Effect of Cooking on the Proximate and Mineral Elements of Small Indigenous Freshwater Fish Species of the Eastern Himalayas

Ch. Sarojnalini[1] and W Sarjubala Devi[2]

[1,2]Centre of Advanced Study in Life Sciences Manipur University, Canchipur-795003
E-mail: [1]sarojnalinich@gmail.com; [2]wsarjubala@yahoo.com

Abstract—*Effects of cooking methods (steaming, frying and currying) on the mineral content of two small indigenous freshwater fishes of the Eastern Himalayas were evaluated. The protein, lipid and ash content were increased from their raw samples. The Cu, Zn, Ca, Mn, K and Na were found higher in Puntiussophore and Fe, Co, Cr and Mg were found higher in Esomus danricus. The highest Zn, Ni, Co and Na content are found in the fried E. danricus. The mineral nutrient found in these small fishes is very much necessary to enhance poor people's accessibility to locally found and preferred fish so as to maintain the micronutrient intake of the population.*

Keywords*: Eastern Himalayas, small indigenous freshwater fishes, cooking effects, mineral content*

1. INTRODUCTION

Small indigenous fish species are valuable source of macro and micro nutrients and play an important role to provide essential nutrients.The study ofmineral elements present in living organisms is of biological importance. Many of such elements take part in some metabolic processes and are known to be indispensable to all living things (Shul'man, 1974). The body usually contains small amounts of these minerals, some of which are essential nutrients, being components of many enzyme system and metabolic activities. The most important mineral salts are that of Ca, Na, K, P, Fe, Cl while many others are also needed in trace amounts. The deficiency in these principal nutritional mineral elements induces a lot of malfunctioning (Shul'man, 1974).

However, there is no report so far on cooking effects on biochemical composition of fish which is used in our daily life, except some reports of Sarojnalini and Sarjubala, 2013; Sarjubala and Sarojnalini, 2012; Sarjubala and Sarojnalini, 2014;Sarojnalini and Sarjubala, 2014. The aim of the present study was to evaluate the cooking effect on minerals content of the two small indigenous freshwater fishes viz.,*Esomusdanricus* and *Puntiussophore*of the Eastern Himalayas.

2. MATERIALS AND METHODS

Description of the Eastern Himalayas (sample collection site)

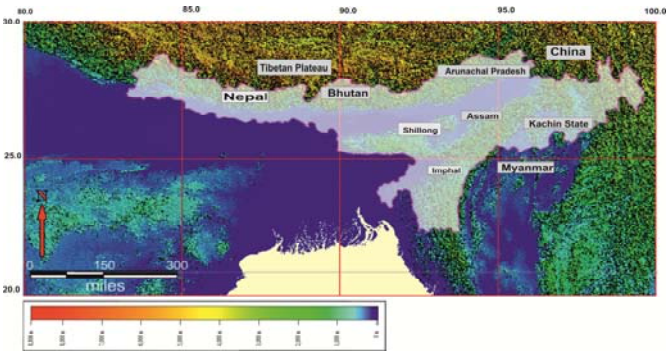

Fig. 1: Map of Eastern Himalayas showing study site

The Eastern Himalayan region (EHR) refers to the region lying between 88°5′ E and 97°5′ E longitude and 26°40′ N to 29°30′ N latitude, covering a total area of 5,24190 square kilometres. The region extends from the Kaligandaki Valley in central Nepal to northwest Yunnan in China, also encompassing Bhutan, the Northeastern states and North Bengal hills in India, South eastern Tibet, and parts of Northern Myanmar. The region spans a wide spectrum of ecological zones and contains parts of three global biodiversity hotspots. The five countries traversed by the Eastern Himalayas (Bhutan, China, India, Myanmar and Nepal) have very different geo-political and socioeconomic systems, and contain diverse cultures and ethnic groups.

Sample collection

A good number of fresh*Esomusdanricus*and*Puntiussophore* was collected from Manipur, Assam and Myanmar region and other different markets of the Eastern Himalayas region (EHR). The vegetables like *Alocasia indica*, tomato and pea were purchased from Imphal market and brought to the

Fishery Research Laboratory of Life Sciences Department, Manipur University.

Sample preparation and cooking

The fresh fisheswere washed with tape water and blotted dry. The vegetables (*Alocasia indica*, tomato, pea, coriander leaf) were washed and chopped for fish curry preparation.

1kg of fish was divided into four equal lots, each lot equivalent to 250g. The first group was uncooked and used as control and the other three groups were cooked in the following methods i.e. steaming, frying and currying.

Steaming methods

250g of fish was taken in a clean container for steaming process. Steaming was done in a pressure cooker (Hawkins).

Frying methods

Another 250g of fish was fried in a pan at temperature 180^0C for 4minutes. Soyabean oil was used for pan-frying.

Currying methods

For fish currying the fried fish was cooked with chopped vegetables for 35minutes. After cooking the fishes were taken out for various analyses.

Fishes in each group were homogenized separately using a mortar and pestle and analyzed to determine the nutritive quality of these fishes. All assays were conducted on triplicate samples of the homogenates.

Determination of Proximate Composition

Moisture: Moisture content was determined by hot air oven method (AOAC, 1980) at 60^0C till a constant weight was obtained. The loss in weight was expressed as percentage in wet weight of the sample.

Total protein: Total nitrogen content was estimated by the modified method of (AOAC, 1980). The samples were subjected to digestion, followed by Nesslerization and finally measured by using spectrophotometer. Total protein values were obtained by multiplying the nitrogen value with 6.25.

Total lipid: Total lipid content was determined as per the modified method of Singh et al., 1990 by using with chloroform and methanol in the ratio of 2:1.

Ash: For determination of ash content, moisture free sample was ignited at 550^0C in a muffle furnace for about 2-3 hours to obtain carbon free white ash as described by AOAC (1980).

Analysis of mineral content

Mineral Analysis was done following the method of AOAC 1995. 2gm powdered fish sample of each sample was taken and dried at 135°C for 2 hours and weighed. It was heated up to 500-550°C in a muffle furnace for 2 hours to get the inorganic residue (ash) and cooled to room temperature and added 2 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 Millipore distilled water. Sample of each species were subjected to an atomic absorption spectrometric analysis. Analysis of minerals Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), Manganese (Mn), Copper (Cu), Cobalt (Co), Nickel (Ni), Chromium (Cr), Zinc (Zn) and Iron (Fe) were done by analyst version, 06, Perkin Elmer, Inca; Atomic Spectrometer (USA) following the method of Perkin Elmer. Na, K and Ca were done with hollow Cathode lamp (HCL). Acetylene was used as fuel in the determination of elements with hollow cathode lamps.

Statistical analysis

The data were analysed using one-way analysis of variance (ANOVA) and the significant differences between means of experiments were determined by post hoc Duncan's multiple range test. A significance level of 0.05 was chosen. Data were analysed using SPSS package (Version 17.0). Differences were considered significant at $P<0.05$ (Sokal and Rohlf, 1974).

3. RESULTS AND DISCUSSION

The proximate composition of raw, steamed, fried and curried samples were shown in Fig. 2 and 3. The protein content was 14.95±0.10% and 20.50±0.08% in raw*Esomusdanricus* and *Puntiussophore*. The protein content of steamed fishes was found higher than the raw fishes.The lipid content was decreased significantly ($p<0.05$) in all the steamed fishes. The lipids were increased significantly ($p<0.05$) from the raw and steamed fishes. The highest lipid content was found in fried *Esomus danricus.*

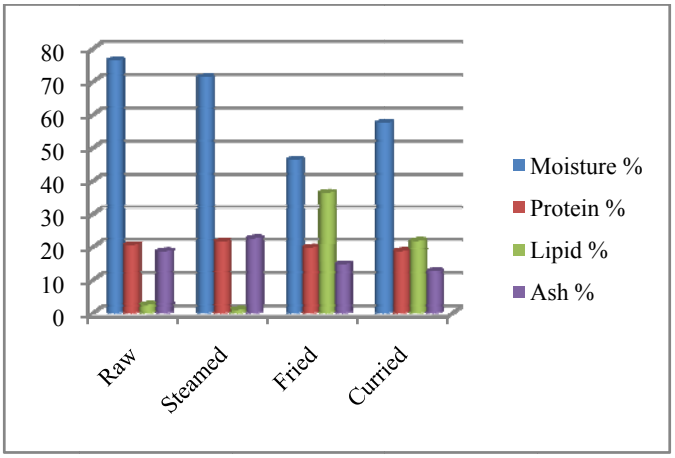

Fig. 2: Proximate composition raw and cooked *Puntiussophore*

The ash content was also increased significantly ($p<0.05$) in all the steamed fishes. The ash content was increased significantly ($p<0.05$) from raw and between the fried fish the highest ash content was found in *Puntiussophore.*

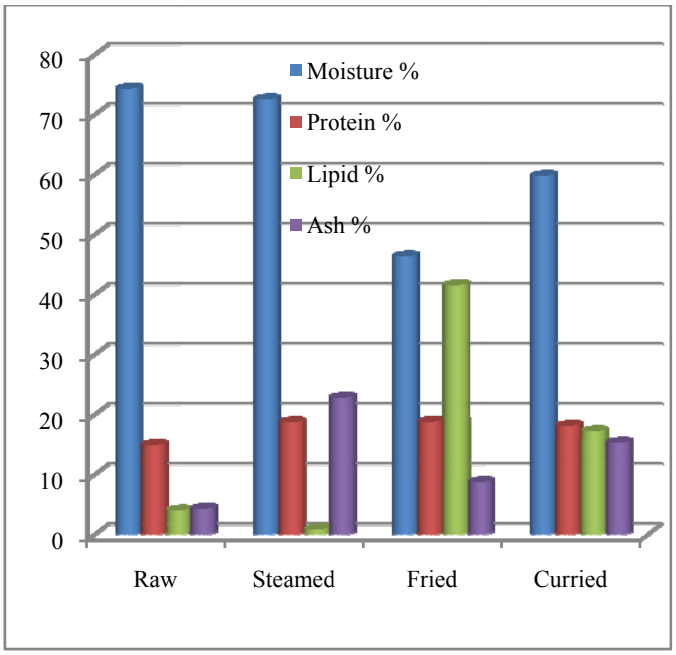

Fig. 3: Proximate composition of aw and cooked *Esomus danricus*

The eleven mineral elements were detected in the two fresh fishes. The highest Fe content was recorded in raw *Esomus danricus*. Similar values of Cr were found in both the fishes and the lowest Zn was obtained in raw *Puntiussophore.* The variation in the concentration of the mineral elements in these fish samples might be due the different chemical forms and their concentration in the aquatic ecosystem.

The **Ca** content was found highest significantly ($p<0.05$) in raw *Esomusdanricus* (947±0.06mg/100g), steamed *Puntiussophore* (1356±0.00mg/100g), fried *Puntiussophore*(1051±0.18mg/100g), curried *Puntiussophore* (930±0.00mg/100g). The **Ca** was foundhigher in these two small indigenous fishes (Table.1 and 2) than BlackbandedTravelly (61.00mg/100g), Europian eel (36.80mg/100g), Spangled Emperor (52.00mg/100g) and rainbow trout (14.70mg/100g). This might be due to use of whole body as well as scaly and bony nature of the small fishes at the same time loss of moisture during frying. The recommended Dietary Allowance (RDA) for adults is 1,000 mg.

The value of **Mg** content was higher than that reported by Abdulrahman and Reshma, (2008) in Spangled Emperor (28mg/100g), Tiger shrimp (49mg/100g) and PearlspottedRabbitfish (30mg/100g). This might be due to the moisture loss during cooking processed.

The **K** content was found maximum significantly ($p<0.05$) in steamed *Puntiussophore*(261±0.12mg/100g). However the present value was lower than that reported by Zamil*et al.* (1992).The RDA adequate intake is about 2,000–5,000 mg.

The highest **Fe** content in three different cooking forms was found in steamed *Esomus danricus* (551±0.16mg/100g). This value is higher than that reported by Gokoglu *et al.,* (2004) and BeyzaErsoy, (2011).

Table 1: Mineral composition of raw and cooked *Esomus danricus* (mg/100g)

E. danricus	Fe	Cu	Zn	Ca	Ni	Co	Mn	Cr	K	Mg	Na
Raw	183±0.16a	3.3±0.16a	159±0.16d	947±0.06d	5±0.02d	4.4±0.09a	24±0.08b	1.3±0.06b	196±0.02c	229±0.02c	72±0.03a
Steam	551±0.16d	8.2±0.10d	138±0.15c	944±0.15c	1.4±0.02a	4.8±0.08b	24±0.08b	1.6±0.08c	218±0.06d	242±0.18d	75±0.11b
Fried	317±0.12b	4.6±0.18b	117±0.14b	852±0.18b	3.7±0.07c	6.4±0.10c	17±0.18a	0.7±0.02a	193±0.13b	222±0.06a	117±0.08c
Curried	523±0.18c	5.2±0.16c	105±0.10a	727±0.18a	3.8±0.08c	4.5±0.16a,b	30±0.16d	1.32±0.12b	130±0.14a	225±0.02b	147±0.19d

ND=Not Detected

Values are shown as mean±standard error of triplicates.

Values within the same row have different superscripts are significantly differences *(P<0.05)*

Table 2: Mineral composition of raw and cooked *Puntiussophore* (mg/100g)

P.sophore	Fe	Cu	Zn	Ca	Ni	Co	Mn	Cr	K	Mg	Na
Raw	152±0.08a	4±0.02a	96±0.08b	902±0.00a	7±0.05d	3±0.01a	19±0.05a	1.3±0.07c	208±0.14c	228±0.08b	82±0.10a
Steam	243±0.12b	9.4±0.07d	138±0.07d	1356±0.00d	1.8±0.06b	4.5±0.11b	32.5±0.06c	0.9±0.01b	261±0.12d	229±0.06c	82±0.10a
Fried	320±0.08d	6.4±0.07c	103±0.03c	1051±0.00c	2.8±0.06c	4.5±0.10b	29.5±0.11b	0.7±0.02a	193±0.16b	225±0.04a	101±0.07b
Curried	279±0.02c	5.6±0.17b	91±0.02a	930±0.00b	ND	3.3±0.13a	37.8±0.03d	1±0.01b	113±0.03a	250±0.05d	143±0.12c

ND= Not Detected

Values are shown as mean±standard error of triplicates.

Values within the same row have different superscripts are significantly differences *(P<0.05)*

The value of **Cu**content in present finding was higher thanHoffman *et al.*, 1994; Rosa *et al.*, 2007; Gokoglu *et al.*, 2004. The recommended Dietary Allowance allows for adults 2 mg, for children 0.05–0.10 mg.

The **Zn** content was found highest significantly ($p<0.05$) in fried *Esomus danricus*(117±0.14mg/100g) and curried *Esomus danricus* (105±0.10mg/100g).This value is higher than that reported by Zamil*et al.* (1992). The RDA allows for adults 15 mg, for children 10 mg.

The **Co** content was found highest significantly ($p<0.05$) in fried *Esomus danricus* (6.4±0.10mg/100g) and curried *Esomus danricus* (4.5±0.16mg/100g).This value is higher than that reported by other author (Abdul and Sarojnalini, 2012).

The RDA of Mn content allows for adults 3 mg, for children 1.6 mg.It was found higher in different cooking methods. Similarly, Rosa *et al.* (2007), reported that the **Mn** content of fried African catfish increased significantly ($P<0.05$).

The **Cr** content was found similar significantly ($p<0.05$) 1.3±0.07mg/100g in raw *Esomusdanricus*and *Puntiussophore*. The RDA of **Cr** allows for adults 50–200mg, for children 20–200mg. The **Cr** was found reduced in different cooking methods of these two fishes.

The variation recorded in the concentration of minerals in three different cooking methods could have been a result of the rate in which they are available in the water bodies.

4. CONCLUSION

The present study has added information about the proximate and mineral content of three different cooking methods are a good source of mineral elements that may contribute to health, growth and development of human beings.

REFERENCES

[1] Abdul, Hei and Sarojnalini, Ch (2012) Proximate composition, macro and micro mineral elements of some smoke-dried hill stream fishes from Manipur, India. Nature and Science 10(1): 59-65.

[2] Abdulrahaman, O. Musaiger and ReshmaD'Squza (2008) The effects of different methods of cooking on proximate mineral and heavy metal composition of fish and shrimps consumed in the Arabian Gulf (2008) ArchivosLalinoamericanas De Nutricion. 58(1):103–109.

[3] AOAC, (1995) Official methods of Analysis of association of analytical chemist (16thed.). Washington DC: AOAC.

[4] BeysaErsoy (2011) Effects of cooking methods on the proximate, mineral and fatty acid composition of European eel (*Anguilla Anguilla*).International Journal of Food Science and Technology. 46:522–527.

[5] Gokoglu, N., Yerlikaya, P., &Cengiz, M. (2004) Effects of cooking methods on the proximate composition and mineral contents of rainbow trout (*Oncorhynchus mykiss*).Food Chemistry84: 19-22

[6] Hoffman, L.C., Prinsloo, J.F., Casey, N.H. and Therog, J. (1994) Effects of five cooking methods on the proximate, fatty acid and mineral composition of fillets of American SharptoothCadfish.Clariasgareipinus.Zei SA TydskrifvirVoedselwetenskap en Voeding 6(4):146–152.

[7] Rosa, R., Bandarra, N.M. and Nunes, M.L. (2007) Nutritional quality of African Catfish *Clariasgariepinus* (Burchell 1822): A positive criterion for the future development of the European production of Siluroidei. International J. of Food Sceince and Technology, 42:342-351.

[8] Sarjubala, W and ChSarojnalini (2012) Impact of different cooking methods on Proximate and mineral composition of *Amblypharyngodon mola* of Manipur. International Journal of Advanced Biological Research 2(4):712-716.

[9] Sarojnalini, Ch and Sarjubala, W. (2013).Impact of Different Cooking Methods on Nutritive Value of Flying Barb (*Esomus danricus*).World Academy of Science, Engineering and Technology. 79: 503-505

[10] Sarjubala, W and Ch. Sarojnalini (2014).Effect of cooking on the polyunsaturated fatty acid Antioxidant properties of small indigenous fish species of the Eastern Himalayas.*Journal of Engineering Research and Applications.* 4(7):146-151.

[11] Sarojnalini, Ch and Sarjubala, W (2014) Antioxidant properties and nutritive values of raw and cooked Pool barb (*Puntiussophore*) of Eastern Himalayas.International Journal of Agricultural, Biosystems Science and Engineering. 8 (1): 13-17

[12] Shul'man, G. E (1974). Life cycle of fish: Physiology and Biochemistry, Halsted Press a division of John Wiley and son Inc. New York (First Ed.) Pg. 101-104

[13] Sokal, R.R. and Rohlf, F.J. (1974) Introduction to biostatistics. In: W.H. Freeman (Ed), 2nd edition, New York, USA, pp.363.

[14] Zamil El–Faer, M., Tarik, N., Rawdah, Khudre, M., Attar and Mohamad Arab (1992) Mineral and prosimate composition of some commercially important fish of the Arabian Gulf.Food Chemistry. 45:95–98.