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The effects of traditional frying method on proximate composition and energetic values of fish species from Karachi coast of Pakistan

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Abstract

The effect of pan frying method was evaluated for proximate composition of selected fish species *Pampus argenteus*, *Lethrinus nebulosus* and *Acanthopagarus arabicus* which were determined by standard procedures. Proximate compositions found in the frying fillets were different to the raw fish samples. The moisture content seems to decrease in all fried samples. The reason of moisture loss at the time of frying produced is excessive protein amount in fried fish as compare to raw fish. Protein content seemed to increase in *Pampus argentus* > *Lethrinus nebulosus* and >*Acanthopagrus arabicus* in their particular fried form. The outcomes shown that protein content was in the ranges of 14.83-25.07 g/100g in fried samples, while the fat content was between 3.76- 9.77 g/100 g. The energy content was the highest in the fried fish *Lethrinus nebulosus* (236 kcal/100 g), *Pampus argentus* (161 kcal/100 g) and *Acanthopagrus arabicus* (135 kcal/100 g). The information achieved in this study would be very important to fish consumers, processors and nutritionists to academically increase their awareness regarding the nutrients contents in selected fish species.

Keywords: Traditional, Arabian Sea, Nutritious, Pampus Argenteus, Lethrinus Nebulosus, Acanthopagarus Arabicus

Major classification: Health Science.

1. Introduction

According to Hantoush, Al-Hamadany, Al-Hassoon, and Al-Ibadi (2015) "Knowledge of the proximate chemical composition (protein, fat, moisture and ash) of fish species can be used to determine their nutritional value and to plan the industrial and commercial processing". Fish have been described to have almost 72 % water, 19 % protein, 8 % fat, 0.5 % calcium, 0.25 % phosphorus and 0.1 % vitamins A, D, B and C (Islam & Joadder, 2005). Fish has usually been familiar as an important meal of high-quality and sufficient amount of protein in the human diet, an average100 g serving of it delivers more than 50% of the recommended daily protein intake, between 10% and 20% of minerals and a significant proportion of lipo-soluble vitamins A, D, and E (Perea, GoÂ mez, Mayorga, & Triana, 2008). A number of health benefits are attributable to fish; it is recommended that fish be compulsory in the diet (Bastías, Balladares, Acuña, Roberto Quevedo, & Ociel Muñoz, 2017). Fish supply 20% of animal protein consumption is to

about 2.6 billion people worldwide (FAO, 2009; Gandotra, Koul, Gupta, & Sharma, 2012). In developing areas of the world, it delivers merely 13% of animal protein intake. Fish meat has considerable amount of essential amino acids, ω-3 and ω-6 fatty acids that well-known to sustenance healthy life (Al- Reza, Karmaker, Hasan, Roy, Hoque, & Rahman, 2015). According to Domingo, Bocio, Falcó, and Llobet, (2007) "the kind of fish, the regularity of eating, and the portion size are vital concerns for the stability of the health advantages and hazards of regular fish consumption".

Fish is always processed by diverse methods before eating. These methods include frying, curry, baking and roasting etc. Cooking process gives them the desired features which are produced through an elaborate sequence of physiochemical modifications during processing. These transformations of food vary liable on its nature and methods of its culinary practice (Zabadi & Tukura, 2017). Bognár (1998) pointed out that cooking not only enhances the hygienic value of the food by removal of harmful microorganisms, it also improves its digestion process in the body. Bognár (1998) also mentioned that frying is the ancient food preparation method which intensifications the physical feature of meal by creation of good odor, appealing look, coating and crispy feature. Since frying involve with a very high temperature (usually 170 to 180℃) it degrades nutrients through hydrolysis and oxidation of fatty acids (Rossel, 2001). Protein in food is denatured during heating due to intense quivering and ultimate splintering of the amino acids hydrogen bonds, which causes a significant modification to the texture of the product (Marimuthu, Thilaga, Kathiresan, Xavier, & Mas, 2011). However, cooking methods are very important parameter for nutritive value of fish (Rehman, Zamri, & Fadilla, 2012). Usually in most of circumstances, deep frying also kept the vitamins Bi, B2, Be and C better than boiling, steaming and stewing (Bognár, 1998).

A number of works (Foline, Rachael, Iyabo, & Fidelis, 2011; Vitaglione &Fogliano, 2004; Abeni, Ibiyinka, & Funmilayo, 2015) on processing methods have been reported, yet, information on the use of particular cooking methods on some fishes are rare. There are some studies (Rehman et al., 2012; Erkan, Ö zden, & Selcuk, 2010; Ersoy & Ozeren, 2009; Karimian-Khosroshahi, Hosseini, Rezaei, Khaksar, & Mahmoudzadeh, 2016; Aberoumand, 2014; Aberoumand & Ziaei-Nejad, 2015) which discuss the impacts of diverse cooking procedures on nutritive value of various fishes. However information about the effects of traditionally shallow pan frying on the changes of nutritional values of selected fish species are still lacking.

Pakistani people usually do not take attention about the healthy choice during purchasing of fish for consumption instead of it; there selection of fish is habitually based on the taste and cost. Frying and curry are two popular methods of consuming fish in overall of Pakistan and even in neighboring countries. However, frying is more prevalent than curry form. The purpose of the present study was to study the effect of popular culinary practice on the nutritional value of the selected species of fishes Therefore the current study was designed to examine the effects of traditionally pan frying method on the proximate composition of three popular marine fish species *Pampus argentus*, *Lethrinus nebulosus* and *Acanthopagarus arabicus* and the values attained in the fried samples were compared with the values found in raw fish.

The current findings was carried out to provide not only information on the nutritional value in raw and fried samples of selected fish species but also give the awareness of healthy choice of purchasing fish and frying method. This would be very valuable for local consumer to tentatively build up their awareness concerning the nutrients contents in selected marine fish species.

2. Material and Methods

2.1. Collection of samples

About 5 kilogram of each type of whole fish species were obtained from different local fish markets and fish harbor in Karachi. Samples of White pomfret (*Pampus argenteus*), Spangled Emperor (*Lethrinus nebulosus*) and Arabian yellow-finned sea bream (*Acanthopagrus arabicus*) were randomly selected, kept in icebox and immediately transferred to the PCSIR laboratory of Karachi without delay, where the identification and measurement of samples were taken and preserved in laboratory within 1 hr. for further treatment.

2.2. Sample preparation and cooking

Samples of selected species of fish were cleaned with distilled water till all impurities and dirt removed. The samples were cleaned as per usual cooking practices (Scaling, beheading, gutting and removing the internal organs). A total of

20 randomly collected fish fillets were divided into two sets. Each group consists of 10 fish fillets, the first one was raw and the second one was shallow pan fried. The mean ±SD lengths (cm) of fish species are present in Figure 1.

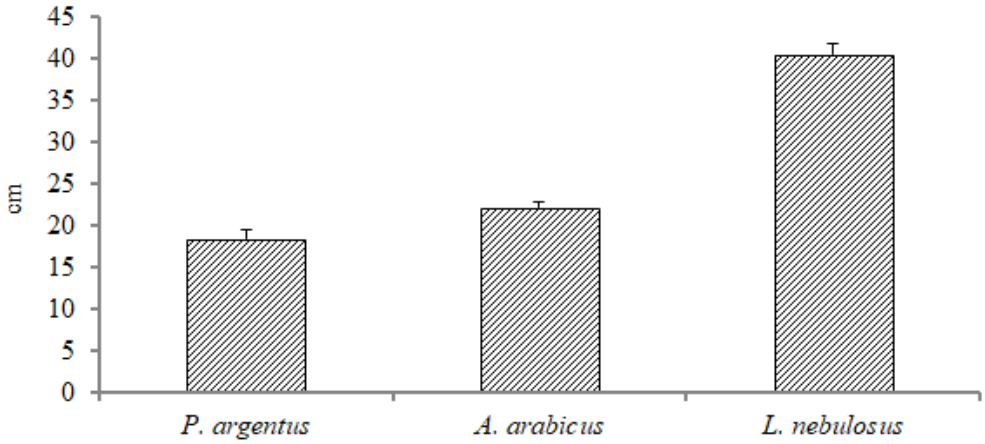

Figure 1: The mean ±SD length (cm) of fish species included in this study.

The pan frying of the traditionally marinated fish species was obtained in a local nonstick pan (2-Litre capacity) at medium gas stove flame approximately for 10 to 15 minutes. On frying equipment where gas flames are used, the flame must be adjusted so that it does not flare up round the sides of the frying vessel and never to a height above the surface of the oil. Sunflower oil was used for shallow pan frying.
After frying, the skin and backbone of the samples were removed. Samples of each group were homogenized in a food blender and then distributed into three batches (n = 3) to achieve the statistical analysis. Samples were wrapped in air-tight zipper pouches and kept into deep freezer at (−20°C) till analysis.

2.3. Analytical methods

In this study we analyzed the concentration of the different nutritional components in raw and fried muscle. The results are expressed in g per 100 g wet weight of raw or fried muscle, respectively. Moisture, ash, protein, lipid and carbohydrate contents were determined in each specimen's tissue according to the Association of Official Analytical Chemists procedures (AOAC, 2000; Latimer, 2012).

2.4. Moisture

Moisture (%) in the meal components was determined by a gravimetric method (Latimer, 2012). About three grams of sample was pre-weighed (W1) in an aluminum dish and kept in an oven at 105℃ for 6 h. The samples were removed from the oven, cool down in a desiccator, and reweighed (W2).
Moisture percentage was calculated according to the formula:
Moisture (%) = (W1 – W2) / W1 x 100.

2.5. Total ash

Total ash content was found out as total inorganic matter by ignition of a sample at 600℃ (Latimer, 2012). Sample (2 g) was balanced into a pre-weighed porcelain vessel and burn up overnight in a muffle furnace at 600℃. The vessel was removed from the muffle furnace, cools down in desiccator and re-weighed. Ash content was calculated according to the following formula:
Ash (%) = (ash weight / sample weight) x 100.

2.6. Crude protein

Crude protein was resolved by the Kjeldahl procedure as described by (Latimer, 2012). Sample (700 mg) was placed in a Kjeldahl digestion tube. 5 g K_2SO_4 + 0.5 g $CuSO_4$ and 25 ml conc. H_2SO_4 were added to the sample. The sample was digested for one hour. About 20 ml deionized water was added to the sample after allowing it to cool. After adding 25 ml NaOH (40%), the sample was then distilled and the ammonia liberated was collected in boric acid and titrated with 0.1N hydrochloric acid. A blank was prepared and treated in the same manner except that the tube was free of sample.

Protein percentage was calculated according to the formula:
Crude protein (%) = (sample titre – blank titre) x 14 x 6.25 x 100 / sample weight
Where, 14 is molecular weight of nitrogen and 6.25 is the nitrogen factor.

2.7. Crude fat

Crude fat was estimated by retaining solvent extraction by a Soxhlet extraction unit (Latimer, 2012).One gram sample was weigh up into an extraction thimble and enclosed it with absorptive cotton. 50 ml solvent (petroleum ether) was added to a pre-weighed cup. Both thimble and cup were attached to the extraction unit (PCSIR Labs., Complex, Lahore, Pakistan). The sample was subjected to extraction with solvent for 30 min followed by rinsing for 1.5 hr. The solvent was evaporated from the cup to the condensing column. Extracted fat in the cup was placed in an oven at 110℃ for 1 hr. and after cooling the crude fat was calculated using following formula:
Crude fat (%) = (Extracted fat / Sample weight) x 100.

2.8. Total Carbohydrates

Total carbohydrate content was calculated as following:
Total carbohydrate (%) = 100 – (Moisture + Crude protein + Crude fat + Total ash)

2.9. Gross energy value (Calories)

The energy value, expressed as kcal and kJ/100 g edible part, was estimated using factors: 9, 4 and 4 kcal/g for fat, protein and carbohydrate, respectively (FAO, 1989). The energy contents were summed to give total or gross energy of the samples (Livesey, 1990). The total energy value was calculated using the crude protein, crude fat and carbohydrate contents of the fish based on the following formula:

Energy value K cal/100g = Px4.0 (Protein K cal/100 g) +Fx9.0 (Fat K cal/100g) + Cx4.0 (Carbohydrates Kcal/100 g).

2.10. Statistical analysis

The impact of shallow pan frying method on the nutritive components of selected fish species was examined using mean standard deviation (SD). The annual quantity of fish consumed is 2 kg/person in 2006 (FAO, 2009) which is equivalent to 5.48 g/day for Pakistan.

3. Results

The cooking method and ingredients are present in Table 1. The proximate compositions of the fin fish samples are essential for determining if the nutritious amount fit in to the limit of dietetic and mercantile stipulations (Bassey, Oguntunde, Iwegbue, Osabor, & Edem, 2014). The proximate composition of raw and the most popular cooking method i.e. “pan fried form” of selected species are presented in (Table 2).

Table 1: Ingredients and traditional methods of preparation of fish species commonly consumed in Karachi, Pakistan.

Species	Cooking process	Sample size (gm)	Oil used (ml)	Ingredients	Method	Cooking time (min)
Pampus argentus	Fried	100	200	*	**	10-15
Lethrinus nebulosus	Fried	100	200	*	**	10-15
Acanthopagrus arabicus	Fried	100	200	*	**	10-15

* Spices containing mainly, salt, red chili powder, turmeric powder, fresh garlic paste and gram flour for coating.
** Wash the fillet with salt and vinegar mix water then clean tap water, fillets coated with spices mix gram flour batter leave for 15 minutes in refrigerator for batter grip of coated ingredients then fry in moderate hot sunflower oil. Turn the fillet with wooden spatula till brown.

Table 2: Mean ± SD of Proximate composition of Raw and cooked fish commonly consumed in Karachi.

Species	*Pampus argentus*		*Lethrinus nebulosus*		*Acanthopagrus arabicus*	
	Raw	Fried	Raw	Fried	Raw	Fried
Moisture %	74±1.2	62.67±2.04	78.1± 0.5	59.37±0.6	71.78±0.31	68.94± 0.11
Ash %	1.85±0.2	3.05±0.18	1.70±1.3	3.50±0.1	1.38±0.01	2.03± 0.06
Crude fat %	0.45±0.1	4.93±0.16	1.23±0.01	9.77±0.8	1.09±0.02	3.76± 0.07
Crude Protein N*6.25 %	16.77±0.6	25.07±0.57	8.75±1.4	18.3±0.6	13.14±0.09	14.46± 0.07
Carbohydrate %	6.93±2.1	4.28±1.13	10.2±0.71	9.07±0.29	12.62±0.44	10.80± 0.19
Calories kcal/100g	97 ±4.74	161 ±7.91	121±9.5	236 ± 4.5	113±1.24	135±0.16

4. Discussion

The premier value of moisture was noted in raw samples while reduction of moisture was observed in fried samples. It was also found that the moisture content decreased in all methods of cooking except for the boiled fillets of striped snakehead fish (Kumar, Sajwan, & Mukherjee, 2012). In the present study these differences were comparable to those stated by (Garcia Arias, Pontes, Garcia-Linares, Garcia-Fernandez, & Sanchez Muniz, 2003; Devi & Sarojnalini, 2012; Rehman et al., 2012; Aberoumand, 2014; Karimian-Khosroshahi et al., 2016). In this study the fried samples moisture content was lowest recorded in *Lethrinus nebulosus* > *Pampus argenteus* > *Acanthopagarus arabicus*. According to Garcia Arias et al. (2003) the main factor of moisture loss by frying produced higher protein content in fried fish as compare to uncooked fish. The intensification in ash, protein and fat content obtained in cooked silver catfish fillets is justified by the lessening in moisture (Garcia Arias et al., 2003). The same pattern observed in present study where fried samples of all fish tend to increase their protein, ash, and fat content after removal of moisture.

In present study the Ash content was observed higher in all fried form of fishes. According to Higashi (1962) this may be happened due to the virtuous bony consistency and high scaly nature of fish and such kind of fish plentifully provide minerals in their cooked forms as compare to large-sized fish do.
The Protein content seemed to increase as a result of fried cooking in all species, as apparent by the increased protein content in *Pampus argentus* (25.07%), *Lethrinus nebulosus* (18.30%) and *Acanthopagrus arabicus* (14.46%) in their respective fried form. Protein content may also increase in fried samples due to traditionally adding of Gram flour as

a coating media for frying, which has high protein content. Musaiger and D'Souza (2008) reported that protein contents of 22.8% to 27.9% in fish generally consumed in the Arabian Gulf. Appropriate protein contents specify that necessary amino acids composition of the fish is of a higher quality (Bassey et al., 2014). Fat content was highest observed in raw samples of *Lethrinus nebulosus* (1.23%), *Acanthopagrus arabicus* (1.09%), and *Pampus argentus* (0.45%). After frying fat content was remarkably increased in *Lethrinus nebulosus* (9.76%) while lowest increase of fat content was observed in *Acanthopagrus arabicus* (3.76%). Fried fish had an excessive amount of fat than raw or other form of cooked fish. The rise of fat content in the fried fish fillets is also associated to oil penetration through the frying process. Fat content can also be increase when moisture evaporates during frying (Saguy & Dana, 2003). The related results have been reported for African catfish fried in sunflower cooking oil (Rosa, Bandarra, & Nunes, 2007).

The Carbohydrate content was calculated by using formula; Carbohydrate % = 100 – (% of moisture + % of ash + % of fat + % of protein). As expected the energy value improved as a result of frying in all types of fishes from their raw forms. As evident by the highest value of energy was observed in in fish *Lethrinus nebulosus* (236 kcal/100 g), *Pampus argentus* (161kcal/100 g) and *Acanthopagrus arabicus* (135 kcal/100 g).

Nutrition has an inclination to be based on marine fish, as one of the elementary foods of a healthy diet. Fish is a source of energy and protein with high biological value, with well-established health benefits (Domingo et al., 2007). Relevance for human consumption of different fish species, regarding nutrition, is assessed according to the European Food Safety Authority (EFSA) and FAO/WHO which include acceptable weekly intake. Consumption of around 1-2 portions of fish per week and up to 3-4 portions per week in the course of pregnancy has been related to preferable functional effects of neurodevelopment in children compared to no fish. Such quantities have also been related to a reduce risk of coronary heart disease in adult persons and are appropriate, with valid intakes and recommendations in most countries considered. However, no extra benefits on neurodevelopmental outcomes and no benefit on coronary heart disease risk might be expected at more consumption. The health benefits of fish consumption in decreasing the threat of coronary heart disease are likely due to the content of n-3 LCPUFA in fish (EFSA, 2010; 2012a,b; WHO, 1989; 1996; 2004).

5. Conclusion

The numerous ways of cooking did have a significant impact on the nutrient components of fish. The pan-frying modes of cooking employed in Karachi did have a considerable influence on the nutrient composition of fish. The changes are subject to on cooking conditions (time, temperature and medium of cooking). Moreover the age, size and location are very important factor for nutritional value of fish. The selected fried fish species had greater content of protein, ash and fat. Higher ash content in fried samples of selected fish species might be due to its traditional using ingredients and notable bony and scaly nature. In present study *Pampus argenteus* after shallow pan-frying, has high amount of protein as compare to other selected species. Protein content may also increase in fried samples due to traditionally adding of Gram flour as a coating media for frying, which has high protein content. These satisfactory values of protein mention that the selected fish species has higher quality of necessary amino acids composition. So it is recommended for public awareness to use shallow pan frying on medium high flame to avoid excess amount of oil intake to obtain all the goodness of selected fish species.

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