



## IMPACT OF DIFFERENT COOKING METHODS ON PROXIMATE AND MINERAL COMPOSITION OF *AMBLYPHARYNGODON MOLA* OF MANIPUR

Wahengbam Sarjubala Devi and Ch. Sarojnalini

Department of Life Sciences Manipur University, Canchipur, Manipur India

Pin code- 795003

### ABSTRACT

The impact different cooking methods (frying, steaming and curried) on the proximate and mineral composition of *Amblypharyngodon mola* were determined. Moisture content were marginally higher in fresh fish (74.72±0.11%) and lowest in the fried fish (22.50±0.04%). Protein and lipid content were recorded higher in fried (14.64±0.22%) and (39.93±0.01%) respectively. Ash content varies from 1.4±0.04% to 6.01±0.21%. The samples had a considerable content of Iron ranging from 1.83µg/g-4.82µg/g, Calcium 8.16-8.95µg/g, Magnesium 2.24-2.65µg/g, Potassium 1.32-2.29µg/g, Zinc 0.96-1.09µg/g, Sodium 0.74-1.69µg/g. Cobalt was not detected in the fried and steamed fish. Copper, Chromium, Manganese and Nickel content were reduced in all the cooking methods. *Amblypharyngodon mola* is a nutrient dense animal source food, rich in Iron, Zinc, Magnesium, Potassium and other elements especially Calcium, thus consumption of *A. mola* of Manipur should be encouraged.

**KEY WORDS** : Small fish, cooking effect, minerals, proximate composition

### INTRODUCTION

Fish is more nutritious than staple foods, providing animal protein, essential fatty acids and micronutrients. The interventions of the food-based strategies which promote production and consumption of locally available nutritious foods have utilized fish instead of supplement distribution as a sustainable way of tackling micronutrient deficiencies (Gibson and Hotz, 2001; Tontisirin *et al.*, 2002; Roosetal., 2007b). It was generally accepted in the nutrition sector that small indigenous fish species made up the greater part of the fish intake especially among the rural poor. Fish is also a dietary source of other important nutrients, small fish which are eaten with bones are available source of highly bioavailability Calcium (Larsen *et al.*, 2000). Small indigenous fish is an important source of Vitamin-A as well as Calcium in poor rural households (Roosetal., 2003). Minerals are essential nutrients, they are components of many enzymes and metabolism, and contribute also to the growth of the fish (Glover and Hogstrand, 2002). The human body usually contains small amount of these minerals and the deficiency in these principal productivity and causes diseases (Mills, 1980). Fish meat contains significantly low lipids and higher water than beef or chicken and is favored over other white or red meats (Neil, 1996; Nestel, 2000). Fish muscle also contains mineral, vitamins and other nutritional compounds which are necessary in a diet (Larsen *et al.*, 2007). The nutritional importance of fish was not so much in its contribution, protein and PUFAs, but in its contribution to micronutrient needs in the diet of the poor people. There are some reports on the biochemical consumption and nutrition value of small indigenous fishes (Roosetal., 2003, Sarojnalini and Vishwanath, 1988a,b, 1994; Bijen *et al.*, 1990). Fish is rarely eaten raw

and usually cooked in different ways before consumption. Heating is one of the common methods in food processing. Heat is applied for food in different ways (Boiling, baking, roasting, frying and grilling) to enhance their flavor and taste; increase shelf life (Garcia-Arias *et al.*, 2003). However, the effect of different cooking methods invariably affects the nutritive value of fish. The effects of different cooking methods on proximate and mineral composition of some fish species have been reported (Ersoy *et al.*, 2006; Gologlu *et al.*, 2004; Kucukgulmezetal., 2006; Rosa *et al.*, 2007; Weber *et al.*, 2008; Stephen *et al.*, 2010). In Manipur, consumption of small fishes is commonly used after frying, roasting and curried form. Hence, the present study was carried out to investigate the effects of different cooking methods of proximate and mineral composition of nutrient dense *Amblypharyngodonmola*.

### MATERIAL AND METHODS

#### Sample collection

Fresh *Amblypharyngodonmola* with a length (4.4- 4.6 cm) and weight of (1.46 – 1.51 g) was collected from Imphal market and other different markets of Manipur. The vegetables like elephant's ear plant, 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

Fresh *Amblypharyngodon mola* and vegetables were washed with tap water several times. The fish samples were divided into four groups, the first one is uncooked and the other three groups were cooked in the following methods: frying, steaming and curried. The frying of the fish was performed in a domestic pan (2 Litre capacity) at

temperature approximately at 180°C for 15 minutes. Soyabean oil was used as the medium for frying. Fried fish was cooked with chopped vegetables for 35 minutes.

**TABLE 1.** Ingredients and methods of preparation of *Amblypharyngodon mola* fish commonly consumed in Manipur.

Local name	Common name	Ingredients and methods of preparation
mukka-NgaThongba	Fish curry	Ingredients: Fish, onions, ginger, salt, turmeric, spices, green water, green pea, elephant ear's plant (Yendem), tomato, coriander, Soyabean oil. Methods: Raw fish was washed with water and fried in hot oil and kept separately. Brown the onions in hot oil and added other ingredients and fried fish cooked under low heat then added water heat till done.
mukka-Nga-Ataoba	Fried fish	Ingredients: Fish, Soyabean oil Methods: Raw fish was washed with water and hot the oil and then fried the fish

### Proximate composition

Proximate composition analysis for homogenized samples of cooked and fresh fish was done in triplicate for moisture, protein, lipid and ash content. The protein was determined by the Official methods of AOAC (1980). The total lipid was extraction from the fish tissue by Chloroform-Methanol (2:1 v/v) solvent system AOAC (1980). Ash and moisture content were determined by the Official methods of AOAC (1980).

### Mineral analysis

For mineral determination 5 g of cooked and fresh fish samples were digested in concentrated HNO<sub>3</sub> (AOAC 1995). The digest was quantitatively transferred to a 50 ml volumetric flask and made up to volume with distilled water. A blank digest was carried out in the same way. All minerals were determined using atomic absorption spectrometry (AAS, Perkin Elmer 3110) against aqueous standards.

### Statistical analysis

The effect of different cooking methods on the proximate and mineral composition of *Amblypharyngodon mola* was analyzed using standard deviation.

### RESULT

Proximate composition of raw, fried, steamed and curried of *Amblypharyngodon mola* are shown in table 2. Fat content was found to be 5.83±0.26% in raw and highest content in the fried fish (39.93±0.01%) and minimum in steamed fish (1.4±0.01%). Moisture content in raw, fried, steamed and 74.72±0.11%, 22.50 ± 0.04%, 72.95± 0.05% and 55.78± 0.04% were obtained respectively. Ash content

was highest in raw 18.86% and lowest in cooked with vegetable 12.6%. The ash content was higher in fried fish (6.01±0.21%). Protein content was recorded higher in the fried fish (14.64±0.22%) and 9.18±0.26% in curried fish. The mineral content of fresh and cooked form of *Amblypharyngodon mola* are shown in table 3. There was variation in the Iron content was (4.82µg/g) and after steamed Iron value was (3.27µg/g), fried (1.83µg/g) and curried (2.78µg/g). Sodium content was varied and highest content was in the curried (1.69µg/g). Sodium content was lower in the steamed fish (0.67µg/g). Copper content were generally in all the cooked fish tested with not much of a variation to the observed between the various modes of cooking. The Zinc content of fresh fish was found to be 1.09µg/g. Zinc levels were higher in steamed fish (1.02µg/g) on the hand fried and curried had same Zinc content (0.96µg/g). The Cobalt levels in curried fish were 0.008µg/g and it was not detected in the fried and steamed fish. The Manganese content of fresh and curried fish was (0.35µg/g and 0.34µg/g) and found less in fried fish. The Calcium content was high in all the cooked fish and 8.95µg/g in fresh fish. The Magnesium content was recorded highest in curried fish 2.27µg/g. The Chromium content in fresh fish was found higher 0.08µg/g and minimum in curried fish (0.004µg/g). The Nickel content of fresh fish was found to be 0.08µg/g. The Nickel levels in fried fish were recorded low (0.021µg/g) which is very low as compared to steamed (0.047µg/g) and curried fish (0.054µg/g). The proximate and mineral compositions of fish was affected by the cooking methods.

**TABLE 2.** Proximate composition of fresh and cooked *Amblypharyngodon mola*

Parameter	Fresh	Fried	Steamed	Curried
Moisture %	74.72±0.11	22.50±0.04	72.95±0.05	55.78±0.04
Fat %	5.83±0.26	39.93±0.01	1.4±0.01	17.36±0.20
Protein %	3.56±0.12	14.64±0.22	5.28±0.06	9.18±0.26
Ash %	1.4±0.04	6.01±0.21	4.19±0.07	5.35±0.01

**TABLE 3.** Mineral composition of fresh and cooked *Amblypharyngodon mola* (µg/g, dry weight)

Parameter	Fe	Cu	Zn	Ca	Ni	Co	Mn	Cr	K	Mg	Na
Fresh	4.82	0.048	1.09	8.95	0.08	0.03	0.35	0.08	1.93	2.26	0.74
Fried	1.83	0.023	0.96	8.61	0.021	ND	0.247	0.016	2.06	2.24	0.96
Steamed	3.27	0.033	1.02	8.79	0.047	ND	0.297	0.006	2.29	2.27	0.67
Curried	2.78	0.038	0.96	8.16	0.054	0.008	0.340	0.004	1.32	2.65	1.69

## DISCUSSION

Fried fish had a higher level of fat than raw or other cooked fish. The increase in fat content of the fried fish fillets is also related to oil absorption during the cooking process. Fat increase can be due to the oil penetration into the food after water is partially lost by evaporation (Saguy and Dana, 2003). Similar results have been reported for African Catfish fried in sunflower oil (Rosa *et al.*, 2007). The lower fat content in the curried *Amblypharyngodon mola* is mainly due to absorption of water used in the curry preparation. The absorption of water is evident when compare the fried *A. mola* similar reports have been found from Arabian Gulf fish and shrimps (Abdulrahman and Reshma 2008). The protein content was generally high which is an expected outcome since fish are a good source of protein (Tidwell and Allan 2001). The higher protein content in the fried fish is due to meat as a result of moisture loss. Further evidence of this is seen in the fact that *A. mola* cooked in curry and steamed had lower protein content but had higher moisture contents. This can be attributed to absorption of water from the cooking medium thereby causing dilution of the muscle tissue analyzed. This higher protein content in fish is important from a dietary point of view since; the quality of fish protein is very high because of its essential amino acid composition (Beklevik *et al.*, 2008). Fish proteins are especially labile and easily denatured than those of meats and the molecules are already stretched to the disruptive action of enzymes that increased in digestion. Adiachi *et al.*, 1958 stated that application of heat result in some increase in digestibility that effect on the 10-20 percent of globular proteins in fish muscles. Further, reports also indicate that fish muscle is more digestible than other animal protein due to lower level of connective tissue (Al-Jedan *et al.*, 1999). The increase in dry matter content was observed in fried fish. The highest moisture content was recorded in fresh and decrease moisture content was noticed in all method of cooked fish when compare to fresh fish. These changes were similar to those reported by (Gokoglu *et al.*, 2004) in rainbow trout and (Garcia-Arias *et al.*, 2003b) in sardines. Water losses, occurring during frying resulted in higher protein content in fried fish as compared to the fresh fish (Garcia-Arias *et al.*, 2003b). Accordingly, the increase in ash, protein and fat content found in cooked silver catfish fillets is explained by the reduction in moisture. Differences in water contents between fresh smoked rainbow trout were found to be significant (Unlusayin *et al.*, 2001). These findings also supported by Gall *et al.*, (1983), that deep fried fish fillet. The higher ash content in the cooked fish, might be due to its higher bony consistency and high scaly nature. Such fish offer minerals in their edible forms more abundantly than large-sized fish do (Higashi, 1962). The Potassium content was high in the fried and steamed fish. It is also observed that the curried fish has low levels

of Potassium as compared to other cooking methods. This might be due to the loss of water on frying thereby causing the concentration of meat thus reflected by increased Potassium value (Morgan *et al.*, 1997). The Sodium levels were considerable in the fish which is mainly due to the salt added to the diet to make it more palatable than the same diets without salt (Beauchamp and Engelman 1991). Copper and Iron content were generally in all the cooked fish tested with not much of variation to the observed between the various modes of cooking. Furthermore, decrease in the iron content in the fried fish compared to the curried (Musaiger, 2006). Iron, Copper, Nickel, Zinc, Cobalt, Chromium, Calcium composition of small fish samples recorded variations in their concentrations. This variation in concentrations of the mineral elements in sampled fish tissues agree with the work of Windom *et al.*, (1987) which stated that such variation was due to the chemical forms of the elements and their concentrations in the environment. In a study in rural households in Bangladesh, it was observed that most of the calcium in large fish with hard bones is lost as the bones from the plate waste (Roos *et al.*, 2003). In contrast, small fish has also been shown to be highly bioavailable (Larsen, Thilsted, Kongsbak and Hansen, 2000). Many factors determine whether or not the mineral content of foods will be completely available to the body. One of the most important of this is food preparation. The quantity of minerals in the cook product is greatly diminished by soaking vegetables preparatory to cooking and discarding the water throwing away liquids from canned foods, eliminating the water in which dried foods have been soaked, paring foods thickly and cutting foods in very small pieces (Mary and Alberto, 2003).

## ACKNOWLEDGEMENT

The authors wish to thank SAIF, NEHU for providing Atomic Absorption Spectrometry (AAS) analysis.

## REFERENCES

- Abdulrahman O. Musaiger and Reshma D'Souza (2008) The effects of different methods of cooking on proximate, mineral and heavy metal composition of fish and shrimps consumed in the Arabian Gulf. *ARCHIVOS LATINOAMERICANOS DE NUTRICION Organo Oficial de la Sociedad Latinoamericana de Nutricion* **58**(1):103-109.
- Adiachi, R.R., Sheffner, L and Spector, H (1958) The in vitro digestibility and nutritional quality of dehydrated beef, fish and beans. *Food Research*. 23:40.
- Al-Jedah, J.H., Ali, M.Z., Robinson, R.K. (1999) The nutritional importance to local communities of fish caught off the coast of Qatar. *Nutrition and Food Science* 6: 288-294.

- AOAC (1980) *Official Methods of Analysis*, 13<sup>th</sup> edn. Association of Official Analytical Chemists, Washington, D.C. USA. Pp. 1411.
- AOAC (1995) Official methods of analysis of the association of the official analysis chemists 16<sup>th</sup> (ed.) Arlington, Virginia.
- Beauchamp, G. K. Engelman, K (1991) High salt intake sensory and behavioral factors. *Hypertension* 17 (1s): 1176-1181.
- Beklevik G, Polat A, Ozogul F. (2005) Nutritional value of Seabase (*Dicentrarchus labrax*) fillets during frozen (-18°C) storage, *Turkish Journal of Veterinary and Animal Science* 29: 89-95.
- Bijen, M., Ch. Sarojnalini & W. Vishwanath (1990) Nutritive value of sun-dried *Esomus danricus* and smoked *Lepidoccephalus guntia*. *Food Chemistry* (Elsevier, U. K.) 36: 89-96.
- Chyun JH, Grimiger P (1984) Improvement of nitrogen retention by arginine and glycine supplementation and its relation to collagen synthesis in traumatized mature and ageing rats. *J Nutr* 114: 1705-1715.
- Ersoy, B., Yanar, Y., Kucukgulmez, A., Celik, M (2006) Effects of four cooking methods on the heavy metal concentrations of sea bass fillets (*Dicentrarchus labrax* Linne, 1785). *Food Chem* 99 (4): 748-75.
- Gall, K. L., Otwell, W.S., Koburger, J.A., Appledorf, H (1983) Effects of four cooking methods on proximate, mineral and fatty acid composition of fish fillets. *Journal of Food Science*. 48:1068-1074.
- Garcia-Arias, M.T., Pontes, E.A., Garcia-Linares, M.C., Garcia-Fernandez, M.C. and Sanchez-Muniz, F.J. 2003b. Cooking-Freezing reheating (CFR) of sardine (*Sardinapilchardus*) fillets. Effects of different cooking and reheating procedures on the proximate and fatty-acid compositions. *Food Chem.* 83:349-356.
- Garcia-Segovia, P., Andres- Bello, A., Martynez- Monzo, J (2007) Effect of cooking method on mechanical properties, color and structure of beef muscle ( *M. pectoralis*). *Journal of food Chemistry*. 84: 19-22.
- Gibson, R.S., Hotz, C. (2001) Dietary diversification/ modification strategies to enhance micronutrient content and bioavailability of diets in developing countries. *British Journal of Nutrition*. 97(1): 145-152.
- Glover, C. N., Hogstrand, C (2002) Amino acids in vivo intestinal Zinc absorption in freshwater rainbow trout. *Journal of Experimental Biology*. 205: 151-158.
- Gokoglu, N., Yerlikaya, P., Cengiz, E (2004) Effect of cooking methods on the proximate composition and mineral contents of rainbow trout (*Oncorhynchus mykiss*). *Food Chemistry*. 84:19-22.
- Higashi, H. (1962) Relationship between processing techniques and the amount of vitamins and minerals in processed fish. In *Fish to Nutrition* ed. R. Heenan R. Krauzer. London Publ. New (Bks) Ltd. London, pp. 125-131.
- Institute of Medicine (2002) Dietary reference intakes for vitamin A, vitamin K, arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, molybdenum, nickel, silicon, vanadium and Zinc, Institute of Medicine of the National Academies. The National Academy Press. Washington D.C. U.S.A.
- Kucukgulmez A, Celik M, yanar Y, Ersoy B, Cikrikei M (2006) Effects of different cooking methods on the proximate composition and mineral contents of sea bass (*Dicentrarchus labrax*). *Adv Food Sci* 28(4):223-227.
- Larsen, T., Thilsted, S. H., Kongsbak, K and Hansen, M (2000) Whole small fish as a rich calcium source. *British Journal of Nutrition* 83(2): 191-196.
- Mills, C.F (1980) The mineral nutrition of livestock. E.J. Underwood, (Ed.) Common Wealth Agricultural Bureaux. Pp. 9.
- Mary, T. Dowd and Alberta Dent (2003). *Elements of foods and Nutrition*. In : Chapter IV. Requirements for regulation and protection minerals and water. (2<sup>nd</sup> Ed.). Published by Biotech Books 1123/74, Tri Nagar, Delhi-110 035. Pp.47-62.
- Morgan, J. N. Berry, M.R., Graves, R. L. (1997) Effects of commonly used cooking practices on total mercury concentration in fish and their impact on exposure assessments. *J.Expo. Anal. Environment Epidemiol.* 7(1): 119-133.
- Musaiger, A.O.(2006) Food composition tables for the Arab Gulf countries. Arab Caenter for Nutrition, Bahrain.
- Neil, J. S (1996) Fish consumption , fish oil, lipids and coronary heart disease, *circulation* 94: 2337-2340.
- Nestel, P. J. N (2000) Fish oil and cardiovascular disease: lipids and arterial function. *American Journal of Clinical Nutrition* 71: 228-231.
- Roos, N., Wahab, M.A., Chamnam, C., Thilsted, S.H.(2007b). The role of fish in food-based strategies to combat vitamin A and mineral deficiencies in developing countries. *The Journal of Nutrition*. 137: 1106-119.
- Rosa, R., Bandarra, N.M. and Nunes, M.L. (2007) Nutritional quality of African Catfish *Clarias gariepinus* (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.

- Sarojnalini and Vishwanath, (1988a) Studies on the Biochemical Composition of some freshwater fishes of Manipur. *Journal of Advanced Zoology* 9(1): 1-5.
- Saguy, S. and Dana, D. (2003) Integrated approach to deep fat frying : Engineering, nutrition, health and consumer aspects. *Journal of Food Engineering*. **56**:143-152.
- Sarojnalini and W. Vishwanath (1994) Composition and Nutritive value of sun-dried *P. sophore*. *J. Food Sc. Technology*. 31 (6): 480-483.
- Stephen NM, Shakila RJ, Jeyasekaran G, Sukumar D (2010) Effect of different types of heat processing on chemical changes in tuna. *J Food Sci Technol* 47(2):L 174-181.
- Tidwell J. H. Allan G. L. (2001) Fish as Food: aquaculture's contribution Ecological and economic impacts and contributions of fish farming and capture fisheries. *Science & Society* 2(11):958-963.
- Tontisirin, K., Nantel, G., Bhattacharjee, L. (2002) Food-based strategies to meet the challenges of micronutrient malnutrition in the developing world. *Proceedings of Nutrition Society* ^1(2): 243-250.
- Unlusayin, M., Kaleli, S., Gulyavuz, H (2001) The determination of flesh productivity and protein components of some fish species after hot smoking. *Journal of Science Food Agriculture* 81: 661-664.
- Vishwanath, W. and Sarojnalini, Ch. (1988b) Nutritive value of some fishes Endemic in Manipur. *Indian J. Fish* **35** (2):115-117,
- WeberJ, Bochi VC, Ribeiro CP, Victorio AM, Emanuelli T (2008) Effect of different cooking methods on the oxidation, proximate and fatty acid composition of silver catfish (*Rhamdia quelen*) fillets. *Food Chem* 106: 140-146.
- Windom, H., Stein, D., Sceldon, R and Smith, J. R (1987) Composition of trace metal concentrations in muscle of a benthopelagic fish. (*Coryphaenoides armatus*) From the Atlantic and Pacific oceans. *Deep sea Research* 34(2): 213-220.