World Journal of Fish and Marine Sciences 4 (2): 218-222, 2012
ISSN 2078-4589

DOI: 10.5829/idosi.wjfms.2012.04.02.61223

Studies on the Proximal Composition of Freshwater Prawns *Macrobrachium rosenbergii* and *Macrobrachium malcomsonii*

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Abstract: Studies on the proximate composition of freshwater prawn *Macrobrachium malcomsonii* and *Macrobrachium rosenbergii* were conducted. The present study indicates the proximate composition including protein, carbohydrates, lipid, amino acid and fatty acids of two species clearly demonstrate that *M. rosenbergii* is possessing relatively high amounts of organic constituents and highly nutritious compared to *M. malcomsonii*. Considering the results obtained in the present study in light of nutritional point of view, *M. rosenbergii* can be very well used as food so that a better choice for commercial culture than *M. malcomsonii*.

Key words:*Macrobrachium rosenbergii* % *Macrobrachium malcomsonii* % Proximate Composition % Fatty Acids % Linoleic Acid

INTRODUCTION

The main aim of the aquaculture has been to increase the production of natural and wild candidate species for culture in conditioned environs. The culture activity indicates that the intervention in the rearing process by exploiting the water bodies to enhance the production through regulated conditions including control of water quality, feeding management techniques and control of disease outbreaks,…etc. In India, the coastal shrimp farming industry has suffered serious losses due to outbreaks of viral diseases and its growth has also been limited through legal constraints, such as the introduction of legislation regulating development in the coastal zone. Recently freshwater prawn culture has been recognized as an alternative, eco-friendly and sustainable system for prawn production [1-5]. Freshwater farming is popular in Southeast Asian Countries but is has not gained much progress in India until recently, although freshwater prawns are high priced product and have high market demand in both domestic and export markets. In India the largest species that are of interest for aquaculture are, of the 100 species of freshwater prawns belonging to the genus *Macrobrachium* recorded worldwide, 40 species are known to be distributed in India. The *Macrobrachium spp.* grow to more than 15 g are regarded as commercially important. Until recently the freshwater prawn farming has been practiced by adopting traditional methods, where the young ones collected from the wild and reared in farms but now artificial seed collection has been introduced for successful rearing of larval stages of *M. rosenbergii* and *M. malcomsonii*. In India the major commercial species are *M. rosenbergii* and *M. malcomsonii*. These species also shows compatibility for polyculture [1, 2] and attains relatively larger sizes up to 200 g in shorter span of time. Therefore, farming of *Macrobrachium spp*. has attracted more attention in recent years [6- 9]. The farmed area utilized for freshwater prawn production also significantly increased from 12,022 ha to 34,650 ha and three fold increase in cultivation in just 2-3 years. Determination of proximate composition in freshwater prawns provide the information about the main organic and inorganic constituents includes proteins, amino acids, carbohydrates, lipids and other substances like vitamins and minerals. Possessing of relatively high quantity of certain components of body composition including proteins, fat, amino acids etc., are the indicators of the existence of good physiological biochemical condition. With this background in the present study, an attempt has been made to evaluate the proximate composition of muscle tissue includes estimation of proteins, amino acids, carbohydrates, lipids etc. in the two major species of freshwater culture prawns *Machrobrachium rosenbergii* and *M. malcomsonii*.

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MATERIALS AND METHODS

Healthy adult prawns of *Macrobrachium malcomsonii* and *M. rosenberii* were captured from Alluru of Nellore district. Only adult Male prawns were selected for analysis in the present investigation (Table, 1).

Estimation of Proximate Composition: The prawns were sacrificed and muscle tissue was sampled. The samples were immediately processed for analysis for proximate composition including protein, carbohydrate, lipid, amino acids, fatty acids, moisture and ash and also for analyzing the profiles of amino acids and fatty acids. The total protein [10], total carbohydrate [11], total lipid [12, 13], total amino acids [14] and the Fatty acids [15] were estimated. The pre weighed wet tissue samples were dried at 40°C to measure the moisture content. The dried tissue sample was subjected to 600°C under Muffle Furnace to measure the ash content.

Analysis of Profiles of Amino Acids: The individual amino acids were determined in muscle tissue using LKB Automatic Amino acid Analyzer. Amino acids were extracted into ethanol medium and were subsequently dissolved in citrate buffer (0.1M) and 0.5 ml was loaded for quantification. Suitable standard also run simultaneously. All the conditions pertaining to the quantification were standardized [16].

Analysis of Fatty Acids Profiles: The profiles of fatty acids were estimated following gas chromatographic (GC) method [17]. Fatty acids were obtained from lipids by Saponification using NaOH dissolved in methanol H_2O mixture (Hydrolyis with alkali). They were methylated into fatty acid methyl ester using HCl and Methanol mixture, which can be easily identified by gas Chromatography.

Table 1: Morphometric details of adult Male freshwater prawns *M. malcomsonii* and *M. rosenbergii*

Parameter	M. Malcomsonii	M. Rosenbergii
Body length (cm)	12.41±1.12 PDC	16.58±1.88+33.60
Body weight (g)	94.38±7.41 PDC	138.95 ±10.12+47.22

Each value is Mean ± SD of 6 individual observations.

PDC: Percent deviation over control i.e *M. malcomsonii* values.

The values are statistically significant at P<0.001.

The fatty acid methyl ester was separated using mixture of hexane and anhydrous diethyl ether. For the organic phase aqueous NaOH was used as base wash and the upper organic larger was separated. 3 ìl of sample was injected and analyzed using Chemito 8610 Gas chromatography, with BPX 70 capillary column and frame ionization dictator. Nitrogen was used as carrier gas. The chromatogram was used for calculation. Standard fatty acids ware analyzed simultaneously. Based on the retention time and peak area, the standard fatty acids, each fatty acid in the unknown sample was identified. The data obtained was subjected to statistical analysis by adopting student‘t’ test.

RESULTS AND DISCUSSION

The male freshwater prawns of *Macrobrachium malcomsonii* and *M. rosenbergii* were captured and body weight and length were recorded and presented in Table, 1. The proximate composition of muscle tissues of above said two prawn species were analyzed and presented in Table, 2. The profiles of amino acids detected through TLC analysis from the muscle of the prawns were presented in Table, 3. Amino acids including Arginine, Histidine, Phenylalanine, Leucine, Tyrosine, Tryptophan, Methionine, Valine, Threonine, Glutamine, Glycine and Proline were analyzed. The profiles of fatty acids were detected in the muscle tissue of prawns and presented in Table, 4. The fatty acids including palmitic acid (16:0), Oleic acid (16:1), Linoleic acid (18:2), Linolenic acid (18:3), Ecosapentaenoic acid (20:5), Decosahexanoic acid (22:5), Arachidic acid (20:0) and Arachidonic acid (20:4) were detected and qualified.

Table 2: Details of proximate composition of organic constituents of Muscle tissue of freshwater prawns *M. malcomsonii* and *M. rosenbergii*

Parameter	M. Malcomsonii	M Rosenbergii
Protein	29.38±1.12 PDC	42.45±1.88+44.49
Carbohydrate	7.52±0.83PDC	10.22±1.15+35.90
Lipid	3.38±0.29 PDC	4.49±0.23+32.84
Amino acids	21.18±1.48 PDC	30.79 ±2.15+45.37
Fatty acids	3.77±0.12 PDC	5.45±0.28+44.56
Moisture	80.34±2.95 PDC	81.38±3.15+.29 NS
Ash	7.38±0.73 PDC	8.49±0.84+15.04

Each value is Mean ± SD of 6 individual observations.

PDC: Percent deviation over control i.e *M. malcomsonii* values.

The values are statistically significant at P<0.001 except NS: Not Significant.

Table 3: Muscle amino acid profiles of freshwater prawns *M. malcomsonii* and *M. rosenbergii*

Amino acid	M. Malcomsonii	M. Rosenbergii
Arginine	0.68±0.03 PDC	0.89±0.05+30.88
Histidine	1.79±0.12 PDC	2.38±0.18+32.96
Phenylalanine	0.54±0.04 PDC	0.77±0.06+42.59
Leucine	0.68±0.06 PDC	0.87±0.08+27.94
Tyrosine	1.68±0.12 PDC	2.23±0.18+32.74
Tryptophane	1.69±0.13 PDC	2.34±0.18+38.46
Methionine	2.03±0.10 PDC	2.37±0.13+16.75
Valine	0.68±0.07 PDC	0.95±0.10+339.71
Threonine	1.12±0.08 PDC	1.39±0.12+24.11
Glutamine	0.93±0.05 PDC	1.13±0.12+21.51
Glycine	1.13±0.12 PDC	1.79±0.16 +58.40
Proline	0.88±0.06 PDC	1.12±0.10+27.27

The values are expressed as g/100 g wet weight of tissue.

Each value is Mean ± SD of 6 individual observations.

PDC: Percent deviation over control i.e *M. malcomsonii* values.

The values are statistically significant at P<0.001.

Table. 4: Muscle tissue fatty acid profiles in freshwater prawns *M. malcomsonii and M. rosenbergii*

Fatty acid	M. Malcomsonii	M. Rosenbergii
Palmitic acid (16:0)	641.18±18.44 PDC	835.35±25.79+30.28
Oleicacid (16:1)	589.92±19.42 PDC	875.18±28.45+48.36
Linoleic acid (18:2)	385.41±12.40 PDC	582.45±20.14+51.12
Linolenic aicd (18:3)	130.14±2.85 PDC	142.17±5.75+9.24 NS
Ecosa pentaenoic (20:5)	385.14±10.15 PDC	540.18±12.72+40.26
Decosahexanoic acid (22:5)	103.45±3.38 PDC	138.14±6.02+33.53
Arachidic acid (20:0)	85.49±2.14 PDC	112.14±3.72+31.17
Arachidonic acid (20:4)	52.95±1.04 PDC	78.35±2.72+47.96

Values are expressed as mg/100 g wet weight of tissue.

Each value is Mean ± SD of 6 individual observations.

PDC: Percent deviation over control i.e *M. malcomsonii* values.

The values are statistically significant at P<0.001 except NS: Not Significant.

Biochemical composition of edible crustaceans is considered to be an important aspect. Several edible crustaceans constitute one of the major sources of nutrient food materials for human beings and form one of the key points of food chain cycle. In general several crustaceans which are available in the local market for human consumption are very delicious and possess relatively good amount of protein and amino acids, along with other nutrient substances. The class of edible Crustaceans including prawns belongs to *Penaeids* and *Palaemonids*, both are highly nutritious with good source of proteins. Moreover the fiber content present in prawns has got a nutritional advantage that it will assess in the reduction of constipation and other related problems in humans. Generally the nutritive values of Crustaceans including the prawns were demonstrated through the biochemical composition of protein content, carbohydrate, lipid, amino acids, fatty acids, vitamins, minerals etc. Therefore by keeping the above background the present investigation is aimed to understand the biochemical composition of freshwater prawns such as *M. malcomsonii* and *M. rosenbergii*. In any culture activity of any candidate species for aquaculture, determination of length-weight relationship data is most important, which will provide very useful information in market oriented farm management [18]. It has been already reported by several authors that in the case of freshwater prawns differential growth patterns in both male and female sex especially *Macrobrachium sps*. The male species relatively grow faster when compare to females. The samples collected were of marketable size prawns. Generally the growth of freshwater prawns were depended on several factors including age and sex, rate and frequency of feeding, quality of food provided, disease control management, control of environmental factors, stocking density, temperature, oxygen content, water quality management, elimination of waste products, above all influence and expression of genetic materials [19] and the above factors will influence the frequency of molting in fresh water prawns, which subsequently influence the productivity of fresh water farm/culture. The frequency of molting facilitates the increase in weight of prawns. It has been already established that in freshwater prawns faster growth rates are associated with higher food concentration and followed consumption at higher temperatures.

The occurrence of high protein and lipid contents in the tissues of prawns reflects that the tissue is highly rich in energy containing substances. Several authors also emphasized that, the quantities of certain constituents vary considerably in different stages of life cycle of prawns and also differences are observed within genera to genera, species to species, size, sex and condition in the life cycle, feeding season physical activity and reproductive stage… etc [1,19- 24].

In the present investigation it is very clear that the two species of prawns selected are showing differential body length and weight. *M. malcomsonii* is showing relatively less growth rates compared to *M. rosenbergii*. It was already established that *M. rosenbergii* appear to record high growth rates compare to other species among freshwater prawns. The results obtained in the present investigation also in absolute concurrence with the earlier reports. The proximate composition values of muscle

tissue also clearly depicts that the values are relatively higher in M. *rosenbergii* compared to *M. malcomsonii*. Due to high amount of organic constituents it is very clear that these substances playing a vital role in inducing more growth potentials in the *M. rosenbergii* compared to *M. malcomsonii*. The carbohydrates are considered to be the first among the organic substances to be utilized for generation of energy in the cell [25].

Generally the carbohydrates serve as precursors for the production /synthesis of amino acids and certain nutrients, which in turn play an important role in the metabolism for inducing growth potential in animals including crustaceans. Generally the lipids contents are known to play an important role not only in the production of energy at cellular level and also play a vital role in the maintenance of structural integrity of the cellular and sub cellular membranes. The lipid also act as vehicles for the transport of lipids soluble vitamins A, D, E and K [23,25]. In the case of crustaceans both hepatopancreas and muscle tissues were the primary tissues for the storage of lipids. But hepatopancreas is the main lipid storage organ in the form of triglycerides; phospholipids etc., but in the case of muscle tissue prawns phospholipids are the principal sources of lipids reserves [26]. In general muscle tissue is recorded with relatively low levels of lipids substances and their derivatives. But in crustaceans the lipids are known to play several roles such as major component of yolk in decapoda crustaceans, lipids are stored in oocytes derived from hepatopancreas and certain species physiological activates related to reproduction and growth in crustaceans [27] and precursor for endocrine hormones. Several authors reported that the incorporation of certain fatty acid in the diet produced highest growth rates and best survival rates in the culture activities of several candidate species [28,29]. The results obtained in the present study also clearly indicates that in the presence of n-3 PUFA, particularly linoleic acid, EPA and DHA induced better growth rates in both the species of *Macrobrachium*. The fatty acid play an important role in the maintenance of membrane permeability [30] acts as precursor for prostaglandins [31] which in turn control reproduction and vitallogenesis. The existence of relatively high quality fatty acids in both the species of *Macrobrachium* indicates their nutritional value and physiological significance.

The present investigation may be concluded that the variations in muscle constituents of male *Macrobrachium malcomsonii* and *Macrobrachium rosenbergii* indicates that the dynamics of protein, lipids, carbohydrates and other important biological components are involved in energy metabolism and regulated by several factors. From the data obtained *M. malcomsonii* and *M. rosenbergii* are considered to be very good species for consumption as they are possessing high amount of proteins and amino acids and essential fatty acids.

ACKNOWLEDGEMENTS

The Authors thank UGC, New Delhi for the financial support to Prof. MSR.

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