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Utilization and Quality of Fish Fingers from Prussian Carp (*Carassius gibelio* Bloch, 1782)

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ABSTRACT

Fish fingers were produced from *Carassius gibelio* and evaluated through nutritional parameters. The fish finger nutritional composition changed with pre-frying process. The moisture, crude fat, crude protein and crude ash contents of fish fingers were determined as 56.543 ± 0.113, 10.507 ± 0.116, 15.577 ± 0.382 and 2.027 ± 0.133, respectively. Unsaturated fatty acids, especially $C_{18:1\ \omega\text{-}9}$ and $C_{18:2\ \omega\text{-}6}$ increased with pre-frying process. The values of pH, thiobarbituric acid (TBA) and total volatile basic nitrogen (TVB-N) changed significantly ($P<0.05$) between fresh fish meat and pre-frying fingers. Scores for flavor, texture, color, odour and general acceptability of frying fish fingers were determined as 8.235 ± 0.207, 8.412 ± 0.193, 8.294 ± 0.206, 8.353 ± 0.170 and 8.471 ± 0.151, respectively.

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INTRODUCTION

Fish meat is very important because of its unique composition and hence considered quality food for human consumption. High-protein contents, as well as essential amino acid profile and less stroma make it easily digestible. It is an important raw material to make different food products (Akkuş *et al*., 2004). Unsaturated fatty acids, minerals and vitamins are known to be rich in this meat (Aitken *et al*., 1982; Gülyavuz and Ünlüsayın, 1999). Fish products are very important for human nutrition, however, its economic value is not that much high according to the current situation. Generally, *Carassius gibelio* is only freshly consumed. There is not many processing techniques except smoking. There is no study on fish fingers from *C. gibelio*. The aim of this study was to produce flesh from *C. gibelio* and to evaluate proximate composition and chemical properties (pH, TBA and TVB-N).

MATERIALS AND METHODS

Sample preparation

C. gibelio were obtained from the local fish market (Eğirdir, Turkey). Fish samples were between 347 to 449 g. Having been transferred to the laboratory, the fish samples were beheaded, gutted and washed to get their fillets. A portion of the fillet was analyzed for nutrient composition. The remaining fillets were minced with a kitchen meat mincer. The fish fingers were prepared following the method previous described (Çaklı *et al*., 2005; Tokur *et al*., 2006). The *C. gibelio* finger mince included 93.5, 1.52, 3, 1 and 0.02 % *C. gibelio* mince, salt, wheat flour, sugar and thyme, respectively. In addition to these, *C. gibelio* finger mince also included 0.24% each of cumin, onion powder, garlic powder and black paper. The ingredients were homogenized. The batter and breading materials were obtained from Pınar Company (İzmir, Turkey). The batter was homogenized for 2 minutes (cold water/batter ratio of 2.2:1 w/w). The batter was covered with breading crumbs and then pre-fried in sun flower oil at 180 ^{o}C for 30 seconds. Fish finger samples were shocked at -80 ^{o}C.

Analytical procedures

Moisture content was measured by automatic moisture analyzer (AND MX-50). Protein contents were determined (Velp UDK 142) according to Kjeldahl methods (AOAC, 2000). Crude fat and crude ash contents were determined according to standard procedures (Lovell, 1975; Lovell, 1981). The pH was measured for the dorsal muscle with a digital electronic pH meter (WTW Mark 320). TBA (thiobarbituric acid) number was determined as it was described by Erkan and Özden (2008). TVB-N (total volatile basic nitrogen) values were estimated using the method described by Nicholas (2003).

Fatty acid profile was determined by gas chromatography after methylation with sodium metoxide according to the methods of Izquierdo *et al*. (2002) and Tokuşoğlu *et al*. (2007). The samples were injected into a gas chromatography (QP 5050 GC/MS) fitted with a capillary column Cp WAX 52 (CB50m x 0.32 mm x 1.2 μm). The temperatures of the injection port and detector were 240 and 250 °C, respectively. The oven temperature was 175 °C for 27 min running time, followed by an increase to 215 °C at a rate of 4°C/min and 5 min at 215 °C followed by an increase to 240 °C at a rate of 4°C/min and 15 min at 240 °C. The carrier gas was helium (10 psi). The identification of peaks was performed by comparison of their retention times with those of pure standard compounds (Sigma, St.Luis, MO, USA) which was based on heptadecanoic acid methyl ester as internal standard.

Sensory analysis

Sensory analysis was done as described by Tokur *et al*. (2006). One day later, shock-frozen samples were fried in sunflower oil at 180°C for 2.5 min and presented to the panelists for their evaluation. Sensory analyses were assessed according to the flavor, texture, color, odour and general acceptability on a 1-9 point hedonic scale. Fifteen trained panelists judged the flavor, texture, color, odour and general acceptability of the fish finger samples. Panelist scored these parameters using a nine-point hedonic scale with a value of 0 corresponded to lowest and a value of 9 to the highest intensity for each parameter.

Statistical analysis

Every parameter was measured in triplicate for each sample. Statistical analyses were performed using SPSS v.9.0 for Windows. Analysis of variance (ANOVA) was used and statistical significance was set at P< 0.05 (Özdamar, 2001).

RESULTS

Results of these studies on nutrient components are given in Table 1. According to these findings; moisture and crude protein decreased but crude fat and crude ash contents increased in pre-fried fish finger samples. Table 2 shows pH, TBA and TVB-N values of raw fish samples, fresh fish finger and pre-fried fish finger samples. The pH value was found as 6.148±0.006 in raw fish and it increased significantly (P<0.05) following frying process. The TBA value showed significant increase whereas TVB-N values decreased significantly (P<0.05) following frying process. Fatty acid contents in samples indicated some changes with pre-frying process (Table 3). $C_{16:0}$ among saturated fatty acids and $C_{16:1}$, $C_{18:1\ \omega\text{-}9}$ and $C_{18:2\ \omega\text{-}6}$ among unsaturated fatty acids had the highest percentage. The results of sensory analysis were determined for flavor, texture, color, odour and general acceptability as 8.235 ± 0.207, 8.412 ± 0.193, 8.294 ± 0.206, 8.353 ± 0.170 and 8.471 ± 0.151**,** respectively. According to the scores of sensory analysis, it was concluded that the panelists liked *C. gibelio* fish fingers.

DISCUSSION

In the present study, according to analysis results, there were statically significant differences (P<0.05) between raw fish and pre-fried samples for moisture, crude fat, protein and ash. Of these, moisture and crude protein contents decreased while crude fat and ash increased significantly. Ünlüsayın *et al*. (2002) reported nutrient contents of *Carassius auratus* (raw flesh) as moisture, crude fat, protein and ash for male and famale *C. auratus* to be 77.40 ± 1.32–75.58 ± 0.34, 2.48 ± 0.65-4.29 ± 0.22, 17.34 ± 1.72-16.69 ± 1.01 and 1.29 ± 0.17-2.11 ± 0.14 %, respectively. These results are almost parallel to our results.

The effects of different processing methods on proximate composition and mineral contents of *Atherina mochon* were determined by El-Sahn *et al.* (1990). Fried fish had a higher level of fat than raw fish, mainly due to the absorption of fat by the processed product. Result of the studies with fish ball of *A. mochon* (El-Sahn *et al*., 1990) and pre-frying fish finger from *Merlangius merlangus* and *Sander lucioperca* (Çaklı *et al*., 2005) were similar to the results of present study. The moisture ratio in pre-frying fish finger decreased with pre-frying processing as reported by Çaklı *et al*. (2005). The findings of the present study were in concordance with those reported by Tokur *et al*. (2006). They reported chemical composition of mirror carp finger from unwashed mince to be 68.50, 15.5 and 2.20 % moisture, crude protein and crude ash, respectively.

Table 1: Some nutrient components of fresh and pre-fried fish finger samples (%) prepared from *C. gibelio*

Samples	Moisture	Crude Fat	Crude Protein	Crude Ash
K	76.243 ± 0.392[a]	4.627 ± 0.323[b]	17.997 ± 0.338[a]	0.933 ± 0.029[b]
FF	64.287 ± 0.318[b]	4.173 ± 0.055[b]	17.437 ± 0.437[a]	1.967 ± 0.103[a]
PF	56.543 ± 0.113[c]	10.507 ± 0.116[a]	15.577 ± 0.382[b]	2.027 ± 0.133[a]

Values (means ± SE) bearing different letters in a column differ significantly (P<0.05).
K: Raw fish samples, FF: Fresh fish finger, PF: Pre-fried fish finger.

Table 2: The pH, TBA and TVB-N values of raw fish samples, fresh fish finger and pre-fried fish finger

Samples	pH	TBA (μgMDA/g)	TVB-N (mg/100g)
K	6.148 ± 0.006[b]	0.193 ± 0.033[c]	14.371 ± 0.146[a]
FF	6.269 ± 0.006[a]	0.700 ± 0.046[a]	12.942 ± 0.444[b]
PF	6.279 ± 0.003[a]	0.337 ± 0.018[b]	12.690 ± 0.222[b]

Values (means ± SE) bearing different letters in a column differ significantly (P<0.05).
K: Raw fish samples, FF: Fresh fish finger, PF: Pre-fried fish finger.

Table 3: The changes in the fatty acid contents (%) of raw fish samples, raw fish finger and pre-fried fish finger

Fatty acids	K	FF	PF
$C_{14:0}$	1.743 ± 0.136^a	1.393 ± 0.278^a	-
$C_{15:0}$	0.980 ± 0.104^a	0.987 ± 0.110^a	-
$C_{16:0}$	21.343 ± 0.305^a	22.660 ± 1.960^a	11.403 ± 0.127^b
$C_{16:1}$	7.487 ± 0.540^a	6.203 ± 0.417^b	1.920 ± 0.079^c
$C_{17:0}$	0.817 ± 0.202^a	0.867 ± 0.137^a	-
$C_{18:0}$	1.237 ± 0.125^{ab}	4.883 ± 0.713^a	3.940 ± 0.104^b
$C_{18:1\ \omega\text{-}9}$	27.107 ± 0.450^b	21.953 ± 0.926^c	33.023 ± 0.378^a
$C_{18:1\ \omega\text{-}7}$	4.423 ± 0.310^a	3.800 ± 0.271^b	1.830 ± 0.131^c
$C_{18:2\ \omega\text{-}6}$	7.913 ± 0.911^c	13.910 ± 0.375^b	46.760 ± 0.269^a
$C_{18:3\ \omega\text{-}6}$	1.863 ± 0.071^a	1.857 ± 0.280^a	0.617 ± 0.021^b
$C_{20:0}$	0.363 ± 0.051^a	0.390 ± 0.145^a	-
$C_{20:4\ \omega\text{-}6}$	4.840 ± 0.675^a	5.250 ± 0.835^a	-
$C_{20:5\ \omega\text{-}3}$	4.743 ± 0.298^a	4.917 ± 0.640^a	-
$C_{22:5\omega\text{-}3}$	0.870 ± 0.207	-	-
$C_{22:6\ \omega\text{-}3}$	1.827 ± 0.302^b	3.307 ± 0.943^a	-

Values (means ± SE) bearing different letters in a column differ significantly ($P<0.05$).
K: Raw fish samples, FF: Fresh fish finger, PF: Pre-fried fish finger; - : Not detected

In the present study, fish fatty acids decreased significantly ($P<0.05$) due to $C_{16:0}$, $C_{16:1}$, $C_{18:1\ \omega\text{-}7}$ and $C_{18:3\ \omega\text{-}6}$. Meanwhile in pre-fried samples with sunflower oil, there was a significant ($P<0.05$) increase in amount of unsaturated fatty acids i.e., $C_{18:1\ \omega\text{-}9}$ and $C_{18:2\ \omega\text{-}6}$. Tokur *et al*. (2006) reported higher quantity of $C_{18:2\ \omega\text{-}6}$ for unwashed mince finger (UWF) and washed mince finger (WF) than the other fatty acids. Our findings are similar to these findings. The meat quality parameters viz., pH, TBA and TVB-N were found to be 6.279 ± 0.003, 0.337 ± 0.018 and 12.690 ± 0.222, respectively with significant ($P<0.05$) differences between the initial pH values. The pH value in the UWF samples has been reported to be 6.80 (Tokur *et al*., 2006). However, our pH value remained as 6.279±0.003 in PF samples. The TBA value is widely used as an indicator of the degree of lipid oxidation. TBA values between K and PF were determined as statistical significant ($P<0.05$) (Table 2). According to Tokur *et al*. (2006), initially, TBA values of both UWF and WF were 0.16 ± 0.01 and 0.20 ± 0.02 mg MDA/kg, respectively. Yanar and Fenercioğlu (1999) made minced fish meat from carp, TBA values at first and at the end of six months storage (-18 ^oC) were found to be 0.6 and 2.2 mg MDA/kg, respectively. Whiting (*Merlangius merlangus euxinus*) fishball with three different methods was done. The TBA value determine initially was 0.20 mg MDA/Kg whereas at the end of 15 days storage it was 1.22 mg MDA/Kg in pre-cooked fishball (Boran and Köse, 2007). These results are almost parallel to our results. The sensory scores of fish fingers obtained from *C. gibelio* in the present study revealed that panelists liked fish fingers in terms of flavor, texture, color, odour and general acceptability. Çaklı *et al*. (2005) made fish fingers from *S. pilchardus*, *M. merlangus* and *S. lucioperca*. They reported sensory quality of fish fingers as good quality score for all of samples (at the beginning). Another fish finger study gave similar results (Tokur *et al*., 2006) as determined for *C. gibelio* fish finger samples. Sehgal and Sehgal (2002) reported that general acceptability of fish fingers from carp were determined as 7.12. However, *C. gibelio* got mean score of 8.471 ± 0.151 during this investigation.

Conclusion

C gibelio is expected to become an important food product with fish finger processing technology. Its consumption thus can be increased in our country.

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