EXTRACTION OF CHITIN FROM WASTE PRAWN SHELLS, PREPARATION OF CHITOSAN BY BIOLOGICAL METHOD AND ITS APPLICATIONS

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Abstract:
Shell waste produced by the seafood industry is one of the most important problems contributing to significant environmental and health hazards. The most frequent method employed for its disposal is burning, which becomes environmentally costly due to the low burning capacity of shells. In such a scenario, conversion of shrimp shell waste to chitosan, a commercially valuable product with a myriad of uses, could serve as an effective mode of shell remediation. In the present study, chitosan was extracted by biological method using Bacillus subtilis employing solid state anaerobic fermentation. Obtained chitosan was tested for its purity by dissolving it in 1% acetic acid. Characterizations like FT-IR, molecular weight, degree of deacetylation, pH and viscosity were performed. Prepared chitosan was used for water treatment to improve water quality and for food packaging to enhance the nutritional quality on storage.

Introduction:
At present, aquaculture is in focus as answer to the growing demand for food. As production in this industry gains momentum, protein emerges as the most important and expensive input component. Since the cost of production keeps steadily increasing with declining natural resources, there is compulsion to find a viable means to ease this problem. It is estimated that aquaculture feed accounts for 40-60% of the operational cost. Naturally our attention should turn to cost effective and easily available feed ingredients.

The shellfish processing industry in India generates 9.5 million tons of shell waste per year (FAO, 2008). About 35-45% by weight of shrimp raw material is discarded as waste when processed into headless shell-on products. Peeling process, which involves the removal of the shell from the tail of prawn, increases the total waste production up to 40-45%. On a global basis, the shrimp processing industry produces over 700000 million tons of waste shell. Although, part of this is used for chitin, chitosan preparation, feed manufacture and as manure, a major portion still remains unused. Environmental implication of traditional disposal methods of such waste, coupled with the strengthening of environmental regulations in many countries, has created an interest in alternative methods of disposal/utilization of this waste.

These waste shells were collected and treated to extract chitin and further convert it to chitosan. Prepared chitosan was analyzed, characterized and compared with standards to ensure its properties.
Objectives:
The following objectives were set and executed:
- Extraction of chitin from prawn shell waste
- Preparation of chitosan from the extracted chitin
- Analysis and characterization of chitin and chitosan
- Utilisation of chitosan for water treatment and fruit packaging.

Methodology:
- Waste shells were collected from fish market, washed with water and dried. Size reduction and screening was done to obtain 0.3-0.8 mm size particles.
- *Bacillus subtilis* bacteria was cultured in Luria - Bertani media. 100 g of sample was mixed with 100 ml of broth medium and fermented for 22 days.
- Fermented sample was treated with mild acid and alkali to obtain chitin.
- Chitin was treated with 50% NaOH for three days to get chitosan.
- Prepared chitosan was tested for its purity, ash content, moisture content, viscosity, degree of deacetylation, molecular weight and FT-IR studies.
- Prepared chitosan was dissolved in acetic acid and used as a coagulant agent for mud water. Optimum pH and optimum dosage was determined for improvement of water quality using chitosan.
- Chitosan was also used as a food preservative by coating the solution of chitosan to grapes. The parameters studied include weight loss, increase in pH and decrease in total soluble solid content. The results of coated and uncoated grapes were compared.

Results and conclusion:
- Carbohydrate and protein concentrations were determined during fermentation to ensure fermentation process. Increase in carbohydrate concentration and decrease in protein concentrations were observed conforming fermentation activity.
- Moisture content, ash content, viscosity, density, degree of deacetylation, molecular weight, FT-IR values were in good agreement with the standard values.
- Chitosan was successfully employed for water treatment. There was a reduction in total dissolved solids and soluble solids after treating with chitosan solution.
- In food packaging, chitosan coating avoided the loss of weight, prohibited increase of pH of grapes and there was a control over the loss of total soluble contents in comparison with uncoated grapes.

Future prospects:
- Further chitosan can be converted into films which can be used as an adsorbent material to remove heavy metals.
- Chitosan extracted in more sophisticated way can be used for human health related applications such as drug delivery, cholesterol controller, wound dressing etc.
- Chitosan is emerging as an important biomaterial due to its excellent biocompatibility and admirable biodegradability with ecological safety and low toxicity.