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Research Article

COMPARISON OF PROXIMATE AND FATTY ACID COMPOSITION OF SHELL OF MARINE EDIBLE SHRIMPS, *HETEROCARPUS GIBBOSUS* (BATE, 1888) AND *ARISTEUS ALCOCKI* (RAMADAN, 1938)

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ABSTRACT

The present study was carried out to assess the proximate and fatty acid compositions of two edible marine shrimp's shell, *Aristeus alcocki* and *Heterocarpus gibbosus* collected from Mandapam coast, Tamil Nadu, India. The results of proximate composition showed the percentage of protein (3.12 mg/g), moisture (50.92 %), carbohydrate (1.29 mg/g), lipid (3.66 mg/g) and ash (19.56 %) contents were higher in shell of *H. gibbosus* compared to *A. alcock* (protein (2.14 mg/g), moisture (41.49 %), carbohydrate (1 mg/g), lipids (2.76 mg/g) and ash (16.10 %)). Likewise *H. gibbosus* contains fifteen fatty acids whereas *A. alcocki* contains twenty one fatty acids. The present study revealed that *H. gibbosus* and *A. alcocki* are having high saturated fatty acids and proximate composition which contribute to a good nutritional status.

Keywords: Shrimp shell, Proximate composition, Fatty acid, Nutritional status.

INTRODUCTION

Marine foods are great importance for their good nutritional value. Nutrients play a vital role in physical growth, development, maintenance of normal body function of physical activity and health. The knowledge of the biochemical composition of any edible organism is extremely important since the nutritive value is reflected in biochemical contents. Seafood products have attracted considerable attention as important protein sources of nutrients in the human diet (Vigneshpriya & Krishnaveni, 2016). In this connection, shrimps are one of the biggest and the most valuable food commodity traded worldwide. Shrimp is an extremely good source of protein and very low fat and calories, making it a healthy food choice for consumers. Shrimp is basically composed of water, lipid, and protein, which provides the nutritional value, functional aspects, and sensory characteristics of the flesh (Gokoglu *et al.*, 2008).

In addition, fat and essential polyunsaturated fatty acids (PUFA) contribute to shrimp dietary quality and sensory values. PUFAs play an essential role in the development of the nervous (brain), photoreception (vision) and reproductive systems (Horrocks & Yeo, 1999). PUFA are not only important for maintenance of the membrane cells but also important for the formation of prostaglandins in body which regulate inflammation and blood clotting. These fats are also needed to absorb fat-soluble vitamins such as A, D, E and K from food and it also regulate cholesterol metabolism in body (Jabeen & Chaudhry, 2011). The study concentrates on proximate and fatty acid composition of shrimp shell. Proximate composition in non-edible part determination involves analysis of moisture, protein, carbohydrates, lipid and ash contents. Shells have also been ground up for use in potions and for various medicinal uses throughout history.

In the present study, proximate composition of shells from two selected marine species namely *Heterocarpus gibbosus* and *Aristeus alcocki* were examined. These deep sea species are commercially important and commonly available along the South east coast of India. In aquaculture

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practices it is preferable to use shrimps shell as growth promoter with fish feed for the enhancement of growth, better feed efficiency and biochemical constituents of edible fishes. Shrimp shell is an excellent source of protein (50–65%, dry weight basis), nutritive components and enzymes (Fanimo *et al*., 2000; Heu *et al*., 2003). Therefore, using of such shrimp shells has drawn much interest from researchers in recent years.

Bearing all these in mind, present investigation was focused to study the proximate composition (such as protein, carbohydrate, moisture, lipids and ash) and fatty acid composition of shell wastes of shrimp *H. gibbosus* and *A. alcocki*. These unused wastes will pollute the environment and is hazardous to human population (Karuppasamy et al., 2016). To overcome these problems, these shell wastes can be utilized for the preparation of poultry feed, fish feed and also used as a fertilizer in the agricultural farm.

MATERIALS AND METHODS

Sample collection and preparation

Marine shrimps were collected from Mandapam landing centre, Southeast coast of India during November, 2016. They were transferred to the laboratory in ice boxes. Further species were taxonomically identified as *Aristeus alcocki* and *Heterocarpus gibbosus*. The study focused on the proximate composition of the non-edible part (shell waste). Hence exoskeletons (carapace and body shells) were peeled, oven dried at 95-105° C and ground into fine powder and stored until use. All the solvents used in the present study were of analytical grade.

Proximate composition

The moisture content (%) was estimated by subtracting the dry weight of the sample from the wet weight (APHA, 2005). Total protein (mg/g) content of the samples was estimated using bovine serum albumin as a standard (Lowry *et al*., 1951). Carbohydrate (mg/g) content was estimated using the methodology of Dubois *et al*. (1956) with glucose as a standard. Lipid (%) content was accessed by adopting Folch *et al*. (1957) method. To determine the ash content (APHA, 2005), samples were incinerated in muffle furnace at 600° C for 4 hours. All the parameters were determined (in triplicates) on dry weight basis.

Fatty acid profile (GCMS)

Total lipid was extracted from (5g) sample using the chloroform: methanol (2:1, v/v; containing BHT 0.1mg/100g) method (Folch *et al*., 1957). The lipids were trans- esterified using 2ml of methanol and 3ml of freshly prepared 5% methanolic H_2SO_4 were added. After mixing, the contents were heated for 2 hrs in a water bath at 70° C. Finally 1ml of hexane was added after cooling the sample. The Fatty Acid Methyl Ester (FAME) analysis was performed by the Clarus 680 GC (Perkin Elmer) equipped with a fused silica column, packed with Elite-5MS (5% biphenyl 95% dimethylpolysiloxane, 30 m × 0.25 mm ID × 250μm df) and Helium was used as the carrier gas with a constant flow of 1.1 ml/min. The conditions used for GC analysis was the injector temperature maintained at 300ºC during the run period and1μL of extract sample injected into the instrument oven temperature was kept constant at 100ºC for 2 min and was then increased to 250ºC at a rate of 10ºC/min and to 280ºC at 30ºC/min. The mass detector conditions were: transfer line temperature 240 °C; ion source temperature 240 °C; and ionization mode electron impact at 70 ev, a scan time 0.2 sec and scan interval of 0.1 sec. The compounds were identified by comparison with the database of spectrum of known components stored in the GC-MS NIST (2008) library.

Statistical analysis

The data were subjected to statistical analysis ($P < 0.05$) by one way Analysis of Variance (ANOVA) using STATISTICA software (StatSoft, 1999).

RESULTS AND DISCUSSION

In general the proximate composition is well known as proportion composition of basic elements such as protein, carbohydrates, lipids, ash and moisture. The shrimp shell waste of the *H. gibbosus* and *A. alcocki* showed the moisture content of about 41% and 51%. *H. gibbosus* showed the high moisture content when compared to the *Aristeus alcocki* (Table 1 and Figure 1). Moisture is required for normal functioning of many biological molecules. It is present in two forms, bound to the protein and in the free form (Stancheva *et al*., 2013). The percentage of water is a good indicator of its relative content of energy, proteins and lipids (Olagunju *et al*., 2012).

The proximate study of two marine shrimp shell, *H. gibbosus* and *A. alcocki* showed significance for protein ($P < 0.05$). The results revealed higher protein content 3.12mg/g in shell of *A. alcocki* and 2.4mg/g in *H. gibbosus* shell waste (table 1 and Figure 2). Protein plays an important role in the maintenance of blood glucose level. It provides all essential amino acids to human in an appropriate amount for optional protein synthesis (El Shehawy *et al*., 2016). The quantity of protein in shrimp is largely influenced by the extent of fat and water content (Dinakaran *et al*., 2009). The high protein content in the lowest size groups may be attributed to increased protein synthesis during the active growth phase as it has been observed elsewhere in shrimp and mantis shrimps (Tanuja, 1996).

The shrimp shells contains low level of carbohydrate when compared to protein (Table 1 and Figure 3). *H. gibbosus* contain 1 mg/g of carbohydrate whereas *A. alcocki* contain 1.29 mg/g of carbohydrate. Thus the results reveled the significantly high value of carbohydrate in *A. alcocki* when compared with *H. gibbosus*. The low carbohydrate content recorded in this study agrees with Okuzumi and Fujii (2000) who stated that carbohydrate constitute only a minor percentage of total biochemical composition. Carbohydrates are utilized by the cells mainly in the form of glucose. A major part of dietary glucose is converted to glycogen for storage. Carbohydrates exhibited an inverse relationship with protein.

Table 1. Proximate composition in shells of *Heterocarpus gibbosus* and *Aristeus alcocki*.

Proximate composition	Shell	
	Heterocarpus gibbosus	*Aristeus alcocki*
Moisture (%)	41.49 ± 0.55	50.92 ± 0.66
Protein (mg/g)	2.14 ±1.00	3.12 ± 0.57
Carbohydrates (mg/g)	1.00 ± 0.13	1.29 ± 0.41
Lipids (mg/g)	2.76 ± 0.23	3.66 ± 0.32
Ash (%)	16.10 ±1.37	19.56 ± 1.27

*Results are the mean value of triplicates ± standard deviation at p<0.05.

Table 2. Fatty acid profile (g/100g) of *Heterocarpus gibbosus.*

Fatty acid profile	Area%
Methanesulfonyl Chloride	0.29
Benzoyl Isothiocyanate	8.29
Tetradecanoic Acid, Ethyl Ester	0.77
Ethyl 13-Methyl-Tetradecanoate	1.13
Hexadecanoic Acid, Methyl Ester	1.93
Hexadecanoic Acid, Ethyl Ester	27.61
Heptadecanoic Acid, Ethyl Ester	0.88
Octadecanoic Acid, Ethyl Ester	3.27
Ethyl Oleate	0.42
Eicosanoic Acid, Ethyl Ester	0.37
Tetradecanoic Acid	2.42
Pentadecanoic Acid	3.49
Hexacosanoic Acid, Methyl Ester	3.13
Docosanoic Acid, Ethyl Ester	0.30
N-Hexadecanoic Acid	45.71

Table 3. Fatty acid profile (g/100g) of *Aristeus Alcocki*.

Fatty acid profile	Area%
Butanedioic Acid, Diethyl Ester	0.23
Diethyl Adipate	0.20
Tetradecanoic Acid, Ethyl Ester	1.87
Ethyl 13-Methyl-Tetradecanoate	1.53
Diethyl Azelate	0.28
Hexadecanoic Acid, Methyl Ester	1.16
Hexadecanoic Acid, Ethyl Ester	29.79
Ethyl 15-Methyl-Hexadecanoate	0.67
Ethyl 15-Methyl-Hexadecanoate	0.43
Ethyl 3,7,11,15Tetramethylhexadecanoate	0.45
Heptadecanoic Acid, Ethyl Ester	1.45
Methyl Stearate	0.34
Octadecanoic Acid, Ethyl Ester	10.37
9-Octadecenoic Acid (Z)-, Ethyl Ester	1.67
Nonadecanoic Acid, Ethyl Ester	0.24
Eicosanoic Acid, Ethyl Ester	0.41
Tetradecanoic Acid	1.58
Pentadecanoic Acid	1.21
N-Hexadecanoic Acid	35.45
Heptadecanoic Acid	0.65
Octadecanoic Acid	10.02

Fatty acids profile

Table 2 and 3 shows the fatty acid composition of shell of *A. alcocki* and *H. gibbosus*. *A. alcocki* showed large number of fatty acids when compared to *H. gibbosus*. n-Hexadecanoic acid was present in higher level in both the samples. In this, PUFA (poly unsaturated fatty acid) contents are generally higher than the SFA (saturated fatty acid). A minimum value of PUFA/SFA ratio recommended as 0.45 to prevent cardiovascular diseases. Tetradecanoic acid, ethyl ester (1.87) showed the higher percentage in *A. alcocki* when compared to *H. gibbosus*. Higher level of Pentadecanoic acid (1.21), Tetradecanoic acid (1.58) and Hexacosanoic acid, methyl ester (1.93) were found in *H. gibbosus* than *A. alcocki* shell waste. These fatty acids also reduce the pain and swelling. (Eswar *et al*., 2014) observed the fatty acid composition in puffer fish. Omega-3 fatty acids have anti-inflammatory and anti-coagulant properties as well as many other important health benefits. In addition, DHA and EPA, belonging to n-3 fatty acids family are considered as essential. The arachidonic acid (n-6) is a precursor of prostaglandin hormone, which is essential for reproduction and vitellogenesis (Bell & Sargent, 2003). Murphy & Ehrendorfer, (1987) reported that similar fatty acid composition result in Jinga shrimp. Both the species contain high value of polyunsaturated fatty acid (PUFA) and monounsaturated fatty acid (MUFA). The digestive lipases might have a higher activity toward certain fatty acids, and the rate and efficiency of absorption differ from each other (Gunasekera *et al*., 2002). However, the *A. alcocki* had greater quantity of these fatty acids than *H. gibbosus* which indicates their nutritional value.

CONCLUSION

Seafoods are excellent sources of high quality proteins, lipids and carbohydrates which are superior to those in meat and poultry. The present study revealed that *H. gibbosus* and *A. alcocki* shells are having high biochemical contents and saturated fatty acids which contribute to a good nutritional status. Thus the proximate and fatty acid values obtained from this study would be very useful to help the consumers in choosing shells from shrimp based on their nutritional values besides providing a food composition database. The nutrient rich shrimp shells could be recommended for the preparation of fish feed, poultry feed and also can be utilized as a fertilizer in the agricultural farm. Finally, if scientific opinion joined with the knowledge of fish farmers and industry, the supply of protein rich food to the burgeoning population as well as the economic efficiency of the country will certainly improve a lot.

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