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Study of Microwave Heating on Nutrient Content of Bangladeshi Fish *Mastacembelus Armatus*

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Abstract: Microwave heating is a multiphysics phenomenon that involves electromagnetic waves and heat transfer; any material that is exposed to electromagnetic radiation will be heated up. This study was performed to compare the effects of microwave heating and conventional cooking method on proximate nutrient and health promoting contents of fresh Baim Fish (*Mastacembelus armatus*) grown in Bangladesh. The moisture and ash content in raw Baim fish were 74.00% and 4.00%, respectively. After conventional cooking moisture and ash content were 77.00% and 4.00%, respectively. On the other hand, after microwave cooking moisture and ash content were 75.00% and 4.00%, respectively. The protein content in raw Baim fish was 15.60% and after conventional cooking this value was 12.07%, whereas 15.60% for microwave cooking. In this study also estimated the fat and carbohydrate content which changed significantly by both conventional cooking and microwave cooking.

Keywords: Microwave Cooking, Nutritional Value, Fish, *Mastacembelus Armatus*

1. Introduction

Fish is a low-fat high quality protein. Fish is filled with omega-3 fatty acids and vitamins such as D and B2 (riboflavin). Fish is rich in calcium and phosphorus and a great source of minerals, such as iron, zinc, iodine, magnesium, and potassium. The American Heart Association recommends eating fish at least two times per week as part of a healthy diet[1].In recent years, fish lipids have also assumed great nutritional significance, because of their high polyunsaturated fatty acid levels. Fish are also considered very rich source of minerals and vitamins. The total content of minerals in the raw flesh of fish and invertebrates is in the range of 0.6–1.5% of wet weight. Mineral components such as sodium, potassium, magnesium, calcium, iron, phosphorus and iodine are important for human nutrition[2]. It contains important n-3 polyunsaturated fatty acids that are likely to lower the risk of heart diseases in adults and are important for neuro-development in infants and young, and are known to support good health[3].

Baim fish is distributed in rivers, beels, ponds and inundated fields throughout Bangladesh[4]. It lives at the bottom in the mud and corners of the stones. Its body is relatively slender, elongated and slightly compressed. It prefers stationary to running water. It is predatory in habit. The young fish feeds on crustaceans and insect larvae, while the adult devours fish and tadpoles[5]. Mookerjee stated that its food may be 44% algae, 16% scales, 40% mud or sands. By eating large amount of algae, mud and sands plays an important role in our ecology[6]. It is reported to be a very good food-fish. It is popular good fish especially when freshly caught. It has high market value[7]. Good sport on rod and line with earth worm bait[5].

The various cooking methods invariably affect the nutritive value of fish and especially vitamins, flavour compounds and polyunsaturated fatty acids. Early developments in the field of nutrition predicted that certain substances, important for the proper functioning of the human body, are lost during cooking of foods. It is imperative to conserve nutrients of food products and also is a major consumer concern related to food preparation. Therefore, it is important to determine the retention of nutrients in fish cooked using several common domestic practices. In these studies, boiling and microwave cooking methods were used to investigate the effects of different cooking methods on the proximate nutrient content of different fishes of Bangladesh. The microwave cooking process presents controversial results in the literature due to

the different conditions that are employed (time, power, and added water).

2. Materials and Methods

2.1. Preparation of Sample

Fresh Baim Fish (*Mastacembelus armatus*) was collected from local market (Sheikh Para, Kushtia, Bangladesh). Samples were washed properly and cut into small pieces from the edible part of the fish.

2.2. Conventional Cooking

Among various methods of conventional cooking, boiling method was applied in the study for the cooking of the selected sample. In this case, the sample to be cooked was just immersed in water at 100^0C and the water was maintained at that temperature till the sample was tendered.

2.3. Microwave Cooking

A weighed, chopped sample was placed in a 250-ml beaker. The sample in the microwave oven was cooked until it is tender (about 45 s in a 700W oven). Remove the sample from the ovenand the nutrition values were estimated.

2.4. Determination of Moisture Content

Moisture was determined by oven drying method. A clean crucible was dried to a constant weight in air oven at 110°C, cooled in a desiccator and weighed (W1). Two grams of finely ground sample was accurately weighed into the previously labeled crucible and reweighed (W2). The crucible containing the sample was dried in an oven to constant weight (W3). The percentage moisture content was calculated as follows:

$$\% \text{ Moisture content} = \frac{W2 - W3}{W2 - W1} \times 100$$

2.5. Determination of Ash Content

For the determination of ash, a clean porcelain crucible was dried inan oven at 100°C for 10 min, cooled in a desiccator and weighed (W1). Two grams of the finely ground sample was placed into a previously weighed porcelain crucible and reweighed (W2), it was first ignited and then transferred into a furnace which was set at 550°C. The sample was left in the furnace for eight hours to ensure proper ashing. The crucible containing the ash was then removed; cooled in a desiccator and weighed (W3). The percentage ash content was calculated as follows:

$$\% \text{ Ash Content} = \frac{W3 - W1}{W2 - W1} \times 100$$

2.6. Determination of Crude Protein Content

Protein in the sample was determined by Kjeldahl method[8]. 2 g of dried samples was taken in digestion flask. Add 10-15 ml of concentrated H_2SO_4 and 8 g of digestion mixture i.e. K_2SO_4:$CuSO_4$ (8:1). The flask was swirled in order to mix the contents thoroughly then placed on heater to start digestion till the mixture become clear (blue green in color). It needs 2 hrs to complete. The digest was cooled and transferred to 100 ml volumetric flask and volume was made up to mark by the addition of distilled water. Distillation of the digest was performed in Markam Still Distillation Apparatus[9]. Ten ml of digest was introduced in the distillation tube then 10 ml of 0.5N NaOH was gradually added through the same way. Distillation was continued for at least 10 min and NH_3 produced was collected as NH_4OH in a conical flask containing 20 ml of 4% boric acid solution with few drops of modified methyl red indicator. During distillation yellowish color appears due to NH_4OH. The distillate was then titrated against standard 0.1N HCl solution till the appearance of pink color. A blank was also run through all steps as above. Percent crude protein content of the sample was calculated by using the following formula:

$$\% \text{ Crude Protein} = 6.25^* \times \%N \text{ (* Correction factor)}$$

$$\%N = \frac{(S-B) \times N \times 0.014 \times D \times 100}{\text{Wt.of the sample} \times V}$$

Where
S = Sample titration reading
B = Blank titration reading
N = Normality of HCl
D = Dilution of sample after digestion
V = Volume taken for distillation
0.014 = Milli equivalent weight of Nitrogen

2.7. Determination of Crude Fat

The fat content was determined by ether extract method using Soxhlet apparatus[10]. Since all the fat materials e.g. fats, phospholipids, sterols, fatty acids, carotenoids, pigments, chlorophyll etc. are extracted together therefore, the results are frequently referred to as crude fat. Approximately 1 g of moisture free sample was wrapped in filter paper, placed in fat free thimble and then introduced in the extraction tube. Weighed, cleaned anddried the receiving beaker was filled with petroleum ether and fitted into the apparatus. Turned on water and heater to start extraction. After 4-6 siphoning allow ether to evaporate and disconnect beaker before last siphoning. Transferred extract into clean glass dish withether washing and evaporated ether on water bath. Then placed the dish in an oven at 105^oC for 2 hrs and cooled it in a desiccator. The percent crude fat was determined by using the following formula:

$$\%\text{Crude Fat} = \frac{\text{Wt.of ether extract x100}}{\text{Wt.of sample}}$$

2.8. Determination of Carbohydrate

The total carbohydrate was determined by difference. The sum of the percentage moisture, ash, crude protein and crude fat was subtracted from 100[11].

Calculation: % Total carbohydrate = 100 - (% moisture + % ash + % Protein +% fat)

3. Result and Discussions

Heating of food leads to various decomposition reactions (i.e., thermolytic and oxidative reactions) of its lipid components including triglycerides, but the extent of loss was different in microwave and conventional cooking for different sample. Food has to be pleasing in appearance and taste in order to be consumed. Cooking as a conventional processing method has a great impact on food nutrients. Most foods are mainly consumed after being cooked and cooking considerably affects their health-promoting compounds, minerals and vitamins. This study compares the changes of nutrient content in Baim fish cooked by conventional and microwave heating.

Previous studies showed that raw samples of Baim fish contained 79% moisture, 2.50% fat, 14.30% protein, 2.20% carbohydrate[12]. In this study, the moisture content in raw Baim fish was 74.00%. After conventional cooking moisture content in Baim fish was 77%, whereas after microwaving it was 75% (Figure 1). Ash content in raw Baim fish was 4.00%, but after conventional and microwave cooking it was unchanged i.e. 4.00% in both cooking (Figure 2).

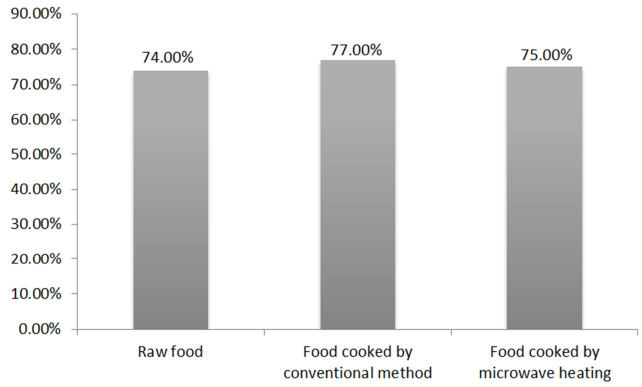

Figure 1. *Change of moisture content in Baim Fish.*

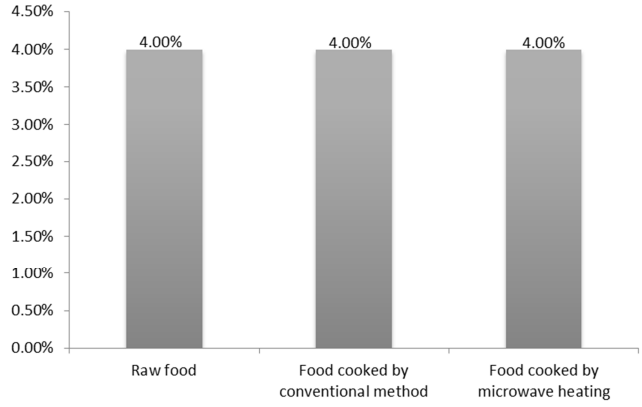

Figure 2. *Change of ash content in Baim Fish.*

Total crude protein of raw Baim fish was 15.60%. After conventional cooking, it was 12.07% and microwave cooking it was unchanged i.e. 15.60% (Figure 3). As shown in Figure 4, crude fat in raw Baim fish was 1.25%. After conventional and microwave cooking it was found 1.12% and 1.00%, respectively. The carbohydrate content in raw Baim fish was 5.15%, whereas 4.92% and 4.42% carbohydrate were found after conventional and microwave cooking respectively (Figure 5).

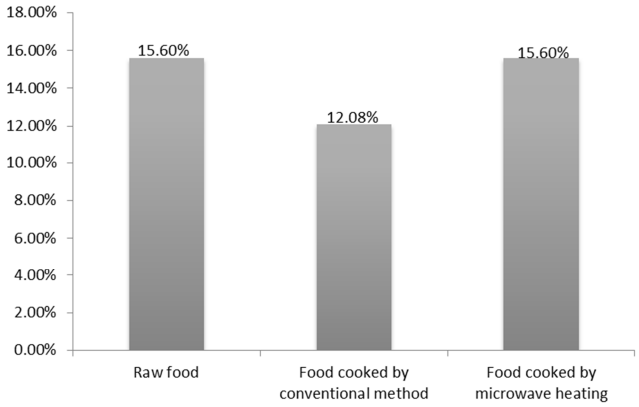

Figure 3. *Change of protein content in Baim Fish.*

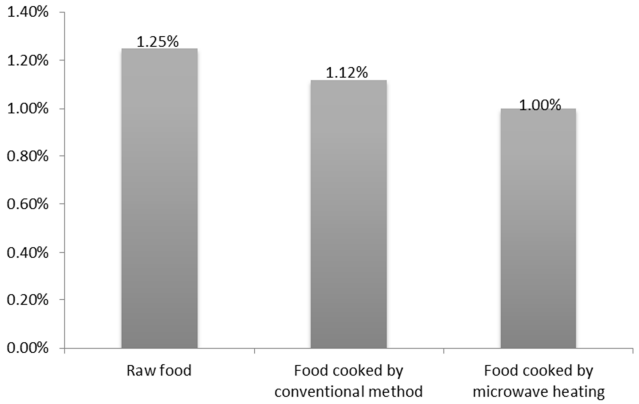

Figure 4. *Change of fat content in Baim Fish.*

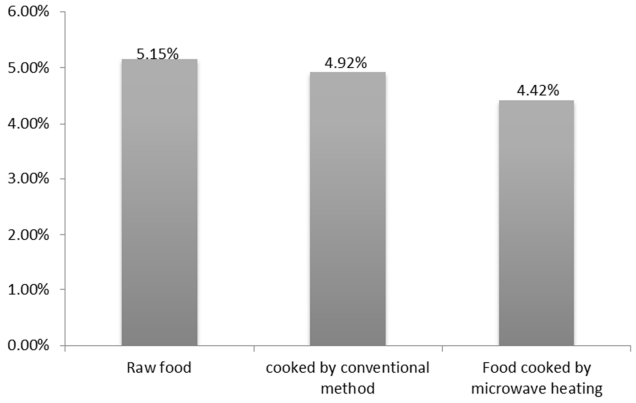

Figure 5. *Change of carbohydrate content in Baim Fish.*

4. Conclusion

Bangladesh is an under developing country and many people of this country are suffering from nutritional problem. For this reason people should choose the best method of cooking by which nutrient content are present in high amount. Results of this study suggested that microwave cooking method is better than other methods because microwave cooked food contains high amount of nutrients.

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