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Assessment of fish oil to check the stability and meat quality of some commercially available tin packed fish in Islamabad, Pakistan

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Abstract

Fish contains all the essential nutrients which is important for human health so it is important to analyse all the nutrients present in tin packed fish meat. Keeping in view its importance present study is conducted on the assessment of fish oil to check the stability and quality of fish meat by proximate analysis of commercially available tin packed fish. Four tin packed fish species i.e., Sardine (*Sardinella longiceps)*, Red salmon (*Oncorhynchus nerka)*, Pink salmon (*Oncorhynchus gorbuscha)* and Skipjack tuna (*Katsuwonus pelamis)* were collected from different supermarkets of Islamabad, Pakistan. Proximate analysis viz., crude protein, crude fat, moisture and ash contents of the fish meat has been done to evaluate the meat quality. The antioxidant activity in oil was also analysed by FRAP assay. The result indicated that maximum percentage of moisture i.e., 78.61% present in Skipjack Tuna meat, Pink Salmon contain highest percentage of crude protein i.e., 70.00%, Red Salmon contain highest percentage of crude fat i.e., 30.00% while Sardine and Skipjack Tuna contains highest percentage of ash contents i.e., 8.00% and the total antioxidant capacity (uM) is higher in oil of Red Salmon (24.35%) followed by Sardines (14.78%), Skipjack Tuna (9.86%) and Pink Salmon (9.48%). It was concluded that the fish meat after thermal processing contains suitable percentage of crude protein, crude fats, and moisture and ash contents.

Key words: Proximate analysis, Antioxidant, Crude protein, Crude fat, Tin packed fish meat

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1. INTRODUCTION

On the basis of habitat and physiology of fish species it is important to analyze all the components present in fish meat to maximize its utilization because it contains all essential nutrients for the people as compared to buffalo, mutton and goat meat[20].

Proximate analysis was performed on most common ten edible species of Agatti Island, India. According to research some of the edible species like *Hyporhamphus dussumieri,Thunnus albacares* and *Parupeneus bifasciatus* contains lipid, carbohydrate, ash and protein content in large amount as compare to other species present in Lakshadweep Sea. Higher percentage of ash (1.65%) and protein found (13.69%) in *T. albacares, lipid (6.97%) in H. dussumieri and* carbohydrate (6.12%) in *P. bifasciatus*. This study shows that

fish meat in Lakshadweep Sea contains the higher nutritional[9]. A study was conducted to check the effect of tin packing on meat quality of Nile fishes. Percentage of protein, lipid and moisture content were 77%-79.1%, 1.8 %-17.3% and 73 %-80 % respectively. It was concluded that storage and packaging affect the quality of the fish meat[15].

Proximate composition of fish species i.e., *Polydactylus quadrifilis, Chrysichthys nigrodigitatus* and *Cynoglossussen egalensis* attained from Ayadehe city, Akwa State has been analyzed by using ordinary approaches. It was concluded that for fats, moisture and protein contents the average values were (67.54 percent, 3.39 percent and 17.83 percent) in *Polydactylus quadrifilis*, (10.62 percent, 66.19 percent and 14.23 percent) in *Chrysichthysnigrodigitatus* and (2.57 percent, 63.97 percent and 18.56 percent) in *Cynoglossussenegalensis*. The amount of crude fiber is (7.67 percent - 10.71 percent), amount of ash is (5.3 percent – 7.7 percent), amount of carbohydrate is; (3.69 percent – 7.26 percent). It was concluded that the fish meal has moisture, crude protein, ash and lipid in higher amount and beneficial for human beings[7].

Research was conducted to analyze the proximate, vitamins and mineral contents present in oven dried fish species of Taiga reservoir. Five fish species *Schilbe mystus*, *Bagrus bayad*, *Oreochromis niloticus*, *Clarias anguillaris* and *Petro cephalus bane bane* were used for study. Results revealed that fish can be consumed as a good source of protein, minerals and vitamins[10]. Tin pack fish meat contains different feed additive, minerals and antioxidants and processed under high temperature[8]. Fish meat can be seal in a proper tin can by providing heat to increase shelf life. It was concluded proper thermal processing reduces the microbial attack on tin packed fish meat[3].

Higher percentage of moisture 72.23%, crude protein content 17.41% was observed in tin pack Tuna fish. Higher energy level and fat contents were also observed. It was concluded that Thermal processing enhances the chemical properties of tin packed fish and reduces the meat spoilage[1]. The effect of chilled temperature on meat quality of Seer (*Scomberomoruscommerson*) fish in single or multiple layers packing was examined. Fish packed in multilayered bag was recommended because it was acceptable for 13 to 14 days as compare to the fish in mono layer packaging, acceptable only 11 to 12 days[16]. A study was conducted on composite analysis of some commercially available fish species i.e., Catfish (*Hemisynodontismembranacea*), Mackerel (*Scomberscombrus*), Tilapia (*Tilapia zilli),* and Atlantic herring (*Clupeaharengus*) from the city of Zaria in Nigeria. It was concluded that Herring and Mackerel contains lower moisture content (68.6%-65.0% respectively), higher lipid content (11.14%- 12.33% respectively), ash (insignificant statistically) and higher amount of carbohydrate (0.63%). Significantly minimum protein (18.45 percent) was present in Atlantic Herring as compared to other fish species[17].

The change in chemical composition of *Mystusseenghala* fish by microbial activity was observed after preserving for 21 days at two different temperatures (-12$\pm$20^{o}C and 4$\pm$10^{o}C). It was estimated that fatty acids increases significantly ($p<0.01$) and percentage of moisture (38.82%), ash (37.88%), lipid (56.68% to 10.96%) and protein (54.35% to 22.70%) decreases. The microbial study indicated that total plate count (TPC) in frozen sample (14th day, TPC=5.78±0.2 log cfu/g) and in chilled sample (10th day, TPC=6.04±0.11 log cfu/g). It was concluded that microbes affect the meat quality of fish[12]. It was indicated by proximate analysis of fish meat of commercially available fishes Grouper (*Epinepheluscoioides*), Spanish mackerel (*Scomberomous maculates*) and Yellow-spotted trevally (*Carangoidesfulvoguttatus*) contain the maximum amount of lipids (omega-3/omega-6)[27]. Antioxidant activity in fish oil emulsion is improved by the organic acid, phenolic components present in apple skin extract. Natural antioxidants (apple pomace) provide more stability to the fish oil as compared to artificial antioxidants (alpha-tocopherol)[18].

Study indicates that antioxidants (propyl gallate and butylated hydroxyl toluene) used for reducing the oxidation process (up to 71%) in fish oil directly increase the stability of fish oil (up to 400%)[7]. A research was conducted to describe the antioxidant activity of polyols, polyhydric alcohols and sugar in emulsions of fish oil. It was concluded that polyols act as both antioxidant and oxidizing agent by suppressed the peroxide value (10-18%) and when combine with phenolic components suppressed its antioxidant activity respectively. Fishy flavor is also suppressed by fish oil emulsion due to the presence of polyols[11].

Purpose of the study is to analyze the stability (natural and artificial anti-oxidant activity) and meat quality (Composite analysis) of commercially available tin packed fishes in Islamabad.

2. MATERIALS AND METHODS

2.1 Studied area

The experiment was conducted on tin packed fish meat obtained from commercial markets of Islamabad, Pakistan. The tin packs were collected and transferred to the Aquaculture and Fisheries Laboratory, Department of Biology, PMAS-Arid Agriculture University Rawalpindi for meat analysis.

2.2 Preparation and sampling for analysis

The fish meat of four different species had been removed from tins and packed in labelled polythene bags for further examination i.e., proximate analysis. The proximate analysis was done on four fish species i.e., Sardines, Red Salmon, Pink Salmon and Skipjack Tuna labelled as B1, C1, D1 and E1 respectively.

2.3 Meat quality

The meat quality was assessed by the composite analysis in terms of moisture, dry matter, crude protein, total fats, and total ash by using standard laboratory procedures (AOAC, 1999).

2.4 Proximate analysis

Proximate analysis was done to determine the amount of protein, moisture, fats and ash content within a material.

The weight of 1 g fish meat was recorded by using analytical balance in laboratory. After taking weight, the sample was oven dried up to 60-65^{0}C. The weight of the sample was again recorded after cooling. The sample was again kept in oven for 15 minutes to gain the constant weight (W2) of the sample. The percentages of moisture were analyzed by using the formula given below:

$$\text{Percentage of moisture} = \frac{W1-W2}{W3} \times 100$$

W1= weight of petri dish + weight of sample before drying, W2= weight of sample + weight of sample after drying, W3= weight of sample.

The dry matters from the meat were calculated by using the formula given below:

$$\text{Dry matter percentage} = 100 - \text{percentage of moisture}$$

The total fat content in meat were determined by using a Soxhlet system (Franz von Soxhlet, 1879). In Soxhlet thimble 3 grams of moisture free fish meat from each sample were placed. Receiving flasks were connected with this apparatus which contain water up to 150 mL. Condensation occurs and fats move drop by drop downward. After 10 hours the extraction was done at the rate of ¾ drops per second. After extraction the weight of the sample was measured. The percentage of fat content in that sample was found out by using the formula given below:

$$\text{Percentage of fats} = \frac{\text{wt. of thimble after extraction} - \text{wt. of empty thimble} \times 100}{\text{Wt. of sample}}$$

In muffle furnace receptacle was placed and heated at 600^{o}C and then cooled for 1 hour in desiccator. The weight of the receptacle was measured and then added 2 gram of dried fish meat for 4-5 hours. When residue was obtained the cool residue was placed in desiccator and weight was obtained. The percentage of the ash was estimated by using the formula given below:

$$\text{Percentage of ash} = \frac{\text{weight of residue} \times 100}{\text{weight of sample}}$$

The crude protein present in fish meat was analyzed by micro kjeldahl's method (Johan G.C.T. Kjeldahl, 1883). The kjeldahl's method consists of three steps i.e., Digestion, Distillation and Titration.

Digestion: 2 gram of dried fish meat, 30 ml of conc. H_2SO_4 and 5g of digestion mixture $CuSO_4$, K_2SO_4, $FeSO_4$ in proportion of 1:5:100 respectively transferred in each kjeldahl's flask. Boiled it for 30 minutes then digestion mixture was permissible to cool down for few minutes.

Distillation: Cold mixture was added in 100 ml volumetric flasks and the volume of the volumetric flasks was adjusted with distilled water. 10 ml dilute digestion mixture along with 10 ml of NaOH (40 %) was added. 10 ml of Boric acid containing a drop of indicator (methyl red) was added into solution the liberating concentration of (Ammonia) was accumulated in it.

Titration: For the analysis of crude protein in fish meat titration of the mixture were done after the indication of golden yellow color. For the analysis of crude protein, percentages of nitrogen were calculated by using the formula given below:

$$\text{Percentage of Nitrogen} = \frac{H_2SO_4 \text{ Normality} \times H_2SO_4 \text{ volume used} \times 100 \times 0.014 \times 100}{\text{Wt. of sample} \times 10}$$

100 = percentage of nitrogen

10 = used volume for diluted mixture

0.014 = standard volume of H_2SO_4 (0.1N) to neutralized 1 ml ammonia

100 = dilution of digested matter

The total percentages of crude protein were found out by the given formula:

Total percentage of crude protein = percentage of nitrogen x 6.25

6.25 = F = factor which is used to estimate the crude protein from the percentage of nitrogen.

2.10 Quality of oil

The total antioxidant capacity of oil in which fish meat were preserved was determined through (Ferric Reducing Ability of Plasma) FRAP assay[4].

Ferric reducing ability of plasma (FRAP) assay

In order to check the antioxidant capacity of oil ferric reducing ability of plasma (FRAP) assay was used[4]. A solution of ferric reducing ability of plasma reagent were prepared by adding (1:10:1) ferric chloride: [(Merck, Germany) (0.054g in 10 ml distilled water)] and acetate buffer: [3.1g sodium acetate trihydrate (Merck, Germany), 16 ml glacial acetic acid (Merck, Germany) and raised to 1 liter with distilled water], 2,3,5-Triphenyltetrazolium chloride (TPTZ): [0.031g TPTZ (Sigma-Aldrich, USA) per ml of 40 mM HCl (Merck, Germany) respectively. For negative control 3mL of distilled water was used during this process. By mixing 100 µL of ascorbic acid (1mM; Merch, Germany) with 3mL of FRAP reagent in a blank a standard was prepared. In FRAP reagent (3000 µl) 100 uL of fish oil from each sample or fish species were added, standard, sample and absorbance of blank were observed at 593nm under spectrophotometer (Arnold O. Beckman, 1940). By using formula given below the value of FRAP from fish oil were estimated.

$$\text{FRAP value of sample (uM)} = \frac{\text{Abs. of sample} \times \text{FRAP value of stand.}}{\text{Abs. of stand.}}$$

2.11 Statistical analysis

The data of proximate analysis were entered and analysed using SPSS version 17. Descriptive statistics were used to calculate the quantitative variables. For quantitative variables like percentage of moisture, percentage of crude protein, percentage of ash content and percentage of fats, mean and standard deviation were calculated. Obtained data of meat quality parameters were subjected to suitable statistical analysis e.g., Two-way ANOVA to obtain the information of high-quality fish meat present in tin packs.

3. RESULTS AND DISCUSSIONS

The study was conducted to analyze different content like crude protein, crude fats, moisture and percentage of ash in terms of composite analysis and the effect of natural and artificial antioxidants present in different tin pack fishes via FRAP assay.

3.1: Proximate analysis of fish meat

Four fish species were taken and transferred into laboratory in order to analyze these contents.

Initial weight of sample B1, C1, D1 and E1 were 92.00g, 161.90g, 134.60g and 78.80g respectively. The multiple comparative measures between the contents present in each sample has been analyzed by ANOVA test.

The constant weight of sample i.e., B1 C1, D1 and E1 after putting it into the oven at 60-65°C was 38.99g, 53.57g, 43.49g and 16.85g respectively. Highest percentage of moisture was observed in E1 (78.61%) followed by D1 (67.71%), C1 (66.91%) and B1 (57.61%) as shown in Table 1. ANOVA test were applied to calculate the variance that shows mean difference is not significant ($p<0.05$).

Table 1. Percentage of moisture

Samples	Initial weight (W1)	Dry weight (W2)	Initial wt. -Dry wt.(W1-W2)	Total percentage of moisture (W1W2)/W1 x100
B1 (Sardines)	92.00g	38.9g	53.01g	57.61%
C1 (Red Salmon)	161.90g	53.57g	108.33g	66.91%
D1 (Pink Salmon)	134.60g	43.49g	91.11g	67.71%
E1 (Skipjack Tuna)	78.80g	16.85g	61.75g	78.61%

Highest percentage of fat content was observed in C1 (21.60%), B1 (21.30%) followed by D1 (10.30%) and E1 (7.30%) as shown in Table 2. ANOVA test were applied to calculate the variance that shows mean difference is not significant ($p<0.05$).

Table 2. Percentage of fat

Samples	Wt. of filter paper	Sample wt.	Filter paper wt. + Sample wt. (W1)	Weight after de fating and drying (W2)	Before treatment – After treatment (W1-W2)	Total Percentage of fats (W1-W2) /3X100
B1(Sardines)	1.35g	3g	4.35g	3.71g	0.64g	21.3%
C1 (Red salmon)	1.42g	3g	4.42g	3.77g	0.65g	21.6%
D1 (Pink salmon)	1.45g	3g	4.45g	4.14g	0.31g	10.3%
E1 (Skipjack Tuna)	1.43g	3g	4.43g	4.21g	0.22g	7.3%

Highest percentage of ash content was observed in B1 (8.00%), E1 (8.00%) followed by C1 (7.50%) and D1 (6.50%) as shown in Table 3. ANOVA test were applied to calculate the variance that shows mean difference is not significant ($p<0.05$).

Table 3. Percentage of ash

Samples	Dish number	Dish weight	Dish wt. + Sample wt. (W1)	Ash weight (W2)	Dish wt. – Ash wt (W1-W2)	Total percentage of Ash (W1-W2)/2x100
B1 (Sardines)	N	19.04g	21.04g	19.20g	0.16g	8.0%
C1 (Red salmon)	S	13.91g	15.91g	14.06g	0.15g	7.5%
D1 (Pink salmon)	Q	18.76g	20.76g	18.89g	0.13g	6.5%
E1 (Skipjack Tuna)	X	19.06g	21.06g	19.22g	0.16g	8.0%

Higher percentage of crude protein was observed in D1 (70%) followed by E1 (66.5%), C1 (63%) and B1 (63%) (Table: IV). ANOVA test were applied to calculate the variance that shows mean difference is not significant ($p<0.05$) as shown in Table 4.

Table 4. Percentage of crude protein

Samples	After titration	Percentage of Nitrogen (Nx1.4007xdil. factor)	Total percentage of crude protein (percentage of nitrogen x F)
B1 (Sardines)	3.6	10.08	63.03%
C1 (Red salmon)	3.6	10.08	63.03%
D1 (Pink salmon)	4.0	11.20	70.0%
E1 (Skipjack tuna)	3.8	10.64	66.50%

3.2 Analysis of variance

The total calculated percentage of moisture 57.61%, 66.91%, 67.71%, and 78.81%, crude protein 63.0%, 63.0%, 70.0%, and 66.5, crude fat 21.3%, 21.6%, 10.3% and 7.3% and ash content 8.0%, 7.5%, 6.5% and 8.0% for B1, C1, D1 and E1 respectively. There was no significant difference ($p<0.05$) between the percentage of these samples as shown in Table 5. It was concluded that the percentage of moisture, crude fat, protein and ash almost same for each sample.

Table 5. Analysis of Variance (ANOVA)

Values	Sum of Squares	Df	Mean Square	F	Significance
Between Groups	15.633	4	3.908	0.004	1.000
Within Groups	14982.775	15	998.852		
Total	14998.408	19			

3.3 Quality of oil

Total antioxidant capacity of oil in which four replicates R1, R2, R3, and R4 of Skipjack Tuna fish species preserved were 9.70uM, 10.00uM 11.00uM and 8.73uM respectively. By using spectrophotometer, it was estimated that the absorbance value of sample 0.131, 0.130, 0.132 and 0.131 and absorbance value of standard 0.027, 0.026, 0.024 and 0.030 of each sample respectively. Mean value of antioxidant capacity present in each replicate of Skipjack tuna fish species was 9.8% as shown in Table 6.

Table 6. Total Antioxidant capacity (TAC) (uM) of Skipjack Tuna oil

Skipjack tuna fish			
Total Antioxidant Capacity (uM)			
Replicate	TAC (uM)	Abs Sample	Abs Standard
R1	9.70	0.131	0.027
R2	10.00	0.130	0.026
R3	11.00	0.132	0.024
R4	8.73	0.131	0.030
Mean	9.86		

Total antioxidant capacity of oil in which four replicates R1, R2, R3, and R4 of Sardines fish species preserved were 14.59uM, 15.00uM 16.33uM and 13.20uM respectively. By using spectrophotometer, it was estimated that the absorbance value of sample 0.197, 0.195, 0.196 and 0.198 and absorbance value of standard 0.027, 0.026, 0.024 and 0.030 of each sample respectively. Mean value of antioxidant capacity present in each replicate of Sardines fish species was 14.78% as shown in Table 7.

Table 7. Total Antioxidant capacity (TAC) (uM) of Sardines oil

Sardines			
Total Antioxidant Capacity (uM)			
Replicate	TAC (uM)	Abs Sample	Abs Standard
R1	14.59	0.197	0.027
R2	15.00	0.195	0.026
R3	16.33	0.196	0.024
R4	13.20	0.198	0.030
Mean	14.78		

Total antioxidant capacity of oil in which four replicates R1, R2, R3, and R4 of Red Salmon fish species preserved were 24.00uM, 25.00uM 26.75uM and 21.67uM respectively. By using spectrophotometer, it was estimated that the absorbance value of sample 0.324, 0.325, 0.321 and 0.325 and absorbance value of standard 0.027, 0.026, 0.024 and 0.030 of each sample respectively. Mean value of antioxidant capacity present in each replicate of Red Salmon fish species was 24.35% as shown in Table 8.

Table 8. Total Antioxidant capacity (TAC) (uM) of Red salmon oil

Red salmon			
Total Antioxidant Capacity (uM)			
Replicate	TAC (uM)	Abs Sample	Abs Standard
R1	24.00	0.324	0.027
R2	25.00	0.325	0.026
R3	26.75	0.321	0.024
R4	21.67	0.325	0.030
Mean	24.35		

Total antioxidant capacity of oil in which four replicates R1, R2, R3, and R4 of Pink Salmon fish species preserved were 9.33uM, 9.77uM 10.50uM and 8.33uM respectively. By using spectrophotometer, it was estimated that the absorbance value of sample 0.126, 0.127, 0.126 and 0.125 and absorbance value of standard 0.027, 0.026, 0.024 and 0.030 of each sample respectively. Mean value of antioxidant capacity present in each replicate of Pink Salmon fish species was 9.48% as shown in Table 9.

Table 9. Total Antioxidant capacity (TAC) (uM) of Pink Salmon oil

Pink salmon			
Total Antioxidant Capacity (uM)			
Replicate	TAC (uM)	Abs Sample	Abs Standard
R1	9.33	0.126	0.027
R2	9.77	0.127	0.026
R3	10.50	0.126	0.024
R4	8.33	0.125	0.030
Mean	9.48		

In line with our results after thermal processing the highest percentage of moisture and crude protein content present in tin packed fish species were 72.23% and 17.41% respectively[1]. Present study indicates the highest percentage of moisture and crude protein present in tin packed species are 70% and 78.61% respectively. It was investigated than tin packed fish species contain all the sensory qualities and taste as in fresh water fish species[19]. Advanced applications were used to preserve fish species in tin pack or in frozen form. The idea of Hazard Analysis critical control point was introduced to improve the meat quality of tin packed fish species[14]. Present study ensures that meat quality of tin packed fish species after using different preventive measures are not affected. There is no significant difference ($p<0.05$) between the percentages of crude protein, crude fat, moisture and ash content present in tin packed fish species.

In line with present study, it was observed that tin pack fish species chela (*Laubuka dadiburjori)* contains the amount of crude protein and moisture in higher amount 76.56% and 13.74% as in fresh water fish species[2]. Present study also indicates that the quality of fish species is not very much affected after thermal processing. Tin packed salmon also contain crude protein and moisture in higher amount 70% and 67.71%

as in fresh water fish species. In contrast with present study Sardines contain the higher concentration of moisture and lower concentration of ash were observed 68.6%, 1.79% respectively as compare to the other species. The concentration of moisture and ash content present in these species were not significant statistically[17]. Present study indicates that moisture content present in sardines is higher 63.15% and the amount of ash content is lower 4.5%.

In contrast with present study, it was investigated that the sensory quality (tenderness and taste) of fish meat does not get affected during thermal processing, growth of microbes does not occur that affects the biochemical properties of the tin packed fish meat[13]. Present study also indicates that post harvesting process of fish meat were free from microbes and retain the sensory qualities of fish meat. Recent studies indicated that stability and quality of fish meat in tin packs were improved by using natural antioxidants Vitamin A, C and E and artificial antioxidants (butylated hydroxy anisole and butylated hydroxytoluene) in the form of supplements[5]. Present study also indicates the antioxidant activity of Vitamin A, C and E which reduces the lipid oxidation in fish meat and increase the shelf life of fish meat in tin packs.

As the feeding behavior of fishes also cause diverse effect on their body composition. Different kinds of environmental factors also affect the meat quality of fishes. It is very important to improve the meat quality of fishes. In most of the poor countries more than 250 million people all over the world are related to the aquaculture or fisheries for their survival. To fulfil their nutritional requirement along with fresh capture fish tin packed fish is also available in the market. The shelf life of these fishes can be enhanced by using different kind of techniques, chemicals and methods for the preservation of fishes. Through this research the quality of tin packed fishes will be analyzed and results will definitely help in the improvement furthermore.

4. CONCLUSIONS

It was concluded that the fish meat after thermal processing contains suitable percentage of crude protein, crude fats, and moisture and ash contents. It can be easily consumable without any harmful effect on human health. Socioeconomically this study is beneficial for the improvement of consumer perception like product stability and quality of meat.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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