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Nutritional Quality of Three Cobitid Fishes of Manipur, India: With Special Reference to Essential Mineral Elements

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Abstract: The study were carried out to determine the proximate composition and essential mineral elements of three Cobitid fish species of Manipur, India viz. *Lepidochephalichthys guntea*, *Pangio pangia* and *Syncrossus berdmorei*. Moisture (76.12±0.05 %) were significantly ($p<0.05$) higher in *Pangio pangia*. In *Syncrossus berdmorei*, significantly ($p<0.05$) higher protein (22.57±0.00 %) and lipid (12.93±0.66 %) were recorded. Whereas, ash (3.23±0.07 %) was significantly higher in *Lepidochephalichthys guntea*. Macro elements Ca, Mg, K and Na were abundantly found in all the fish studied and micro elements Mg, Ni Cu, Zn, and Fe were also found in adequate amount. Results from the analysis revealed that macro elements viz. Ca (2150±8.71 mg/100g) and Mg (131.7±2.05 mg/100g) and micro elements viz. Na (112.5±0.06 mg/100g), Ni (2.25±0.02 mg/100g), Cu (0.47±0.007 mg/100g) and Zn (3.05±0.014 mg/100g) were found significantly ($p<0.05$) higher in *Lepidochephalichthys guntea*. Whereas K (90.81±1.14 mg/100g) and Mn (1.26±0.01 mg/100g) were significantly ($p<0.05$) higher in *Syncrossus berdmorei* among the fishes studied. Fe content was recorded significantly ($p<0.05$) higher than other micro elements and found highest in *Syncrossus berdmorei* (28.61±0.10 mg/100g) amoung the fish studied. From the above analysis it has been reveal that all the fishes were good sources of protein, lipid, ash and mineral contents which can provide high nutritive value for human diet.

Key words: *Proximate, macro and micro elements, nutritive value, human diet.*

I. INTRODUCTION

Cobitid fishes are usually small, slender fishes which are more abundant and diverse in Southeast Asia. They are distinguished by the present of an erectile, moveable, bifid suborbital spine. Most species are elongated, some are somewhat flattened or at least have a flat belly which indicate a life on or in river bottom. Some are borrow into sand, mud and detritus. The species are mostly found in rivers, lakes or swamps, they feed on small animals in the bottom sediment [18].

The family Cobitids are amoung the Small Indigenous Fishes (SIS). Many SIS are less than 10 cm or 3.9 inches in length and they are consumed as a whole [29]. These fishes have short life cycle and can be grow in all types of inland water bodies. North East India owing to its topographical features provides an ideal habitat for various endemic small fishes. As many as 47 genus of small fishes are recorded from North East India out of this 40 genus are found in Manipur [37]. In Manipur, this small fishes are abundant in river, beels, streams, canals and ponds. Due to overfishing, destruction of their habitats and feeding ground, some of the small fishes are on the verge of extinction. So, there is an urgent need for the conservation and proper management to increase the productivity of these small fishes.

Small Indigenous Fishes are consuming as a whole which provide an excellent source of micronutrients. Whole small fish with bones are an extremely Ca rich food [33] and in some species, vitamin A is richly accumulated around their eyes and viscera [24]. Many of the elements are taking part in various metabolic processes and are known to be indispensible to all living things. Among the elements the most important mineral elements are Ca, Na, P, Fe, K, Cl and many are also needed in trace amount. The deficiency of these important nutritional minerals induces many malfunction as it reduce productivity and causes diseases such as inability of blood clot, osteoporosis, anaemia, etc. Roos *et al*., 2007 [23] have reported that vitamin A, calcium, iron and zinc are abundantly present in commonly consumed small fishes of Bangladesh. In Bangladesh small fishes play a pivotal role as rich sources of vitamin A and to combat vitamin A deficiency among the children [29]. In addition to the nutritional values, it is crucial to say that Small

Indigenous Fishes plays a vital role in life and economy of vast majority of the fisherman community and poor rural. It is well accepted throughout the world that fish are the good source of protein and other important mineral elements for the maintenance of healthy body [1]. Compare to other source of protein, fish protein are known for the excellent source of protein from their amino acid composition and protein digestibility [22].

In Manipur, any types of big or small fishes are consumed in fresh or process form. Small cobitid fishes viz *Syncrossus berdmorei* and *Lipidocephalus irrorata* endemic in this area are highly esteemed among the people and also provide essential nutrients among the peoples of Manipur [4]. The measurement of proximate profiles such as moisture, lipid, protein content, ash content, etc is often necessary to ensure that they meet the dietary requirements and commercial specification [13]. So, the aim of the current study was to investigate proximate composition, macro and micro elements of Small Indigenous Fishes of Manipur as an extension to the previous worker on this field and to provide knowledge of nutritional value prior to human consumption.

Rest of the paper is organized as follows, Section I contains the introduction, Section II elaborate the related work of nutritional aspects of fishes of various countries around the world, section III explain the various methodology of different nutritional aspects of the fishes studied and statistical analysis, Section IV describes results and discussion on various nutritional qualities that has reveal after the analysis of the fishes studied and Section V concludes research work with future directions).

II. RELATED WORK

There are some reports on the biochemical composition and nutritional qualities of small fishes. Some of the related work done by various worker are Sakuntala *et al*., 1997 [29] studied on the role of Small Indigenous Fish species in food and nutrition security in Bangladesh, Larsen *et al*., 2000 [33] has reported on small fishes as a rich sources of calcium, Roos *et al*., 2007 [23] have describe about the role of fish in food based strategies to combat Vitamin A and mineral Deficiencies in Developing countries, Saronalini 2010 [4] have reported on Nutritive value of two indigenous Cobitid fishes of Manipur, Abdul and Sarojnalini 2012 [11] have done on the nutrition aspects of Fresh and Smoked dried hill stream fishes of Manipur. C. Sarojnalini and W. Sarjubala, 2014 [5] have reported on various nutritional aspects of fresh and cooked small indigenous fishes of Manipur.

III. MATERIAL AND METHOD

Sample collection:

Cobitid fishes viz *Lepidochephalichthys guntea* (Halminton, 1822), *Pangio pangia* (Halminton, 1822) and *Syncrossus berdmorei* (Blyth, 1860) of Manipur were collected and shown in fig 1 to 3. Respective collecting sites and total length-weight were shown in Table 1 and Fig 4 respectively. The collected fish sample consists of six samples each was brought in fresh with proper care in cold chain to Fishery laboratory, Department of Life Science, Manipur University and washes immediately in running tap water and fishes are taken as a whole for undergoing various analyses.

***Fig 1**: Lepidochephalichthys guntea*

***Fig 2**: Pangio pangia*

***Fig 3**: Syncrossus berdmorei*

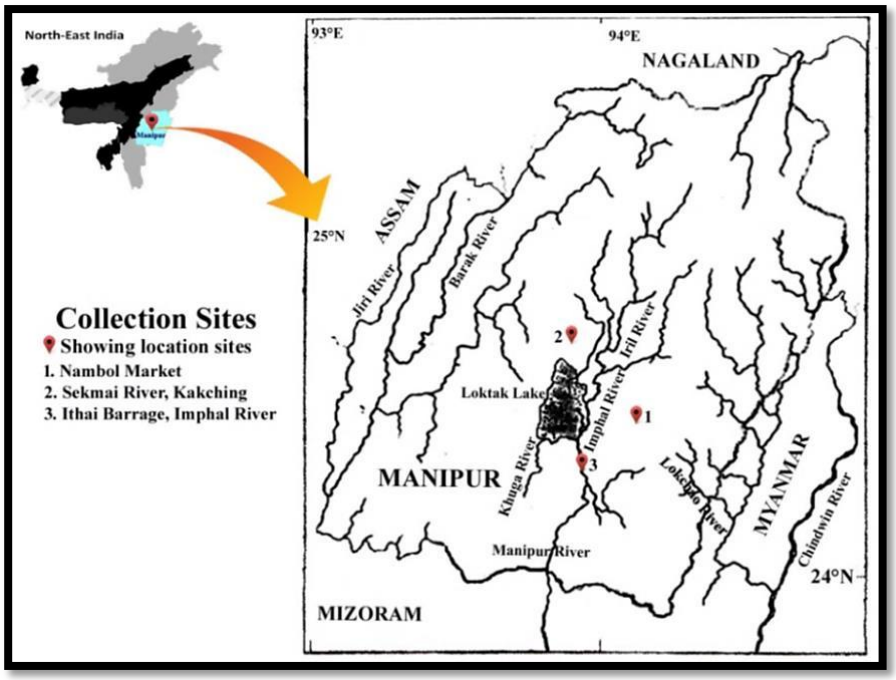

***Fig 4**: Map showing the collection sites of the fish samples*

Table 1: The respective collection sites and length- weight of five Small Indigenous Fishes of Manipur.

Species	Local name	Collection site	GPS Location	Total Lengtl (cm)	Weight (gm	IUCN Red list Status
Lepidochephalichthys guntea	Ngakijou	Nambol Market	24˚43'01.49'' N 94˚50'09.88''E	7.93±0.31	3.12±0.32	Least concern
Pangio pangia	Nganap	Nambol Market	24˚43'01.49'' N 94˚50'09.88''E	6.90±0.15	1.42±0.06	Least concern
Syncrossus berdmorei	Sareng-Khoibi	Sekmai River, Kakching Imphal River, Ithai Barrage	24˚28'05.79'' N 94˚59'44.54''E 24˚25'31.43'' N 94˚50'16.87''E	13.76±0.14	17.92±0.61	Near threatened

Values are mean of three replicate.

Proximate composition:

Moisture content was determined by hot air oven method [2] at 60˚C till a constant weight is obtained. The loss in weight was express in percentage in wet weight of the sample. Total Nitrogen content was determined by modified micro- Kjeldahl method [2]. The sample were subjected to digestion, Nesslerization and finally measured by using UV-1800 UV-Spectrophotometer, Shimadzu. Total protein value was obtained by multiplying the total nitrogen value with 6.25. Total lipid was also extracted by following the modified method of Singh et al, 1990 [16] by extraction with chloroform and methanol in the ratio of 2:1. For the determination of ash content, moisture free sample was ignited at 550˚C in a muffle furnace for about 2-3 hours to obtained carbon free white ash as described by AOAC, 2002 [2].

Mineral analysis:

Samples for mineral analysis were prepared according to recommendations of Perkin Elmer's, 1996 [26]. 2 gm. of mince fish sample was taken and dried at 135ºC for 2 hours and weighed. It was heated up to 500-550ºC in a muffle furnace and obtained carbon free ash. It was added 2 ml H_2NO_3 and evaporated to dryness. 10 ml H_2NO_3 was added and dissolved ash by heating continuously on a hot plate. It was transferred to a volumetric flask (50ml) and added HCl as necessary and

diluted to volume with deionized distilled water (Millipore). All care was taken for cleanliness and non-contamination.

Atomic absorption spectrometer analysis:

Analysis of mineral elements Ca, Mg, Na, K, Mn, Ni, Cu, Zn and Fe were done by Atomic Absorption Spectrometer 203 following the methods of Perkin-Elmer (1996) [26]. Most of the mineral elements Na, K, Ca etc. were done with hollow cathode lamps (HCL). Na and K were analyzed through Flame Photometer – 121,122,125.

Statistical analysis:

The data were subjected to one way-ANOVA and the significant mean were compared by Duncan's multiple range tests ($P<0.05$). Relationship between proximate composition and length-weight and essential mineral elements and length-weight were identified using Pearson's correlation coefficients. Differences and correlations were considered significance when $p<0.05$ and $p<0.01$ were obtained. Species were grouped and classified in a cluster by their similarities produce in the data. The linkage in dendrogram shows the order of dissimilarities designated as a distance index [35]. All the statistical analyses were performed using SPSS version 16.0.

IV. RESULT AND DISCUSSION:

Proximate Composition and Macro and Micro elements of the three Cobitid Small Indigenous Fishes of Manipur namely *Lepidochephalichthys guntea*, *Pangio pangia* and *Syncrossus berdmorei* are shown in Fig. 5 and Table 3.

Proximate analysis

Results obtained from various analysis show that highest moisture content was found in *P. pangia* (76.12±0.50%) which were followed by *L. guntea* (71.21±1.08 %) and lowest in *S. berdmorei* (65.63±2.08 %). The lower in the lipid content might be due to high lipid content in the fish [36]. The moisture ranging from 65.63±2.08 % to 76.12±0.50 %, which shows significance different ($p<0.05$) among the fishes, showing that percentage moisture content of all the fishes were under the acceptable level (50-80 %) [25].The knowledge of moisture content of food stuffs serves as a useful index of their keeping qualities and susceptibility to fungi infection [28].

Relatively higher protein to moderate level of protein content was shown in fishes studied. The highest protein content was found in *S. berdmorei* (22.57±0.005 %) and lowest was found in *P. pangia* (10.79±0.40 %). Fishes are the good sources of protein, but the differences observed might be owing to low potential of consumption or absorption capability and conversion potential of essential nutrients from their diet or local environment into a biochemical attributes needed by the fishes [31].

Lipids are highly efficient sources of energy and they contain more than twice the energy of carbohydrate and protein [19]. They serve as source of energy during starvation. In present study mean lipid content varies from 4.20±0.20 % to 12.93±0.66 % and shows a significance difference between the species ($p<0.05$). Highest lipid content was found in *S. bermorei* (12.93±0.66 %) and the lowest was found in *L. guntea* (4.20±0.20 %). According to Ackman, 1989, [27] 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%). High lipid fishes have less water and more protein than low lipid fishes [36]. The low lipid content of the fish might be due to poor storage and the use of fat reserves during the spawning activity. The highest ash content was recorded in *L. guntea* (3.23±0.07 mg/100g) and lowest in *P. pangia* (1.57±0.06 %) which shows significance difference ($p < 0.05$) between the species. Amount of ash content delineate the mineral content in food items. The observed ranges of the ash in all fishes indicate that they are good sources of mineral like potassium, calcium, manganese, magnesium, iron, zinc, etc. Higher content of ash may be due to higher bony consistency and highly scaly nature [6].

As reported by Deka *et al.,* 2012 [3] variation in proximate composition of fish flesh may vary with species variation, season, age and quality of food. Besides this some physiological reasons and change in environmental condition might also greatly affect the proximate composition in fishes.

The relationship of moisture, protein, lipid and ash were stratified by total length and weight of the fishes (Table 2). From the analysis it was revealed that moisture content was negatively correlated with total length (-0.959), weight (-0.944), protein (-0.994), lipid (-0.697) and ash (-0.234). Whereas, protein content shows positive correlated with total length (.984), weight (0.974), lipid (0.770) and ash (0.128) except moisture (-0.994). Moreover lipid content was positively correlated with total length (0.873), weight (0.894), protein (0.70) but negatively correlated with moisture (-0.697) and ash (-0.534). However ash content was positively correlated with protein (0.128) only. Furthermore the correlation coefficient (r^2) of moisture, protein, lipid and ash with total length are -0.959, 0.984, 0.873, and -0.053 respectively. Whereas correlation coefficient (r^2) of moisture, protein, lipid and ash with weight were -0.944, 0.974, 0.894 and -0.098 respectively. From this analysis it can be revealed that larger the total length and weight, higher concentration of protein and lipid will be accumulated in the fishes. The cluster analysis dendrogram of proximate composition was depicted in Fig 6 which illustrate that *L. guntea* shows good similarities with *P. pangio*. Whereas *S. berdmorei* shows no similarities with other fishes studied

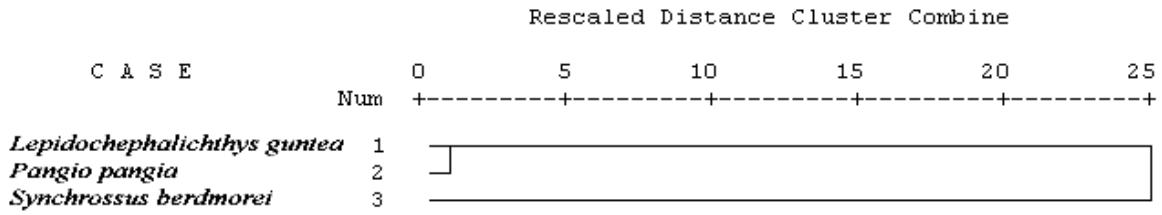

***Fig 6**: Dendrogram of Cobitids fishes using Ward's method with respect to proximate composition*

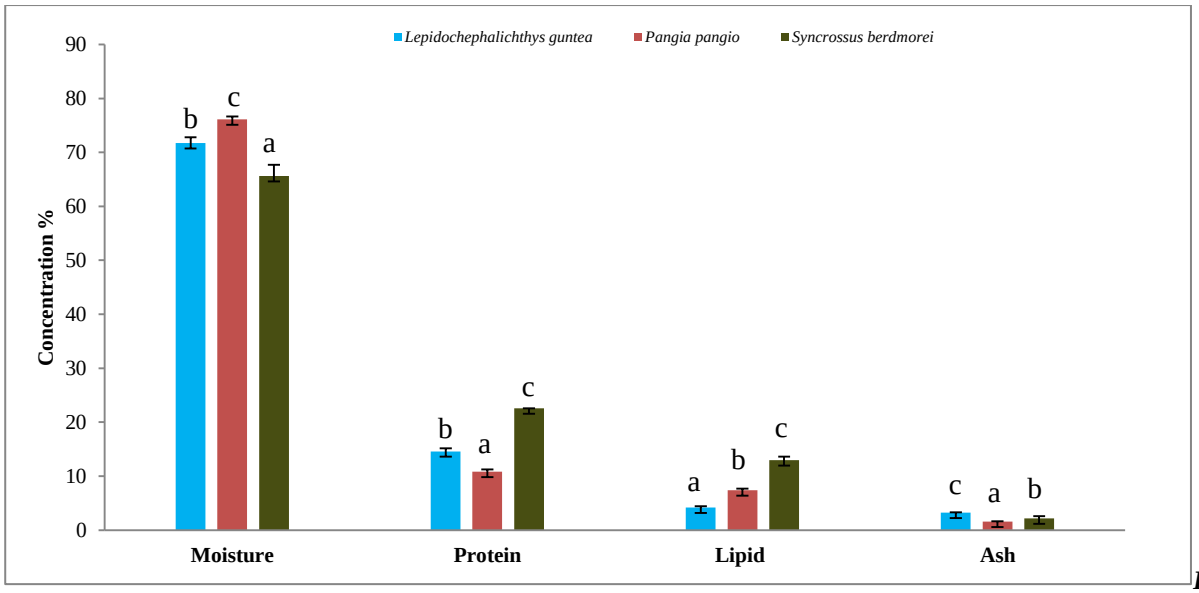

***Fig 5**: Proximate composition of three Cobitid fishes of Manipur. Means with different superscript shows on the bars are the significant difference by Dancan's multiple range test ($p<0.05$).*

Table 2: Pearson's correlation between proximate composition and total length-weight

	Total length	Weight	Moisture	Protein	Lipid	Ash
Total length	1					
Weight	0.999	1				
Moisture	-0.959	-0.944	1			
Protein	0.984	0.974	-0.994	1		
Lipid	0.873	0.894	-0.697	0.770	1	
Ash	-0.053	-0.098	-0.234	0.128	-0.534	1

*Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

Minerals analysis

The concentration of the studied minerals viz. macro elements (K, Na, Ca, Mg) and micro elements (Fe, Ni, Zn, Mn, Cu) in three Cobitids fishes were shown in Table 3. A different concentration of minerals was detected and the concentration of macro and micro element in decreasing order as follows; Ca>K>Mg>Na and Fe>Zn>Ni>Mn>Cu respectively. The comparison of three fishes by Duncan's One way ANOVA revealed that there were significantly different ($p<0.05$) concentration in all the elements. Bhouri *et al.* (2010) reported in decreasing order of K>Na> Mg>Ca>Zn>Fe>Mn>Cu in muscle of wild Sea bass. The similar observation was shown by Abdul *et al.* (2012) in smoke dried Hill Stream Fishes of Manipur. Many researchers did not observed any definite order in magnitude of the elements. This variation in concentration of elements is due to the chemical forms of the elements and their concentration in the local environment [12].

The content of K and Na in all the fishes studied ranges from 87.33±0.29 mg/100g to 90.81±1.14 mg/100g and

45.0±0.20 mg/100g to 112.5±0.06 mg/100g respectively. Highest K and Na content were found in *S. berdmorei* and *L. guntea* respectively. The result of K was within the ranges and Na was lower than the previous report on the study of *Puntius sophore* of eastern Himalayas [5], they found that the content of K and Na is 82.24±0.10 mg/100g and 208±0.14 mg/100g respectively. The intake of K in both adult and children have an specific outcome in the maintenance of normal regulation of blood pressure, cardiovascular disease, coronary heart disease, stroke, renal function, blood lipid level, catecholamine level and potential adverse effect [34]. Moreover it also regulates the normal functioning of the nerves and muscles, the sugar metabolism, acid base balance and oxygen metabolism in the brain. Sodium regulates the electrolyte and acid-alkali balances, the conductive capacity of the nerves, muscle contractions and the production of adrenaline and amino acids. RDA of K and Na intake as safe and adequate are 1875-5625 mg/day and 1100-3300 mg/day respectively [21].

Concentration of Ca in all the fishes studied shows significantly difference ($p<0.05$) among the species. Highest Ca content was found in *L. guntea* (2150.0±8.71 mg/100g). This report show higher concentration than the previous report on micronutrient content of fish species in Bangladesh [23], on their report they found the content of Ca in Small Indigenous Fishes in the range of 199 mg/100g to 1061 mg/100g. Higher concentration of Ca might be due to the presence of the scales and bony nature of the fishes. Fish bone is rich in Ca but as fish bone is not necessarily eaten, the amount of bone discarded as plate waste must be adjusted for Ca content in edible part. However, in this fishes, higher concentration of Ca is due to the analysis of fishes as a whole. The amount of Ca content in Small fishes has higher value then the milk and the Ca in fish bone has the same bioavailability of milk [33]. Thus consumption of small fishes as a whole plays an important role as source of Ca. For the positive Ca balance RDA of Ca intake in the adult should be in the ranges of 500-600 mg/day [21].

Mg is needed for bone, protein, and fatty acid formation, formation of new cells, vitamin B activation, muscle relaxation, blood clot formation, and energy metabolism [32]. Aquatic food products, like other animal products, are poor sources of Mg. Mg concentration of fish species varies from 73.5±0.9 mg/100g to 131.7±2.05 mg/100g having a significantly difference ($p<0.05$) among the fishes. The concentration of Mg in *L. guntea* shows highest value among the species. Similar results were recorded in some hill stream fishes [10] as in the ranges of 82.00mg/100g to 131.20 mg/100g. The RDA for Mg in adult is 540 to 1000 mg/day [21].

The highest Fe (28.61±0.10 mg/100g) content was found in *S. berdmorei* and the lowest concentration was recorded in *L guntea* (13.55±0.26 mg/100g). In previous literature the Fe content have been reported in the ranges of 3.77 mg/100g to 8.57 mg/100g in fresh hill stream fishes of Manipur [10]. However, in small fishes of Bangladesh and Combodia the concentration of Fe is recorded in the ranges of 1.8±0.7 mg/100g to 12.0mg/100g and 0.7±0.1 mg/100g to 11.3±3.4 mg/100g respectively [23]. In the present study the concentration of Fe is higher than that of the concentration reported by previous workers. This might be due to the availability of the Fe in local environment, diet, absorption capability and their preferential accumulation. Adequate Fe in the diet is very important for decreasing the incident of anaemia which is considered a major health problem especially in young children. Anaemia is also related to delayed cognitive development and intellectual impairment in children, reduces work capacity, risk of maternal mortality, as well as altered immune function [8]. The RDA for Fe of adult men in India is 5-35 mg/day [21].

The maximum and minimum Cu content were 0.47±0.007 mg/100g and 0.22±0.01 mg/100g in *L. guntea* and *S. berdmorei* respectively. Abdul 2013 [10] has reported that the concentration of Cu in hill stream fishes is in the range of 0.299 mg/100g to 1.50 mg/100g. Intake of Cu is essential for good health, however high intake of Cu may cause health problem such as liver and kidney damage and the deficiency of Cu may lead to various complicated diseases like anaemia, vascular complication, osteoporosis and neurological manifestation [21]. FAO/WHO, 1999 [9] has set a limit for heavy metal base on body weight of an average adult (60 Kg body weight), the provisional tolerable daily intake (PTDI) for Pb, Fe, Cu and Zn are 214 µg, 48 mg, 3 mg and 60 mg respectively. The concentration of Cu content in fish samples shows within the range of limit intake [9]. The RDA for Cu intake of adult men in India is 2 mg/day [21].

Deficiency of Zn manifest with symptom like growth failure, depress immunity, anorexia, diarrhea, altered skeleton function and reproductive failure [21]. Adequate intake of Zn has been found necessary to reduce childhood illness, enhance physical and decrease mobility, mortality in poor children [17] and also involved in most metabolic pathways in plants, animal and human. The concentration of Zn in all the fishes ranges from 1.40±0.01 mg/100g to 3.05±0.014 mg/100g. Abdul (2013) [10] has reported in fresh hill stream fishes of Manipur in the ranges of 1.23 mg/100g to 3.850 mg/100g. The RDA for Zn of adult Indian was 12 mg/day [21].

The highest concentration of Mn and Ni in the fishes studied were 1.26±0.01 mg/100g in *S. berdmorei* and 3.05±0.01 mg/100g in *L. guntea* respectively. The results obtained were within the ranges of the concentration in hill stream fishes of Manipur [10]. The daily intake of Mn is needed for the growth of bone and good health in human, deficiency of Mn lead to problem of nervous system [7]. It

also activates numerous enzyme including oxidoreductases, lyases, ligases, hydrolases, kinases, decarboxylases, and transferases. Ni aid in prolactin production thus involved in human breast milk production. It also helps in ions absorption as well as adrenaline and glucose metabolism, hormone, lipid, cell membrane, improves bone strength and may also play a role in production of RBC. However, occupational exposure to Ni may cause adverse health affect such as skin allergies, lung cancer and fibrosis [14]. The RDA of Mn is 2.5 mg/day [21] and RDA of Ni for proper balance is 1 mg/day [20].

Relationship between essential mineral elements and total length-weight of these fishes were presented in Table 4.In these analyses, it is revealed that total length is positively correlated with Fe (0.813) which is followed by Mn (0.692) and K (0.688) respectively. These same elements were also positively correlated with weight of the fishes. However Ca, Mg, Na, Ni, Cu and Zn were negatively correlated with total length (-0.502, -0.324, -0.091, -0.553, -0.612 and -0.470) and weight (-0.541, -0.367, -0.137, -0.591, -0.648 and -0.510) of the small fishes suggesting that higher total length and weight may accumulates lower concentration of Ca, Mg, Na, Ni Cu and Zn. The cluster analysis dendrogram with respect to mineral elements was shown in Fig 7 which illustrates that *P. pangio* shows good similarities with *S. berdmorei*. Whereas *L. guntea* shows no similarities with other fishes studied.

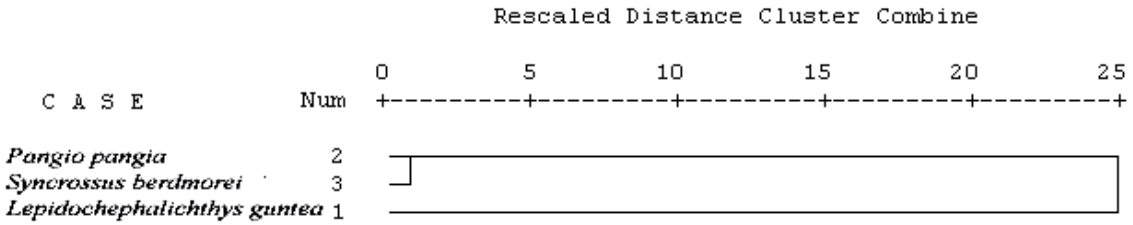

***Fig 7**: Dendrogram of Cobitids fishes using Ward's method with respect to Mineral elements*

Table 3: Composition of the macro and micro element of three Small Indigenous Fishes

	Nutrient content mg/100g			
	Lepidochephalichthys guntea	***Pangio pangia***	***Syncrossus berdmorei***	***RDA (mg/100g)***
Macro elements				
Calcium (Ca)	2150.0±8.71^{c}	905.0±3.12^{b}	680.33±2.28^{a}	500-600†
Magnesium (Mg)	131.7±2.05^{c}	73.5±0.66^{a}	77.0±0.66^{b}	30-340†
Sodium (Na)	112.5±0.06^{c}	45.0±0.20^{a}	64.99±0.08^{d}	1100-3300†
Potassium (K)	87.33±0.29^{b}	57.5±0.15^{a}	90.81±1.41^{c}	1875-5625†
Micro elements				
Manganese (Mn)	1.15±0.005^{b}	0.27±0.009^{a}	1.26±0.01^{c}	2-5†
Nickel (Ni)	2.25±0.029^{c}	1.84±0.01^{a}	1.73±0.02^{b}	1.0*
Copper (Cu)	0.47±0.007^{c}	0.29±0.02^{b}	0.22±0.01^{a}	2†
Zinc (Zn)	3.05±0.014^{c}	1.59±0.011^{b}	1.40±0.01^{a}	12†
Iron (Fe)	13.55±0.26^{a}	20.53±0.03^{b}	28.61±0.10^{c}	5-35†

Values are mean of three replicate.
Mean (±SD) followed the same latter are not significantly different ($P \leq 0.05$).
†National Institute of Nutrition
****DRI: National Institute of Health, USA.***

Table 5: Pearson's correlation between essential mineral elements and total length-weight

	Total length	Weight	Ca	Mg	Na	K	Mn	Ni	Cu	Zn	Fe
Total length	1										
Weight	0.999*	1									
Ca	-0.502	-0.541	1								
Mg	-0.324	-0.367	0.981	1							
Na	-0.091	-0.137	0.907	0.972	1						
K	0.688	0.654	0.282	0.464	0.660	1					
Mn	0.692	0.659	0.276	0.458	0.655	1.0*	1				
Ni	-0.553	-0.591	0.998*	0.967	0.880	0.224	0.218	1			
Cu	-0.612	-0.648	0.991	0.947	0.843	0.147	0.147	0.97*	1		
Zn	-0.470	-0.510	0.999*	0.987	0.922	0.311	0.311	0.995	0.986	1	
Fe	0.813	0.839	-0.912	-0.814	-0.654	0.143	0.143	-0.935	-0.958	-0.896	1

*Correlation is significant at the 0.05 level (2 tailed)

** Correlation is significant at the 0.01 level (2 tailed)

V. CONCLUSION AND FUTURE SCOPE:

From the above analysis, it can be conclude that Cobitid Fishes are good sources of protein, lipid and minerals (Ca, Mg, Na, K, Mn, Ni and Zn). Fish protein is known to be best animal protein source with high digestibility and good protein efficiency ratio. Fish lipid provide enormous amount of PUFA and MUFA especially Decosahexaenoic acid, Linoleic acid etc. which contribute to various health related benefit like lowering the risk of heart attack and stroke, developing eye and grey matter of brain and so on. They are also good sources of essential mineral elements which can combat various diseases like osteoporosis, night blindness, scurvy, hormone metabolism etc. This small fishes are consumed as a whole, thus can receive all the important nutrients which are benefit to maintain the heath, growth and development. It also provides the knowledge about the importance of Small Indigenous Fishes for their high nutritive value and good food for monitoring mineral deficiencies, so consumption of Small Indigenous Fishes should be encouraged.

Moreover further action is needed for conservation of small fishes. Many small fishes are in the verge of extinction due to ignorance of their nutritive value, destruction of habitat and feeding ground. Thus it required specific policy by the government and various research programmes and other related agencies to co-ordinate their effort for the conservation of these fishes. These small fishes are highly nutritious so, further research is highly needed to propagate these fishes to make easily available to the people.

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