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Comparative Analyses of the Nutritional Composition of Fish, Fish Eggs and Fowl Eggs

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Abstract: Malnutrition and under nutrition has been a great challenge globally particularly in underdeveloped and developing countries. The present study was conducted to evaluate the nutrient composition of fish eggs, (which are often discarded as wastes) and compare same with fishes and poultry eggs (both local and exotic). Eggs from catfish, tilapia, exotic and local chickens, as well as tilapia and catfish flesh were analyzed for proximate, vitamin and mineral compositions using modified standard AOAC methods. Results showed that the highest value for crude protein (30.56±0.12g/100g) was seen in the catfish egg, the least value (13.25±0.38g/100g) was recorded in the tilapia fish. The values for crude fat and carbohydrate were seen to be highest in catfish (6.86±0.12g/100g) and (10.41±0.16) and least (0.53±0.15g/100g) and (0.63±0.32) catfish egg. The differences in moisture between the samples were not statistically significant ($p<0.05$). There was no crude fibre present in the various eggs, however, percentage in catfish (6.23±0.04) was higher than in tilapia. Catfish egg had the highest amount of vitamin B_1 (1.49±0.02g/100g) and cobalt (23.09±0.01g/100g). From the foregoing, fish eggs should not be discarded nor undervalued by consumers but should rather be harnessed by nutritionists and even households as supplements and therapeutics against deficiency diseases.

Key words: Fish · Fish Eggs · Bird Eggs · Vitamins · Proximate analysis and Mineral Compositions

INTRODUCTION

The dietary protein intake in developing countries is far below the recommended amount of 0.66 g/kg/day. It is a well-documented fact that the provision of energy, without a corresponding intake of critical protein and micronutrients, would lead to an increase in weight and other health challenges, hence the concerted efforts world-over to mitigate malnutrition and under-nutrition [1, 2]. In most developing countries, protein sources are from cereal-based staple foods [3] which usually contain lower quantities of proteins compared to that in animal sources of such as fish, meat and egg [4].

Eggs are a nutrient-dense food source that contributes to diet. Although they may not be said to be unusually rich source of any particular nutrient, they provide substantial quantities of a wide variety of nutrients [5]. Eggs remain a staple food within the human diet consumed in various forms by people throughout the world as a cheap source of protein. Having multifunctional properties, eggs provide the most complete protein of any food, together with fats, vitamins and minerals, hence, they are perceived as a nutraceutical food product [6- 8]. Fish eggs also are a good source of quality element for human nutrition due to their therapeutic role in the reduction of certain cardiovascular diseases [9].

On the other hand, fish is widely used throughout the world, as a good source of high value proteins as well as its supply of fatty acids necessary for the development of the brain and body [10], making a significant contribution in areas with malnutrition especially in developing countries where consumption of insufficient protein remains a persistent problem. Although some authors, have reported on the proximate composition of some fish species [11- 13] the assessment of proximate composition of fish eggs has not been given much attention. However, there have not been comprehensive comparisons between such common fishes and their eggs with other eggs unlike bird eggs which have been analyzed for their nutritional constituents. This is evident in how most people, owing to negligence occasioned by ignorance prefer fish to its eggs thereby discarding fish eggs as wastes. This study is therefore aimed at evaluating the nutritional compositions of some fishes' eggs and comparing them with the fishes themselves and also with both local and

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exotic chicken eggs, in other to provide information that will could serve as a reorientation on the attitude of consumers to the consumption of fish eggs, thereby reducing the menace of malnutrition and under nutrition in the society.

MATERIALS AND METHODS

Sample Collection: Six samples including; catfish egg (*Siluriformes sp.*), tilapia egg (*Oreochromis niloticus*), the tilapia, catfish as well as eggs of exotic chicken (*Gallus domesticus*) and local chicken (*Gallus gallus*). Fresh and raw chicken eggs and fishes were purchased from Abakaliki and Nsukka and were transported to the laboratory for analyses.

Fish Egg Preparation: The catfish *(Siluriformes sp.)* and tilapia *(Oreochromis niloticus)* were cut open from the basal part from the rear through the abdomen and to the neck using sterile blades to expose the eggs. The eggs were emptied into clean glass beakers and frozen to be preserved for the analysis.

Methods

Proximate Analysis: The moisture, protein, fat, carbohydrate and ash contents of the samples were determined by the methods of the Association of Official Analytical Chemists [10]. Moisture content was determined using the dry oven method according to the AOAC [10]. For each size group, 5 g of homogenized samples were weighed out in triplicate into preconditioned moisture dishes. The dishes with samples were placed in oven and dried for 16 hours at 98°C, as this temperature avoids loses of volatile food components. After the 16 hours of drying, the dishes were cooled down in desiccators and the moisture content of the samples calculated accordingly.

Crude protein was determined by the Kjeldahl methods using sulphuric acid for sample digestion. Total nitrogen was quantified by titrating the distillate against 0.05 M hydrochloric acid. Methylene blue and methyl red mixture was used as indicator. Crude protein was determined by multiplying the nitrogen value by the conversion factor of 6.25.

Crude fat was obtained by exhaustively extracting 2.0 g of each sample in a Soxhlet apparatus using petroleum ether (b.p. 40 - 60°C) as the extractant (AOAC, 2005), while the ash content was determined by igniting the sample for 12 hours in a furnace at 525°C.

Mineral Analyses: The preparation of samples for mineral elements analysis followed a method described by AOAC (2005). Approximately 5 g of each sample (wet weight) were placed in a Teflon digestion vessel and double acid digested with nitric acid (HNO3) and perchloric acid (HCLO4). Samples were then analyzed for mineral contents of iron (Fe), manganese (Mn), zinc (Zn), potassium (K), calcium (Ca) magnesium (Mg), Copper (Cu), Iron (Fe) and Cobalt (Co) using the Atomic Absorption Spectrophotometer (Shimadzu AAS, AA-6300). Total phosphorus was determined by spectrophotometric vanadium phoshomolybdate method.

Vitamin Analysis: For vitamin A content, total carotenoids content was determined using the Harvest plus method and the absorbance of the carotenoids were read in spectrophotometer at the specific wave length of 450 nm. This value was then converted to Vitamin A by dividing it with12 conversion factor. Vitamin A was expressed as retinol activity equivalent (RAE). Vitamins B1, D and E were determined by HPLC method . The dye titration method which makes use of the reducing power of the vitamins and employs 2, 6-dichloroindophenol (DCIP) as the redox indicator for the determination of ascorbic acid was used for this determination of vitamin C (AOAC, 2005). About 5 g of the samples were weighed into 50 ml of distilled water in flasks; the solutions were filtered using filter papers. 5 ml each of the filtrates were taken and 1 ml of glacial acetic acid with 1 ml of chloroform was added to them. The mixtures were titrated with 2, 6 dichloroindophenol dye, to faint pink.

Statistical Analysis: All samples were analyzed in triplicates and subjected to statistical analysis. Results were subjected to analysis of variance (ANOVA) using SAS statistical software (Stata Corporation, Texas and USA). Multiple comparisons of means were done using the Duncan method and p-values p?0.05 were considered statistically significant. Data are expressed as milligram per 100/g wet samples

RESULTS

Percentage Proximate Composition: The values in Figure 1 represent the means and standard deviations of the p roximate compositions in the various samples. The highest value for crude protein content (30.56±0.12g/100g) was seen in the catfish egg, the least value (13.25±0.38g/100g) was recorded in the tilapia fish.

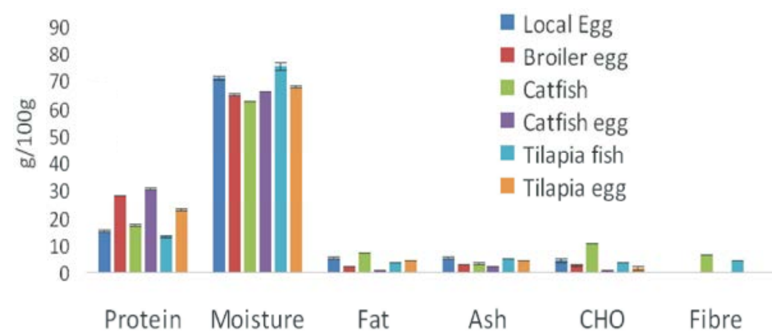

Fig. 1: Proximate Compositions of catfish, tilapia, fish Eggs (tilapia and catfish) and chickie eggs (local chicken and broiler)

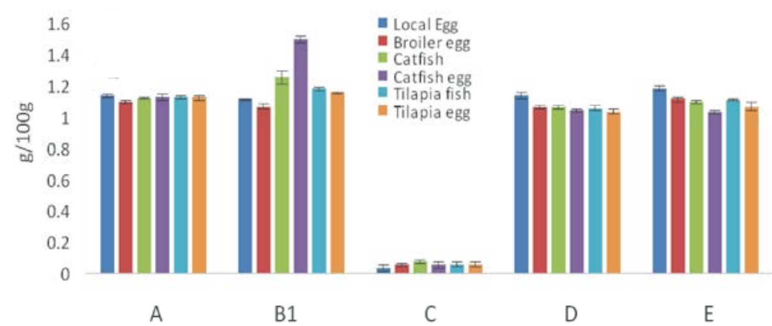

Fig. 2: Vitamin composition of catfish, tilapia, fish Eggs (tilapia and catfish) and Bird eggs (local and exotic chicken)

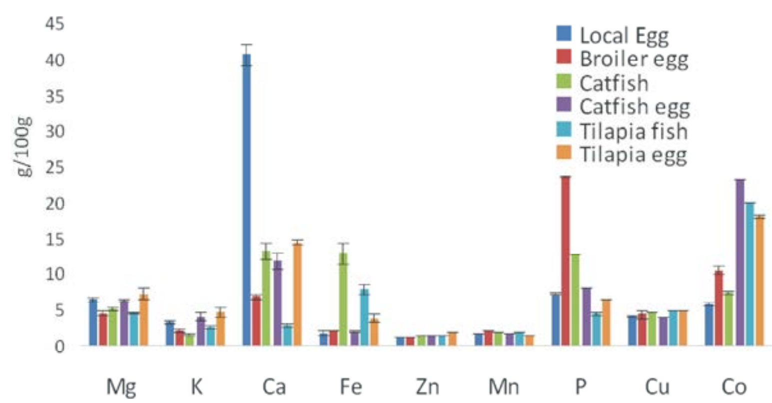

Fig. 3: Mineral composition of catfish, tilapia, fish Eggs (tilapia and catfish) and Bird eggs (local and exotic chicken)

The moisture content ranged from 74.93 ±1.36 g/100g for tilapia fish to 62.73±0.09 g/100g for catfish, although the differences between the samples were not statistically significant ($p<0.05$). The ash content ranges between 1.89±0.07 g/100g for catfish egg to 5.07±0.29 g/100g for local chicken egg. Surprisingly, the values for crude fat were seen to be highest in catfish (6.86±0.12g/100g) and least (0.53±0.15g/100g) catfish egg. In the same vein, carbohydrate was highest (10.41±0.16) in catfish and least (0.63±0.32) in its eggs. There was no crude fibre present in the various eggs, however, catfish was higher (6.23±0.04) in percentage crude fibre content than tilapia (4.36±0.11).

Vitamin Composition: Figure 2 shows the results of the vitamin composition of the various samples. There were no significant differences ($p>0.05$) in vitamin A across all the samples, whereas there amounts of vitamin C across the different samples were very low. However, catfish egg had the highest amount (1.49±0.02g/100g) of vitamin B_1, with broiler eggs having the least amount (1.06±0.01g/100g). Local chicken eggs had the highest amounts of vitamins D and E content while catfish egg and tilapia egg had relatively higher concentrations. Local eggs had the highest vitamin D content (1.13±0.01g/100g) Vitamin D, broiler egg and catfish had the same (1.06±0.01g/100g). The vitamin E content was relatively higher in local egg (1.18±0.01g/100g) while catfish egg had the least value (1.03±0.01g/100g).

Mineral Composition: The mean values and standard deviations of the minerals evaluated in the samples as shown in Figure 3. The highest value for calcium was seen in tilapia fish (40.56±1.45g/100g), while the least value was from local egg (2.7±0.17g/100g). Magnesium ranged from 4.43.0±0.29g/100g in broiler egg to 7.22±0.79g/100g in tilapia egg, while the highest amount of cobalt was observed in catfish egg (23.09±0.01g/100g) and the least in local egg (5.73±0.23g/100g). Potassium also ranges from 1.46±0.04g/100g in catfish to 4.60±0.60g/100g in tilapia egg.

On the other hand, the highest amount of phosphorus was observed in broiler egg (23.57±0.11g/100g) while the least amount was in tilapia fish(4.46±0.23g/100g). Iron was highest in catfish (12.77±1.44g/100g) and least in local egg (1.67±0.29g/100g). There was no significant difference ($p>0.05$) in the levels of manganese, zinc and copper in all the samples. Manganese composition was highest (7.22±0.79g/100g) in tilapia egg and least (4.43±0.29) in broiler egg, while zinc range from 1.84±0.06g/100g in tilapia egg to 0.31±0.01g/100g in catfish.

DISCUSSION

The need to carry out constant investigations in to the nutritional content of existing as well as emerging goods for human consumption cannot be over emphasized, hence the need to evaluate the nutritional contents of the eggs from two fish species in comparison to the flesh of the fishes as well as eggs from both local and exotic fowls. The results of our study showed some differences in the nutritional contents of both the fishes and their eggs. The nutritional composition of freshwater fish has been known to vary with species, sex, size, season and geographical location [14, 15] and this is found to be true also for the fishes' eggs.

Fish eggs contain necessary nutrients to support cellular growth and homeostasis during embryonic development [16]. Certain factors such as feed intake and sexual changes can influence the nutritional composition of fishes [17]. The present study was focused on species are popularly found fish markets in South Eastern Nigeria and are economically accessible not only in the region but all over Nigeria at large.

Protein was the highest nutrient recorded in all the samples. This is in accordance with most of the researches carried out on different eggs where percentage proteins were reported to be higher than even the fat contents [18, 19]. This is also in-line with the report of Kovac-Nolan *et al.* [20], who stated that protein forms the largest quantity of dry matter in fish. The fact that the highest percentage crude protein value was recorded in the catfish egg is a great revelation since fish consumers as well as breeders/aqua culturists have always seen fish eggs as wastes which could only serve as feed additives. Layman [21] had reported that sea and freshwater fishes are the most nutritious protein source. This performance of the catfish egg is so important owing to the fact that proteins are essential for normal body function, growth and maintenance of body tissue and hence is considered to be an important tool for the evaluation of biochemical and physiological standards of any organism [22].

The proximate composition of the tilapia was similar to that obtained by Osibona [23] except for differences in the protein levels. The range of protein for the tilapia was within the range reported by Palani *et al.* [24]. Protein, ash, vitamin B_1, vitamin C and vitamin D contents recorded in the catfish was similar to that obtained by many other researchers [25- 27]. Most macronutrients like calcium, magnesium, zinc, iron, copper and potassium were slightly different from result of previous studies by Saoud *et al.* [28]. The catfish which is a high lipid fish had lesser percentage moisture content than the low-lipid tilapia.

There was a huge difference in the value of crude fat observed in the catfish egg and the catfish. The difference could be due to water temperature difference, stage of life of the fish eggs, environmental salinity, food type and species as speculated by Shahina *et al.* [29]. The least percentage crude fat observed from the catfish egg as opposed to the highest percentage crude fat in the catfish among the all the samples studied proves another very important desirable attribute for this nutrient source above even fowl eggs and fishes. The fat content in the egg samples excluding the catfish eggs were relatively high [30, 31]. Therefore, consumers of catfish egg would not be prone to ingesting high level of cholesterol which may lead to cardiovascular disease which is contrary to a report that perceives eggs as agents of high cholesterol levels [32].

The percentage ash contents for all the samples studied were within the World Health standard as affirmed by Tawfik [33]. The presence of fibre only in the catfish and tilapia were not unexpected as eggs are not known to be good sources of fibre.

Results showed the fish eggs as compared to bird eggs and fishes contained appreciable concentrations of potassium, sodium, magnesium, calcium and phosphorus suggesting that these eggs could be used as good sources of minerals. The variations recorded in the concentration of the different mineral components in the samples examined could have been influenced by the concentration of these components available in the water body [34, 35] and the ability of the fish to absorb and convert the essential nutrients from the diet or the water bodies where they live [36, 37]. Other elements such as zinc, iron, cobalt, manganese and copper varied in concentration among the samples studied. Most of these microelements are equally important in trace amounts, but they tend to become harmful when their concentrations in the tissues exceed the metabolic demands [38, 39]. The vitamin C content of all the eggs species was very negligible, as well as crude fibre which was equally absent in all the egg species as supported by World Health Standard. The zinc, iron and manganese contents in this research for the samples are within the World Health standard.

The fishes, fish eggs and bird eggs were shown to be rich sources of vitamins A, B_1, D and E which have been proven to have useful effects on human health and metabolism [7- 9]. However, the catfish egg showed the highest concentration of vitamin B12 which further distinguishes it from all the other samples studied.

It could be observed from the study that the eggs of the catfish showed some exceptional qualities in percentage crude proteins, vitamin B1 and a unique low fat content while not lacking in any of the nutrients investigated apart from fibre. Therefore, such fish eggs should not be discarded nor undervalued by consumers but should rather be harnessed by nutritionists and even households as supplements and therapeutics against deficiency diseases.

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