



Organoleptic assessment after different processing techniques (drying, smoking, freezing and salting) of exotic and indigenous fish species of Pakistan

Riffat Yasin¹, Khizar Samiullah^{*}, Muhammad Hafeez-Ur-Rehman¹, Inayat Ullah Malik², Muhammad Samee Mubarik³, Omer Draz³, Shakila Naz³, Mahpara Gilani³

¹Department of Zoology, GC University, Faisalabad, Pakistan

²Department of Fisheries and Aquaculture, Ravi Campus, Pattoki, UVAS, Lahore, Pakistan

³Department of Biological Sciences, University of Sargodha, Sub campus Mianwali, Pakistan

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Abstract

The study was conducted to assess the impact of drying, freezing, smoking and salting on organoleptic/sensory attributes of one exotic *Oreochromis niloticus* and two indigenous fish species *Labeorohita* and *Cirrhinus mrigala* of Pakistan. Fifty four fish specimens of exotic fish species *Oreochromis niloticus* and Fifty four indigenous fish species *Labeorohita* and *Cirrhinus mrigala* (total 108 specimens) were collected with the help of net from earthen fish ponds from Fish Farms Complex, Research and Training Facilities for Fisheries and Aquaculture at Ravi Campus Pattoki and Fish Hatchery, Satiana road, Faisalabad. The design of the research was completely randomized and the findings were assessed through two way ANOVA. Organoleptic study was carried out by a panel of ten trained judges using hedonic scale for each species. Graded results revealed a general decline in organoleptic properties such as colour, texture, freshness, and taste of the fishes stored. Among all the three fish species, *Labeorohita* exhibited the best result in all the treatments, followed by *Cirrhinus mrigala* and *Oreochromis niloticus*. Both *Labeorohita* and *Cirrhinus mrigala* came up as the best species in presenting quality meat to the judges.

*Corresponding Author: Khizar Samiullah ✉ khizar502@yahoo.com

Introduction

Fish is the economical, healthy and a very important foodstuff with high quality of animal protein (16-20%) and other required nutrients like amino acids, vitamin A and D, unsaturated fats and essential minerals that are rare in cereal based diets (Gadowaski and Caddell, 1991; Jamin and Ayinla, 2003; Virk and Sexena, 2003; Werner, 1991). Fresh fish is generally soft, it easily gets damaged and as fish dies fresh fish becomes unfit for human consumption within a day after capture (FAO, 1999; Adegunwa *et al.*, 2013; Nunoo and Kombat, 2013). Fish culture and production is a source of income for millions of people and source of foreign exchange for many countries (Al-Jufaili and Opara, 2006; Oostervee, 2008). It needs proper handling during harvesting and safe preservation and processing to retain its quality and nutritional value because it deteriorates rapidly if not properly handled (Whittle 1997, Okonta and Ekelemu, 2005). Soon after death fish invite a favourite platform for proliferation of wide variety of microbes (Ojutiku *et al.*, 2009; Aliya *et al.*, 2012; Oparaku and Mgbenka, 2012). Therefore it is necessary to ensure that fish once caught is safe and is delivered to consumers in secure and contaminant free form. Preservation methods are applied with an intention to making the fish safer and extend its shelf-life (Cihazala, 1994). Numerous handling methods and processing techniques are in use in different countries of the world which include chilling, depuration, freezing, salting, canning, drying, sun-drying and smoking which increase fish availability to the consumers (Eyabi-Eyabi, 1998; Obodai *et al.*, 2011). These techniques have numerous effects on the physical and nutritional quality of fish because different processing and drying methods have different effects on the nutritional compositions of fish (Oparaku and Mgbenka, 2012).

It has been observed that different processing and drying methods have different effects on nutritional compositions of fish. This is because heating, freezing and exposure to high concentration of salt lead to chemical and physical changes and therefore digestibility is increased due to protein denaturation

but the content polyunsaturated fatty acids is often reduced (Eyo, 2001; Tao and Linchun, 2008). Therefore the qualities of fish using different methods cannot be the same. In this research paper we have performed organoleptic analysis of one exotic *Oreochromis niloticus* and two indigenous fish species *Labeorohita* and *Cirrhinus mrigala* of Pakistan after using different processing techniques like drying, freezing, smoking and salting.

Materials and methods

Experimental site

Organoleptic analysis was conducted at the Central lab of Department of Zoology, GC University, Faisalabad.

Experimental Animal and Collection of Samples

In the current study, easily available exotic fish species *Tilapia Oreochromis niloticus* and two indigenous fish species Rohu *Labeorohita* and Mori *Cirrhinus mrigala* were selected as a candidate species.

The fifty four fish specimens of *Tilapia Oreochromis niloticus* and fifty four specimens of which twenty seven samples of Rohu *Labeorohita* and twenty seven samples of mori *Cirrhinus mrigala* (total 108 specimens) were collected from earthen fish ponds located in Fisheries and Aquaculture Department at Ravi Campus Pattoki. The fishes were transported to Central lab of Department of Zoology, Wildlife and Fisheries, GC University, Faisalabad by using polythene plastic bag.

The size of specimens belonging to tilapia was 200 g approximately while the weight of specimens of rohu and mori was approximately 1 kg. Fish products were developed by different preservation methods like drying, freezing, smoking and salting (Fig. 1).

The developed products were subjected to chemical analysis for nutrients and organoleptic tests for physical evaluation. Two samples of each species were used to determine nutritional properties of the raw fish which was used as control group.

Organoleptic analysis

Organoleptic assessment was laid on twenty seven fish samples from each species rohu and mori of approximately 1 kg weight and fifty four specimens of tilapia of approximately 200 g for the colour or appearance, aroma texture, taste and the overall acceptability of the fish as a control group and also after using different processing techniques like drying, freezing, smoking and salting (Fig. 1) were evaluated by using a ten point grading Hedonic scale {poor (1 to 3), fairly good (4 to 5), good (6 to 7) and very good (8 to 10)} conducted by a 10-man panellist (Desrosier and Desrosier, 1977).

Statistical analysis

Data was analysed by two way ANOVA. Means were expressed using Minitab statistical programme at significant values $p < 0.05$.

Results*Sensory analysis*

Sensory analysis of three fish species tilapia, rohu and mori was conducted with 54 tilapia of 200g and 27 rohu and 27 mori of approximately 1 kg each. From every species colour or appearance, aroma texture, taste and the overall acceptability was evaluated by using a ten point grading Hedonic scale.

Table 1. Sensory evaluation of fish by 10-man panelist through selected parameters.

Parameters (mean value)	Tilapia				Rohu				Mori			
	Colour	Aroma	Texture	Taste	Colour	Aroma	Texture	Taste	Colour	Aroma	Texture	Taste
Control	7	4.2	4.4	5.3	9	5.5	7.9	6.8	7	5.8	7	6
Oven drying (110 °C, 45 min)	6.1	5.7	6.1	7.4	5.9	6	6.3	7.5	5.7	5.6	6.5	7.5
Smoking (70-85 °C, 20h)	6.6	5.6	6.3	6.6	6.3	6.2	6.1	6.9	6.1	6.1	6.5	6.7
Freezing (30 day)	8.3	8.2	8.4	8.9	8.3	8.5	8.6	9.2	8.3	8.5	8.4	9
Freezing (60 day)	7.9	7.4	7.6	8	7.7	7.7	8.1	8.3	7.9	7.8	7.8	8.4
Freshly smoked	5.2	5.1	6	7.8	5.4	6.3	6.3	7.8	6.2	5.8	6	5.2
Smoking (20 days)	6.9	7.9	8	6.5	7.9	7.7	7.4	7.1	7.5	7.8	7.5	6.7
Salting (30 days)	7.6	5.9	5.6	6.1	7.3	5.6	6	6.2	7.7	6.6	6.2	6.2
Salting (60 day)	7	7.2	7.4	6.8	7.5	7.4	6.9	7.3	6.9	7.6	7.1	7.3

From the sensory evaluation results (Table 1), it is observed that in the control group the colour or appearance of rohu was of very good quality (9) while colour was good (7) in tilapia and mori. Aroma was fairly good (5.8) in mori while at lowest level in tilapia but still it was fairly good. In case of texture very good

texture was observed in rohu (7.9) while in tilapia it was at lowest level and fairly good (4.4). Taste of raw fish was also evaluated and rohu was found good (6.8) in taste while it was at lowest level of taste (5.3) in tilapia.

Table 3. Two-way ANOVA: Aroma versus Treatment, Species.

Source	DF	SS	MS	F	P
Treatment	8	31.7467	3.96833	31.78	0.000
Species	2	1.2422	0.62111	4.97	0.021
Error	16	1.9978	0.12486		
Total	26	34.9867			

S = 0.3534 R-Sq = 94.29% R-Sq (adj) = 90.72%.

Colour/appearance

Colour or appearance is critical in quality evaluation and is considered most important parameter which is used by the consumers to accept or reject the fish products. The colour or appearance was noted at

highest level i.e. good (6.1) in tilapia fish and lowest (5.7) in mori in fish dried in electric oven while it was good 6.6 in tilapia and 6.1 in mori in fishes dried in smoking kiln which indicate that colour remain better after drying in smoking kiln.

The colour was found best and very good (8.3) in three species studied tilapia, rohu and mori after 30 days freezing while it was 7.9 in tilapia and mori and 7.7 in rohu after 60 days freezing. In freshly smoked fish colour or appearance was 6.2 in mori and 5.2 in tilapia while it was 7.7 in mori and 7.3 in rohu after

20 days preservation of smoking which indicate that freshly smoked fish is of poor quality may be due to over smoking. In 30 days salted fish colour value was maximum at 7.9 for rohu and minimum for tilapia 6.9 while it was 7.5 in rohu and 6.9 in mori after 60 days salting.

Table 4. Two-way ANOVA: Texture versus Treatment, Species.

Source	DF	SS	MS	F	P
Treatment	8	19.2896	2.41120	5.87	0.001
Species	2	0.9274	0.46370	1.13	0.348
Error	16	6.5726	0.41079		
Total	26	26.7896			

S = 0.6409 R-Sq = 75.47% R-Sq(adj) = 60.13%.

Flavor/Aroma

Flavor/Aroma/Odour is an important quality parameter to accept or reject the product, as poor level will discourage people from accepting such food product. As the assessment was concerned the flavor or aroma of the fish product in processed fish species after using different techniques like drying, freezing, smoking and salting was also observed. It was noted that in fish dried in electric oven value was (6) highest in rohu and 5.6 in mori while drying in smoking kiln aroma value was 6.2 in rohu and 5.6 in tilapia. After

30 days freezing of fish aroma value was 8.5 in rohu and mori while 8.2 in tilapia. After 60 days freezing value was 7.8 in mori and 7.4 in tilapia and rohu. In freshly smoked fish the value was 6.3 in rohu and 5.1 in tilapia while in fishes preserved up to 20 days after smoking the value was maximum 6.6 in mori and minimum 5.6 in tilapia. Processing by salting up to 30 days give value of aroma maximum in 7.9 in tilapia and 7.7 in rohu while after 60 days salting value was 7.6 in mori a 7.2 in tilapia.

Table 5. Two-way ANOVA: Taste versus Treatment, Species.

Source	DF	SS	MS	F	P
Treatment	8	22.2000	2.77500	8.80	0.000
Species	2	1.1356	0.56778	1.80	0.197
Error	16	5.0444	0.31528		
Total	26	28.3800			

S = 0.5615 R-Sq = 82.23% R-Sq(adj) = 71.12%.

Texture

It was noted that the textures of all three fish samples after applying 4 preservation techniques were rated above the average.

The values for texture in fishes dried in electric oven was 6.5 in mori and 6.1 in tilapia while in specimens dried in smoking kiln value was rated high in mori 6.5 and low 6.1 in rohu. After 30 days freezing texture

value was 8.6 in rohu and 8.4 in mori while it was 8.1 in rohu and 7.6 in tilapia after 60 days freezing. Texture value in freshly smoked fish was 6.3 in rohu and 6 in mori and tilapia while it was noted 6.2 in mori and 5.6 in fish specimens smoked and preserved for 20 days. After processing by salting the values were 8 in tilapia and 7.4 in tilapia after 30 days salting and 7.4 in tilapia and 6.9 in rohu after 60 days salting.

Taste

Sensory evaluation of fish after drying by electric oven indicates that the value of taste was 7.5 in rohu and mori while 7.4 in tilapia. After drying by smoking kiln average rating value was maximum 6.9 in rohu and minimum 6.6 in tilapia. After 30 days, freezing value was maximum 9.2 in rohu and 8.9 in tilapia while it was observed 8.4 in mori and 8 in tilapia after 60 days freezing. Smoking result indicated that taste value in freshly smoked fish was 7.8 in rohu and tilapia and 5.2 in mori while fish smoked and preserved for 20 days indicates that taste value were 6.2 in mori and rohu while minimum value 6.1 was recorded in tilapia. Taste of salted fish was also observed and was noted that value was 7.1 in rohu and 6.5 in tilapia after 30 days salting while taste rating value was 7.3 in rohu and mori and 6.8 in tilapia.

Analysis of variance

Statistical analysis was conducted by Two-way ANOVA through Minitab programme and it was calculated that Colour had highly significant difference among treatments while non-significant among species. Aroma had highly significant difference among treatments while significant among species. Texture was highly significant among treatments while non-significant among species. Taste had also highly significant difference among treatments while non-significant among species as shown in the data described in Tables 2-5.

Discussion

Olley *et al.*, 1988 described the influence of drying and smoking on the nutritional properties of fish. Kumolu-Johnson and Ndimele (2001) studied effect of salting, brining and sun drying on the shelf-life of *Clarias gariepinus*. Nutrient composition of selected fresh and processed fish species from Lake Malawi was studied by Omodara and Olaniyan (2012). Arannilewa *et al.* (2005) described effect of frozen period on the chemical, microbiological and sensory quality of frozen tilapia fish (*Sarotherodon galilaleus*). Salan *et al.* (2006) observed use of smoking to add value to salmonid trout. Akinola *et al.* (2006) evaluated traditional and solar drying system

towards enhancing fish storage and preservation in Nigeria. Nuray and Ozkan (2007) estimated proximate composition and mineral contents in aqua cultured sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*). Saliu (2008) studied effect of smoking and frozen storage on the nutrient composition of some African fish. Turkkan *et al.*, (2008) examined effects of cooking methods on the proximate composition and Fatty Acid composition of Seabass. Ojutiku *et al.*, 2009 organized comparative study of sun drying and solar drying of *Hyperopisus bebe occidentalis*. Omodara and Olaniyan, 2012 studied effects of pre-treatments and drying temperatures on drying rate and quality of African catfish (*Clarias gariepinus*). Aliya *et al.* (2012) checked effects of freshness of starting material on the final product quality of dried salted shark. Mohammed and Karrar (2012) discovered salting and drying techniques on treated meat of *Mormyrus niloticus* collected from the White Nile in Sudan.

When we discuss our results, whole data for the colour was analyzed it was observed that all the three fish species i.e. rohu, mori and tilapia have very good colour after 30 days freezing and the lowest level was observed 5.2 in tilapia which was freshly smoked which indicate that smoking has adverse effect on fish colour or appearance.

The overall values of aroma after using different processing techniques indicates that fishes best in aroma were rohu and mori having value 8.5 after 30 days freezing while the lowest value of aroma was observed 5.1 in freshly smoked tilapia fish. This may be the result of over smoking, as the product had a burnt flavor.

The overall result of texture indicates that best texture value was observed in rohu 8.6 after 30 days freezing having firm skin which was not easily removed from the muscles and suitable for eating and the lowest texture was poor quality 5.6 in tilapia after 20 day preservation of smoked fish; the reason may be that due to this processing technique the product became very fragile. When overall analysis was

conducted about taste of all processed specimens the best taste was observed in rohu having 9.2 value after 30 days freezing as samples were neither burnt nor fresh and hence possessed good cooking attribute

while the lowest taste value was observed in freshly smoked fish which was 5.2 in mori indicating that smoking has adverse action on fish processing due to burning effect.



Fig. 1. Processing techniques: a- 30 days salting; b- 60 days salting; c- drying by smoking kilin; d- drying by electric oven; e- 30 days freezing; f- 60 days freezing; g- freshly smoked; h- smoking for 20 day preservation.

Our results discussed above are compared favorably with formerly described work of (Obemeata and Christopher 2012; Eyo 1998; Olley *et al.*, 1988; Kumolu-Johnson and Ndimele, 2001; Arannilewa *et al.*, 2005; Salan *et al.*, 2006; Saliu, 2008; Ojutiku *et al.*, 2009 and Aliya *et al.*, 2012) which revealed that the reduction in score of graded parameters such as: colour, texture, aroma and taste varied with different

preservation techniques. Major changes were observed in freshness and taste which became unacceptable. Although a variety of biochemical, physical (Gill, 1992; Gill, 1997) and microbiological methods (Gram and Huss, 1996) have been used to assess freshness, the sensory evaluation is still the most satisfactory method to achieve such a goal Hassan and Ali (2011).

Conclusions

The present study concluded that different processing techniques improve some sensory attributes, like flavor, juiciness and tenderness, thereby increasing the overall acceptability of the finished product. It is concluded that all the three fish species i.e. rohu, mori and tilapia have very good colour, aroma, texture and taste after freezing, drying and salting but has adverse after smoking.

When overall analysis was conducted of all processed specimens the best was observed in rohu after every processing method as samples were neither burnt nor fresh and hence possessed good cooking attribute while the lowest value was observed in mori. However, this study was limited up to sensory characteristics; further study needs to be done on species chemical composition and volatile compounds.

As smoking is employed by remote fishing communities due to traditional preference of the local people due to lack of sophisticated preservation techniques so it is less recommended as wood smoke produce microscopic particles, have dull and unattractive colour and due to overall less acceptability which is observed during organoleptic analysis.

The health risk may also be faced due to inappropriate smoking. Finally it is conclude that fish may consume after freezing but try to consume the fish in fresh condition as early as possible since quality remain better in earlier stage and also freezing is better processing method when preservation of nutrient is the focus also this processing made fish less susceptible to spoilage.

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