

Production of Kokoreç from Rainbow Trout (*Oncorhynchus mykiss*, Walbaum 1792) and Determination of Shelf life

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Abstract

In the present study, kokoreç which is one of our traditional food was produced from the rainbow trout (*Oncorhynchus mykiss*) meat instead of intestine. The fish kokoreç obtained from mixture of trout meat, tomato, green pepper, garlic, thyme, chili pepper flakes and cumin was stored at $4\pm 1^\circ\text{C}$ by using transparent watertight packages (PET). The shelf life of the product was determined by applying analyses of sensory, chemical (pH, total volatile basic nitrogen and thiobarbituric acid) and microbiological (total mesophilic aerobic bacteria, total psychophilic aerobic bacteria, total mold and yeast, coliform bacteria) in every day. In addition, it was found that the fish kokoreç has 70.54% moisture, 16.24% crude protein, 8.63% crude lipid and 2.28% crude ashcontent. The chemical and microbiological analysis findings did not exceed acceptability limit values. When the sensory analysis results were considered, the shelf of the product at $4\pm 1^\circ\text{C}$ was determined as 5 days. The effect of storage time on the sensory analyses was not significant statistically ($P < 0.05$).

Keywords: Rainbow trout (*Oncorhynchus mykiss*), kokoreç, shelf life, proximate composition, chemical, microbiological

INTRODUCTION

As a result of advancing technology and changes in social structure nowadays, interest and demand of people to fast food increased, a growth was observed in consumption of the fast food [1]. Fast food is a food system which provides service at short notice to large number of consumer, food prepared with standard methods are produced and sold. This system both appealed to taste buds and proposed to time problem of people whose days are passed away from home. In Turkey, the term of fast food is used in the meaning of both food eaten on the street without sitting down and the fast food system. Mostly consumed fast food type of food-drinks in Turkey are bagel, toast, döner, lahmacun (very thin Turkish pizza covered with seasoned minced meat and onions), pitta bread, hamburger, sandwich, pizza, french fries, fried chicken, grilled/fried fish sandwich, baked potato, kokoreç, cola drinks, tea, coffee etc. [2]. Anatolia where receive to several civilizations due to its long historical process and geographical position

has a rich and typical food range. The meat products which take part in traditional foodrepresent Turkish food culture make a significant contribution to this variety [3]. One of the fast food type of traditional food is kokoreç.

Kokoreç is the cleaned intestine of butchery small cattle. It is cooked as grilled, fried, tandouri or boiled saute [4]. Kokoreç is a product made by winding the small intestine of sheep or lamb around mezenterial fat and usually cooked with coal-fired grills after it is subjected to a mild heat treatment. Consumption of this meat product which is first risky food in European Union accession process is quite common. Depending on increased fast food consumption during the recent years, also a growth has been observed in the kokoreç consumption in especially big cities [5].

Even though the meat and meat products contain nutritional elements which have high biological availability, the fact that saturated fat content of these products cause to some health problems especially heart condition

generates a tendency toward less consumption of them by consumers. Therefore it has been understood that seafood which has high protein amount, unsaturated fatty acids reducing cholesterol level, fat soluble A and D vitamins, also contains vital minerals like zinc, iodine and phosphorus should be in diets and interest to seafood has been increasing day by day [6].

Although there have been studies interested in investigating microbiological quality of the kokoreç [4, 7, 8, 9] and determining consumption preference of the fast food including kokoreç [10,11, 12, 13] it was not encountered with any study about production of kokoreç from fish and properties of the product.

In the present study, kokoreç which is one of our traditional food was produced from the rainbow trout (*Oncorhynchus mykiss*) meat instead of the intestine. In addition the shelf life of the product was determined by applying sensory, chemical and microbiological analyses.

MATERIALS AND METHODS

Raw material

Fresh rainbow trout (*Oncorhynchus mykiss*, Walbaum 1792) with an average length of 42.17±0.93 cm and average weight of 1476±106.16 g were purchased from a fisherman in Sinop. They were transferred to the laboratory in a polystyrene box with crushed ice within 30 min. Fish were headed, gutted and filleted.

Preparation of Kokoreç

Formulation for making the trout kokoreç was determined as following: %49.52 fried fish meat, %39.62 tomato, %4.95 green pepper, %3.00 sunflower oil, %1.98 garlic, %0.29 salt, %0.26 thyme, %0.25 chili pepper flakes and %0.12 cumin. The trout fillets which were divided into two, inner and outer surfaces covered with flour were fried until the two surfaces of them golden brown (three each minutes) inside 500 ml of superheated sunflower oil in a roasting plate. Fried fillets were skinned, deboned and they were separated into small pieces. The garlic and pepper were cubbed on a metal cutting-board, tomatoes were grated inside a plastic case. Latex gloves were used in all stages that were made by hand such as separating into pieces, cutting, grating. In the plate, garlic and pepper

were roasted inside 100 ml of sunflower oil. Following, tomatoes were added on roasted garlic and pepper and they were cooked. Pieces of the fried fish meat were added into this mixture too and it was continued to cooking process until it get less watery texture. The kokoreç was prepared by adding salt, thyme, cumin and chili pepper flakes for giving flavor typical to kokoreç short while ago of the cooking process was ended.

Packaging and storage

After, the kokoreç was cooled at room temperature for 30 minutes, approximately 94.84±0.63 g weight of it was placed in self-lidded plastic (PET) cases. The samples were placed into a refrigerator at 4±1°C and stored until their shelf life was ended. All analyses were carried out in triplicate. For each sampling day, two random packages were analyzed.

Biochemical analysis

Crude protein, crude lipid and crude ash analyses were carried out according to AOAC methods, respectively [14]. Moisture content was determined by the method of Ludorf and Meyer [15].

Chemical analysis

pH analysis was carried out with the instrument Werkstätten 82362 Weilheim, Germany, according to Curran et al. [16]. Total volatile basic nitrogen (TVB-N) was determined according to method of Lucke and Geidel modified by Antonacopoulos [17]. Thiobarbituric acid (TBA) was determined according to Tarladgis et al. [18].

Microbiological analysis

Microbiological analyses were made according to Baumgart [19]. Results were given as log cfu / g.

Sensory analysis

Trained panelists (six men and four women) attended to sensory analysis. Samples were served to the panelists for evaluation of appearance, texture, odor and flavor. Scoring was made by using scores between 0 - 5. In this evaluation, score of 20 was accepted as 'excellent', scores between 19.9-18.2 were accepted as 'very good', 18.1-15.2 were accepted as 'good', 15.1 - 11.2 were accepted as 'middle', 11.1 - 7.2 were accepted as

‘acceptable’ and 7.1 - 4.0 were accepted as ‘spoiled’ samples [20].

Statistical analysis

The Minitab 15 (Minitab Inc. USA) program was used to search for significant differences among mean values of different results. Differences between means were analyzed by one-way analysis of variance (ANOVA) and the sensory analysis values were analyzed by chi-square test. The P value ($P < 0.05$) was used to determine significant differences. The results are presented as mean \pm SE.

RESULTS

Values of moisture%, crude protein%, crude lipid% and crude ash% of the fresh and fried trout and trout kokoreç samples were presented in Table 1. The moisture, protein, lipid and ash, carbohydrate and energy values of the trout used in the present study were found as 66.57%, 17.76%, 10.34% and 1.41%, respectively. These values were determined as 66.35%, 22.31%, 9.84% and 1.26% in the fried trout, respectively. The moisture, protein, lipid and ash values of the kokoreç which was prepared by adding various vegetable and spices after fried were 70.54%, 16.24%, 8.63% and 2.28%, respectively.

pH values of the fresh and fried trout and trout kokoreç samples were presented in Table 2. The pH values of fresh and fried trout were found as 6.05 and 6.45, respectively. When the initial pH value of kokoreç was 6.50, this value decreased and increased from time to time and it was determined as 6.00 at the end of the storage of 5 days. Effect of storage time on pH value was found significantly ($P < 0.05$).

In Table 2, TVB-N values of the fresh and fried trout and trout kokoreç samples were presented. At the beginning of the storage TVB-N values of fresh and fried trout and kokoreç were detected as 15.19, 15.25 ve 17.24 mg/100 g, respectively. The TVB-N amount of the kokoreç increased during the storage and it became 24.10 mg/100 g at the end of the storage of 5 days. It was determined that effect of storage time on TVB-N value was significant ($P < 0.05$).

TBA values of the fresh and fried trout and trout kokoreç samples were presented in Table 2. The TBA values of fresh and fried trout and kokoreç were 1.60, 6.16 ve 1.62 mg MA/kg at

the beginning of the storage. The TBA amount of the kokoreç increased and decreased from time to time during the storage and it became 1.71 mg MA/kg at the end of the storage of 5 days. Effect of storage time on TBA value was found significantly ($P < 0.05$).

In Table 3, microbiological analysis results of the fresh and fried trout and trout kokoreç samples were presented. Total mesophilic aerobic bacteria, total psychrophilic aerobic bacteria, total mold and yeast and coliform bacteria counts of the fresh trout were found as 4.13, 4.34, 4.16 ve 2.80 log cfu/g, respectively. No microbial load was detected in the fried trout and kokoreç.

Table 1. Biochemical composition of the fresh trout, fried trout and trout kokoreç

	Fresh trout	Fried trout	Trout kokoreç
Moisture (%)	66.57 \pm 0.46 ^a	66.35 \pm 1.65 ^a	70.54 \pm 0.33 ^a
Crude protein (%)	17.76 \pm 0.64 ^a	22.31 \pm 1.59 ^b	16.24 \pm 0.27 ^a
Crude lipid (%)	10.34 \pm 0.88 ^a	9.84 \pm 0.09 ^a	8.63 \pm 0.19 ^a
Crude ash (%)	1.41 \pm 0.02 ^a	1.26 \pm 0.01 ^b	2.28 \pm 0.01 ^c

^{a,b,c} Means within a row with different superscripts differ at $P < 0.05$.

Values are shown as mean \pm standard error of triplicates.

Table 2. Chemical analysis results of the fresh trout, fried trout and trout kokoreç

	pH	TVB-N (mg/100 g)	TBA (mg malonaldehyde / kg)
Fresh trout	6.05 \pm 0.05 ^a	15.19 \pm 1.51 ^a	1.60 \pm 0.04 ^a
Fried trout	6.45 \pm 0.05 ^a	15.25 \pm 1.41 ^a	6.16 \pm 0.21 ^b
Storage time days)	Trout kokoreç		
0	6.50 \pm 0.10 ^a	17.24 \pm 0.61 ^a	1.62 \pm 0.12 ^{ac}
1	6.23 \pm 0.03 ^b	17.64 \pm 0.73 ^a	1.90 \pm 0.08 ^b
2	6.48 \pm 0.06 ^a	20.13 \pm 0.37 ^b	1.88 \pm 0.13 ^b
3	6.18 \pm 0.08 ^b	21.29 \pm 0.60 ^b	1.48 \pm 0.03 ^c
4	6.25 \pm 0.06 ^b	20.58 \pm 0.66 ^b	1.46 \pm 0.04 ^c
5	6.00 \pm 0.04 ^c	24.10 \pm 0.34 ^c	1.71 \pm 0.02 ^{ab}

^{a,b,c} Means within a row with different superscripts differ at $P < 0.05$. Values are shown as mean \pm standard error of triplicates

Sensory changes of the trout kokoreç samples were presented in Table 4. According to the results of sensory analysis appearance, texture, odor and flavor of it had the lowest scores at the end of the storage of 5 days. The sample which was evaluated as ‘acceptable’ until 4th days spoiled at day 5.

Table 3. Microbiological analysis results of the fresh trout, fried trout and trout kokoreç

	TMAB (log cfu /g)	TMPB (log cfu /g)	TMK (log cfu /g)	TK (log cfu /g)
Fresh trout	4.13±0.14	4.34±0.08	4.16±0.01	2.80±0.05
Fried trout	<10	<10	<10	<10
Storage time (days)		Trout kokoreç		
0	<10	<10	<10	-
1	<10	-	<10	-
2	<10	<10	<10	-
3	<10	-	<10	-
4	<10	-	-	-
5	<10	-	<10	-

TMAB: total mesophilic aerobic bacteria; TMPB: total psychophilic; TMK: total mold and yeast; TK: Total coliform; (-) not detected.

Table 4. Sensory analysis results of the trout kokoreç

	Storage time (days)					
	0	1	2	3	4	5
Appearance	5.0±0.0 ^a	5.0± 0.0 ^b	4.4±0.24 ^c	3.8±0.2 ^d	2.8±0.2 ^e	2.0±0.32 ^e
Texture	4.8±0.2 ^a	4.6±0.24 ^b	4.6±0.24 ^c	3.4±0.24 ^d	2.0±0.0 ^d	1.2±0.2 ^d
Odor	5.0±0.0 ^a	4.6±0.24 ^b	4.4±0.24 ^c	3.4±0.24 ^d	2.8±0.2 ^d	1.6±0.24 ^d
Flavor	4.8±0.2 ^a	4.6±0.24 ^b	4.2±0.2 ^b	3.0±0.0 ^c	2.6±0.24 ^c	1.4±0.24 ^c
General acceptance	19.6±0.4 ^a	18.8±0.49 ^b	17.6±0.51 ^c	13.6±0.4 ^d	10.2±0.49 ^{de}	6.2±0.86 ^e
Quality	VERY GOOD	VERY GOOD	GOOD	MIDDLE	ACCEPTABLE	SPOILED

^{a,b,c,d,e}Means within a row with different superscripts differ at P < 0.05.

Values are shown as mean ± standard error of triplicates.

DISCUSSION

The values of trout containing 66.57% moisture, 17.76% protein, 10.34% lipid and 1.41% ash according to our findings were stated by different researchers as 73.38%, 19.80%, 3.44%, 1.35% [21]; 70.32%, 20.15%, 2.62%, 1.29% [22]; 72.31%, 20.15%, 4.61%, 1.29% [23]; 70.67%, 21.23%, 3.88%, 1.48% [24]; 76.40%, 15.70%, 4.58%, 2.51% [25]; 74.50%, 17.17%, 4.79%, 0.99% [26] respectively. The protein amount of the trout used in the present study was similar to İnanlı et al. [26] when the ash amount of it was similar to Gokoglu et al. [21]. The amount of lipid% was found higher than the results of other researchers. As a reason to differ of the lipid amount; it may be given reasons such as purchasing of fish from different fish farms, nutrition conditions and catching conditions. The amount of moisture% was determined as lower than other literature findings. It has been thought that, this difference may be arisen from the high lipid content of the fish meat.

Gokoglu et al. [21] reported the values of moisture, protein, lipid and ash of fried trout as 62.69%, 26.34%, 12.70% and 1.66%, respectively. In another study, these values

were stated as 63.55%, 25.84%, 6.16% and 2.31%, respectively [24]. These findings were similar to our study. In the present study it was found that the fish kokoreç which was prepared by adding oil, tomato, pepper, garlic and spices to fried fish had 70.54% moisture, 16.24% protein, 8.63% lipid and 2.28% ash content. It has been supposed that high moisture content of the vegetables which were added to fried fish caused to proportional increase in the moisture value of kokoreç, low protein and lipid content of the vegetables decreased the protein and lipid values proportionately.

It was reported that the pH value of fresh fish was between 6.00-6.50, this value increased depending on storage time and acceptability limit value was between 6.80-7.00 [15]. At the same time, value of pH was not a certain criteria and it must be always supported with sensory and chemical analyses [27]. The pH value of the fried fish which was determined as 6.45 increased after the kokoreç was cooked with addition of other ingredients. It was differed between 6.48-6.25 at later days, decreased to 6.00 at day 5. It has been thought that this decrease in the value of pH may be resulted from used ingredients in the kokoreç content.

TVB-N value has increased in paralel with time during storage of fish and seafood. Limit values of the TVB-N amount has differed in fish and other seafood. Huss [28] reported that the TVB-N amount of newly caught fresh fish was between 5-20 mg/100g, fresh acceptable limit value was between 30-40 mg/100g. Varlik et al. [29] evaluated the quality according to the value of TVB-N as 'very good' until 25 mg/100g, 'good' until 30 mg/100g, 'marketable' until 35 mg/100 g and 'spoiled' if it is higher than 35 mg/100 g. The initial TVB-N value of the kokoreç was 17.24 mg/100 g, the value increased to 24.10 mg/100 g at the end of the storage of 5 days. However it did not exceed the acceptability limit value. Any comparison was not possible because it did not encountered with other studies about fish kokoreç.

One of the changes caused to product spoilage is lipid oxidation. A bitterish flavor and yellow-brown color occur in the oxidized products. Thiobarbituric acid (TBA) value is one of the criterias which points out the lipid oxidation [26]. According to researchers value of the thiobarbituric acid must be lower than 3 mg MA/kg in a very good material when it must not be higher than 5 mg MA/kg in a good material. The acceptability limit value was between 7-8 mg MA/kg [29]. It may be said that thyme which was known with its antioxidant property and used in the product content was effective on the low TBA values in our study. In addition, being at low levels of both TVB-N and TBA during storage at $4\pm 1^\circ\text{C}$ seems normal for 5 days.

Because its raw material is intestine, commercially available kokoreç may be risky health-wise and in particular microbiologically in cases where being it is not fresh, not washed and cleaned properly and/or not cooked sufficiently [4]. The minimum and maximum total bacteria counts of kokoreç samples which were consumed in various restaurant, cafeteria, canteen and costers in Istanbul were 5.30×10^3 and 7.00×10^5 , respectively. These minimum and maximum counts for coliform, *E.coli*, *S.aureus* and anaerob were pointed out as $<1.00 \times 10^1$ - 2.10×10^4 , $<1.00 \times 10^1$ - 6.60×10^2 , $<1.00 \times 10^2$ - 4.80×10^3 and $<1.00 \times 10^1$ - $<1.00 \times 10^1$, respectively [9]. In another study, it was reported that microbiological quality of

raw kokoreç samples in Bursa was quite high [8] . In our study the microbial load of the fresh fish decreased with fried and it was detected at $<10 \log \text{cfu/g}$ levels. This situation continued during storage in the fish kokoreç too, similarly. The cooking process and the antimicrobial properties of used thyme and cumin spices to prepare the kokoreç may be a factor affecting low level of the microbial load during storage. In conclusion, it may be said that used fish as raw material to prepare the kokoreç instead of the intestine was more reliable microbiologically.

It was stated that the most important criteria determining quality of the product during storage of food was sensory analysis results and a product whose results of the analysis were not appropriate could not be consumed. Other results of made analysis must be evaluated together with the sensory analysis results [30] . The fish kokoreç prepared in the present study was found desirable by the panelists. The scores given by the panelists during sensory evaluation of the trout kokoreç showed decrease day by day. From the initial day to end of the storage of 5 days, the scores of appearance, texture, odor and flavor decreased from 5.00 to 2.00, from 4.80 to 1.20, from 5.00 to 1.60 and from 4.80 to 1.40, respectively. The kokoreç which was evaluated as 'acceptable' until 4th day spoiled at day 5.

Along with fish consumption in Turkey is not so much, fresh fish comprised the most of consumed fish. Consumption of the fresh fish is limited few cooking methods such as fried, grilled or baked. In our study, the trout kokoreç which is a ready - to - eat new product in different flavor, odor and apperance was prepared by cooking of fried trout added vegetable and spices in the teflon roasting plate. In comparison with other commercially available kokoreç, the healthier product in particular microbiologically was produced. It may be said that shelf life of 5 days for the kokoreç which is one of the fast food and its immediately consumption is preferred can be provide an opportunity to commercially evaluation of it. As a conclusion, it has been seen that the trout kokoreç has consumption potent in catering industry and it is the product which can contribute to seafood processing sector.

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