

# Quality and Safety Characteristics of Different Commercially Available Frozen Fish Fillets

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**Abstract-** Consumption of fish that accumulates harmful toxic substances directly causes food-borne diseases in humans. Unhygienic processing conditions during the processing of fish to manufacture different products also increase the chances of contamination. The present study was conducted to compare the quality and safety status of the fish fillets supplied by different brands in the superstores of Faisalabad. Samples of fish fillets of different brands were collected and stored at refrigeration temperature. Proximate analysis (moisture, protein, ash, and fat), heavy metal analysis (cadmium, nickel, lead, arsenic), and microbiological analysis (total plate count and total coliform count) of fish fillets were performed before and after frying. Fish fillets were fried at 180°C for 10-12 minutes in the cooking oil. Cooking yield, texture analysis, and sensory evaluation of the fish fillets were also performed. The results of the study showed that the Fish Express brand carries a higher amount of moisture percentage (80.1±0.11) in the frozen fish fillets than any other brand. In contrast, the highest protein contents were reported in frozen fish fillet samples of the Menu brand (18.63±0.2). Lead concentration (PPM) showed the highest mean values of 1.01±0.012 in Ocean Fresh in fried fish fillets. The cooking loss showed the highest mean values of 21.6±0.25 in Fish Express. Total plate count (TPC) showed the highest mean value of 2.91±0.21 in Fish Express, frozen fish fillets and it decreased in fried samples. Total coliform count (TCC) showed the highest mean values of 3.53±0.036 in Ocean Fresh in fried fish fillets. Texture showed the highest mean values of 7.66±0.55 for Menu. Taste showed the highest mean values of 8.00±0.00 for the Menu brand. Overall acceptability showed the highest mean values of 8.33±0.55 for the Menu brand. One and two-way analysis of variance was applied to the obtained results to compare the quality and safety status of different brands of fish fillets before and after the frying. Fish fillets of the Menu brand were found high in quality and safety compared to all other brands.

**Keywords-** Fish Fillets; Sea Food; Quality Characteristics; Safety Analysis; Sensory Evaluation.

## I. INTRODUCTION

Food is the primary and only source to fulfill the energy and nutrient needs of the body. Food is not only the source to supply the basic nutrients to the body but also exposes humans to foodborne microbes and toxins (Aertsens et al., 2009; Walls et al., 2019). Human population has been increased rapidly and the demand for the food has also raised in the recent era. Freshness, naturalness, and little processing are the most desired food traits, according to research conducted in 60 countries with 30,000 customers (Naeem et al., 2020). Globally, foodborne illnesses are the main threat to consumer health and also significantly impact the economy of the country due to the burden on the healthcare system of the country (Abdul-Mutalib et al., 2015). As the world's population expands and the socioeconomic position of developing countries improves, global demand for meat and other animal-based goods is predicted to rise. The human population is estimated to reach 9.5 billion by 2050, and the need for animal-based protein is predicted to double (Rose et al., 2015). Using traditional animal-based manufacturing to fulfill this rising need is a rather inefficient means of doing so public acceptance and commercialization will necessitate considering ethical, ecological, and human health concerns, as well as consumer perception and factors like taste and pricing (Al-Kandari et al., 2019).

Food safety is a two-way process that involves food business operators as well as consumer's awareness about the preparation of foods to keep it safe (Panghal et al., 2018). Among different foods, fish is the main food that is consumed all over the world due to its high nutritional value. The consumption of fish supplies healthy fatty acids and high-quality protein to the consumers. Omega-3 and Omega-9 and the main fatty acids that are present in fish meat (Dave & Routray, 2018; Speranza et al., 2021). Fish also supplies fat-soluble vitamins to the human body (Mathiassen et al., 2011). Different fish products are also available in the market and frozen fish fillets are the main product that is consumed by the consumers (Maesano et al., 2020). Consumption of fish and its products has been increased in the last few years due to awareness among people about the negative impacts of red meat consumption on human health

(Maesano et al., 2020). Fish products from Asia are a major supplier to the EU market. In the last five years, the aquaculture sector in certain Asian countries has grown to become a major producer and exporter of white fish and shrimp (Holmen et al., 2021; Saeed et al., 2022).

Seafood items are an important part of many developing nations' basic food baskets, and their quality and safety issues are inextricably tied to the concept of food security (Hoque & Myrland, 2022). Fish and seafood products are vital parts of a well-balanced diet and contribute to excellent health (Thorvaldsen et al., 2021). They're high in a variety of critical nutrients that aren't found in many other foods. Fishery products are essential for human nourishment, and the fishery industry is a major source of revenue and a key component of international trade for many coastal governments and districts (Ljubobratović et al., 2022).

According to a report presented at the Food and Agriculture Organization's 30th Conference of Fisheries Commission in Rome in 2012, 128 million tonnes of fish products are made available for human utilization each year around the world, with an average of 18.4 kg consumed per individual annually, responsible for nearly 15% of the animal protein intake of 4.3 billion individuals (Sogn-Grundvåg et al., 2021). Fish, on the other hand, is widely recognized as one of the most fragile and perishable foods, and manufacturers are paying close attention to quality assurance (Chen et al., 2022).

Cooking of frozen fish fillets is the most important step before consumption that may cause safety issues for humans if undercooked. Different brands are processing the fish to manufacture the fish fillets and each brand has their own processing line and conditions (Wang et al., 2021). Therefore, the present research study focused on investigating the quality and safety concerns of the frozen fish fillets of different brands available in the supermarkets of Faisalabad.

The research study will be conducted on the following objectives:

- To evaluate the quality and safety status of the frozen fish fillets of different brands sold in Faisalabad.
- To compare the quality and safety status of the frozen and fried fish fillets.

## II. MATERIALS AND METHODS

### A. Samples Collection

Frozen fish fillet samples of different brands were collected from the different superstores of the Faisalabad region. The brands mentioned were explored in this research study for the safety and quality evaluation of frozen fish fillets.

### B. Processing of Samples

Fish fillets were fried in the cooking oil. Frozen fish fillets were kept outside the refrigerator for two hours before frying. Fish fillets were fried at 180°C for 10-12 minutes. Processing of fish samples in the form of frying was done to investigate the cooking yield, proximate analysis, and microbial load. Five different brand's samples were collected for the analysis and all brands were given different numbers to avoid any biasness during sample analysis in the laboratory and data interpretation.

Menu, Siblou, Mon Salwa, Ocean Fresh, and Fish Express were used as the main brands for this research study.

### C. Moisture Contents

Moisture contents of the frozen and fried fish fillet samples were done by following the procedure described in AOAC (2016). In order to measure the moisture level in samples, a standard method of oven drying was used. In a pre-weighed China dish about 5g finely chopped fish filler sample was taken and placed for duration of 24 hours at 105°C in the oven. Then the samples were re-weighed after drying. Losses in weighed of samples before and after drying is moisture content percentage. It was determined by using the formula below;

$$\text{Moisture (\%)} = \frac{\text{Wt.}_f - \text{Wt.}_d}{\text{Wt.}_f} \times 100$$

Wt.<sub>f</sub> = Weight of fresh sample

Wt.<sub>d</sub> = Weight of dry sample

### D. Crude Protein Contents

Crude protein contents of the frozen and fried fish fillet samples were done by following the procedure described in AOAC (2016). Kjeldahl method was used to determine the protein contents. In which 2 g of groundfish fillet sample was digested and distillation and titration methods were used. After this level of crude protein content was calculated by following the formula;

$$\text{CP (\%)} = (\text{N} \times 14.007 \times (\text{V}_s - \text{V}_b) \times 6.25 \times 250) \times \text{D}100/\text{W} \times 1000$$

Where CP: Crude protein

N: Normality (0.01) of Standard HCL acid

V<sub>s</sub>: Vol. of standard HCL acid to titrate a sample

V<sub>b</sub>: Vol. of standard HCL to titrate a blank

W: Weight (g) of dry sample used; D= Dilution factor (250/10)

### E. Ash Contents

Ash contents of the frozen and fried fish fillet samples were done by following the procedure described in AOAC (2016). Ash percentage of fish fillet samples was evaluated by using the method described by AOAC (2016). To determine ash content, 2g of sample was taken which was oven-dried and grounded. Then it was dried at 100 °C and weighed by using a digital weighed balance and then put into a muffle furnace. The samples were incinerated for 5 hours at a temperature of 550 °C. They were then weighed. Calculations for ash contents were made by using the following equation;

$$\text{Ash (\%)} = \frac{\text{CSD (g)} - \text{CSA}}{\text{CSD (g)}} \times 100$$

Where CSD: Weight of crucible + sample before incineration

CSA: Weight of crucible + sample after incineration

### F. Crude Fat Contents

Crude fat contents of the frozen and fried fish fillet samples were done by following the procedure described in AOAC (2016). In order to find crude fat gravimetric measurement method was used. The first step involves the homogenization and ground of 20g of fish fillet sample. Then it is passed through a 1mm sieve and weighed and placed in extraction thimbles. In the end ether extraction was carried out using the Soxhlet apparatus. Ether evaporation was carried out at 105°C and the remaining mixture was weighed. The percentage of crude fat was determined by using the following formula.

$$\text{Crude Fat\%} = \frac{\text{Wt}_i - \text{Wt}_f}{\text{Wt}_i} \times 100$$

Where CF: Crude Fat

Wt<sub>i</sub> = Initial weight of sample

Wt<sub>f</sub> = weight of defatted sample

### G. Heavy Metal Analysis

Heavy metals detection was done by using the procedure defined by AOAC (2016). For Heavy metals detection sample was prepared by wet digestion method.

#### Wet Digestion

For wet digestion concentrated HNO<sub>3</sub> was added to fish fillet sample. Fish fillet samples having weight 0.5g along with conc. HNO<sub>3</sub> 5ml were mixed in flask called digestion flask. Hot plates having temperature of 80-90°C were used for digestion the temperature of these plates was then raised to 150°C to complete digestion. About 3-5ml more acid was added to solution till to get a clear solution. After the process of digestion completed the mixture was let to cool at room temperature and then the whole mixture is filtered, and the total volume is raised up to 25ml using distilled water. To avoid evaporation the clear sample was placed in refrigerator and a blank solution was also prepared. The prepared standard solution was analyzed for Cadmium, Nickel, Arsenic and Lead by Atomic Absorption Spectrophotometer (AAS) (Sens AA; GBC scientific equipment spectrophotometer) at the specified conditions as follows;

**Table 1: Heavy metals detection limits**

Metal	Lamp Wavelength (nm)	Slit Width (nm)	Lamp Current (nm)	Fuel Flow Rate (l/min)	Burner Height (cm)	Detection Limit (ppm)
Ca	228.8	0.7	5	30	8	0.02
Pb	248.3	0.7	12	30	8	0.01
Ni	231.6	0.7	5	30	7	0.05
Ar	217	0.7	5	30	8	0.01

$$\text{Conc. Of Element} = R \times G/W \text{ (ppm, mg/kg)}$$

In this equation

R= Reading for element conc., (ppm digital scale of AAS).

D= Dilution factor of the prepared sample.

W= sample weight

### H. Microbiological Analysis

#### Total Plate Count

Total plate count in the frozen and fried fish fillet samples was determined according to procedure described by Kilinc et al. (2008). First of all, normal saline solution was prepared using the sodium chloride in the amount of 8.5g/L and the solution was autoclaved for fifteen minutes at 121 degree centigrade. After that nutrient agar was used to prepare the media for the

microbiological analysis of the total plate count. The above mentioned normal saline solution was prepared for the dilution of the samples. 37 g of the nutrient agar was taken in the conical flask and 1000 mL of water was added in it and mixed properly and then autoclaved for 15 minutes in the autoclave for 121 °C. To determine total plate count in milk, 6 test tubes were taken after sterilization and categorized as 10-1-10-6. With the aid of a pipette, 9 ml of normal saline solution was pipetted into each test tube. After stabilizing its temperature at 60 °C, nutrient agar was poured into petri dishes and allowed to solidify before use. Transferred 1 milliliter of sample to test tubes. Then, 1 ml of the sample from the first dilution was transferred to the second dilution test tube. Continued until the sixth dilution test tube. Streaking of the petri plates were done and placed in the incubator to provide the optimum conditions for the growth of bacteria at 37 °C for 24 hours. The colonies of bacteria were counted with a colony counter. For counting, petri dishes with 30 to 300 colonies of bacteria were chosen. Total plate count was counted by using this formula:

$$\text{TPC (CFUE/ml)} = \frac{\text{No. of colonies counted} \times \text{Dilution factor}}{\text{Volume factor}}$$

#### I. Texture Analysis

Texture analysis of the fried fish fillets was done using texture analyzer as procedure described by AOAC (2016). A texture measurement system works by physically deforming a test sample in a controlled way and then measuring how it responds. Some of the force response's features come from the sample's mechanical properties, which are related to certain sensory texture features. This idea is used by a texture analyzer, which follows the steps automatically, takes measurements, and reports the results. Forces created by this movement are used to change how consumers interact with each other. Digital readings were recorded to present the texture analysis.

#### J. Sensory Evaluation

Sensory evaluation of the fried fish fillets will be done using 9-point hedonic scale (Ahmad et al., 2021; Pongsetkul et al., 2022). Semi-trained panelist from National Institute of Food Science and Technology (NIFSAT) were provided with the evaluation Performa as given in Appendix 1. The panelists were asked to express their opinion about the milk samples by giving score (9= like extremely; 1= dislike extremely). Three sensory parameters were tested using the hedonic scale. Taste, color and overall acceptability of the fish fillets was tested through the sensory evaluation using the hedonic scale.

#### K. Statistical analysis

One way analysis of variance was applied on the obtained results and post-hoc test will be used to compare different brands (Khan et al., 2014; Montgomery, 2017).

without any differentiation among cultures and geographical areas. Primarily, the concern of food safety arises when food is passed from different parts of food chain from production to processing, packaging, storage and consumption. Food safety can only be assured when food remain free from any allergens, chemical, biological and physical hazards. A research study was

## III. RESULTS AND DISCUSSION

### A. Proximate Analysis of Frozen and Fried Fish fillets

Food safety and quality are two different but inter-related terms. Food quality is the subjective term that may vary with respect to different cultures and geographical areas. On the other hand, food safety is the objective term that remain the same

conducted to understand the quality and safety status of frozen fish fillets of different brands available in the market for the consumers.

Table 1 shows the proximate analysis of the frozen fish fillet samples of the different brands. It clearly shows that Fish Express brand carries the higher amount of moisture percentage (80.1±0.11) in the frozen fish fillets than any other brand. In contrast, highest protein contents were reported in frozen fish fillet samples of the Menu brand (18.63±0.2). Highest value of ash contents was reported in the frozen fish fillets of the Mon Salwa brand (1.05±0.04). These findings were similar to the earlier study of Emire and Gebremariam (2010).

**Table 2: Proximate analysis of frozen fish fillet samples.**

Brand Name	Moisture (%)	Crude Protein (%)	Crude Fat (%)	Ash (%)
Menu	77.2±0.10 <sup>cd</sup>	18.63±0.2 <sup>a</sup>	3.1±0.06 <sup>a</sup>	0.88±0.02 <sup>d</sup>
Siblou	77.0±0.05 <sup>d</sup>	18.0±0.1 <sup>b</sup>	2.9±0.02 <sup>c</sup>	0.96±0.04 <sup>c</sup>
Mon Salwa	78.3±0.19 <sup>b</sup>	17.4±0.1 <sup>c</sup>	2.5±0.02 <sup>d</sup>	1.05±0.04 <sup>b</sup>
Ocean Fresh	77.5±0.31 <sup>c</sup>	17.9±0.05 <sup>d</sup>	3.0±0.02 <sup>b</sup>	0.92±0.01 <sup>cd</sup>
Fish Express	80.1±0.11 <sup>a</sup>	16.2±0.15 <sup>e</sup>	2.1±0.05 <sup>e</sup>	1.5±0.01 <sup>a</sup>

Values are expressed as Mean ± SE.

Table 2 shows the proximate analysis of the fried fish fillet samples of the different brands. It clearly shows that Ocean Fresh brand carries the higher amount of moisture percentage (71.2±0.30) in the fried fish fillets than any other brand. In contrast, highest protein contents were reported in fried fish fillet samples of the Fish Express brand (25.13±0.11) as shown in the table 2. Highest value of ash contents was reported in the fried fish fillets of the Ocean Fresh brand (1.8±0.05).

**Table 3: Proximate analysis of fried fish fillet samples**

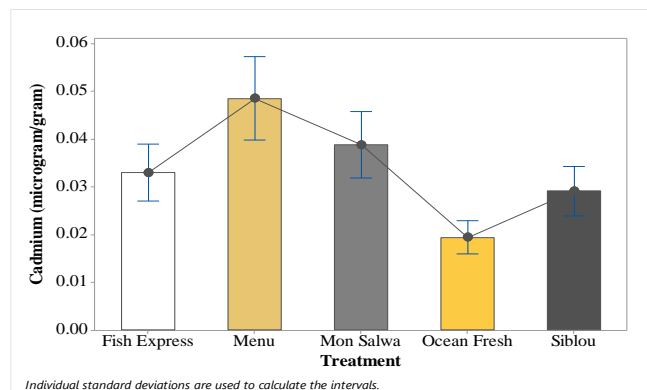
Brand Name	Moisture (%)	Crude Protein (%)	Crude Fat (%)	Ash (%)
Menu	69.2±0.21 <sup>c</sup>	23.3±0.2 <sup>c</sup>	5.1±0.07 <sup>b</sup>	1.12±0.03 <sup>d</sup>
Siblou	70.2±0.24 <sup>b</sup>	21.2±0.6 <sup>d</sup>	4.2±0.01 <sup>c</sup>	1.5±0.06 <sup>c</sup>
Mon Salwa	68.1±0.20 <sup>d</sup>	24.1±0.19 <sup>b</sup>	5.3±0.02 <sup>b</sup>	1.6±0.01 <sup>bc</sup>
Ocean Fresh	71.2±0.30 <sup>a</sup>	20.7±0.17 <sup>e</sup>	3.8±0.09 <sup>d</sup>	1.8±0.05 <sup>a</sup>
Fish Express	67.0±0.19 <sup>e</sup>	25.13±0.11 <sup>a</sup>	6.0±0.03 <sup>a</sup>	1.71±0.07 <sup>ab</sup>

Values are expressed as Mean ± SE.

**B. Cadmium Concentration in Frozen Fish fillets Samples**

Contamination of heavy metals such as cadmium is important with respect to human health. Presence of heavy metals in the food samples is the main food safety problem that is directly affecting the consumers. Cancer, kidney failure, brain damage, immune system dysfunction, skin lesions and nervous system disorders are the main issues that are related with the consumption of contaminated food with heavy metals. Graph 3.1 shows the means of cadmium concentration in frozen fish fillets samples among different brands. It shows the mean values of 0.05±0.004, 0.03±0.002, 0.04±0.003, 0.02±0.001, and

0.03±0.002 for Menu, Siblou, Mon Salwa, Ocean Fresh and Fish Express, respectively. The results clearly showed that highest value was recorded for Menu and the lowest value was recorded for the Ocean Fresh brand.

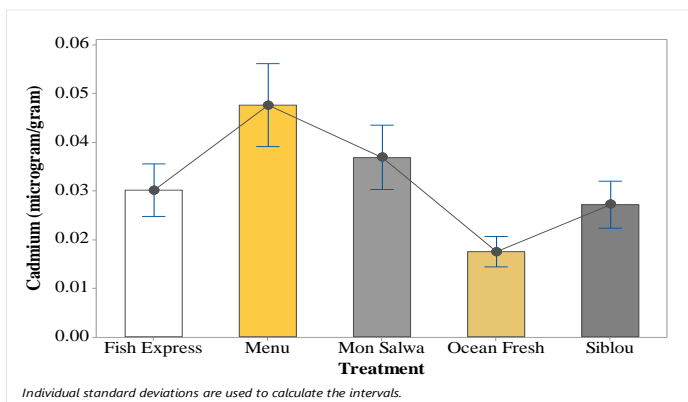


**Graph 1: Means of Cadmium concentration in frozen fish fillets samples among different brands.**

The main reason for the presence of cadmium residues in the fish fillets samples of different brand is that contaminated fish was used in the processing and no previous sample analysis were done before processing. Another reason might be the contamination of fish fillets during processing due to unhygienic processing conditions and equipment in the processing hall. Water in Pakistan is highly contaminated by industrial and sewage waste and fishing in such water enhance the chances of contamination in fish products and raw fish samples.

**C. Cadmium Concentration in Fried Fish fillets Samples**

Contamination of heavy metals such as cadmium is important with respect to human health. Presence of heavy metals in the food samples is the main food safety problem that is directly affecting the consumers. Cancer, kidney failure, brain damage, immune system dysfunction, skin lesions and nervous system disorders are the main issues that are related with the consumption of contaminated food with heavy metals. Graph 3.2 shows the graphical presentation of the means for cadmium concentration in fried fish fillet samples.



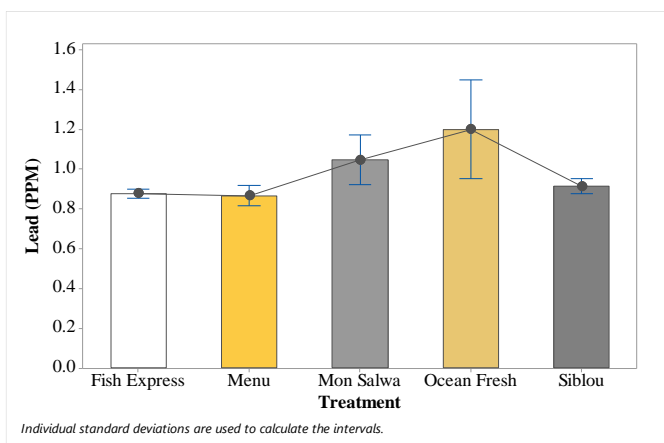
**Graph 2: Means for Cadmium concentration in fried fish fillet samples among different brands.**



Results in graphs are expressed in the form of bars having standard deviation to understand the differences. It shows the mean values of  $0.04 \pm 0.003$ ,  $0.02 \pm 0.001$ ,  $0.01 \pm 0.002$ ,  $0.03 \pm 0.003$ , and  $0.03 \pm 0.002$  for Menu, Siblou, Mon Salwa, Ocean Fresh and Fish Express, respectively. The results clearly showed that highest value was recorded for Menu and the lowest value was recorded for the Ocean Fresh brand. Results of the study matched with the findings of the Rose et al. (2015) who studied the contamination levels in fish in freshwater in United Kingdom. Results are also supported by the findings of the Olaifa et al. (2004) who investigated the fish contamination in lake and fresh water samples in Nigeria.

**D. Lead Concentration in Frozen Fish fillets Samples**

Contamination of heavy metals such as lead is important with respect to human health. Presence of heavy metals in the food samples is the main food safety problem that is directly affecting the consumers. Cancer, kidney failure, brain damage, immune system dysfunction, skin lesions and nervous system disorders are the main issues that are related with the consumption of contaminated food with heavy metals. Graph 3 shows the graphical presentation of the means for lead concentration in frozen fish fillet samples. Results in graphs are expressed in the form of bars having standard deviation to understand the differences. It shows the mean values of  $0.87 \pm 0.02$ ,  $0.91 \pm 0.01$ ,  $1.04 \pm 0.05$ ,  $1.2 \pm 0.01$ , and  $0.88 \pm 0.009$  for Menu, Siblou, Mon Salwa, Ocean Fresh and Fish Express, respectively.



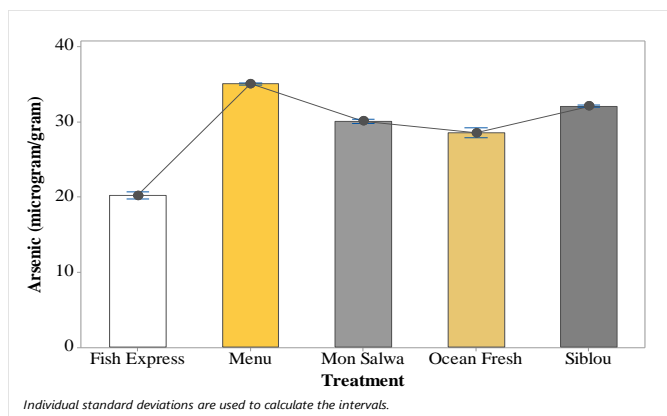
**Graph 3: Means for Lead concentration in frozen fish fillet samples among different brands.**

The results clearly showed that highest value was recorded for Mon Salwa and the lowest value was recorded for the Menu brand. The main reason for the presence of lead residues in the fish fillets samples of different brand is that contaminated fish was used in the processing and no previous sample analysis were done before processing. Another reason might be the contamination of fish fillets during processing due to unhygienic processing conditions and equipment in the processing hall.

**E. Arsenic Concentration in Frozen Fish fillets Samples**

Contamination of heavy metals such as arsenic is important with respect to human health. Presence of heavy metals in the food samples is the main food safety problem that is directly

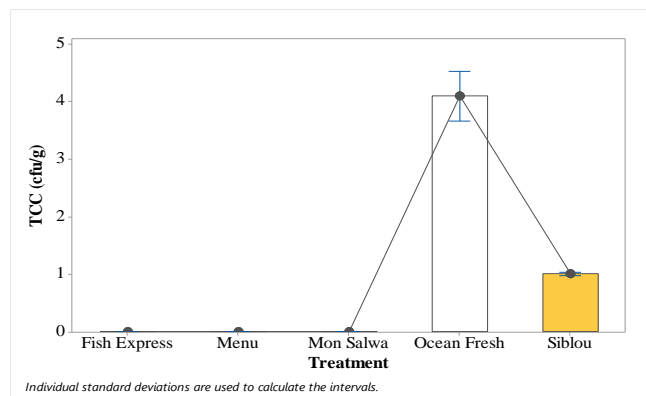
affecting the consumers. Cancer, kidney failure, brain damage, immune system dysfunction, skin lesions and nervous system disorders are the main issues that are related with the consumption of contaminated food with heavy metals. Graph 4 shows the graphical presentation of the means for arsenic concentration in frozen fish fillet samples. Results in graphs are expressed in the form of bars having standard deviation to understand the differences. It shows the mean values of  $35.03 \pm 0.05$ ,  $32.07 \pm 0.05$ ,  $30.08 \pm 0.1$ ,  $28.5 \pm 0.2$ , and  $20.2 \pm 0.2$  for Menu, Siblou, Mon Salwa, Ocean Fresh and Fish Express, respectively. The results clearly showed that highest value was recorded for Menu and the lowest value was recorded for the Fish Express brand. Similar research findings were also discovered by Dahl et al. (2010).



**Graph 4: Means for Arsenic concentration in frozen fish fillet samples among different brands.**

**F. Total Coliform Count Concentration in Frozen Fish fillets Samples**

Contamination of coliforms is important with respect to human health. Presence of coliforms in the food samples is the main food safety problem that is directly affecting the consumers. Food poisoning, hepatitis and stomach aches are the main issues that are related with the consumption of contaminated food with coliform.



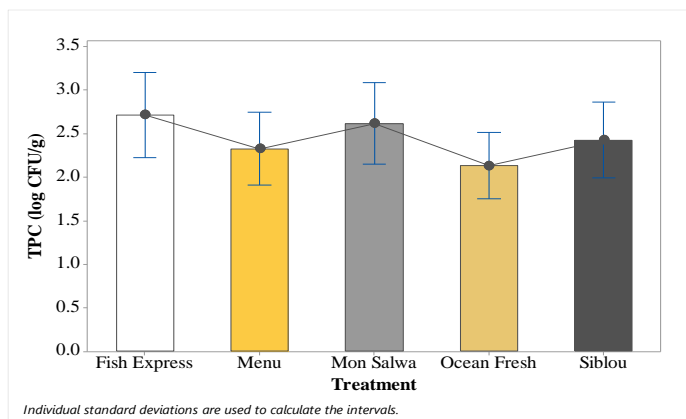
**Graph 5: Means for TCC (CFU/g) concentration in frozen fish fillet samples among different brands.**

Graph 5 shows the graphical presentation of the means for TCC in frozen fish fillet samples. Results in graphs are expressed

in the form of bars having standard deviation to understand the differences. It shows the mean values of  $0.00\pm 0.00$ ,  $1.006\pm 0.01$ ,  $0.00\pm 0.00$ ,  $4.1\pm 0.17$ , and  $0.00\pm 0.00$  for Menu, Siblou, Mon Salwa, Ocean Fresh and Fish Express, respectively, that is aligned with previous research results of Topić Popović et al. (2010). The results clearly showed that highest value was recorded for Siblou and the lowest value was recorded for the Menu, Mon Salwa, and Fish Express brand.

#### G. Total Plate Count Concentration in Fried Fish fillets Samples

Presence of pathogens in the food samples is the main food safety problem that is directly affecting the consumers. Food poisoning, hepatitis and stomach aches are the main issues that are related with the consumption of contaminated food with coliform. Graph 6 shows the graphical presentation of the means for TPC in fried fish fillet samples. Results in graphs are expressed in the form of bars having standard deviation to understand the differences. Earlier study by Bavitha et al. (2016) showed parallel results.



**Graph 6: Means for TPC (log CFU/g) concentration in fried fish fillet samples among different brands.**

It shows the mean values of  $2.32\pm 0.17$ ,  $2.42\pm 0.17$ ,  $2.62\pm 0.20$ ,  $2.13\pm 0.15$ , and  $2.71\pm 0.20$  for Menu, Siblou, Mon Salwa, Ocean Fresh and Fish Express, respectively. The results clearly showed that highest value was recorded for Mon Salwa and the lowest value was recorded for the Ocean Fresh brand.

#### H. Sensory Properties of Fried Fish fillets Samples

Sensory properties of the product decide at the initial phase about the acceptability of the product from the consumers. An outstanding product with high nutritional value is totally a failure if sensory parameters are not upto the mark. Sensory properties depict the quality and safety of the product, indirectly, as if the product is contaminated with metals, or pathogens, sensory properties will change. Therefore, researcher use sensory properties as the tool for the measurement of safety and quality status of the product.

Table 4 shows the means of taste concentration in fried fish fillets samples among different brands. It shows the mean values of  $8.00\pm 0.00$ ,  $7.66\pm 0.55$ ,  $6.66\pm 0.55$ ,  $7.00\pm 0.00$ , and  $6.00\pm 0.00$  for Menu, Siblou, Mon Salwa, Ocean Fresh and Fish Express,

respectively. The results clearly showed that highest value was recorded for Menu and the lowest value was recorded for the Fish Express brand as parallel outcomes were obtained by Choi et al. (2023). Table 4 shows the means of appearance concentration in fried fish fillets samples among different brands. It shows the mean values of  $8.00\pm 0.00$ ,  $7.00\pm 0.00$ ,  $7.66\pm 0.55$ ,  $6.66\pm 0.55$ , and  $6.00\pm 0.00$  for Menu, Siblou, Mon Salwa, Ocean Fresh and Fish Express, respectively. The results clearly showed that highest value was recorded for Menu and the lowest value was recorded for the Fish Express. Similar findings were observed for appearance by Di Monaco et al. (2009)

**Table 4: Means of sensory characteristics evaluation in fried fish fillets samples among different brands.**

Brands name	Appearance	Taste	Texture	Overall Acceptability
Menu	$8.00\pm 0.00$	$8.00\pm 0.00$	$7.66\pm 0.55$	$8.33\pm 0.55$
Siblou	$7.00\pm 0.00$	$7.66\pm 0.55$	$7.00\pm 0.00$	$7.66\pm 0.55$
Mon Salwa	$7.66\pm 0.55$	$6.66\pm 0.55$	$6.66\pm 0.55$	$6.66\pm 0.55$
Ocean Fresh	$6.66\pm 0.55$	$7.00\pm 0.00$	$6.00\pm 0.00$	$7.00\pm 0.00$
Fish Express	$6.00\pm 0.00$	$6.00\pm 0.00$	$5.66\pm 0.55$	$6.33\pm 0.55$

Values are expressed as Mean  $\pm$  SE.

Table 4 shows the means of texture concentration in fried fish fillets samples among different brands. It shows the mean values of  $7.66\pm 0.55$ ,  $7.00\pm 0.00$ ,  $6.66\pm 0.55$ ,  $6.00\pm 0.00$ , and  $5.66\pm 0.55$  for Menu, Siblou, Mon Salwa, Ocean Fresh and Fish Express, respectively. The results clearly showed that highest value was recorded for Menu and the lowest value was recorded for the Fish Express. While the means of overall acceptability in fried fish fillets samples among different brands. Same results were overserved on texture and overall acceptability by Chiang et al. (2011); Mexis and Kontominas (2009) It shows the mean values of  $8.33\pm 0.55$ ,  $7.66\pm 0.55$ ,  $6.66\pm 0.55$ ,  $7.00\pm 0.00$ , and  $6.33\pm 0.55$  for Menu, Siblou, Mon Salwa, Ocean Fresh and Fish Express, respectively. The results clearly showed that highest value was recorded for Menu and the lowest value was recorded for the Fish Express.

#### IV. CONCLUSION

In essence, this research provides insights into the significant matter of food safety, specifically pertaining to the intake of fish, within the superstores of Faisalabad. The results demonstrate notable disparities in the quality and safety criteria across various fish fillet brands, underscoring the significance of stringent inspection and monitoring procedures throughout the whole production and processing process. The Menu brand stands out as a notable performer, demonstrating exceptional quality and safety characteristics in comparison to its competitors. The findings of this study emphasize the importance of making strict standards and practices a priority for consumers, regulatory organizations, and industry stakeholders in order to reduce the risks associated with foodborne infections and safeguard public health and well-being.

### ACKNOWLEDGMENT

The researchers would like to extend their appreciation to all the authors who have made significant contributions and provided support over the course of this study. The contributors' support in the areas of sample collection, laboratory analysis, and data interpretation greatly enhanced the calibre and comprehensiveness of this study.

### FUNDING

The present study did not get any dedicated financial support from public, commercial, or not-for-profit funding bodies.

### CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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