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Research Article

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Nutritional studies on marine mollusk *Pleuroploca trapezium* (Gastropoda: Fasciolariidae) from Tuticorin coastal waters

T. Prem Anand[1], C. Chellaram[1], M. Chandrika[2], C. Galdis Rajamalar[2], A. Nafiza Parveen[1] and Felicia Shanthini[3*]

[1]*Department of Biomedical Engineering, Vel Tech Multitech Engineering College, Chennai, Tamilnadu, India*
[2]*Department of Chemistry, Vel Tech Multitech Engineering College, Chennai, Tamilnadu, India*
[3]*Department of Marine Science and Coastal Resource Management, Madras Christian College, Chennai, Tamilnadu, India*

ABSTRACT

The nutritional quality of Pleuroploca trapezium meat was assessed using feeding trails on albino rats. Rats fed with standard casein diet were kept as control. In the test animals, the Protein Efficiency Ratio (PER), assimilation, assimilation efficiency, consumption efficiency and growth efficiency were higher than in the control animals. Protein and carbohydrate digestibility were also higher in the test animals and this indicates the higher bioavailability of these nutrients in the P. trapezium meat. The present study highlights the nutritional quality of P. trapezium meat as an important food source that can be utilized just like other seafood. The different value added products that have been developed in the present study have good shelf life and nutritive value.

Key words: Marine mollusc, Nutritional value, Gulf of Mannar

INTRODUCTION

The expanding world population stresses the need for the identification of strategies to solve the complex problem of inadequacy of food. In turn to this seeking alternative but nutritionally good sources of food. Since the nutritional superiority of sea foods is well established, the increasing demand for good quality protein for the ever increasing population has led to increasing exploitation of the marine living resources [1-3]. The meat of the gastropod *Pleuroploca trapezium* is delicious but is not familiar seafood and is consumed only by a small section of the fishing population. Even though gastropod meat has considerable nutrients, the unpopularity of the meat among the local population is mainly due to the mindset of the people rather than their palatability. The need to provide scientific facts to augment the arguments placed before the consumer is imperative to break their prejudice, and to encourage them to consume the available protein sources. As there is an increasing demand for ready to serve and ready to cook products from seafood, the work regarding products development using *P. trapezium* meat gain significance in the present scenario.

Nutritional values of Oil Sardines, Pink Perch mince, Shrimp extract powder, Squilla [4,5], Yellow Clams [6] and Antarctic Krill [7] have been studied using albino rats. The present study was made to understand the nutritional quality of the meat of *Pleuroploca trapezium* using feeding trials on albino rats and the results have been compared with a standard casein control diet.

EXPERIMENTAL SECTION

Processing of raw meat

Fresh raw meat of *P. trapezium* was procured from the shell and meat dealer and brought to the laboratory in an icebox. They were cleaned and washed thoroughly in potable water. It was then cut into thin slices and deodourised

by the method of Sen and Rao (1965)[8] as follows: The meat was cooked for 5 min in equal amount of pH5.5 adjusted water by the addition of orthophosphoric acid and drained by pressing. The meat was again dispersed in hot water at pH 5.5 and allowed to boil for 5 min. Draining and boiling was repeated for two more times, and the meat thus deodourised was drained, cooled and dried in a mechanical drier at 50-60°C for 2 days and powdered using a pulveriser. This meat powder was used for the preparation of test diet.

Preparation of control and test diets

The control and test diets were prepared using the ingredients given in Table 1 following the method given by George and Mathew (1996)[6]. All the ingredients were mixed together with the addition of water and made into small balls and stored at -18°C. The principal difference between the test and control diet was that in the control diet casein was added as the standard reference protein and in the test diet it was substituted with *P. trapezium* meat. Vitamin mixtures are, Vit A - 5000 IU, Vit D_3 - 400 IU, Vit E - 15 mg, Vit B_1 - 5 mg, Vit B_2 - 5 mg, Nicotinamide - 45 mg, D-Panthenol - 5 mg, Vit B_6 - 2 mg, Vit C -75 mg, Folic acid -1000 µg and Vit B_{12} - 5 µg. The Salt mixture percentages are K2HPO4 – 30, KCl - 9.4, $MgSO_4$ - 14.8, $FeSO_4$. H_2O - 1.4, $Ca_3(PO_4)_2$ -27.4, $MnSO_4$. 7 H_2O - 0.2 and $CaCO_3$ -16.8.

Proximate composition analysis of the diets

The proximate composition of the diets such as protein was estimated by employing Biuret method of Raymont *et al.* (1964) [9], total carbohydrate and lipid were estimated by the method of Dubois *et al*. (1956) [10] and Bligh and Dyer (1959) [11] respectively.

Feeding experiment

The feeding trial was also carried out by the method of George and Mathew (1996)[6]. .Ten male weaning albino rats having similar mean weights were purchased from local market and housed individually in cages having wire mesh bottoms. Before the start of the experiment, rats were weighed and their initial weights were noted. Five were kept as control and were fed with casein diet, while the other five test rats were fed with test diet. Feed and water were supplied *ad libitum*. The unconsumed feed and fecal matter were removed separately every day and weighed and the feed consumption was estimated. The daily food intake and weekly increase in body weights were recorded for 28 days and the growth rate was studied. Production, food consumption, assimilation, assimilation efficiency, metabolism, gross growth efficiency, net growth efficiency, relative growth rate and consumption efficiency were calculated using the following formulae.

Production : Final weight – Initial weight

Food Consumed : Food given – Uneaten food

Assimilation : Food consumed – Faeces

$$\text{Assimilation Efficiency} \quad \frac{\text{Assimilation}}{\text{Food Consumed}} \times 100$$

Metabolism Assimilation – Production

$$\text{Gross growth efficiency} : \quad \frac{\text{Production}}{\text{Food Consumed}} \times 100$$

$$\text{Net growth efficiency} : \quad \frac{\text{Production}}{\text{Assimilation}} \times 100$$

Relative Growth rate : Production/Initial weight / No. of animals / No. of days

Consumption efficiency : Consumption / Initial weight / No. of animals / No. of days

Protein Efficiency Ratio (PER) of *P. trapezium* meat protein was measured in rats at 4 weeks. PER is an expression, which relates the gram of weight gained to the grams of crude protein fed according to the formula

PER is described by the equation

$$\text{PER:} \quad \frac{\text{Increase in the mass of animal produced (wet wt.)}}{\text{Mass of protein in feed (dry wt.)}}$$

$$\text{FCR:} \quad \frac{\text{Mass of food consumed (dry)}}{\text{Increase of mass of animal produced (wet)}}$$

Apparent protein, carbohydrate and lipid digestibility were estimated using the formula:

$$\text{Apparent nutrient digestibility (\%):} \quad \frac{\text{Nutrient in feed} - \text{Nutrient in excreta}}{\text{Nutrient in feed}}$$

The animals were also monitored for any abnormal toxic/deficiency symptoms.

RESULTS

The proximate composition of test and control diet is given in Table 2. Feeding trials showed that the rats consumed the formulated feeds in good quantities. There was no rejection by the rats for the feeds containing *Pleuroploca* meat protein and absolutely no unhealthy symptoms of deficiency disease or abnormal toxicities were observed in the rats throughout the experimental period.

Table 3 gives an account of weight gain, average food intake, PER and FCR of rats fed on test and control diet. The average food intake was 163.325 g and 170.095 g in rats fed with control and test diets, respectively, and average weight gain was 76.4 g and 77.8 g in rats fed with control and test diets. The Protein Efficiency Ratio (PER) was only 2.915 in control rats, whereas in the rats fed with the test diet it was 3.243. The average Food Conversion Ratio (FCR) of test diet was 2.909, whereas in control diet it was 4.4.

The average values of assimilation, assimilation efficiency, relative growth rate, metabolism, consumption efficiency, gross growth efficiency and net growth efficiency of the rats fed with control and test diets are given in Table 4. The average assimilation of control feed was 91.162 whereas for test feed it was 99.668. The assimilation efficiency was 93.587 and 95.356 in the control and test diets, respectively. The average relative growth rate was 0.0159 in control rats and 0.0222 in test rats. Metabolism was slightly lower in the rats fed with test diet than in the control and it was 64.306 in control rats and 63.456 in test rats. The rats fed with control diet had a consumption efficiency of 0.052, whereas in those fed with test diet it was 0.0912. The average gross growth efficiency of test rats was high (34.709) compared to that of control rats (26.116) and also the average net growth efficiency was higher (36.398) in test rats than the control rats (27.77).

The results of the apparent nutrient digestibility of the control and test group are given in Table 5. The apparent protein digestibility of the test group was 95.35% and control group was 93.81%. The apparent lipid digestibility of rats fed with test and control diet was 93.39 and 98.84% respectively, and for carbohydrate digestibility it was 98.88 and 97.669% respectively for test and control rats.

Table 1. Percentage composition of diet

S. No	Ingredients	Control	Test
1	Casein	12.60	-
2	*Pleuroploca* meat powder	-	18.2
3	Refined groundnut oil	7.0	7.0
4	Vitamin mixture	1.0	1.0
5	Salt mixture	2.0	2.0
6	Dextrose	25.0	25.0
7	Corn starch	52.4	46.8

Table 2. Proximate composition of diet

S. No	Parameters	Control	Test
1	Protein %	16.044	14.104
2	Carbohydrate %	11.446	12.23
3	Lipid %	2.84	2.98

Table 3. Average weight gain, average food intake and Protein Efficiency Ratio and Food Conversion Ratio of rats fed for 28 days on test and control diet

S. No	Parameter	Control	Test
1	Average weight gain (g)	29	21.86
2	Average food Intake (g)	76.4	77.8
3	Average food Intake (g)	163.325	170.095
4	Average protein consumed (g)	26.203	23.99
5	Protein Efficiency Ratio (PER)	2.915	3.243
6	Food Conversion Ratio (FCR)	4.4	2.909

Table 4. Average values of assimilation, assimilation efficiency, relative growth rate, metabolism, consumption efficiency, gross growth efficiency and net growth efficiency

S. No	Parameter	Control	Test
1	Assimilation (%)	91.162	99.668
2	Assimilation efficiency (%)	93.587	95.356
3	Relative growth rate	0.0159	0.0222
4	Metabolism	64.306	63.456
5	Consumption efficiency	0.052	0.0912
6	Gross growth efficiency (%)	26.116	34.709
	Net growth efficiency (%)	27.77	36.398

Table 5. Apparent nutrient digestibility (%) of rats fed with control and test diets

S. No	Apparent nutrient digestibility	Control	Test
1	Protein digestibility %	93.81	95.35
2	Carbohydrate digestibility %	97.669	98.88
3	Lipid digestibility %	98.84	93.39

DISCUSSION

The healthy state of the test animals were observed throughout the experimental period of our study which is well supported by the similar findings of Raghunath *et al*. (1994) [12] who observed no uu toward symptoms during the feeding trials of albino rats with shrimp extract powder and krill. . However, Nair et al. (1987) [13] reported that in rats fed with water-soluble nitrogenous fractions of squilla their coats turned rough, sticky and brownish and alopecia was also noticed within 24-28 h of intake of the diet. Further stunted growth and slight diarrhea were also noted. In the case of rats fed with whole protein powder of squilla, alopecia developed and other adverse symptoms were noticed on the skin after 15 to 20 days of feeding (Nair *et al*., 1987) [13]

In the present study, the average food intake and average weight gain were more in the rats fed with *Pleuroploca* meat powder than in the casein diet. Similar result was observed by George and Mathew (1996) where diet containing clam meat induced marginally higher growth rates than the standard casein diet. Mathew *et al*. (1982)[8] reported that the intake of squilla protein, casein or a mixture of both by the experimental rats were not significant with the growth. Nutritional values of proteins are used as a guide to the effectiveness of a particular protein source in supplying the animal's requirements. In accordance with the report of Mukundan *et al*. (1994) [14], in the present study also the level of major nutrients were almost similar and so the nutritional quality of any particular diet will depend only on the quality of its protein. PER is one of the methods for quantifying the nutritional value of proteins. In the present study PER was high in the rats that received the test diet of *Pleuroploca* meat powder. Similar results were obtained in clam (*Katelysia* and *Tapes* sp.) fed rats and the ratios were 3.48 and 3.41 respectively, which were higher than the control rats (2.7). Mukundan *et al*. (1994) have also reported higher PER in test group fed with pink perch mince (3.0) than pink perch surimi (2.7) and casein (2.8). Mathew *et al.* (1982)[5]studied the nutritional quality of squilla and reported that there was no significant difference in PER when fed on casein, squilla protein or a mixture of both.

The value of feeds for providing the necessary energy for growth is determined by two parameters - FCR or utilization efficiency and PER. FCR was low in *P. trapezium* fed rats than in the control diet. FCR (for which a lower value indicates an improved outcome) is a low and 1 has been reported in fish. Higher assimilation,

assimilation efficiency, relative growth rate, consumption efficiency, gross growth efficiency and net growth efficiency were observed in test diet and so it is better than the control diet to aid in the growth of the animals. The word 'metabolism' describes the reactions, catabolic and anabolic, occurring within an organism that results in nutrients being used for energy or growth. In the present study the metabolism of rats fed with the test diet was found to be slightly lower than that of the rats group fed with the control diet.

The quality of a feed is a function of how well that feed meets the nutrient requirements of an animal. Not only should the feed contain the correct proportions of nutrients, but also the nutrients must be able to be digested and absorbed in a form that makes them available for providing energy and substrates for growth to the animal. This is termed bioavailability. The digestibility of the food is currently the primary determinant of bioavailability. Digestibility remains the most widely used method of determining how much of a given food component is bioavailable. Digestibility is the quantification of the digestive process and it gives a relative measure of the extent to which ingested food and its nutrient components have been digested and absorbed by the animal. Nutrient digestibility refers to a specified nutrient such as protein, lipid, amino acid or carbohydrate of the diet and/or the ingredient. In the present study the apparent nutrient digestibility of protein and carbohydrate were found to be higher in the rats that were given the test diet, and lipid digestibility was higher in the control rats. Mathew *et al*. (1982)[5] found no significant difference in digestibility in casein, squilla protein or a mixture of both fed rats but Raghunath *et al*. (2000)[7] found low protein digestibility.

The present study clearly shows that *P. trapezium* meat has good nutritional value and bioavailability, so it is recommended to every section of people who love seafood. The taste of the meat is also unique. The meat must also be popularized to make use of this valuable underutilized resource and thereby pave way to gain status like other seafood in the market. Efforts to culture this gastropod can also be carried out to understand its feeding habits, reproduction etc.

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REFERENCES

[1]. T Prem Anand; C. Chellaram; S. Kumaran; C. Felicia Shanthini, Biochemical composition and antioxidant activity of Pleuroploca trapezium mean. *Journal of Chemical and Pharmaceutical Research*, **2010**, 2(4), 526-535.
[2]. C Chellaram; T Prem Anand; S Kumaran; RS Sreenivasan, Central Nervous System Depressant Properties of Reef Associated Gastropods, *Drupa margariticola* and *Trochus tentorium* from Gulf of Mannar, Southeastern India. *Journal of Chemical and Pharmaceutical Research*, **2011**, 3(1), 154-159.
[3]. G Priya; C Chellaram, In vivo hepatoprotective effect of *Trianthema decandra* extracts on carbon tetrachloride induced rats. *Journal of Chemical and Pharmaceutical Research*, **2011,** 3(3), 154-158.
[4]. NU Nair; NB Nair, Condition index and percentage edibility of *Crassostrea madrasensis* (Preston) inhabiting the Cochin harbour. *Fish. Technol.* **1987**, 24, 14-21.
[5]. PT Mathew; AL Nair; PV Prabhu, Squilla protein: chemical composition and nutritional value. *Fish. Technol.* **1982**, 19, 97-100.
[6].C George; PT Mathew, Biochemical and nutritional evaluation of yellow clams. *Fish. Technol*. **1996**, 33 (1), 41-45.
[7].MR Raghunath; TV Sankar; AG Radhakrishnan; K Jayan; L Jose, Biochemical investigations on Antarctic Krill, *Euphausia superba*. *Fish. Technol.* **2000**, 37 (1), 19-24
[8]. DP Sen; TSS Rao, Deodourization of fish protein concentrate from Bombay duck (*Harpodon nehereus*). *J. Food Sci. Technol.* **1966**, 3, 27-28.
[9].JEC Raymont; A Austin; Linzford. Biochemical studies on marine zooplankton. I. Biochemical composition of *Neomysis integer*. *J. Cons. Perm. Explor. Mer*. **1964**, 28, 354-363.
[10].M Dubois; KA Giller; JK Hamilton; KA Befors; F Smith, Colorimetric method for determination of sugars and related substance. *Analyst. Chem*. **1956**, 28, 350-356.
[11]. EG Bligh; WS Dyer, A rapid method of total lipid extraction and purification. *Can. J. Biochem. Physiol*. **1956**, 37, 911-917.
[12]. C. Raghunathan; K Ayyakkannu, Reproductive biology of *Pleuroploca trapezium* Linnaeus (Neogastropoda: Fasciolaridae). *Phuket Mar.Biol.Cent.Spec.Publ*. **1994**, 13, 89-93.
[13] AL Nair; P Madhavan; PV Prabhu, Nutritional studies on the evaluation of the safety of squilla protein. *Fish. Technol.* **1991**, 28, 142-145.

[14] MK Mukundan; S Mathew; K Gopakumar, Nutrients and nutritional quality of Pink Perch (*Nemipterus japonicus*) mince and their fate on surimi manufacture. In: *Nutrients and Bioactive Substances in Aquatic Organisms* (Devadasan, K., Mukundan, M.K., Antony, P.D., Nair, P.G.V., Perigreen, P.A. and Joseph, J. Eds.) pp. 299, Society of Fisheries Technologists (India), Cochin.**1994**