SLJoAS Sri Lankan Journal of Applied Sciences

Research Article

www.sljoas.uwu.ac.lk/index.php/sljoas

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

S.Uventhikka[a*], K.Sivashanthini[a], T.Thayalini[b] , P. Jasotha[c] and K. Velauthamurty[c]

[a]Department of Fisheries, Faculty of Science, University of Jaffna, Sri Lanka, 40000.

[b]Unit of Siddha medicine, University of Jaffna, Sri Lanka, 40000.

[c]Department of Chemistry, Faculty of Science, University of Jaffna, Sri Lanka, 40000.

*** Corresponding author email address**: uventhikka.ss8@gmail.com

(Received 20th April 2022; Accepted 24th February 2023)

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].

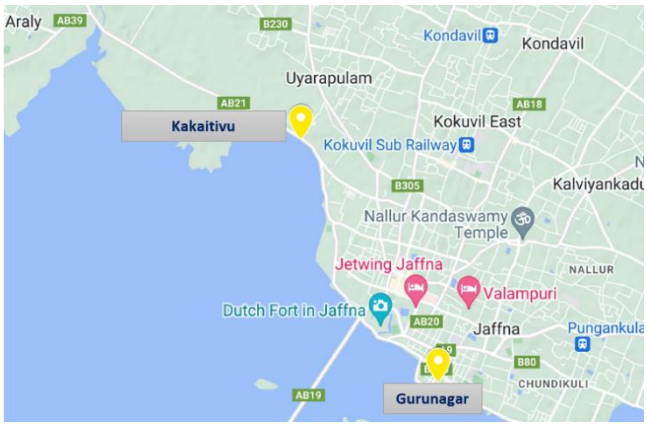

Fig. 1. Sampling sites around Jaffna Peninsula:(a) Gurunagar (b) Kakaitivu

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˚C. The frozen fish bone was placed outside the refrigerator and thawed around 1-2hours at room temperature.

2.3 Extraction of fishbone powder

Fishbone was washed and boiled separately in distilled water for about 2 hours at 100˚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˚C. Then dried in the hot air oven at 60˚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˚C. For moisture determination, 5g of fish bone powder was dried in a hot air oven at 60 °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±SD of three replicate determinations. The proximate composition of the investigated specimens (Table 1 and 2) shows high percentage of ash (50.74±0.65%) and lowest percentage of lipid (3.50±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± standard deviation)

Proximate parameter	Content (%)
Protein	22.07±0.29
Lipid	3.50±0.16
Moisture	6.29±0.35
Ash	50.74±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±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±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±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±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 *Pseudotolithus typus* and *Pseudotolithus elongatus* reported as 0.51-0.72% of Potassium and 0.39-0.40 % of sodium [15]

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

$$\%N = \frac{x\ moles}{1000cm3} \times \frac{(vs-vb)}{m\ g} \times \frac{14\ g}{moles} \times 100 \times \frac{250ml}{10ml} \quad (2)$$

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

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

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.

Acknowledgements

I would like to thank all the Academic and Non-academic staffs of the Department of Fisheries at the faculty of Science, University of Jaffna, Sri Lanka for their great assistance and support during the field and Laboratory work. Furthermore, I am grateful to Mrs.S.Sathyaruban and Mr.K.Gunaalan for their guidance and valuable comments.

Conflicts of Interest

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

References

[1] AOAC, 2000. *Association of Official Analytical Chemists.* 17th Edn ed. Washington: AOAC.

[2] AOCS, A. P. A. 5.-0., 2004. *Rapid Determination of Oil/Fat utilizing high temperature Solvent extraction.* s.l.:AOCS.

[3] Changhu, X., Zhaojie, L., Cheng, S. & Zhongliang, W., 1995. Studies on the preparation of active calcium from pollack frame. *J Qingdao Ocean University 1995*, 25(2), pp. 173-178. https://www.researchgate.net/publication/290125556

[4] Chitravadivelu., k. & Sivapalan, A., 1984. Food and Feeding of Siganus lineatus from Waters around Northern Sri Lanka. *J.Natn Sci. Coun, Sri Lanka*, 1(12).

[5] Hemung, B., 2013. Properties of Tilapia Bone Powder and Its Calcium Bioavailability Based on Transglutaminase Assay. *International Journal of Bioscience, Biochemistry and Bioinformatics*,3(4),pp.306-309. http://www.ijbbb.org/papers/219-S015.pdf

[6] Jaikumar, M., 2012. A Review on Biology and Aquaculture Potential of Rabbitfish in Tamilnadu (Siganus canaliculatus).. *International Journal of Plant, Animal and Environmental Sciences*,2(2),pp.57–64. https://www.researchgate.net/publication/267556927

[7] Johns, P., 1977. The structure and components of collagen containing tissues in WardA. G. Cours, A.. In: A. G. Cours, ed. *The Science and Technology of Gelation.* London: A (Eds.), Academic Press, pp. 31-72.

[8] Kaya, A. & Salamah, S., 2008. *Utilization of Catfish (Pangasius sp.) Bone Flour as Calcium and Phosphor Sources in Biscuit Manufacturing.*, Bogor: Master Thesis: Graduate Program, Bogor Agricultural University..

[9] Ketharani, U. & Sivashanthini, K., 2016. Nutritional Composition of Selected Species of Sea cucumbers from Waters around Jaffna Peninsula, Sri Lanka. *Ving. Journal of Science*, Volume 13, pp. 67-72. http://dx.doi.org/10.4038/vingnanam.v13i1-2.4123

[10] Kumar, P., Annathai, R., J.R., S. & and Shanmugam, S., 2014. Proximate and Major Mineral Composition of 23 Medium Sized Marine Fin Fishes Landed in the Thoothukudi Coast of India.. *J Nutr Food Sci*, 4(1), pp. 1-7. http://dx.doi.org/10.4172/2155-9600.1000259

[11] Lu, H., 2004. Continuous lactic acid fermentation of Haddock hydrolysate. *J.Waxi university of Light Industry*, pp. 103-106.

[12] Luu, p. & nguyen, m., 2009. Recovery and utilization of calcium from fish bones byproducts as a rich calcium source. *Tạp chí khoa học và công nghệ*, pp. 91-103.

[13] Malde, M. et al., 2012. Calcium from salmon and cod bone is well absorbed in young healthy men: a double-blinded randomised crossover design. *Nutrition & Metabolism* , 20 July, p. 61. http://dx.doi.org/10.1186/1743-7075-7-61

[14] Nagabhushanam, R. & Mane, V., 1978. seasonal variation in the biochemical composition of perna viridis at ratnagiri on the west coast of india. *Hydrobial*, 57(3), pp. 69-72.

[15] Njinkoue, J. et al., 2016. Proximate composition, mineral content and fatty acid profile of two marine fishes from Cameroonian coast: Pseudotolithus typus (Bleeker, 1863) and Pseudotolithus elongatus (Bowdich, 1825). *NFS Journal*, pp. 27-31. http://dx.doi.org/10.1016/j.nfs.2016.07.002

[16] Perman, J., 1992. Calcium nutriture for mothers and children. In: New York: R. C. Tsang and F. Mimouni (Eds.),Raven Press, p. 66. http://dx.doi.org/10.1093/ajcn/58.5.717b

[17] Phleger, C. F., 1975. Bone lipids of Kona Coast reef fish: skull buoyancy in the hawkfish, Cirrhites pinnulatu. *Comparative Biochemical and Physiology*, B(52), pp. 101-104.

[18] Rezaei, F. and VanderGheynst, J.S., 2010. Critical moisture content for microbial growth in dried food-processing residues. *Journal of the Science of Food and Agriculture*, *90*(12), pp.2000-2005.

[19] Talib, A., Tomia, A. & Tangke, U., 2016. The Use Flour Bones of Fish Skipjack (Katsuwonus Pelamis L) By Boiling It Naoh On The Model Mice Ovariektomi. *IOSR Journal Of Pharmacy*,6(6),pp.1-6

[20] Tont, S. A., Pearcy, W. G. & and Arnold, J. S., 1977. Bone structure of some marine vertebrates. *Marine Biology*, Volume 39, pp. 191-196.

[21] Toppe, J., Albrektsen, S., Hope, B. & and Aksnes, A., 2007. Chemical composition, mineral content and amino acid and lipid profiles in bones from various fish species. *Comparative Biochemical and Physiology*, 146(B), pp. 395-401. http://dx.doi.org/10.1016/j.cbpb.2006.11.020

[22] Wahyuningtyas, L. et al., 2017. Nutritional profile of Rabbitfish (Siganus spp.) from the Kepulauan Seribu(Thousand Islands), Jakarta, Indonesia. *International Food Research Journal*, 24(2), pp. 685-690.
https://www.researchgate.net/publication/317932898