DOI:10.33451/florafauna.v23i2pp423-431

FLORA AND FAUNA ISSN 2456-9364 (Online)

2017 Vol. 23 No. 2 PP 423-431 ISSN 0971 - 6920 (Print)

EVALUATION OF NUTRIENT COMPOSITION AND MINERAL CONTENT OF TRADITIONALLY DRIED SMALL INDIGENOUS FISHES

SHADAB MASUD* AND CHANDANA HALDAR

Department of Zoology,
Institute of Science,
Banaras Hindu University,
VARANASI-221005, INDIA
*Corresponding Author
Email: shadab.masud@gmail.com

Received **:** 25.08.2017; ***Accepted*** : 03.10.2017

ABSTRACT

Small indigenous fish species (SIS) are rich in nutrients and can be ensure nutritional security even in their dried state. Four dried cyprinid food fishes viz. *Salmophasia bacaila*,*Aspidoparia morar*,*Amblypharyngodon mola* and*Puntius sophore* were studied. All the four species are rich in protein content so they are important source of animal protein. The results showed variation in moisture, protein, fat, ash, fiber and in mineral content. Moisture was estimated 5.69% (*P. sophore*) to 7.42% (*A. morar*). Protein content varied from 52.32% (*S. bacaila*) to 60.79% (*A. morar*). Fat, ash, fiber, Ca and P content varied from 15.56% to 29.76%, 11.52% to 17.96%, 0.09% to 0.35%, 3.17% to 5.87% and 1.54% to 3.06% respectively. Higher levels of protein in SIS make them an important dietary supplement to promote growth and tissue healing and can be able to reduce the animal protein requirements for increasing human population. The overall result reveals that the SIS of the region are highly nutritious.

Figure : 01 References : 55 Tables : 01

KEY WORDS : Calcium, Dried SIS, Phosphorus, Proximate composition.

Introduction

Fish is considered as a rich source of protein, good quality fat, micronutrients and other elements for the maintenance of healthy body[6]. Vitamins, minerals, and necessary nutrients keep the body healthy and sustain life. Inadequate uptake of quality proteins and calories in diet leads to protein energy malnutrition (PEM or protein-calorie malnutrition, PCM) which is the most lethal form of malnutrition[39]. Fisheries, apart from contributing to nutritional security also have significant role in nutrition, employment and foreign exchange earning of the country. India is the second largest producer of fish in the word with a share of 5.68% of the global total, as per FAO statistics[23]. Societies with high fish intake have lower rates of acute myocardial infarctions and atherosclerosis, better cognitive functions, and better neural and visual development in fetuses[45]. Nutritional studies show that fish protein is ranked in the same class as chicken protein, yet beef protein, milk and egg albumin are inferior to it[47]. SIS are nutrient-dense and often overlooked in developing nations[44]. They inhabit in rivers and tributaries, ûoodplains, ponds and tanks, lakes, beels, streams, lowland areas, wetlands and paddy ûelds.

SIS which are defined as species attaining a maximum length of 25 cm, contribute[19] significantly to the nutritional as food as well as livelihood security of the rural mass. In India rural population depend highly on indigenous species of fish for nutrition, although very little attention has

ACKNOWLEDGEMENTS : Authors thank to Director Institute of science, BHU for providing all facilities. Financial support by Department of Science and Technology, New Delhi to Dr.ShadabMasud, Women Scientist- B, under the scheme KIRAN (Project no. DST/Disha/SoRF-PM/017/2013/G) and CAS, UGC-New Delhi to Prof. ChandanaHaldar is gratefully acknowledged.

been paid on their role in aquaculture enhancement, nutrition, processing, biology, captive breeding, livelihood security and conservation needs. SIS because of their comparatively small size were not regarded as economically important fish, although, they have positive nutritive and economic values[26,28], and can play a more significant role in the national food economy. So it is essential to know the proximate composition of the SIS to report their nutrient composition from the public health point of view. Proximate composition is the analysis of water, fat, protein and ash contents of fish[12]. However, these values vary considerably within and between species, size, sexual condition, feeding season and physical activity[53].Dried fishes are often an alternative to fresh fishes in many places[34].Dried fish are particularly rich in Ca and other micronutrients[17].Therefore, the aim of this study is to evaluate the biochemical composition and nutritional quality of high valued dried SIS for human welfare.

Basic knowledge about the nutrient quality is not only important to know its nutritive value, but also for its better processing and preservation[40].Therefore, in view of these facts, the present study was carried out to assess the proximate and mineral compositions of four cyprinid food fishes viz. *S. bacaila, A. morar*, *A. mola*and *P. sophore* with the objective of enhancing the scope for their utility from the public health point of view.

Materials and Methods

The details of material used in the studies and methods employed for the analysis of data are presented as following:

Collection of the fishes and location of the experiment

The experimented fishes were collected in fresh condition from different fish markets (where maximum catch of SIS comes from river Ganga) of Varanasi city; Uttar Pradesh (25Ú 21' N, 83Ú 1' E and about 76 m above mean sea level) situated in the eastern gangetic plains of India. Soon after collection the fishes were brought to the department of zoology, Banaras Hindu University.

Identification of selected species

Identification of fish specimens were carried out following[9,14,15,53]. On the basis of present studies four small indigenous fish species (SIS) were analyzed for nutritive value and mineral content.

Preparation of fish sample:

All the collected samples washed for foreign material under running tap water and then excess water will wipe off by simple blotting. Samples will be then dried directly under sun in protected area up to 4-7 days. During sun-drying, they were kept covered by dense meshed nylon or mosquito net to avoid outside contamination and prevent bird attack and fly infestation. Daily weight will be recorded till the constant weight of the dried fish is attended indicating the complete drying process. Dried fishes will be grinded into powder form and will be stored in separate air tight jars with proper labeling for further analysis.

Proximate composition

The determination of proximate composition was analyzed chemically[7] while the mineral percentage was determined by using (AAS) Atomic Absorption Spectrophotometer.

Estimation of moisture:

About 5 gram of fairly grinded samples were taken into each known weight crucible and weighed in a digital balance (Citizon, MP-5000). The samples were allowed to dry into the oven (super delux model, NSW-143Narang)at 105°C for about 8 to 10 hours until a constant weight was reached and cooled in desiccators and were weight again.

Calculation:

$$\% \text{ of moisture} = \frac{\text{weight loss}}{\text{orignal weight of sample taken}} \times 100$$

Estimation of Crude protein:

Crude protein content was determined[7]. Approximately,2.0 ± 0.01 g of moisture free sample was weighed and digested along with conc. H_2SO_4 and a pinch of digestion mixture ($NaSO_4$: $CuSO_4$ at the ratio of 9:1) in a Kelplusdigestor (Kelplus KES 12 L Pelican Equipments, Chennai, India.) at 350°C for 4 h until the sample became colorless. The digested sample was diluted to 100 ml in a volumetric flask with distilled water. About 5 ml of aliquots was distilled for 10 min with 40 % sodium hydroxide in a Kelplus distillation apparatus (KelplusDistyl EM VA, Pelican Equipments, Chennai, India.) and the distillate was collected in 2% boric acid solution containing mixed indicator. The nitrogen content was determined by titration against standard N/70 H_2SO_4 solution. The crude protein content was then calculated by multiplying

with the factor 6.25.

Calculation:

% of N_2 = (Titration reading-blank reading) × Strength of Acid × 100/5 × 100/ weight of the sample. For most routine purpose the % of protein in the sample is then calculated by multiplying the % of N_2 with an empirical factor 6.25 for the fish.

% of the protein = % of total N_2 × 6.25

Estimation of Crude fat:

Crude fat content was determined[7]. Approximately, 2 ± 0.2 g of moisture free sample was placed individually in a thimble and kept in the pre-weighed extraction flask. The flask was filled with 2/3 volume of petroleum ether and the apparatus (Pelican Equipments, Chennai, India) was assembled. Extraction was carried out for about 2 h at 200°C. After the extraction, excess ether was carefully collected and the residual ether was evaporated to dryness. The difference between the initial and the final weight gave the crude fat content.

Calculation:

$$\% \text{ of Fat} = \frac{\text{Weight of residue}}{\text{Weight of sample taken}} \times 100$$

Estimation of Ash:

Ash content was determined as the inorganic residues such as oxides, sulphates, silicates and chlorides left behind, in the dry muscle based on the standard method[7]. Approximately, 2 ± 0.2 g of moisture free sample was taken individually in a silica crucible and kept for charring on hot plate now the sample was placed in the Muffle furnace set at 550ÚC for 12-15 h. The difference between the initial and the final weight gave the crude ash content.

Calculation:

$$\% \text{ of Ash content} = \frac{\text{Weight of ash}}{\text{Weight of sample taken}} \times 100$$

Gross energy:

The gross energy content was calculated from the chemical composition using values of 5.65 and 9.45 Kcal/g for protein and lipid respectively[20].The data are expressed in Kilojoules/ gram (1 Kcal = 4.184 KJ)

Mineral analysis:

Calcium and phosphorus were determined using (AAS) Atomic Absorption Spectrophotometer[7].

Results and Discussion

Biochemical composition of flesh is a good indicator for the fish quality[21].Physiological condition and habitat of fish was studied[1,42,26]. Fish of various species don't provide the same nutrient profile to their consumer[25] and even within the same species from one individual to another. The body composition of fish seems to depend on sex, season and diet[52].

The taxonomic position of studied species has been given (Table-1). All the studied species were belonging to the order cypriniformes. *A. mola* and *A. morar* are herbivore while *S. bacaila* and *P. sophor* are omnivore in nature[13,37].

Proximate composition

The proximate composition of sundried SIS is presented in Table-1. All proximate components and minerals were analyzed in duplicate and presented here as the mean. Depending on the species, results showed variation in proximate composition and in mineral content present in the dried samples (Fig. 1).

The moisture content was estimated as 6.01%, 7.42%, 5.98% and 5.69% in *S. bacaila*, *A. morar*, *A. mola* and *P. sophor* respectively. The result of the present study reveals that the highest moisture content was found in *A. morar*and lowest was recorded in *P. sophore* as shown in Table 2. Fish flesh in fresh condition contains up to 20-30% protein, 70-80% water, 2-12% lipid[35]. The percentage of water is good indicator of its relative contents of energy, proteins and lipids. The lower the percentage of water would be greater the lipids and protein contents and higher the energy density of the fish[16].

Knowledge of the moisture content of food items gives useful hints of existing qualities and susceptibility to fungal infection. Generally no microbe could grow in dried products with moisture content below 15%[21]. The high moisture content would increase the deterioration level of fish when kept for a long time. This is because micro-organisms would be highly active with high moisture content[35]. The sun dried SIS contain an average of 10-20% moisture[24].The moisture content had ranged from 19.17 to 23.12% in three dried fish species[36]. The market samples of sun-dried *G. chapra*had moisture ranging from 9.61 to 18.64%[10]. The range of moisture content of fourteen dried fishes 18.23 to 23.61% reported[8]. Moisture content varied 11.65%-13.50% in seven dried SIS[49]. In our

TABLE-1: Proximate composition (%), mineral composition (%) and gross energy (KJ/g) of SIS (on dry matter basis)

SIS	Dry Matter	Moisture	Protein	Fat	Ash	Fiber	Ca	P	Gross energy
S. bacaila	93.99	6.01	52.32	29.76	13.52	0.35	3.17	1.93	24.13
A. morar	92.58	7.42	60.79	24.53	15.81	0.09	4.72	3.06	24.07
A. mola	94.02	5.98	56.44	29.39	11.52	0.18	3.21	1.54	24.96
P. sophore	94.31	5.69	56.78	15.56	17.96	0.14	5.87	2.91	19.57

study, the moisture content was found to be low 5.69 to 7.42% which is close to the findings of[30] in traditionally dried rui fish (9.07%). The variation in data may be due to geographical differences, food habits, season, Sex, habitat *etc.*

Protein forms the largest quantity of dry matter in fish[48]. The highest percentage of protein was reported in *A. morar* (60.79%) and lowest in *S. bacaila* (52.32%). Our results are very much similar to other studies. Normally sun dried fishes contain 60-80% protein[24]. Protein contents are relatively high in studied species indicating that fish are good source of protein. Therefore, these fishes are likely to be a good source for meeting our daily protein needs. Adults, pregnant and lactating mothers required 34-56g, 13-19g and 71g protein daily respectively[51].Higher protein content in fish has been observed by several workers. Protein content varied widely from 17.2-78% in 23 dried fish species[29]. Protein content varying between 40.69 to 66.52% in fourteen dried fish species[8] and 53.45-76.39% in five dried fishes[20].

Fat generally varies much more widely than other proximate components of fish, and usually reflects differences in the way fat stored in particular species but may also be affected by seasonal/ lifecycle variations and the diet/food availability of the species at the time of sampling[2].For example, bottom dwelling species such as the indigenous major carps are typically lean fish, storing fat in the liver whereas; migratory fish such as Ilish have a higher content of dark muscle which tends to be rich in fat[4]. Processing of fish for consumption involves removal of head and viscera. These byproducts of fish are expected to be rich in lipids and proteins. Fish head can be a good source of PUFA[50].

From the study it has been found that the range of lipid in studied species varied from 15.56-29.76%. Our result very much similar to dried *L. bata* (13.77-14.01%) reported[38].

Carbohydrates and non-protein compounds are presented in negligible amount and are usually ignored for routine analysis of fish[12]. In the present study very low fiber content was recorded in the studied SIS 0.09-0.35%.

Ash content range from 11.52-17.96% and is positively related to mineral content of the fish species. It is the inorganic residue that is left after the organic material has been burnt off[3].Higher ash content may be due to inclusion of bones as edible parts which would lead to higher ash content in these species.In *Labeo bata*[38] also find similar ash percentage varied within 16.37-16.95%.As the edible parts of large fish do not include the bones, viscera and organs, the micronutrient content is much lower than that of small fish[31].

Minerals constitute the micronutrients serve as the components of many enzyme activities by which the human body acquires and utilized food to maintain health and physical activity[5].Minerals such as calcium and phosphorus are closely related to metabolism especially in bone formation and the maintenance of acid- base equilibrium in fish. Minerals such as Ca and P are closely related to metabolism especially in bone formation and the maintenance of acid-base equilibrium in fish. Almost 99% calcium and most of the phosphorus (80%) in the body are in the form of bones, teeth and scales. The remaining small portions are widely distributed throughout the organ and tissues[27].Since these species are normally cooked and eaten whole, with organs and bones, play a critical role in micronutrient intakes, as most micronutrients are concentrated in these parts[33] they contain very large amounts of calcium as well as some iron and zinc[43]. Small fish with bones may be an important source of calcium in human diets. The results of the calcium (Ca) and Phosphorus (P) content of four SIS are shown in Table-1. The highest calcium content was found in *P. sophore* (5.87%) and *S. bacaila* showed the lowest value (3.17%). Phosphorus was in the range of 1.54-3.06%. Phosphorus helps in the activity of adenosine polyphosphates and phospholipids[41]. As would be expected, Ca and P contents were much higher in species in which bones are commonly consumed and included in the edible part[18,33,41,43]. The high Ca content of SIS was also reported[43] *A. mola* (853 mg/100 g), *P. ranga*(955 mg/100 g) and *E. danricus* (891 mg/100 g). Ca content 1.06 to 1.26% in 5 minor carpsreported[54]. Ca and P content of SIS was 0.85 and 3.20% and 1.01 and 3.29% respectively[27] which is more or less similar to the values obtained in the present study.

The gross energy content of small indigenous fish species in the present study ranged between 19.57 to 24.96 KJ / g. The high calorific value could be attributed to high fat content[32].The calculated gross energy content of *S. bacaila*, *A. mala*, *A. morar* and *P. sophore* were more or less similar[27].

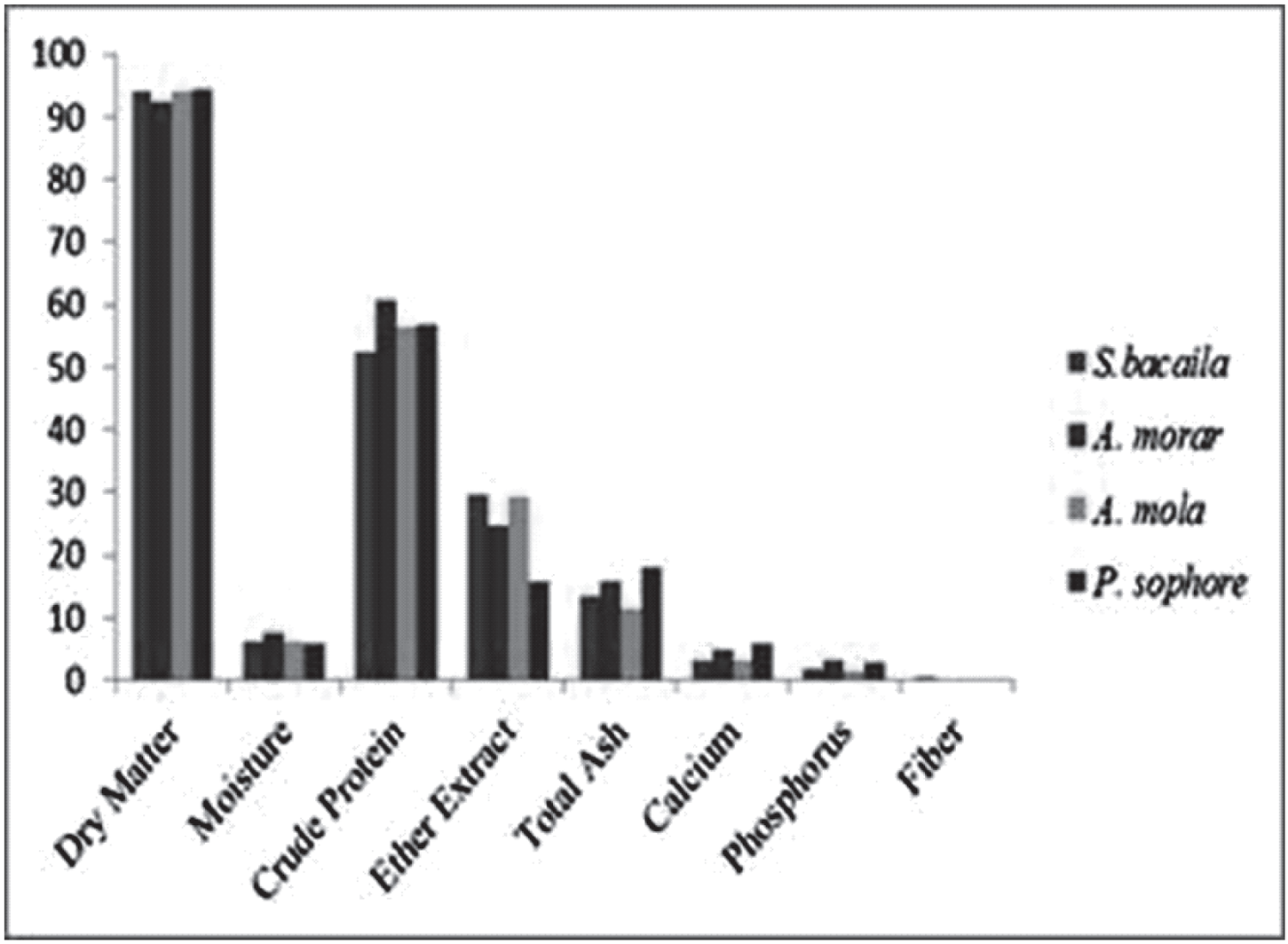

Fig. 1 : Proximate composition and mineral content of different SIS

Conclusion

This investigation provides practical and useful information on the nutritional quality aspects which will be valuable for nutritionists, the fishing industry and investigators for who are interested in developing them into high-protein foods.Necessary steps should be taken to increase the production of the species by aqua farming and proper management of natural habitat of the species. Artificial breeding of the species can increase the supply of fry for culture. This study clearly indicates that the proximate values obtained would be useful to help the consumers in choosing fish based on their nutritional values. Results showed that all these fishes, have a good quantity of protein just like the commercial fishes, so they can be safely used in food as protein supplement. Promotion of the production and consumption of small fish in population groups with low intakes of milk and milk products should therefore be encouraged.

References

1. ABEROUMAD, A. AND POURSHAFI, K. (2010) Chemical and Proximate Composition of Different Fish Species Obtained from Iran. *World Journal and Marine Sciences* **2 :** 237-239.
2. ABABOUCH, L. (2005) Lipids. FAO Fisheries and Aquaculture Department, Rome, Italy. Available from: http://www.fao.org/fishery/topic/14826/en (retrieved 27.03.14).
3. ADEWUMI, A.A., ADEWOLE, H.A. AND OLALEYE, V.F. (2014) Proximate and elemental composition of the fillets of some fish species in OsinmoResevior, Nigeria. *Agric. Biol. J. North America,* **5** : 109-117.
4. ALAM, A.K. M.N., MOHANTY, B.P., HOQ, M.E. AND THILSTED, S.H. (2012) Nutritional values, consumption and utilization of *Hilsa tenualosailisha* (Hamilton 1822). In: Proceedings of the Regional Workshop on *Hilsa*: Potential for Aquaculture, 16– 17 September 2012, Dhaka, Bangladesh.
5. ALLEN, D. AND GATLIN, D.M.(1996) Dietary mineral requirements of fish and marine crustaceans. *Reviews in Fisheries Science* **4 :** 75-99.
6. ANDREW, A.E. (2001) Fish Processing Technology. University of Ilorin Press, Nigeria. 7-8.
7. AOAC (1995) Official methods of analysis. Association of Official Analytical Chemists, Inc., Washington, DC, USA.
8. AZAM, K., BASHER, M.Z., ASADUZZAMAN, M., HOSSAIN, M.H., AND ALI, M.Y. (2003) Biochemical quality assessment of fourteen selected dried fish. *Univ.J. Zool. Rajshahi Univ.* **22** : 23-26.
9. BERG, L.S. (1947) Classification of Fishes both Recent and Fossil. J.W. Edwards, Ann Arbor, Michigan: 517.
10. BHATTACHARYA, S.K., BANDYOPADHYAY, J.K. AND CHATTOPADHYAY, A.K. (1985) Improved dried product on Blanching of *Gudusiachapra*prior to sun-drying. In: "Harvest and Post-Harvest Technology of Fish. Society. Fish.Technol. India 531.
11. BRODY, S. (1945) Bioenergetics and Growth. Reinhold Publishing Corporation, New York.
12. CUI,Y. AND WOOTTON, R.J. (1988) Bioenergetics of growth of Cyprinids, Phoxinus, the effect of the ration and temperature on growth rate and efficiency. *J.of Fish Biol.* **33** : 763-773.
13. DAS, S.M. AND MOITRA, S.K. (1963) Studies on the food and feeding habits of some fresh water fishes of India, Part IV, A review of the food and feeding habits with general conclusions. Ichthyologica, **2** : 107-115.
14. DAY, F. (1878) The fishes of India; being a natural history of the fishes known to inhabit the seas and freshwaters of India, Burma and Ceylon. Reprinted by Today and Tomorrow Publishing House, pages 778+ pls 195.
15. DAY, F. (1889) The fauna of British India including Ceylon and Burma. London, **1** : 375 pp.
16. DEMPSON, I.B., SCHWARZ, C.J., SHEARS, M. AND FUREY, G. (2004) Comparative proximate body composition of Atlantic salmon with emphasis on parr from fluvial and lacustrine habitats. *J of Fish Biol.* **64** : 1257-1271.

17. FAO (2014) ICN2 Second International Conference on Nutrition. Better nutrition better life. Maximizing the contribution of fish to human nutrition.19-21 November 2014 Rome, Italy.

18. FAO/INFOODS (2013) FAO/INFOODS Food Composition Database for Biodiversity Version 2.1-BioFoodComp2.1 Food and Agricultural Organization of the United Nations. World Health Organization, Geneva, Switzerland.

19. FELTS, R.A., RAJTS, F. AND AKHTARUZZAMAN, M. (1996) Small indigenous fish species culture in Bangladesh. Technical brief.IFADEP Sub-project- 2.Development of Inland Fisheries. 41.

20. FLOWRA, F.A., NAHAR, D.G., TUMPA, A.S. AND ISLAM, M.T. (2012) Biochemical analysis of five dried fish species of Bangladesh. *University J. of Zoology, Rajshahi University* **31 :** 9-11.

21. FRAZIER, W.C. AND WESTHOFF, D.C. (1978) Microorganisms important in food microbiology. In: Food Microbiology, Third Edition, McGraw-Hill Book Company. New York. 539.

22. GRAVES, T.D.D. (1970) Body composition changes during growing in young sockeye (*Oncorhynchusnerka*) in fresh water. *Bangladesh J. Fish Res. Can.* **27** : 929-942.

23. HANDBOOK ON FISHERIES STATISTICS (2014) Dept. of Animal Husbandry, Dairying & Fisheries, MINISTRY OF AGRICULTURE, Govt of India, New Delhi.

24. HAQUE, E. (2004) *Bangladesher ChhotoMachh* (A book on small fishes of Bangladesh), *Published by Graphic Sign, Mymensingh,* **2200 :** 81-84.

25. HERNANDEZ, M. D., MARTINEZ, F.J. AND GARCIA, B. (2001) Sensory evaluation of farmed sharp snout seabream (Diploduspuntazzo). *Aquacult. Int.* **9** : 519-529.

26. HOSSAIN, M.A. AND AFROZE, S. (1991) Small fish as resource in rural Bangladesh. *Fish Byte,* **9** : 16-18.

27. HOSSAIN, M.A., AFSANA, K. AND AZAD, SHAH, A.K.M. (1999) Nutritional value of some small indigenous fish species (SIS) of Bangladesh.*Bangladesh J. Fish. Res.,* **3** : 77-85.

28. HOSSAIN, M.A., RAHMAN, M.H., PARWEEN, S. AND MAHMAN, M.A. (1994) Fish stock assessment and utilization of seasonal ditches. *J. Ecobiol.,* **6** : 61-66.

29. HUSSAIN, M.M., KARIM A., ALAM Z., ISLAM M.M.S., KHAN A. AND HOSSAIN A. (1992) Effect of pre-treatment on the drying of Ghonia fish, *Labeoghonius* in the open sun and in a tent. *Bangladesh J. Zool.* **20** : 231-238.

30. ISLAM, M.N. (1982) Combined solar and cabinet drying of fishes. *J. Ins. Enggs., Bangladesh.* **19** : 7-11.

31. JESSICA, R. B., THILSTED, S. H., GEOFFREY, C.M., WAHAB, M.A., MOSTA, F.A., A.R.H., JETTE, J. AND STANGOULIS, J. (2015) Nutrient composition of important fish species in Bangladesh and potential contribution to recommended nutrient intakes. *J. of Food Comp. and Anal.* **42** : 120–133

32. KEREMAH, R.I. AND AMAKIRI, G. (2013) Proximate composition of nutrients in fresh adult catfishes: *Chrysichthysnigrodigitatus, Heterobranchusbidorsalis* and *Clariasgariepinus*in Yenagoa, Nigeria. Greener. *J. of Ag. Sc.,* **3** : 291-294.

33. LARSEN, T., THILSTED, S.H., KONGSBAK, K. AND HANSEN, M. (2000) Whole small fish as rich calcium source. *Br. J. Nutr.* **83 :**191–196.

34. LAURETI, E. (1998) Fish and fishery products: World Apparent Consumption Statistics Based on Food Balance Sheets (1961-1993). FAO Fisheries Circular, No. 821, Revision 3, Rome.

35. LOVE, R.M. (1980) The Chemical Biology of Fishes. Brown ME (Edn), Academic press. New York, USA.

36. MANSUR, MOHAMMAD, ABUL, RAHMAN, SHAFIQUR, MOHAMMAD, NURULABSAR, KHAN, MD. SHAHEED REZA, KAMRUNNAHAR AND SHOJI UGA. (2013) *African J. of Ag. Res.* **41** : 5149-5155, 24. DOI: 10.5897/AJAR12.773.

37. MASUD, SHADAB (2013) Studies on biology and fishery of some carp minnows in lower stretch of river Yamuna, At Allahabad. D. Phil. Thesis, University of Allahabad.

38. MD. SAROWER-E-MAHFUJ, HOSSAIN, BELAL, M. AND MINAR, M.H. (2012) Biochemical Composition of an Endangered Fish,*Labeobata*(Ham. 1822) from Bangladesh Waters. *American Journal of Food Technology,* **7** : 633-641.\

39. MOHANTY, B.P., MAHANTY, A., GANGULY, S., SANKAR, T.V., CHAKRABORTY, K., RANGASAMY, A., PAUL, B., SARMA, D., MATHEWS, S., KURUKKAN, A.K., BEHERA, B., MD. A., DEBNATH, D., VIJAYA GOPAL, P., SRIDHAR, N., AKHTAR, M.S., SAHI, N., MITRA, T., BANERJI, S., PARIA, P., DAS, D., DAS, P., VIJAYAN, K.K. LAXMAN, P.T. AND SHARMA, A.P. (2014) Aminoacid composition of 27 food fishes and their significance in clinical nutrition. *J. Amino Acids.Article* ID **269797**, 7 pages.

40. MRIDHA, M.A., LIPI, S.Y., NAREJO, N.T., UDDIN, M.S., KABIR, M.S. AND KARIM, M. (2005) Determination of biochemical Composition of *Cirrhinusreba* (Ham., 1822) from Jessore, Bangladesh, *J. of Sc. & Tech. University Peshawar* **29** : 1-5.

41. NAIR, P.G.V. AND MATHEW, S. (2001) Biochemical composition of fish and shell fish, Central Institute of Fisheries Technology, Cochin-682029, ICAR.

42. RAVICHANDRAN, S., KUMARAVEL,K. AND FLORENCE, E.P. (2011) Nutritive composition of some edible finfishes. *Int. J. Zool. Res.,* **7** : 241-251

43. ROOS N, ISLAM, M.M. AND THILSTED, S. H. (2003) Small fish is an important dietary source of vitamin A and calcium in rural Bangladesh. *J. Nutr.* **53** : 425-437.

44. ROOS, N., WAHAB, M.A., HOSSAIN, M.A.R. AND THILSTED, S.H. (2007) Linking human nutrition and fisheries: Incorporating micronutrient-dense, small indigenous fish species in carp polyculture production in Bangladesh. *Food and Nutrition Bulletin,* **28** (2).The United Nations University.

45. SAOUD, I. P., BATAL, M., GHANAWI, J. AND LEBBOS, N. (2008) Seasonal evaluation of nutritional benefits of two fish species in the eastern Mediterranean Sea. *Int. J. of Food Sci. and Tech.,* **43** : 538–542.doi:10.1111/j.1365-2621.2006.01491.

46. SHAMSAN, E. F. AND ANSARI, Z. A. (2010) Biochemical composition and caloric content in sand whiting *Sillagosihama* (Forsskal), from Zuari Estuary, Goa. *Indian J. Fish,* **57** : 61-64.

47. SRIVASTAVA,V.K. (1959) Limnological studies of freshwater bottom II. Qualitative composition and variation of the available food supply for fishes. *Proc. Nat. Sci. India.* **29 :** 207-210.

48. STEFFENS, W. (2006) Fresh water fish wholesome foodstuffs. *Bulg. J. Agric. Sci.,***12** : 320.

49. SULTANA, S., PARWEEN, S. AND HOSSAIN, M.A. (2011) Biochemical analysis of some dried sis fishes of the river Padma in Rajshahi. *J. Life Earth Sci.* **6** : 39-43.

50. SWAPNA, H.C., AMITKUMARRAI, BHASKAR, N. AND SACHINDRA N.M. (2010) Lipid classes and fatty acid profile of selected Indian fresh water fishes. *J. Food Sci. Technol.* (July-August 2010) **7** (4) : 394-400.DOI: 10.1007/s13197-010-0065-6.

51. ANONYMOUS (2002) Food and nutrition board, institute of medicine.National academy of sciences.Dietary reference intake of energy, carbohydrate, fiber, fat, fatty acids, Cholesterol, protein and Amino acid (micronutrients). www.nap.edu.

52. TAKAMA, K., SUZUKI, T., YOSHIDA, K., ARAI, H. AND MITSUI, T. (1999) Phosphatidylcholine levels and their fatty acid compositions in teleost tissues and squid muscle. *Comparative Biochemistry and Physiology Part B,* **124** : 109–116.

53. TALWAR, P.K. AND JHINGRAN, A.G. (1991) Inland fishes of India and adjacent countries. **I & II** Oxford & IBH Publishing House, Calcutta.

54. THILSTED, S.H., ROOS, N. AND HASSAN, N. (1997) The role of small indigenous fish species in food and nutrition security in Bangladesh. *Naga*, ICLARM Quart. December, 13-15.

55. WEATHERLEY, A.H. AND GILL, H.S. (1987) The biology of fish growth. Academic Press, London, UK.