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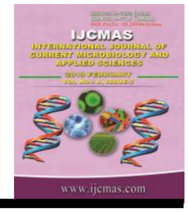

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Nutritional Composition of Fish Bone Powder Extracted from Three different Fish Filleting Waste Boiling with Water and an Alkaline Media

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A B S T R A C T

In the present study, the fish bone powder has been extracted by boiling the fish filleting waste with water and 2% sodium hydroxide solution (NaOH) about 30 min at 80-90 ºC boiling temperature. This study aimed to determine the nutritional composition of three different fish bone powder extracted with water and an alkaline solution. The nutritional composition of Grouper (*Epinephelus diacanthus*), Emperor (*Letrinus fraenatus*) and White snapper (*Pristipomoides filamentosus*) fish bone power extracted by two treatment method showed statistical significant difference ($P < 0.05$). The results of nutritional composition of five different fish bone powder showed high crude protein and fat in fish bone extracted by water as boiling media. The moisture and ash was high where the fish bone is produced from alkaline solution. In this study, the alkaline extraction method showed higher ash content so this method could be used to extract the mineral content from fish filleting waste. Results demonstrated that extracted fish bone powder was nutritious and can contribute significantly to human health requirements. The expected output of this research will help to effectively utilize the seafood processing waste and also reduce environmental pollution.

Keywords

Fish bone power, Nutritional composition, Water and Alkaline extraction

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Introduction

Fish is healthy food for human, which is widely accepted as a very good source of animal protein and other elements needed for maintenance of a healthy body. The nutritional value of any food is extremely important. The nutritional composition of foods generally includes moisture, ash, lipid, protein and carbohydrate contents. Proximate analysis is the first approach for food product characterization. These food components may be of interest in the food industry for product development, quality control or regulatory purposes (Trugo, 2003).

Generally whole fish contains about 70 to 80% water, 20 to 30% protein and 2 to 12% lipid (Kumar *et al.*, 2014). Processing of aquatic products is associated with a large amount of waste products like fish heads and bone account for about 45% of waste (Lu, 2004). These fish byproducts in the form of edible and non-edible by-products. It is becoming more and more imperative to solve the problem by utilizing these wastes rather discarding that cause's environmental pollution. Waste disposal and by-product management in food processing industry pose problems in the areas of environmental protection and sustainability (Russ and Pittroff, 2004). The major non-edible by-products arising out of fish processing include viscera, skin, scales, bones and bone frames. Fish bone that generated from fishing industry after filleted is about 30% of the total weight of fish. The main uses of these by products include the production of feeds, which possess low economic value and other products like hydrolyzed protein, which involves complex production processes and high production costs (Deng *et al.,* 2001; Yu, 2000).

The fish bone powder can be extracted by simple methods and also which can be used in food supplements. Fish bone powder will be extracted by boiling the fish frame with water, alkaline and acid or combination of these treatments. The alkaline treatment is more common method to extract the fish bone powder from fish filleting frame (Kettawan *et al.,* 2002). Bubel *et al.*, (2015) studied essential mineral content of fish bone powder from Baltic cod (*Gadus morhua callarias*) and Atlantic salmon (*Salmo salar*) filleting frame using extraction methods like an alkaline environment (soaking in 2 M NaOH, Sodium Hydroxide), processing with 0.1% citric acid (aroma removal) and 5% H_2O_2 (Hydrogen Peroxide) as disinfection, rinsing with tap water, drying, and grinding the end-product. The recovery of components with potential biological activities and functionalities provides a means for value addition to the fish processing waste and also add to plant economy. In this era interest in the use of seafood by products is increasing. Minimal publications are available regarding the fish bone powder isolation and its nutritional composition from selected fish filleting frame. From this viewpoint, the expected output of this research will help to effectively utilize the seafood processing waste and also reduce environmental pollution.

Materials and Methods

Raw material

Three species of fish filleting waste or by product (about 5killogram) of Grouper (*Epinephelus diacanthus*), Emperor (*Letrinus fraenatus*), White snapper (*Pristipomoides filamentosus*) fishes were procured in iced condition from Indofisheries fish processing plant Harekala, Mangaluru.

Fish bone powder extracted by water as boiling media

Five different fish filleting waste was washed and boiled separately in distilled water for about 30 minute (min) at 80-90 ºC. The meat adhered was cleaned manually from fish frame and washed with water. Then they will be dried in the hot air oven (ROTEK Instruments, B and C Industries Cochin, India) at 100 ºC about 3 hour (hr). The fish bone powder was kept in plastic container at room temperature. The nutritional compositions were determined.

Fish Bone powder extracted by alkaline as boiling media

The fish bone powder was extracted by the method of Nemati *et al.*, (2017) with some modification. The five different fish frame was boiled with 2% NaOH solution with the ratio of 1:5 (Fish frame to NaOH) at 80-90ºC for 30 min. The pH was recorded by using pH meter of 'Eu Tech (pH 510') and after reaching to neutral pH the fish bone was rinsed with distilled water and then they will be dried in the oven drying at 100 ºC (3 h). The bones were pulverized into finer particles using a pestle and mortar. The bone powder was kept in plastic container at room temperature. The nutritional compositions were determined.

Nutritional composition determination

The nutritional composition like moisture, crude proteins and an ash were estimated using the standard methods of AOAC (2005). For moisture determination, 5g (gram) of fish bone powder was dried in a hot air oven at 105 °C until a constant weight was obtained. Total crude protein was indirectly determined by multiplying the total nitrogen content (% N) by the factor 6.25 using the Kjeldahl method. An ash content was determined by combustion of sample in a muffle furnace (ROTEK Instruments, B and C Industries Cochin, India) for 7 h at 550 °C. The total fat was estimated by the method of Bligh and Dyer (1959).

Statistical analysis

All data were studied with one-way analysis of variance (ANOVA) was performed to determine the differences between two treatments. Significance of differences was defined at ($P < 0.05$). All data values were presented as mean ± standard deviation (SD).

Results and Discussion

The chemical composition varies greatly between fish species and even between individuals of the same species, mostly due to age, sex, environment and seasonal variations (Hyldig *et al.,* 2007). The moisture content of three fish bone powder extracted by water and an alkaline media is depicted in Figure 1. The moisture found to be high in fish bone extracted by an alkaline method are 5.96% for Grouper, 4.12% for Emperor, 3.41% for White snapper and low moisture was found in water extraction method of three fish bone powders are 1.09% for Emperor, 1.64% for Grouper, 2.71% for White snapper. Moisture content of food is influenced by type, variety and storage condition. In the moisture content of three fish bone powder the significant differences were found between water and an alkaline extraction method ($P < 0.05$). Moisture was found high in all three species of fish bones extracted by an alkaline method compare to water extraction method. The reason might be alkaline extraction method of fish bone powder had fine particle size compare to water extraction process so finer particles absorb more water. Moisture content of food is influenced by type, variety and storage condition. One factor that affects the water absorption is porosity (Talib *et al.*, 2014). Similar results relating to the content of water (2.46%), was obtained by Hemung (2013) in the powder from tilapia bones, which were manufactured using the alkaline processing method (0.8% NaOH, 90°C) for 1 h. Talib *et al.,* (2009) found 2.98% of moisture content for Madidihang (*Thunnus albacores*) fish bone powder prepared by water as boiling media.

The results of crude protein percentage of three fish bone powder (Fig. 2) processed by water and an alkaline media showed significant difference ($P < 0.05$). The very low crude protein was found in fish bone powder extracted by alkaline solution compare to water extraction methods are 8.75% (Emperor), 6.57% (White snapper), 3.28% (Grouper) for an alkaline extraction method and 25.16% (Grouper), 19.69% (Emperor), 16.49% (White snapper), respectively.

The main reason of low protein in an alkaline extraction method was boiling with NaOH solution will remove the protein content from fish bone powder. Therefore, an alkaline solution would be more effective way to leach out proteins from the bone (Toppe *et al.*, 2007). The results obtained in the present study was comparable with Murthy *et al.*, (2014), they extracted Yellowfin tuna (*Thunnus albacares*)bone powder by boiling tuna frames with water and 0.5% NaOH.

The total fat content results of fish bone powder with two treatments are given in Figure 3. The significant difference ($P < 0.05$) in total fat content of fish bone powder was found between the two treatments. Emperor fish bone powder showed total fat content of 10.70% for water as boiling media and 0.56% of fat was found in an alkaline extraction method.

In water extraction method Grouper and White snapper fish bone powder has got has total fat were about to 9.94% and 7.26%, respectively. And also in an alkaline extraction process Grouper and White snapper fish bone powder total fat content was 3.28% and 6.57%, respectively. The fat content of three fish bone powder found to be very low in an alkaline treatment method than water treatment. Kettawan *et al.*, (2002) reported that, the amount of the fat might be decrease due to the combination of heat and NaOH to remove the fat content from fish frame. Fat from three fish bone powder extracted by water was high and alkaline solution was low. The results of present study was compared with Yellowfin tuna (*Thunnus albacares*) bone powder fat content was 11.02% for water extraction method and about 3.86% for an alkaline extraction method (Nemati *et al.*, 2017).

The effects of water and an alkaline extraction method of three different fish bone powder with reference to an ash content is shown in Figure 4. An ash percentage of fish bone powder extracted by an alkaline media was high about 87.60 % for Grouper, 85.34% for White snapper, 84.35% for Emperor fish bone powder and low in water extraction method it was about to 57.41% for Grouper, 67.82% for Emperor fish, 70.54% for White snapper fish bone powder, respectively (Table 1 and 2).

Table.1 Percentage wise details of protein, fat and water for bone powder obtained from water extraction method

Fish bone powder	Moisture %	Crude protein%	Total fat%	Ash%
Grouper	1.64±0.07	25.16±0.06	9.94±0.90	57.41±0.26
Emperor	1.09±0.05	19.69±0.20	10.70±0.00	67.82±0.45
White snapper	2.71±0.00	16.49±0.62	7.26±0.00	70.54±0.00

Table.2 Percentage wise details of protein, fat and water for bone powder obtained from alkaline extraction method

Fish bone powder	Moisture %	Crude protein%	Total fat%	Ash%
Grouper	5.96±0.11	3.28±0.07	0.74±0.00	87.60±0.05
Emperor	4.12±00	8.75±0.20	0.56±0.00	84.35±0.54
White snapper	3.41±0.03	6.57±0.00	1.59±0.21	85.34±0.61

Fig.1

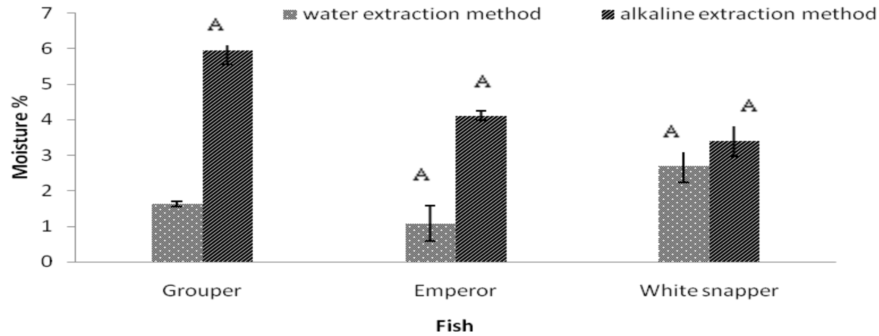


Fig.2

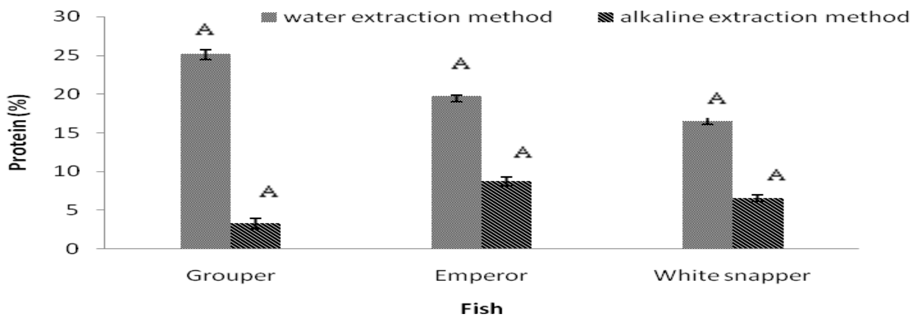


Fig.3

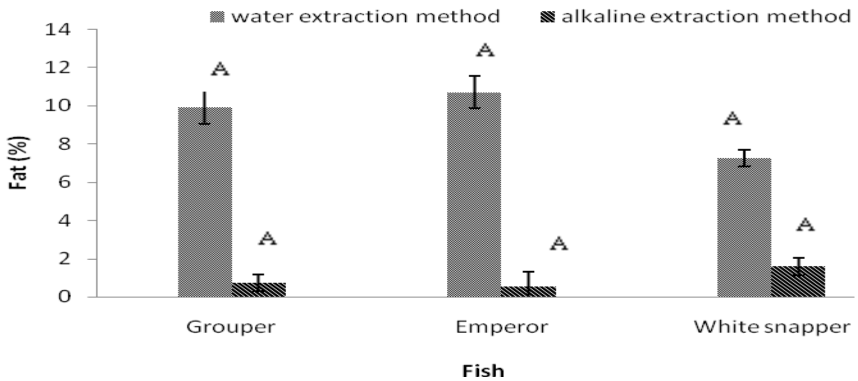
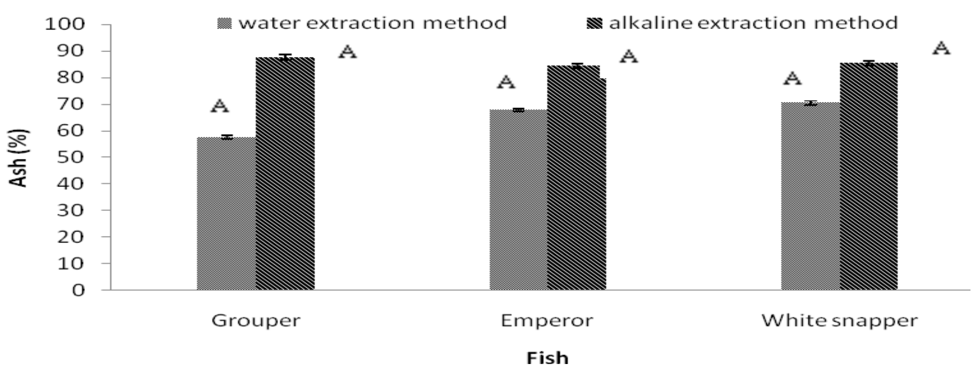


Fig.4



An ash content of fish bone powder extracted by two treatments was significantly different (P < 0.05). An ash content of three fish bone powder extracted with alkaline method is significantly higher than fish bone powder extracted by water media. Leach out of protein and fat that can ultimately increase the ash content of the final material (Talib *et al.*, 2009). The results of an ash content in the study was coinciding with the results of Toppe *et al.*, (2007) for Cod fish and Saithe fish bone powder extracted by water as boiling media. Logesh *et al.*, (2012) found 91-95% of ash content for Oil sardine (*Sardinella longiceps)* and Ribbon (*Trichiurus savala)* fish bone extracted by an alkaline as boiling media The recovery of fish bone powder by alkaline treatment was effective way to get rid of organic materials such as fat and protein and to get the high purity of fish bone powder (Hemung, 2013).

In conclusion, results demonstrated that extracted fish bone powder are nutritious and can contribute significantly to human health requirements. The filleting wastes are enriched with additional beneficial effects, applied to upgrade fish processing waste into products of commercial utility. These approaches may help in reducing the organic load caused by the fish processing industry. Further, the recovered minerals have potential application in various industrial and medical applications.

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