

# Proximate and Mineral Composition of Fish Bone Powder of *Siganus lineatus* Collected from Waters Around Jaffna Peninsula, Sri Lanka

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## Abstract

*Siganus lineatus* is one of the marine reef fish which found in marine and brackish water environment. The family Siganidae is nutritionally and economically important in Sri Lanka. Thus the knowledge on their chemical composition could help to be used as an ingredient of traditional medicine to cure osteoporosis in the future. The current study was aimed to produce *Siganus lineatus* fishbone flour and analyze the selected nutritional composition. From December 2019 to February 2020 *Siganus lineatus* were collected from the Jaffna coasts. Fishbones were boiled into a water medium. The treated fish bones were ground for easy handling. Proximate composition of lipid, moisture, protein, ash and mineral composition of calcium, phosphorus, potassium, and sodium were determined. AOAC and AOCS standards were used in the proximate analysis. Mineral compositions were determined by using a Digital Flame Photometer for Calcium (Ca), Potassium (K) and Sodium (Na) and by Multiparameter Photometer for phosphorus (P). The ash, protein, moisture, and lipid contents were 50.74±0.65%, 22.07±0.29%, 6.29±0.35% and 3.50±0.16% in fishbone of *Siganus lineatus* respectively. The mineral composition Ca, P, K, and Na were 12.5%, 7.66%, 0.42% and 0.36% respectively and the ratio of calcium: phosphorus is 2:1. In this study, the water extraction method showed higher ash content so this method could be used to extract the mineral content from fishbone. Results demonstrated that extracted fish bone powder was nutritious and can contribute importantly to human health requirements of calcium-deficient disease in future.

Keywords: Calcium deficient disease, Digital Flame Photometer, Fishbone powder, Multiparameter Photometer, Siganidae, *Siganus lineatus*

## 1 Introduction

Fish is regarded as an important resource enriched with animal protein and other nutrition, plays a key role in the maintenance of a body. For the healthy body of a human, the nutritional contents of any food are regarded as an important factor. The nutritional compositions such as moisture, ash, lipid, protein, and carbohydrate contents are analyzed to find out the proximate analysis which leads to the approach of food characterization. Generally, fish hold about 70 to 80% water, 20 to 30% protein and 2 to 12% lipid [10].

Rabbitfish (*Siganus* spp.) are widespread in the Indo-Pacific Ocean, classified under Family Siganidae and economically important in the coastal areas and brackish water bodies of Sri Lanka. Market demand for rabbitfish is increasing as they are mainly consumed locally but could be exported [22]. However the studies related to nutritional contents of rabbitfish's fishbone had not been studied so far. Fishbone includes the delicate parts of the skeleton of bony fish, such as fin rays, spines, and ribs. Fishbone consists of high calcium

(Ca) content and calcium and phosphorus (P) constitute about 2% (20 g/ kg dry weight) of the whole fish.

The chemical composition of fish bones varies, and normally, lipid levels vary from fatty fish to lean fish. Fatty fish contain higher lipid levels, and lower protein and ash levels compared to lean fish species [13]. Fish processing waste including the heads and bony parts are reported as 45% [11]. The Ca/P ratio values and nutritional compositions suggest that consumption of these fish bone powder could be recommended to prevent calcium deficient diseases. This research is intended to observe how fishbone could be used as an ingredient for traditional medicine to cure osteoporosis in the future.

## 2 Material and Methods

### 2.1 Sample collection

*Siganus lineatus* samples were collected twice a month from fishermen from their catches from each fish landing station at Gurunagar and Kakaitivu (Fig.1). Regular field visits were made from December 2019 to February 2020.

Approximately the same total length (20-25cm) and total weight (150g-250g) of *Siganus lineatus* were collected for the analysis. *Siganus lineatus*, commonly referred to as the Golden-line spine foot has an oval and compressed body. The body is light grey, darkest above, with about 12 parallel longitudinal yellow lines as wide as interspaces and broken below into spots. The caudal fin is slaty-grey with a large brown spot slightly larger than the eyeball. It has a small terminal mouth [4].



Fig. 1. Sampling sites around Jaffna Peninsula: (a) Gurunagar (b) Kakaitivu

## 2.2 Raw material

*Siganus lineatus* fish (about 5.5 kilogram) was filleted and removed the flesh parts. The filleted fish frame was cleaned manually, and stored in the refrigerator at  $-20^{\circ}\text{C}$ . The frozen fish bone was placed outside the refrigerator and thawed around 1-2 hours at room temperature.

## 2.3 Extraction of fishbone powder

Fishbone was washed and boiled separately in distilled water for about 2 hours at  $100^{\circ}\text{C}$ . The meat adhered was cleaned manually from fish frame and washed with water. Then the bone was cut into small pieces, and it was immersed into distilled water and autoclaved for about 45 minutes at  $121^{\circ}\text{C}$ . Then dried in the hot air oven at  $60^{\circ}\text{C}$  for about 6 hours (YCO – 010; Germany). Dried bone was grinded well. Motor and pestle were used to make fine bone powder. The fish bone powder was stored in plastic container at room temperature for further nutritional composition analysis.

## 2.4 Nutritional composition determination

The nutritional composition such as ash, moisture, crude proteins were estimated using the standard methods of AOAC, (2000) [1]. Ash content was determined by using muffle furnace based on the vaporization of water and volatiles with burning organic substances at a temperature for 6h at  $550^{\circ}\text{C}$ . For moisture determination, 5g of fish bone powder was dried in a hot air oven at  $60^{\circ}\text{C}$  until a constant weight was obtained. Total crude protein was indirectly determined by using the Kjeldahl method. Lipid content was

determined by using Soxhlet's procedure [2]. The fish bone powder was dissolved with distilled water and then used for the determination of Ca, Na and K content. These minerals were determined by using Digital Flame Photometer (Model FP910, PG instruments limited, United Kingdom). Phosphorus content was determined by Multiparameter Photometer (Model 83099, HANNA Instruments). All analyses were carried out on three samples.

## 3 Results and Discussion

The moisture, protein, lipid, ash, Calcium (Ca), Phosphorus (P), Potassium (K), and Sodium (Na) in the bone of collected *Siganus lineatus* was examined. Each value indicates the mean  $\pm$  SD of three replicate determinations. The proximate composition of the investigated specimens (Table 1 and 2) shows high percentage of ash ( $50.74 \pm 0.65\%$ ) and lowest percentage of lipid ( $3.50 \pm 0.16\%$ ). In The Mineral composition analysis, Calcium resulted in high percentage and was found to be 12.5% while Sodium was 0.36% as lowest value (Table 2).

Table 1: Proximate composition of the investigated *Siganus lineatus* fishbone powder (mean values  $\pm$  standard deviation)

| Proximate parameter | Content (%)      |
|---------------------|------------------|
| Protein             | $22.07 \pm 0.29$ |
| Lipid               | $3.50 \pm 0.16$  |
| Moisture            | $6.29 \pm 0.35$  |
| Ash                 | $50.74 \pm 0.65$ |

Table 2: Mineral composition of the investigated *Siganus lineatus* fishbone powder

| Minerals Composition | Content (%) |
|----------------------|-------------|
| Ca                   | 12.5        |
| P                    | 7.66        |
| K                    | 0.42        |
| Na                   | 0.36        |

The major component in the bone powder was ash content, which was found to be  $50.74 \pm 0.65\%$ . The ash in bone powder from several fish species could be found up to 40% [21]. According to the Hemung, (2013) ash in *Siganus lineatus* bone powder was lower than the earlier reported value of bone powder from Tilapia could be found to be 75% [5]. Protein content in *Siganus lineatus* bone powder was  $22.07 \pm 0.29\%$ . This value for the bone powder from cod, blue whiting, salmon, trout, herring, mackerel were found in the range of 26-41% [21].

*Siganus lineatus* bone powder was analyzed and showed the amount of moisture content at  $6.29 \pm 0.35\%$  which is not sufficient for microbial growth. According to the Rezaei, (2010) less than 15-16% prevent the microbial growth in products [18]. This stable form provides an easy/safe way to use the fishbone powder as the ingredient in many applications such as good alternative for dairy products, fertilizer, and fishmeal. Lipid content in *Siganus lineatus* bone powder was  $3.50 \pm 0.16\%$ . The lipid content in fish bone was reported to be in the range of 1-27% [7].

Calcium and Phosphorus contents were 12.5% and 7.66% for *Siganus lineatus* fish bone powder respectively, and the ratio of calcium: phosphorus is close to 2:1. The results could be related to the studies of animal bones and fish bones. Some studies suggested that phosphate is needed for calcium transportation. Some research reported that high phosphorus and low calcium consumption are not conducive to optimizing peak bone mass. Therefore, with ratio of Ca: P, fish bone may be the optimum ration for calcium transportation or optimizing peak bone mass [12]. According to Pollack fish bones reported as 38.27% of calcium and 17.73% of phosphorus and the ratio of calcium: phosphorus being 2:1, which is similar to that of human bones [3].

Potassium and Sodium contents were 0.42% and 0.36% for *Siganus lineatus* fish bone powder respectively. According to the *Pseudolithus typus* and *Pseudolithus elongatus* reported as 0.51-0.72% of Potassium and 0.39-0.40 % of sodium [15]

$$\% \text{Moisture} = \frac{M^{\text{initial}} - M^{\text{dried}}}{M^{\text{initial}}} \times 100 \quad (1)$$

$$\%N = \frac{x \text{ moles}}{1000 \text{ cm}^3} \times \frac{(vs-vb)}{m.g} \times \frac{14 \text{ g}}{\text{moles}} \times 100 \times \frac{250 \text{ ml}}{10 \text{ ml}} \quad (2)$$

$$\% \text{Protein} = F \times \%N \quad (3)$$

$$\% \text{Ash} = \frac{\text{Weight of Ash}}{\text{Weight of original sample}} \times 100 \quad (4)$$

#### 4 Conclusion

The present study provides fundamental information about nutritional quality of *Siganus lineatus* fishbone powder. Information about the chemical composition of fishbone powder of *Siganus lineatus* is lacking at present. In this study, *Siganus lineatus* bone powder was produced successfully. The nutritional values of species were evaluated. The major component was ash. It showed that the white powder contained less moisture and lipid contents. This study shows that the investigated fish species are good sources of many major nutrients and minerals. These filleting wastes can be applied to products of commercial usage. Further, the minerals have good application in various industrial and medical applications.

#### 5 Recommendation

Advanced research could be carried out for extraction of Ca and P on the *Siganus lineatus* and their toxicity analysis. Extraction and purification procedures could be tried out with different solvents to produce high-quality fishbone powder.

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#### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper

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