein isolate powder (TPIP) was determined. According to analysis results protein, lipid, ash and moisture content of TPIP was 85.74%, 1.66%, 3.35% and 3.44%. Lone et al. (2015) prepared protein isolate from rainbow trout by pH shift method (Alkaline) and studied functional properties. In their research, protein, lipid, ash and moisture values of protein isolate were determined as 75.6%, 2.4%, 4.0% and 3.5%, respectively. Radwuken et al. (2009) investigated biochemical and gel properties of tilapia surimi prepared by a traditional washing method and protein isolated using alkaline and acidic processes. In their research, the protein recovery ratio of the acidic process was over than alkaline process (85.4% and 71.5%, respectively). The increased yield of alkaline and acidic processes support the recovery of sarcoplasmic proteins in muscle. Furthermore, because the majority of sarcoplasmic proteins was maintained after acid-aided processing, a maximum yield may be attained in

Table1. The chemical composition and color values of commercial tarhana powder and trout protein isolate powder

	Crude Protein (%)	Crude Lipid (%)	Crude Ash (%)	Moisture (%)	L	a	b
Commercial Tarhana Powder	10.92±0.08	1.78±0.02	4.74±0.06	9.49±0.09	45.12±0.82	15.31±0.42	27.12±0.87
Trout Protein Isolate Powder	85.74±0.07	1.66±0.06	3.35±0.29	3.44±0.11	51.67±0.15	9.00±0.04	17.41±0.03

Values given Mean ± Standard error (n=3).

Table 2. The color values of the soups

	L	a	b
Control	35.34±0.88^{a}	17.07±0.26^{a}	24.36±0.51^{a}
T1(3.5% protein isolate)	32.03±0.26^{b}	13.88±0.29^{b}	19.38±0.48^{b}
T2 (7% protein isolate)	31.67±0.80^{b}	13.34±0.50^{b}	18.99±1.85^{b}

Values given Mean ± Standard error (n=3). Different superscript letters (a, b, c) denote significant differences ($p<0.05$) in the same column.

this technique (Choi and Park, 2002). When adjusted to pH 5.5, the alkaline-aided process displays higher protein denaturation and consequently less protein precipitate than the acid-aided process (Kristinsson and Hultin, 2004). Researches on catfish and tilapia revealed that the alkaline-aided method recovered much more soluble proteins in the supernatant after the second centrifugation, but the acid-aided process recovered more sarcoplasmic proteins together with the muscle proteins (Kristinsson and Ingadottir, 2006; Kristinsson et al., 2005). This result indicates that the acid-aided approach resulted in better protein recovery.

In present study L*, a* and b* values of TPIP were 51.67; 9.00, and 17.41, respectively. Lone et al. (2015) reported the color values of rainbow trout protein isolate in terms of L*, a* and b* as 44.08, 14.19, and 42.10.

The lightness of the protein isolate, can be affected by the connective tissue of the fish used. Yellowness related to lipid content of the product. Co-presipitation of heme proteins may affect redness, oxidation of hemoglobin also affect the yellow-brown color. The presence of heme proteins in the final product can explain the redness (Kristinson et al., 2005).

In the study, three different soup groups were formed. In the study, three different soup groups were formed. Accordingly, control group (C): without isolate; 3.5% protein isolate added (T1) and 7% protein isolate added (T2) groups. For sensory characteristics of soup groups were compared using color analysis and sensory analyzes by panelists. The color values of the prepared soups are given in Table 2.

Color results of C, T1 and T2 are shown in Table 2. As seen in Table 2, L*, a* and b* values of T1 (32.03, 13.88 and 19.38, respectively) and T2 (31.67, 13.34 and 18.99, respectively) were similar and lower than C (35.34, 17.07 and 24.36, respectively). According to the statistical analyzes performed, there was a significant difference (P<0.05) between C and the other groups. The differences between T1 and T2 were not important statistically (Figure 2).

Gohari (2022) measured the average L*, a*, b values of control group as 81.07, 6.11 and 31.17, in order. Bilgiçli and İbanoğlu (2007) determined the L*, a* and b* values of control group of tarhana soup as 79.84, 7.47 and 31.28, respectively. The addition of additives to tarhana soup was effective on the color of T1 and T2 darker than the C. However, as the color values were similar in T1 and T2 showed that the different ratios added to the soup did not have a significant effect on the color of the soup.

According to the sensory analysis results, the highest texture, odor and general acceptability values (7.38; 7.50 and 7.50, respectively) were obtained in T1 while, these values (6.50, 7.13 and 7.13, in order) were the lowest in C (Figure 3). When the results were

Figure 2. Control and TPIP added tarhana soups

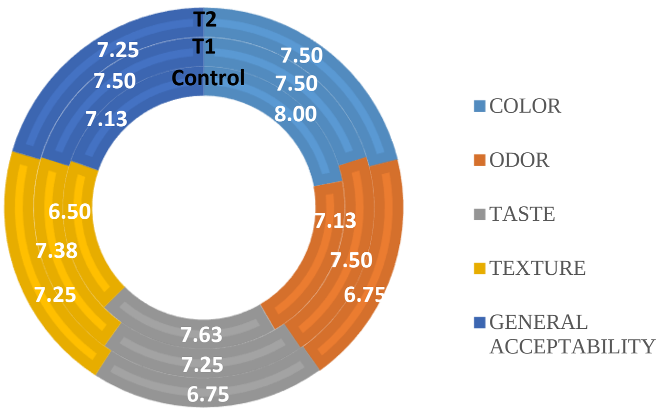

Figure 3. Sensory scores of control, T1 and T2

evaluated on the statistical analysis, it was determined that there was no significant difference between all groups in terms of color, odor and general acceptability (P>0.05). Test score of T1 is higher than T2 in terms of texture scores, it was determined that the isolate groups were better than the control group (P<0.05). In the study, while the highest value for taste was belongs to T1, it was determined that T2 and C groups followed to this group The difference between the T1 and C groups was found to be statistically significant (P<0.05). T2 showed similarty to both T1 (P>0.05) and C (P>0.05) groups.

There are few researches on the sensory qualities of enhanced tarhana in the literature. Koca et al. (2015) investigated the sensory qualities of tarhana made using kaldirayak (*Trachystemonorientalis* (L.)) and purslane (*Portulaca oleracea* L.) and discovered that the plants used in tarhana had no significant influence on overall acceptability. According to Isik and Yapar (2017), tomato seed replacement (particularly 15%) improved the overall acceptability of tarhana.

Conclusion

Recently, foods enriched with protein sources are of great interest. In the present research, it was aimed to evaluate the acceptability of tarhana soup, which was added fish protein isolate at two different ratios, by consumers in terms of sensory properties. There was no significant difference between all groups in terms of color, odor and general acceptability. With this preliminary study, it was determined that the fish protein isolate did not have a negative effect on the sensory properties of tarhana. It is thought that further studies are needed to determine the effects of added fish protein isolate on the functional and biochemical quality of tarhana.

Ethical Statement

Not applicable.

Funding Information

Not applicable.

Author Contribution

BBD: Conceptualization, production, analysis, writing and editing, GBM: Production, analysis, writing, editing.

Conflict of Interest

The authors declare that they have no known competing financial or non-financial, professional, or personal conflicts that could have appeared to influence the work reported in this paper.

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