

Nutritional Values of Some Fresh Water Fishes from Two Different Districts of Manipur

Hawaibam Romharsha¹, Mayanglambam Shantosh² and Chungkham Sarojnalini³

^{1,2,3}Fishery Research Laboratory Department of Life Sciences Manipur University, Canchipur
E-mail: ¹romharsha@gmail.com, ²shantmay13@gmail.com, ³sarojnalini.ch@gmail.com

Abstract—The four fresh water fish species (*Devario yuensis*, *Hypsibarbus myitkyinae*, *Poropuntius clavatus* and *Tor tor*) were studied for proximate compositions, total amino acids and essential mineral elements. *T. tor* and *P. clavatus* were collected from the Barak River located in Tamenglong district and *D. yuensis* and *H. myitkyinae* were collected from Moreh Market, Chandel district of Manipur. The result showed that the moisture content was found highest in *T. tor* (76.35±0.04%) and lowest in *D. yuensis* (71.56±3.83%). The fish species recorded good amounts of ash content ranged from 3.38±0.10% (*D. yuensis*) to 7.75±0.20% (*P. clavatus*). The highest protein content was recorded in *T. tor* (26.24±0.62%) and *P. clavatus* recorded considerably lower at 5.99±0.05%. The total lipid content varied among the species as 2.70±0.28% in *P. clavatus* and 6.33±0.17% in *D. yuensis*. Total amino acid content was recorded highest in *T. tor* (720.75±1.30 mg/100g) and lowest in *P. clavatus* (229.5±0.00 mg/100g). Ca, Fe, Na & K were abundantly found in the above studied fish species. The above studied wild fresh water fishes were have been served the people of Manipur as a good source of protein and may be further exploited for commercial purposes.

Keywords: Fresh water Fishes, Nutritional values, Proximate composition, Total Amino Acids, Mineral elements.

1. INTRODUCTION

It is well accepted throughout the world that fish are the good source of protein and other important element for the maintenance of healthy body [4]. Compare to other source of protein, fish protein are known for the excellent source of protein from their amino acid composition and protein digestibility [13]. Besides excellent source of protein they are also an important source of vitamins as well as minerals including Calcium, Iodine, Selenium, Iron, etc. There are abundant evidences manifesting the significance of fish consumption in brain development and learning in child, protect vision and eye health and protection from cardiovascular diseases and some cancer [21].

Fish is the main food item of the majority of the people in the state of Manipur since time immemorial. It has received increased attention as a potential source of animal protein and essential nutrients for human diet. Fish meat contains significantly low lipids and high water content than beef or

chicken and is favoured over other white or red meats. The nutritional value of fish meat comprises of moisture, dry matter, proteins, lipids, vitamins and minerals plus the caloric value of the fish. High-grade protein and other organic products are also obtained from fishes. Therefore, efforts are being made all over the world to exploit both the marine and fresh water bodies for fish production.

Besides cultural fishes, the wild fishes also provide a major bulk of fish protein. Hence, studies on different sources and nutritive values of wild fishes are necessary [5]. Generally, animal protein is better than plant protein in respect of qualities. Consumption of fish provides important nutrients to a large number of people worldwide and makes a very significant contribution to nutrition. And, the information concerning the chemical composition of the fishes is very much necessary to ensure that they meet the requirements of man's diet.

The chemical composition of fish consists of the major and minor constituents. The analysis of the major constituents (i.e., proximate composition) of fishes is necessary for providing information of the concentrations of protein, lipid, ash and moisture of the particular species. And, the contents of proximate composition are traditionally used as indicators of the nutritional value of fish [24]. Composition of live-weight, whole body fish is 70-80% water, 20-30% protein and 2-12% lipid [14]. Food and Agriculture Organisation [8] has also reported that normally fish contains 72% water, 19% protein, 8% fat, 0.5% calcium, 0.25% phosphorus and 0.1% vitamin A, D, B & C. etc. Fish is also a good source of essential fatty acids, vitamins & minerals. Fish oils are responsible to keep the cholesterol level low in the blood thus help in controlling the cardiovascular diseases [10]. There are also some reports on the nutritive importance of hill stream fishes of Manipur as well as the other north eastern states of India [5, 11, 1]. Therefore, it is necessary to undertake an extensive study about the nutritive importance of the cold water fish species found in Manipur.

2. MATERIALS AND METHODS

2.1 Site Selection

A survey of investigating the different sites of Manipur was conducted during the period from September, 2013 to April, 2014. After the survey work was completed, two sites were selected for the collection of fish.

Tor tor and *Poropuntius clavatus* were collected from the Barak river, Tamenglong District, Manipur. Whereas, *Devario yuensis* and *Hypsibarbus myitkyinae* were collected from Moreh Market, Chandel district, Manipur. All the fish samples were brought to the Fishery Research Laboratory, Department of Life Sciences, Manipur University, Canchipur with proper caring for the purpose of Nutritional analysis. The length-weight of the collected fish species is shown in Table 1.

Moisture was determined by the Hot air oven method [3]. Total lipid was also extracted by following the method of Singh *et.al.* [23]. Total Protein was obtained by multiplying the values of Total Nitrogen with 6.25 (conversion factor) following the method of modified micro-kjedahl [3]. And the Ash content was also calculated following the method of [3].

Total amino acid were determined by the method describe by Moore, S. and Stein, W.H. [15]. Calculation of the amount of total free amino acids was done by using standard curve prepared from leucine by pipetting out 0.1-1.0 ml (10-100µg range) of working standard solution. Result was expressed in percentage equivalent of leucine.

Mineral (Fe, Zn, Ca, Cu, Mg, Mn, K and Na) analysis was done following the method of Perkin-Elmer [19]. Ash of respective sample was digested in HNO₃ making carbon free and make up to the volume of 50 ml distilled water and subjected to analyse the dissolved metal content.



(i) *Devario yuensis*



(ii) *Hypsibarbus myitkyinae*



(iii) *Poropuntius clavatus*



(iv) *Tor tor*

Table 1: Length-Weight of the collected fish species.

Species	Local name	Length (cm)	Weight (gm)
<i>Devario yuensis</i>	Ching-nga	6.5-7.0	2.37-3.43
<i>Hypsibarbus myitkyinae</i>	Heikak-nga	12.15-13.53	22.87-24.32
<i>Poropuntius clavatus</i>	Nung-nga	08.60-18.80	05.50-31.05
<i>Tor tor</i>	Ngara	23.00-39.00	125.00-785.00

3. RESULTS

Proximate composition of the above freshwater fish species found in natural environment of Manipur were analysed and the results were shown in Table 2. The moisture content among the fish species ranged from 71.56% (*Devario yuensis*) to 76.35% (*Tor tor*). The relative lipid content varied from one fish to another. *D. yuensis* recorded the highest lipid content of 6.33% and *Poropuntius clavatus* at 2.70%. Ash content ranges from as low as 3.30% in *D. yuensis* to a high of 7.75% in *P. clavatus*. The highest protein content among the four species was recorded in *T. tor* (26.24%) and lowest in *P. clavatus* (5.99%). Total amino acids were recorded among the fishes in the ranges of 229.5 mg/100g in *P. clavatus* to 720.75 mg/100g in *T. tor*.

Table 2: Proximate composition and Total amino acids of the fish species:

Species	Moisture %	Ash%	Protein % (WWB)	Lipid %	TAA (mg/100g)
<i>Devario yuensis</i>	71.56±3.83	3.38±0.10	21.00±0.00	6.33±0.17	457.00±0.50

<i>Hypsibarbus myitkyinae</i>	74.12±1.78	5.00±0.62	14.16±0.98	3.47±0.18	487.00±0.20
<i>Poropuntius clavatus</i>	75.80±0.20	7.75±0.20	5.99±0.05	2.70±0.28	229.5±0.00
<i>Tor tor</i>	76.35±0.04	5.6±0.14	26.24±0.62	4.60±0.71	720.75±1.30

The results are mean±S.D. of the samples taken in triplets.

The mineral content of the fishes studied were shown in the Table no. 3. It has been observed that the Ca was recorded highest in *H. myitkyinae* (279.15 mg/100g) and lowest in *T. tor* (32.78 mg/100g). Na and K were observed in the ranges from 850.00mg/100g (*D. yuensis*) to 1012.60 mg/100g (*T. tor*) and 475.00 mg/100g (*D. yuensis*) to 1323.50 mg/100g (*P. clavatus*) respectively. The highest Mg content in the fishes studied was found in *D. yuensis* (22.3 mg/100g) and lowest was found in *H. myitkyinae* (13.45 mg/100g). From the fishes studied Fe is the micro-element that abundantly present amount the fishes. Micro elements viz. Mn, Zn, Ni and Cu were also recorded abundantly in all the fishes. Highest Mn, Zn, Ni and Cu were recorded 8.65 mg/100g (*P. clavatus*), 24.30 mg/100g (*H. myitkyinae*), 4.08 mg/100g (*T. tor*) and 19.40 mg/100g (*P. clavatus*) respectively.

4. DISCUSSION

Proximate composition generally refers to the percentage composition of basic constituents such as water, protein, lipids and ash. Information concerning the chemical composition of freshwater fishes in general is valuable to nutritionists concerned with readily available sources of low-fat, high protein foods such as most freshwater fishes [20, 15, 9]. The measurement of some proximate profiles such as protein contents, lipids and moisture contents is often necessary to ensure that they meet the requirements of food regulations and commercial specifications.

Table 3: Essential mineral contents among the fish species

Elements (mg/100g)	<i>Devario yuensis</i>	<i>Hypsibarbus myitkyinae</i>	<i>Poropuntius clavatus</i>	<i>Tor tor</i>
Ca	259.5±0.12	279.15±1.17	210.45±0.68	32.78±0.54
Mg	22.3±0.30	13.45±0.39	14.85±0.40	16.30±0.22
Mn	5.4±0.19	6.52±0.15	8.65±0.16	4.48±0.06
Ni	14.8±0.10	24.30±0.19	9.40±0.13	15.75±0.39
Cu	1.68±0.13	2.70±0.17	1.90±0.60	4.08±0.15
Zn	9.3±0.10	2.97±0.15	19.90±0.18	2.30±0.22

Fe	409.65±0.15	311.55±0.06	193.58±0.17	212.30±0.46
Na	875.00±1.32	850.00±0.90	1012.00±1.60	1012.6±1.36
K	550.00±0.66	475.00±1.08	1323.50±1.78	747.25±2.82

The results are mean±S.D. of the samples taken in triplets.

The moisture content in the above studied freshwater fish species (71.56% in *Devario yuensis* to 76.35% in *Tor tor*) is comparable with the values as reported by Sarojnalini and Vishwanath [22]. They reported that moisture content was 71.00 to 80.00% in some fresh water fishes of Manipur. Relatively high protein to low protein was observed in the fish studied. The relatively high to moderate percentage of protein could be attributed to the fact that fishes are good sources of pure protein, but the differences observed in the present values might be due to the fishes' consumption or absorption capability and conversion potential of nutrients from their diet or local environment in to such biochemical attribute needed by the organisms body [6]. The lipid contents in the present study were found in the ranges of 2.70% in *P. clavatus* to 6.33% *D. yuensis* are also well comparable with the earlier reports in various cold water freshwater species worldwide as reported by Naeem and Salam, [16] which is shown in Table no. 4. As reported by Ackman [2], fishes were grouped into four categories according to their fat content, lean fish (< 2%), low fat (2 to 4 %), medium fat (4 to 8 %) and high fat (> 8%). Analysis of lipid content in the fishes shows low fat fish to high fat fish. The low lipid content of the fish could be due to poor storage and the use of fat reserves during the spawning activity [2]. The ash content in the present work is considerably high than those reported by Naeem and Salam [16]. Osibona *et al.*, [18], mentioned that high ash content in fish suggests the fish is a good source of minerals. And the total amino acid content is related with the increased or decreased in the availability of foods.

Table 4: Proximate composition values of various coldwater freshwater species worldwide*.

Species	Locat-ion	Water cont-ent (%)	Ash con-tent (%)	Protein conte-nt (%)	Fat cont-ent (%)
<i>Salmo trutta</i>	Norway	66.00-81.50	2.40-2.80	14.00-17.50	2.00-7.70
<i>Salmo garidneri</i>	Norway	NA	NA	12.60-19.10	1.50-12.80
<i>Cyprinus carpio</i>	Michigan	69.95	0.96	13.55	15.56
<i>Onchorhynchus nerka</i>	Pacific Ocean	NA	2.1-4.2	15.80-18.70	2.00-4.10
<i>Aristichthys nobilis</i>	Black Sea	73.86-84.54	2.65-5.52	9.43-16.54	0.18-6.37
<i>Lota lota</i>	Finland	64.5	1.4	16.2	9.4
<i>Salmo salar</i>	Canada	75.00-82.00	NA	13.00-17.00	NA

<i>Peprilus triacanthus</i>	NW Atlantic	80.40	1.45	NA	1.60
<i>Salvelinus fontinalis</i>	N America	74.30	1.30	21.50	3.40
<i>Oncorhynchus keta</i>	NE Pacific	74.10	1.18	21.30	3.86
<i>Pomatomus saltatrix</i>	Virginia	70.16	1.12	19.56	2.00

*Reference: Naeem and Salam, 2010.

The concentrations of several elements found among the fishes were significantly different. The highest concentrations of Fe and Mg were found in the *Devario yuensis* among the species studied ($p < 0.01$). The level of iron (Fe) among the fishes studied ranged from 193.58 ± 0.17 mg/100g (*Poropuntius clavatus*) to 409.65 ± 0.15 mg/100g (*D. yuensis*). Magnesium (Mg) is found in the ranged of 13.45 ± 0.39 mg/100g (*Hypsibarbus myitkyinae*) to 22.3 ± 0.30 mg/100g (*D. yuensis*). Mg is important for maintaining electrical potential in nerves and muscle membranes and its deficiency leads to neuromuscular dysfunction. Fish is a major source of Fe for adults and children and its deficiency causes Anemia. Daily requirement of Mg and Ca by an adult man is 340 mg and 17 mg respectively [17].

Sodium (Na), Potassium (K), Calcium (Ca) and Iron (Fe) were abundantly found in *Hypsibarbus myitkyinae*. The highest element found in *H. myitkyinae* is Na (850.00 ± 0.90 mg/100g) and the lowest element is Copper (2.70 ± 0.17 mg/100g). Sodium regulates the electrolyte and acid-alkali balances, the conductive capacity of the nerves, muscle contractions and the production of adrenaline and amino acids. A normal adult man required Na at an average of about 2092 mg/day whereas a normal adult man requires K at an amount of 3750 mg/day [17].

Highly content elements in *Poropuntius clavatus* are sodium (1012.00 ± 1.60 mg/100g) and potassium (1323.50 ± 1.78 mg/100g). The highest manganese (Mn) and zinc (Zn) content were recorded as 8.65 ± 0.16 mg/100g and 19.90 ± 0.18 mg/100g in *P. clavatus*. Daily intake of small amounts of Mn is needed for growth and good health in humans, otherwise deficiency of Mn can cause nervous system problems [7]. Zn is an essential element in human diet. The average Zn requirement by an adult man is 9.4 mg/day [17].

The highest copper (Cu) content among the fishes studied was recorded in *Tor tor* (4.08 ± 0.15 mg/100g). Deficiency signs of copper include anemia, vascular complications, osteoporosis and neurological manifestations. The average requirement of Cu in an adult man is about 2 mg/day [17].

The present work provides the proximate composition, total amino acids and essential mineral contents of the four fresh water fish species from two different districts of Manipur. Quantifying the proximate composition is very important to the nutritionists concerned with readily available sources of low-fat, high-protein foods such as most freshwater fishes.

Further work is on-going in our laboratory to investigate the other nutritional quality of the above studied cold water fresh fish species of Manipur.

5. ACKNOWLEDGMENT

The authors thank to the Head of the Department, Department of Life Sciences, Manipur University for providing laboratory facilities. They also greatly appreciate the colleagues of the Fishery Research Laboratory for giving cooperation during the entire work.

REFERENCES

- [1] Abdul Hei & Sarojnalini, Ch. Proximate composition, Macro & Micro elements of some smoke-dried hill stream fishes from Manipur, India. *Nature & Science*. 2012. 10(1) pp:59-65
- [2] Ackman, R.G. Nutritional composition of fats in seafoods. *Progress in Food and Nutritional Science*. 1989. 13 pp:161-241
- [3] AOAC. *Official Methods of Analysis*. Association of official Analytical Chemists, Washington D.C. 1990.
- [4] Andrew A.E. Fish processing technology. *University of Horin Press*, Nigeria. 2001. pp 7-8
- [5] Bhagowati, A.K., Ratha, B.K. Biochemical composition and nutritional value of three species of Hill stream Fish belonging to the Genus *Garra* from North Eastern India. *Proc. Indian natn. Sec. Acad-B48* No. 1. 1982. pp 67-72.
- [6] Burgess. GHO. Increasing the direct consumption of fish. In: Pirie WW (Edu). *Food Protein Sources*. *International Biological Program 4*. Cambridge University Press, Cambridge. 1975. pp: 187-200.
- [7] Demirezen, D and Uruc, K. Comparative study of trace elements in certain fish, meat and meat products. *Meat Science*. 2006. 74 pp:255-260.
- [8] FAO. Fish for Food & Development. 1991. pp: 1-49.
- [9] Foran JA, Carpenter DO, Hamilton MC, Knuth BA, Schwager SJ. 2005. Risk-based consumption advice for farmed Atlantic and wild pacific salmon contaminated with dioxins and dioxin-like compounds. *Environ. Health Persp*. 2005. 33 pp:552-556.
- [10] Gulzar, S. and Zuber, M. Determination of omega-3 Fatty Acid composition in Fresh Water Fish. *Int. J. Agric. Bio*. 2000. 2 pp:342-343.
- [11] Kosygin, L., Lilabati, H., Vishwanath, W. Proximate composition of commercially important Hill stream fishes of Manipur. *J. Fish*. 2000. 48(1): 111-114
- [12] Louka, N.F. Juhel, V. Fazilleau and P. Loonis (2004) A novel colorimetry analysis used to compare different drying fish process. *Food control*. 15:327-334.
- [13] Love, R.M. *The chemical Biology of Fishes*. Acad. Press, London. 1970. pp 547.
- [14] Moore, S. and Stein, W.H., In: *Method Enzymol* (Eds. Colowick, S.P. and Kalpana, N.D.), *Academic press*, New York, 3 pp:468.
- [15] Mozaffarian D, Lemaitre RN, Kuller LH, Burke GL, Tracy RP, Siscovick DS. Cardiac benefits of fish meal consumed. *Circulation*. 2003. 107 pp: 1372-1382.
- [16] Naeem M and Salam A. Proximate composition of freshwater bighead carp, *Aristichthys nobilis*, in relation to body size and condition factors from Islamabad, Pakistan. *African Journal of Biotechnology*. 2010. 9(50) pp:8687-8692.

-
- [17] National Institute of Nutrition. Nutrients requirement and recommended dietary allowances for India, *A Report of the Expert Group of the Indian Council of Medical Research*. Hyderabad, 2009.
- [18] Osibona, A. o., Kujemiju, K. and Akande, G. R. Proximate composition and fatty acids profile of the African catfish, *Clarias gariepinus*. *Acta SATECH*. 1(1): 2009. Pp:85-89.
- [19] Perkin Elmer, *Analytic methods for Atomic Absorbtion Spectroscopy*, The Perkin Elmer Inc. U.S.A. 1996.
- [20] Sadiku, S.O.E. & Oladimeji, A.A. Relationship of proximate composition of *Lates niloticus* (L), *Synodontis schall* RES. *Commun*. 1991. 3(1) pp:29-40.
- [21] Sarkar, T.V., Ananda, R., Mathew, S., Asha, K.K., Lakshmanan, P.T., Varkey, J., Aneesh, P. and Mohanty, B.P., Chemical composition and nutritional value of Anchovy (*Stolephorus commersonii*) caught from Kerela coast, India. *European journal of experimental biology*, 2013. 3(1) pp: 85-89
- [22] Sarojnalini, Ch. & Vishwanath, W. Studies on the biochemical composition of some fresh water fishes of Manipur. *J. Adv. Zoo*. 1988. 1. 9(1) pp:1-5.
- [23] Singh, M.B., Sarojnalini, Ch., and Vishwanath, W., Nutritional values of sundried *Esomus danricus* and smoked *Lepidocephalus guntea*, *Food Chemistry*, 1990, 36 pp:89-96.
- [24] Stansby, M.E. Proximate Composition of Fish. Fish in Nutrition. Ed by Erik Heen and Rudolf Erenzer. *Fishing News (Books) Ltd.*, Ludgate 110 Fleet Styreet, London, E.C.4, England. 1962.