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ISSN: 0975-7538
Research Article

# Assessment of Minerals from Shell Waste of *Penaeus indicus*

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**ABSTRACT**

The industrial processing of marine product creates large amount of bio wastes. These bio wastes mainly consist of shrimp shells and head which may cause environmental pollution. Marine wastes can be recycled in an appropriate way and the lead components can be extract and it is found to have nutritional value and other pharmacological applications. Shrimp muscle alone does not act as a good source of protein but shrimp shell also has enormous amount of protein. The shrimp shell is found to contain high amount of protein and other important minerals which are essential to human body. Recently much attention has been paid to natural nutrients due to their non-toxicity. The present investigation was planned to quantify the protein and minerals like zinc, copper and selenium from shrimp shell waste. The shrimp shell is found to contain 33g/100g of protein and also with minerals such as Lead, copper, zinc, tin, selenium. Hence the present investigation is said to have a specific influence on health as a low- cost natural substitute to overpriced drugs. Thus the effective utilization of shrimp shell waste enhances biomedical research field, for the development of natural drug for many chronic disease without side effects and at the same time can reduce environment pollution.

**Keywords:** Marine products; pollution; protein; minerals; nutritive value; therapeutic applications.

## INTRODUCTION

Marine surroundings is a substantial collection of exclusive bioactive natural products, with structural and chemical features which are not found in terrestrial natural products. The marine organisms are the rich origin of nutraceuticals and promising successor for the treatment of various human disorders. Moreover 80% of distinct plant and animal species are found in the world are present in oceans. Marine organisms such as sponges, tunicates, fishes, soft corals, nudibranchs, sea hares, opisthobranch Molluscs, echinoderms, bryozoans, prawns, shells, sea slugs, and marine microorganisms are the most excellent sources of bioactive compounds.

The ocean provides excessive moments to discover new compounds as it has more than 13,000 molecules described out of which 3000 are having active properties (Vignesh et al., 2011). The natural products acquired from the marine are mainly secondary metabolites which are not generated by biological or regular metabolic pathways. These secondary metabolites does not have any primary function associated with the development, growth, or propagation of a species (Martins et al., 2014). At present, the drug industry is working on screening and isolation of novel molecules with undiscovered pharmacological properties that can be utilised for the progress of advanced therapeutic promoters for commercial use. Many of the element play vital role in the living body as part of metallo-proteins and metallo-enzymes as well as enzyme cofactors. (Anirudran et al., 2014).

Shrimp trade delivers very large amounts of shrimp bio-waste at the time of processing, nearly 45-55% of the weight of raw shrimp are solid wastes. These wastes are taken by feed mills at a low price. Thus we can produce value-added products from these bio wastes because it is enriched with protein, minerals, glycosaminoglycans, carotenoids and chitin. Currently scientists are involved in genuine try to pursuit for the hopeful compounds from both natural resources and synthetics. The compounds that are obtained are assessed for their antioxidant properties (Meechai et al., 2016).

Among the shrimp only 40% is edible and the rest 60 % is account for the processing disposables (Barratt and Montano., 1986). Only 5% of shrimp waste is used for animal feed. Accumulation of these discards over time results in an environmental concerns as they not only produce disgusting smell but also draw pathogenic insects, rodents, flies and also become source for the growth of microorganisms thus creating an unhygienic atmosphere. The immediate solution to this problem seems to be quick recycling of the shell wastes generated and extraction of commercially viable substances to be further used in other applications (Robert G.A.F., 2008).

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Contact: +91-9941709668
Received on: 13-05-2017
Revised on: 14-06-2017
Accepted on: 18-06-2017

 

Thus the bioconversion of shell waste is possibly the greatest cost effective and eco-friendly procedure for waste utilization. Hence, by the proper approaching of the shrimp shell waste we can clear most of the environmental concerns facing the shellfish processors. Thus the proper utilization of shrimp shell waste will strengthen its status as a biomedical research material, for development of natural safe medicine without side effects. This study is focused on the quantification of proteins and minerals in the shrimp shell waste which can be utilized in future as a good nutritional supplement. It will acts as a cheap and non- toxic alternative to the costly drugs.

## MATERIALS AND METHODS

### Preparation of Raw Material

Shell wastes of prawn species *Penaeus indicus* was collected from the Kasimedu market in Chennai, Tamilnadu, India. The wastes includes the prawn head, cephalothorax, abdominal shell and the tail portion. The head part and the adhering meat from the abdominal and tail portions of the shell were removed. The other unwanted materials were removed and the shell wastes were cleansed under the running water and dehydrated under shade. They were packaged in polyethylene bags and kept at -200°C until use. The stored dry samples were homogenized in a laboratory mixer prior to extraction of diverse components such as protein, minerals, lipids and ash from the shell.

### Proximate Composition

Total nitrogen, total lipids, ash and moisture contents were quantified according to Association of Official Analytical Chemists (AOAC., 1990). Determination of moisture content was done by oven drying in which the samples are at 105 °C until constant weight. By the ignition of samples at 600 °C for 24 h the ash content of the sample was determined. Crude protein was estimated by Kjeldahl method. The heavy metals present in shrimp shell waste was determined by Standard Operating Procedure [SOP] method.

### Extraction of crude protein from shell waste by Kjeldahl method

### Procedure

5.0 ml of shrimp shell waste powder sample was taken in a digestion tube. All the ingredients were added except sample to another digestion tube which acts as blank. 2 tablets of $K_2SO_4$ and Se is added which acts as a catalyst.10ml of concentrated sulphuric acid was added and the tubes were heated for 30 minutes at 420ºC. After heating the digesting tubes were cooled to 50-60 ºC.50 ml of distilled water was added to each tube.Then the digested samples were placed in the digestion tubes to the distilling unit and 50.0 ml of 35% (w/v) NaOH was added. 100 ml of distillate was collected by distilling the sample in 25.0 ml of 4.0 % (w/v) boric acid. Add 2-3 drops of methyl red indicator to the Erlenmeyer flask and titrate against 0.1 M HCl. Calculate the protein amount (% protein).

### Analysis of minerals from shell waste by SOP method

SOP method is used extensively in the identification of arsenic, cadmium, lead, selenium, tin, copper, mercury and zinc content in shrimp shell waste using closed-system mineralization by microwave digestion and measurement with inductively coupled plasma mass spectrometry.

### Sample preparation

Shrimp shell wastes are cleaned well without any contaminants and reagents other than water which is to be used in sample preparation. The sample was homogenised to obtain a homogenous test portion.

### Procedure

Take 0.5 g of shrimp shell waste sample in digestion vessel. Then add 5 ml of deionised water and 5 ml of nitric acid to the digestion vessel. Each series of analyses should include a blank test to minimise the contamination. Each series of analyses should contain a reference material containing a known amount of the elements of quantify which is then subjected to digestion under the same conditions as the sample under examination. Microwave digestion was done for 45 minutes. To avoid pressure spikes inside the vessel a gradual increase between the selected phases was recommended. The temperature and pressure inside the digestion vessel can be reduced by a cooling phase. The final state of digestion of the sample depends on the digestion temperature and the higher the temperature, the less carbon residue is left to the quality of the mineral deposit. The digestion solution should be clear, without any suspended particles, and its volume should be practically the same as before digestion. After digestion, open the vessels, then rinse the covers and walls with deionised water, take up in polypropylene flasks, and dilute to 25 ml with deionised water and the measurement was done with inductively coupled plasma mass spectrometry.

## RESULTS AND DISCUSSION

### Proximate Composition of Shrimp Shell Waste

The proximate compositions of shrimp shell waste was shown in Table 1. *Penaeus indicus* shell wastes contains components like protein, minerals, lipids and ash. The composition of shell waste of *P.indicus* differs with species and also with some more factors. Nair et al., states that the proximate composition of prawn shell waste was found to contain 75-80 % of moisture, 30-35 % ash on dry basis, 35-40 % of protein on dry basis and 3-5 % fat (dry basis) (Nair et al., 2002). The values noted from this current study also compares with the above values, and further with the values stated by Madhavan and Nair (Madhavan and Nair, 1975). The moisture content of the sample is 14.57% and the ash content is 29.40%. The crude lipid content in the

**Table 1: Proximate composition of the shell waste of Penaeus indicus**

| Components | Shrimp Shell Waste |
|---|---|
| Moisture content % | 14.57 ± 0.16 |
| Ash content % | 29.40 ± 0.69 |
| Crude Lipid % | 2.06 ± 0.02 |
| Crude Protein | 33.04g\100g |

**Table 2: Minerals in Penaeus indicus shell waste**

| Minerals | mg/kg |
|---|---|
| Zinc | 9.21 |
| Arsenic | 0.25 |
| Cadmium | 0.25 |
| Tin | 0.80 |
| Mercury | 0.25 |
| Lead | 16.20 |
| Copper | 15.20 |
| Selenium | 0.55 |

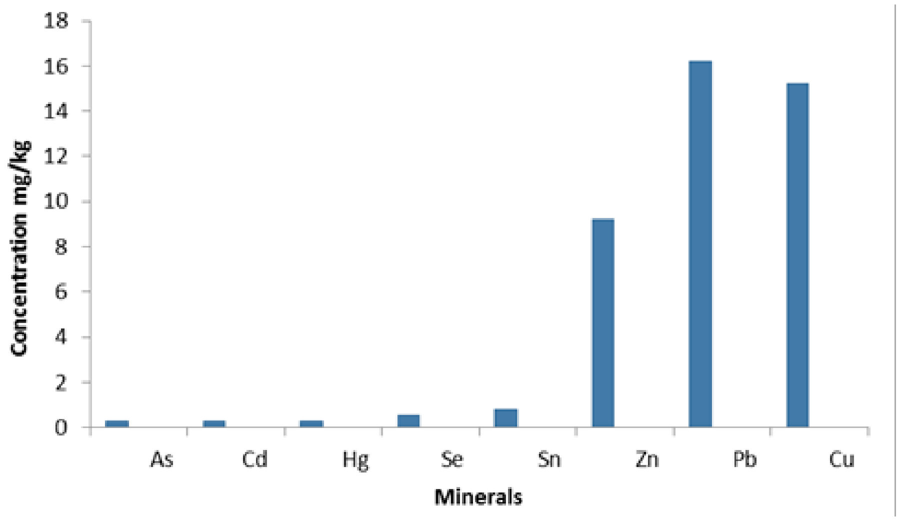


**Figure 1: Minerals in shrimp shell waste**
**Heavy metals mg\kg**

sample was observed to be 2.06%. According to Okuzumi and Fujii lipids are the good sources of energy and they enclose the energy two times higher than of carbohydrates and proteins (Okuzumi and Fujii., 2000). Universally they function as an important food supply with protein and are exposed to periodic variations affected by environmental changes like temperature. (Nagabhushanan and Farooqui., 1982). The protein content of *T. fuscatus* (67.68-68.46%) was identical by Devanathan *et al*., 2011 for *Babylonia spirata* (a gastropod). The crude protein present in the *Penaeus indicus* shell waste sample was observed to be 33.04g\100g which is determined by Kjeldahls method.

**Mineral analysis**

The mineral contents of shrimp shell waste of *Penaeus indicus* was given in Table 2 and Graph 1. Zinc, Lead and Copper were present in the shrimp shell samples. Arsenic, Cadmium and mercury were present in the sample in trace amounts. The most abundant micro element in the sample was zinc and it ranges about 9.21mg\kg. The zinc content was observed to be lower than the values noted by Sudhakar *et al*., for *Podopthalmus vigil* and that observed by Fasakin *et al*., 2000. Zinc is found to be exist in every tissues of the body and is a constituent of greater than 50 enzymes (Bender, 1992). Meat has high content of zinc in the diet. Copper is an essential element of the body and is noted to be 15.20 mg\kg in the shrimp shell. In the activity of many enzymes, cytochrome c oxidase, ceruloplasmin, amine oxidases and Cu/Zn superoxide dismutase copper is involved (Jaiser and Winston, 2010). Lead is seen to be 16.20mg\kg and Tin is seems to be 0.80mg/kg in the shrimp shell. Selenium is one of the important mineral which is responsible for immunity improvement, acts against free radical damage and inflammation, and also involved in maintaining a healthy metabolism. Selenium is observed in trace amount. Selenium deficiency leads to iodine deficiency, possibly increases the risk of cretinism in infants (Chen, 2012). It seems to be 0.55mg/kg.

U.S. Department of Health and Human Services and the U.S. Department of Agriculture proposed that Americans raised their consumption of seafood products to two times a week. These results shows that the shrimp-shell wastes of *Penaeus indicus* may acts as a potential source of protein and minerals for humans which should be covered in the diet. Furthermore the- se can be utilized for the production of novel drug in future.

**CONCLUSION**

The shell wastes of *Penaeus indicus* can be utilized to identify the bioactive components like proteins, minerals and other compounds. The present study observations indicate that proteins and minerals are abundantly present in shrimp shell waste which is the cheap and easily available source. Thus the efficient utilization of these wastes yields high economic value. Nowadays pathogens are very resistant and lasts to be very difficult in treating the infectious diseases, and hence there is an urge for the discovery and development of new antibiotics which has turn into a great priority in biomedical research. In the continuing effort of the utilization of shrimp shell wastes by the community, many antibiotic agents can be isolated; we have paid attention only on those that seem to carry the greatest potential.

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