Indian J. Anim. Nutr. 2023. 40 (3): 375-380
doi:10.5958/2231-6744.2023.00047.6

Indian Journal of Animal Nutrition

Proximate and Mineral Composition of Small Indigenous Fishes (Sifs) From the Western Ghats of Kerala

Lovedeep Sharma*, Sachin Pandit and Anvar Ali
Department of Fisheries Resource Management
Kerala University of Fisheries and Ocean Studies, Panangad, Kerala, India
*Correspondence: lovedeeps@kufos.ac.in

ABSTRACT

Small indigenous fish species (SIFs) are often highly nutritious, providing essential nutrients such as proteins, fatty acids, vitamins and minerals, as can be consumed whole body. These nutrients are crucial for maintaining overall health and preventing malnutrition. The present study offers preliminary information on the proximate and mineral composition of SIFs endemic to the Western Ghats. The moisture content was found to be highest in *Systomus sarana* (78.4%) followed by *Puntius mahecola, Pethia punctata* and *Dawkinsia filamentosa*. The present findings revealed that *Pethia punctata* (15.2±0.15%) has the highest protein content as compared. *P. mahecola* (2.65±0.75%) *and P. punctata* (3.65±0.01%) are low-fat fishes, while *D. filamentosa* and *S. sarana* belong to the medium-fat category. Ash content for all the species under study ranged between 0.99-5.02 %. The carbohydrate content ranged between 3-5% and fibre ranged between 1-6% for these species. These species contain significant quantities of minerals, such as calcium (2.30 to 2.64 % dry weight basis) and phosphorus (2.21 to 2.63 %dry weight basis), underscoring their significance as a mineral source. The results demonstrated that small indigenous fish (SIFs) possess a noteworthy abundance of nutrients, establishing their crucial role in ensuring livelihood and nutritional security.

KEYWORDS: Barbs, Endemic, Nutritional value, Small indigenous fish

Article received: 23 August 2023; Article accepted: 15 September 2023

INTRODUCTION

Small indigenous fish species (SIFs) are those, which can grow to a maximum size range of 25 to 30 cm in the adult stage of their life (Felts et al., 1996). Nutrient-dense small indigenous fish species are particularly important, especially in developing and under developed countries, as poor populations commonly consume these whole with bones and play an important role in counteracting micronutrient deficiencies (Kongsbak et al., 2008; Mahanty et al., 2014). These fish species play a crucial role in addressing malnutrition within low-resource communities in developing nations due to their ready accessibility, affordability, adherence to traditional and cultural dietary preferences, and nutritional value (Roos et al., 2003). Initially considered as 'weed/ trash fishes' or 'low-value fishes,' these species have now been recognized for their positive characteristics. These include self-recruiting nature, prolific breeding, attaining maximum body size in a shorter lifespan, and comparable palatability to larger food fishes (Hossain et al., 1999; Mohanty et al., 2013). As a result, their aquaculture potential has been acknowledged, leading to their widespread integration in polyculture systems alongside carps and catfishes in countries like India and Bangladesh. (Hossain et al., 1999; Mohanty et al., 2013; Nandi et al., 2013; Dutta et al., 2018).

The SIFs play a vital role in the economies of developing countries due to their extensive use as a readily available and affordable protein source, enriched with micronutrients, particularly minerals. This sets them apart from the commonly recognized principal freshwater aquaculture species in the region, such as the Indian and exotic Chinese major carps (Thilsted et al., 1997; Roos et al., 2007). Despite the use and potential recognized, the contribution of SIFs is either not represented properly

or abruptly presented in the global fishery statistics (Lakra et al., 2010). Biochemical studies of fish muscles are of considerable importance in terms of their nutritive value for humans as well as the physiological needs of fish at different periods of life (Euphrasia, 2004). This study aims to uncover the proximate and mineral composition of SIFs from Kerala, located in the Western Ghats region of India, and to elucidate their significance in enhancing nutritional and livelihood security. To provide valuable insights into their potential as sustainable and nutritious food sources, thereby promoting healthier diets and livelihoods that are more resilient for the local communities in the region.

MATERIALS AND METHODS

Fish sample

Fresh fish samples were obtained from the Bhoothathankettu Dam, Periyar River and Malankara Reservoir, Idduki district, Kerala. Small indigenous fishes i.e. *Dawkinisa filamentosa, Systomus sarana, Puntius mahecola* and *Pethia punctata* were collected for the current study. Total length was measured to the nearest centimetre using a Yamayo dial calliper and body weight to the nearest gram using an electronic weighing balance (Shimadzu).

The average Length and weight of sampled species are as follows: *Dawkinisa filamentosa*(TL=12.5 cm and BW= 19.8g), *Systomus sarana* (TL=13.4cm and BW=24.8g), *Puntius mahecola* (TL=10.5cm and BW=12.4g) and *Pethia punctata* (TL= 4.2cm and BW=5.8g). After cleaning and degutting, the samples were stored in a freezer at 4°C in order to facilitate proximate analysis.

Proximate analysis

Muscle samples of all four species were analysed in triplicates to estimate moisture, ash, protein, fat and fibre following standard methods of AOAC, 1997. Total carbohydrate was calculated using the difference between 100% (accepted total value of nutritional status) and the sum of all percent values of moisture, protein, fat and ash.

Analysis of minerals.

The mineral concentration in the fish muscle samples was measured using an Atomic Absorption Spectrophotometer (ICE 3000 series AAS model-Thermo-Scientific) and expressed as parts per million (ppm) or micrograms per gram (ìg/g). For Calcium, in mineral analyses, samples (1.000 g) were incinerated in porcelain crucibles at 450°C overnight, and then treated with 5 ml of 6 M HCl, boiled to dryness on a hot plate, cooled and the residue re-dissolved with 10 ml of 0.1 M nitric acid. The solutions were left standing for 2 h and then transferred to 50 ml volumetric flasks, topped with ultra-pure water and used for determination of Ca. For Phosphorus: Phosphorus was analysed by uv-vis spectrophotometer using molybdate-ascorbic acid colorimetric method at 823 nm wavelength, according to AOAC method 995.11.

STATISTICAL ANALYSIS

All the experiments were performed in triplicates and the results were expressed as the means ± standard deviation. Statistical analysis was done using MS Excel and PAST 4.0.

RESULTS AND DISCUSSION

The average proximate composition of all small indigenous fish species viz. *Systomus sarana*, *Puntius mahecola, Pethia punctata* and *Dawkinsia filamentosa* are depicted in Table 1 & Fig. 1. The results showed that *S. sarana* contains the highest moisture content followed by *P. mahecola P. punctata* and *D. filamentosa*. The acceptable level of moisture in eatable fish muscle is 60-80% (Sankar et al., 2010) and all the SIFs under study contain moisture of acceptable range. The present study revealed that moisture fraction, the greatest component of fish body by weight in these smaller fish species found to be similar to the values reported for the major and minor carps in India (Gopakumar, 1997; Mahanty et al., 2014, Dutta et al., 2018; Jena et al., 2018).

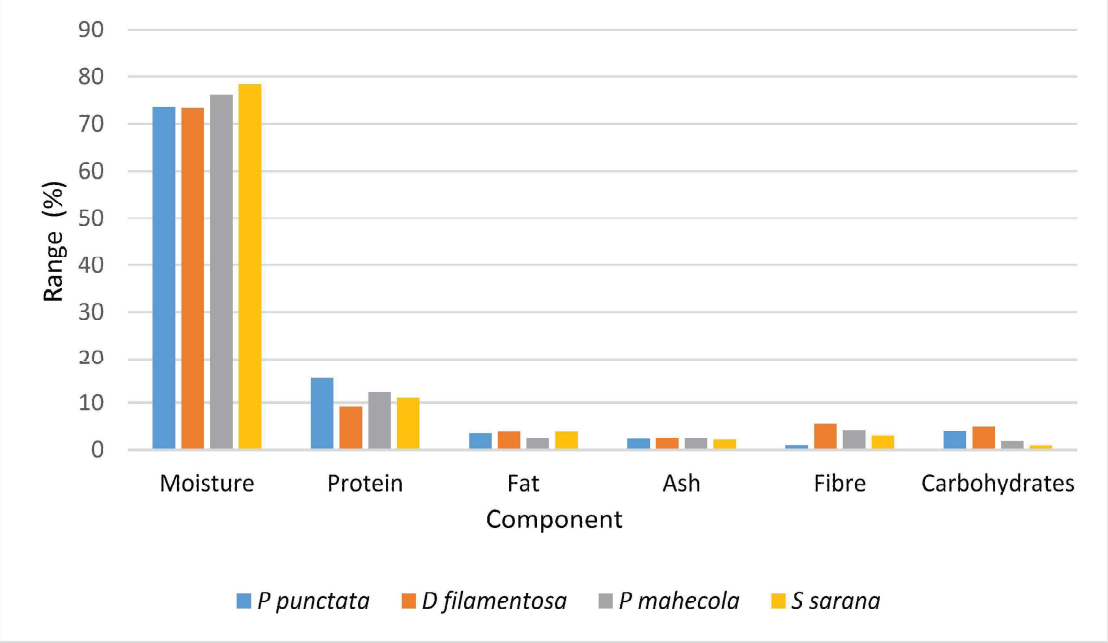

Figure 1. Proximate composition of small indigenous fish species

Table 1. Proximate composition of raw muscles of SIFs from Kerala, India

Parameter	*P. punctata*	*D. filamentosa*	*P. mahecola*	*S. sarana*
	Mean ±S.D	Mean ±S.D	Mean ±S.D	Mean ±S.D
Moisture (%)	73.6±1.37	73.5±1.29	76.2±2.21	78.4±1.98
Protein (%)	15.2±0.15	9.24±0.20	12.3±0.23	11.2±0.17
Fat (%)	3.65±0.01	4±0.03	2.65±0.01	4.01±0.02
Ash (%)	2.35±0.02	2.64±0.03	2.61±0.01	2.16±0.02
Crude Fibre (%)	1.01±0.19	5.55±0.32	4.33±0.0.25	3.19±0.21
Carbohydrates (%)	4.07±1.18	5.02±1.21	1.84±1.01	0.99±0.21

The highest protein content was found in *P. punctata,* whereas the lowest was in *D. filamentosa*. The protein content of studied indigenous barbs more or less coincides with the protein contents of barb species such as *Gadusia chapra* (15.2±1.78 %), *Puntius chola* (14.1 ± 2.01 %), *Pseudeutropius atherinoides* (15.84±1.50 %) and *Puntius ticto* (15.4%)reported by (Mazumder et al.,2008; Borah, 2019). The variations found in the values obtained may also arise from the ability to absorb and conversion of potential nutrients from their diets or their local environment.

The protein content of *Dawkinsia filamentosa* (Vijayakumar, 1987) is estimated to be in the range of 9.18-15.1% with a fat content range of 1.8-3.52%, which is almost similar to the present study. Another Smiliogastrin cyprinid barb *Systomus sarana*, is also known to possess a fat content of 3.15% (Gopakumar, 1997) which is nearly similar to the current study. The high protein content assisted with alow-fat content in *P. punctata* and *P. mahecola* qualifies these fish species as a good source of animal protein.

According to the findings of the current study, *P. punctata* and *P. mahecola* were classified as lean fish (2-4% fat content), whereas *D. filamentosa* and *S. sarana* were categorized as medium fat fish (4-8% fat content) based on the classification by Ackman (1989).The values of fat contents of studied fish are similar to the result of small indigenous freshwater fishes (Mohanty et al.,2010; Mazumder et al.,2008; Romharsha and Sarojnalini, 2018; Jena et al.,2018).

Ash is an indicator of mineral content in food items and higher ash contents pertain due to a greater number of bones (Olagunju et al.,2012; Romharsha and Saronalini, 2018). The present findings opined that ash content ranging from 2.16 to 2.64% in small indigenous fishes is a reliable indicator of essential minerals such as phosphate, potassium, calcium, zinc, iron and magnesium (Olagunju et al.,2012). Mineral contents Calcium and Phosphorus were estimated for all SIFs and ranged between 2.3-2.64% and 2.17-2.63% respectively (Table 2). Ash content can also be a useful measure of quality and a criterion for identifying the authenticity of the food quality (Dutta et al., 2018).

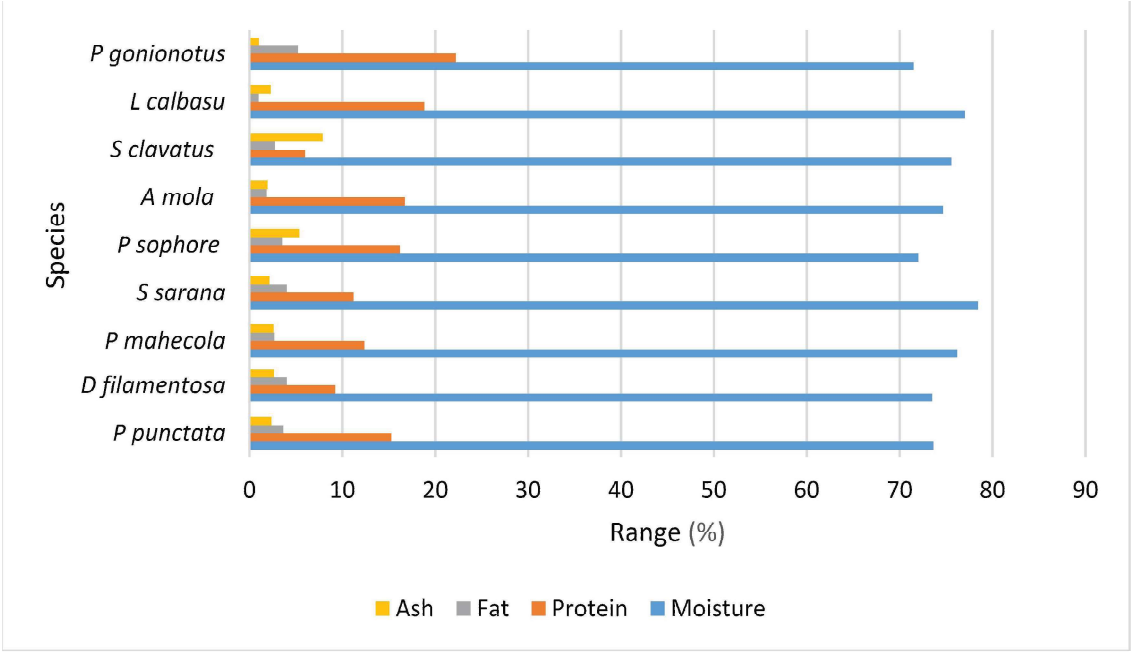

Figure 2. Variation of proximate components in different freshwater fish species

Table 2. Mineral content in SIFs (% dry weight basis)

Species	Calcium	Phosphorus	Ca/P
P. punctata	2.64	2.42	1.09
D. filamentosa	2.30	2.21	1.04
P. mahecola	2.34	2.42	0.96
S. sarana	2.32	2.63	0.88

The Ca/P ratio is considered significant in terms of food fish importance because it reflects a favourable nutritional composition. Maintaining a proper balance of calcium and phosphorus (nearly 1) is crucial for various physiological functions in the body, including bone health, nerve function, and muscle contraction. Therefore, a balanced calcium-to-phosphorus ratio in fish contributes to their overall nutritional value and highlights their importance as a food source (Hossain et al., 1999). When comparing small indigenous fishes (SIFs) with other freshwater fishes, it becomes evident that these species serve as a notable source of various nutrients. Particularly, *P. punctata* and *P. mahecola* stand out for their substantial protein content and low-fat content in their muscle tissue.

The findings of the present study highlight that small indigenous fish species (SIFs) from the Western Ghats exhibit significant nutritional value, displaying sufficient levels of protein, ash, fat, and minerals, despite minor variations. Additionally, SIFs are considerably more affordable than larger food fishes in the market. This makes these SIFs an excellent

choice as an economical and natural nutritional supplement for inclusion in the daily diets of local communities.

Specifically, *P. punctata* and *P. mahecola*, two small indigenous fish species (SIFs), have emerged as excellent choices for food consumption due to their favourable nutritional composition. These species exhibit high protein content and low-fat levels, making them well-suited as a food source. Their protein-rich nature contributes to muscle development and repair, while the low-fat content aligns with the growing preference for healthier dietary options.Moreover, SIFs, in general, offer a significant advantage as a food source.

ACKNOWLEDGEMENT

The authors would like to thank the Centre of Excellence in Food Processing Technology (CEFPT), Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi for providing the laboratory facilities during the research work. The authors also like to thank Dean Fisheries, KUFOS for the support.

REFERENCES

Ackman, R.G. 1989. Nutritional composition of fats in seafood. Progress in Food & Nutrition Science. 13(3-4): 161-241.

Association of Official Analytical Chemists (AOAC). 1997. Official Methods of Analysis of Association of Official Analytical Chemists, International. 16th Edn. AOAC International, Virginia.

Borah, B. C. 2019. Small indigenous freshwater fish species in nutrition of ethnic population of North East India. Acta Scientific Nutritional Health. 3(7): 158-167.

Dahanukar, N. 2015. *Pethia punctata*. The IUCN Red List of Threatened Species 2015:e.T172391A70227573.http://dx.doi.org/10.2305/IUCN.UK.20151.RLTS.T172391A70227573.en

Day, F. 1865. On the fishes of Cochin, on the Malabar Coast of India. Part II. Anacanthini. Proceedings of the Zoological Society of London. 286-318.

Dutta, P. K., Molla, T.H., Islam, M. S., Bashera, M. A. and Ahsan, M. S. 2018 Study of mineral constituents, proximate composition of fish flesh and physicochemical characteristics of fish lipid in *Puntius gonionotus*. International Journal of Current Research.10 (7): 70966-70999.

Euphrasia, C. J. 2004. Bionomics, resource characteristics and distribution of the threatened freshwater fishes of Kerala. Doctoral dissertation. Cochin University of Science and Technology.

Felts, R. A., Rajts, F. and Akhteruzzaman, M. 1996. Small indigenous fish species culture in Bangladesh (Technical Brief), IF ADEP sub-project-2. Development of Inland Fisheries, 41.

Gopakumar, K. 1997. Biochemical composition of Indian Food fish, Edited and published by K. Gopakumar, CIFT, ICAR, Kochi 29- 44p

Hossain, M. A., Afsana, K. and Shah, A.K.M. 1999. Nutritional value of some small indigenous fish species (SIS) of Bangladesh. Bangladesh Journal of Fisheries Research 3(1): 77-85.

Jacob, E. 2013. Studies on the captive breeding and reproductive biology of two indigenous ornamental fishes of the Western Ghats. PhD Thesis. Mahatma Gandhi University.

Jena, D., Jena, A. K., Panda, A., Parhi, J., Biswas, P. and Pattanaik, S. S. 2018. Proximate analysis of some small indigenous fish species (SIS) of Tripura, India. Journal of Entomology and Zoology Studies. 6(4): 470-474.

Kongsbak, K., Thilsted, S. H. and Wahed, M. A. 2008. Effect of consumption of the nutrient-dense, freshwater small fish *Amblypharyn godon mola* on biochemical indicators of vitamin A status in Bangladeshi children: a randomized, controlled study of efficacy. British Journal of Nutrition 99: 581-597.

Lakra, W. S, Sarkar, U. K., Gopalakrishnan, A. and Kathirvelpandian, H. 2010. Threatened freshwater fishes of India. National Bureau of Fish Genetic Resources, ICAR, Lucknow

Mahanty, A., Ganguly, S., Verma, A., Sahoo, S., Mitra, P., Paria, P., Sharma, A. P., Singh, B. K. and Mohanty, B. P. 2014. Nutrient profile of small indigenous fish *Puntius sophore*: proximate composition, amino acid, fatty acid and micronutrient profiles. National Academy Science Letters. 37(1): 39-44.

Mazumder, M. S. A., Rahmani, M. M., Ahmed, A. T. A., Begum, M. and Hossain, M.A. 2008. Proximate composition of some small indigenous fish species in Bangladesh. International Journal of Sustainable Crop Production.3(4): 18–23.

Mohanty, B. P. 2010. Fish as Health Food. In: Ayyappan S, Moza U, Meenakumari B, Jena JK, Pandey AK (eds) Handbook of fisheries and aquaculture,. ICAR-DKMA, New Delhi. ii+ 843–861pp.

Mohanty, B.P., Pati, M. K., Bhattacharjee, S., Hajra, A. and Sharma, A. P. 2013. Small indigenous fishes and their importance in human health. Advances in Fish Research. 5: 257-278.

Nandi, S., Majumder, S. and Saikia, S. K. 2013. Small freshwater fish species (SFFs) culture: issues from nutrient security, carp-SFF integration and feeding ecology. Reviews in Fish Biology and Fisheries. 23(3): 283-291.

Olagunju, A., Muhammad, A., Bello, S., Mohammed, A., Mohammed, H. A. and Mahmoud, K. T. 2012. Nutrient composition of *Tilapia zilli, Hemi-synodontis membranacea, Clupea harengus* and *Scomber scombrus* consumed in Zaria. World Journal of Life Sciences and Medical Research. 2(1): 16-19.

Panwar, D., Panesar, P. S. and Chopra, H. K. 2023. Evaluation of nutritional profile, phytochemical potential, functional properties and anti-nutritional studies of *Citrus limetta* peels. Journal of Food Science and Technology. 1-11.

Romharsha, H. and Sarojnalini, C. 2018. Proximate composition, total amino acids and essential mineral elements of some cyprinid fishes of Manipur, India. Current Research in Nutrition and Food Science. 6(1): 157-164.

Roos, N., Islam, M. M. and Thilsted, S. H. 2007. Small indigenous fish species in Bangladesh: contribution to vitamin A, calcium and iron intakes. The Journal of Nutrition. 133(11): 4021-4026.

Sarkar, U. K. and Lakra, W. S. 2010. Small indigenous freshwater fish species of India: significance, conservation and utilization. Aquaculture Asia. 15(3): 34-35.

Thilsted, S. H. and Wahab, M. A. 2014. Production and Conservation of Nutrient-Rich Small Fish (SIS) in Ponds and Wetlands for Nutrition Security and Livelihoods in South Asia. Proceedings of a World Bank/SAFANSI Funded Regional Workshop on Small Fish and Nutrition, 47. Dhaka, Bangladesh, March 1–2.

Vijayakumar, B. 1987. Relationship between water, lipid and protein in the muscle liver and gonad in a freshwater fish, *Puntius filamentosus* (Val.). Fishery Technology 24: 75-76.

Wahab, M. A., Alim, M. A. and Milstein, A. 2003. Effects of adding the small fish punti (*Puntius sophore* Hamilton) and/or mola (*Amblypharyngodon mola* Hamilton) to a polyculture of large carp. Aquaculture Research 34(2): 149-163.