Research on Conversion of Natural Wastes to Useful Products by Application of Radiation Processing for Agricultural Sector of Myanmar

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Objectives

1. To explore research on production of super water absorbent and plant growth promoter using natural wastes and gamma radiation.
2. To build up productive, profitable and sustainable agricultural systems using these products

I. Introduction

The Republic of the Union of Myanmar is the largest country of South-East Asia located between 9°32′ N & 28°31′ N Latitude and 92°10′ E & 101°11′ E Longitude. Myanmar is situated in the western part of the South-East Asia, bordering the Bay of Bengal and the Andaman Sea with its 2400 km long coast line. It is potentially rich with marine natural resources and also there are many rivers and streams in Myanmar. Therefore, prawns and crabs are abundant in fresh and sea water area. In addition, coconut palms are available in the country and coconut is a basic ingredient for many curries and foods of Myanmar people. Natural wastes such as prawn shells and coconut shell (coir dust) are generated annually across Myanmar. Myanmar has a tropical climate with three seasons namely rainy (mid-May to mid-October), winter (mid-October to mid-February) and summer (mid-February to mid-May). Dry regions depend on rainy reason for water resources. More food production is needed for increasing global population. Fertilizers and water are two main factors which put limitations on the agricultural products. Plan for improving the utilization of water resources and nutritive fertilizers is of a high importance.

Over the past decades of years, chemical fertilizers have been the primary means of enhancing soil fertility. They contain no humus so that they cannot improve the soil texture. For long term usage, the crops do not yield as much as expected due to the problem of declining soil fertility. Moreover, chemical fertilizers might have some harmful effects such as high cost and environmental pollution (air and water). In recent years, natural polymers are being explored for many applications because of their unique characteristics such as easy availability, biocompatibility and biodegradability. Irradiated chitosan can stimulate plant defense respond and enhance disease resistance of plants, immunize plants to kill many kinds of fungus, bacteria and virus. Super Water Absorbents is a class of hydrogel like materials with increasing interest in agriculture and in polluted land. Practically, SWAs appear as materials with promising characteristics to improve the use of water in soils. To fulfil the major needs for improving safe agricultural productivity in the country, and to apply radiation technology for useful products in agriculture, current research is based on radiation processing of natural wastes for production of super water absorbents and plant growth promoter (liquid fertilizer) using Gamma Radiation. In this research, prawn shell and coir dust were used as raw materials for production of these useful products.

II. Experimental Procedure

Materials

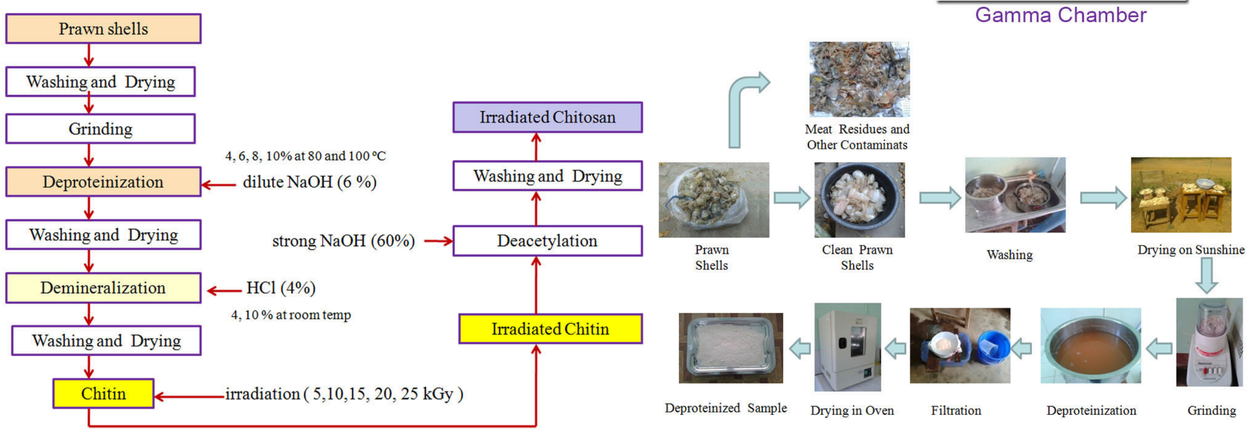

Raw Prawn Shells


Clean Prawn Shells


Coir fiber

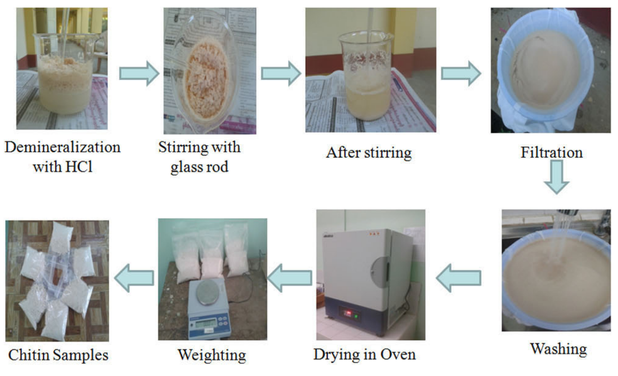

Coir dust


Gamma Chamber



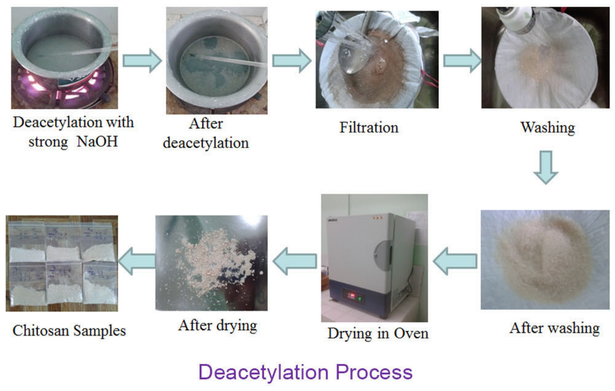
Flow diagram of research work for chitosan

Sample Preparation and Deproteinization



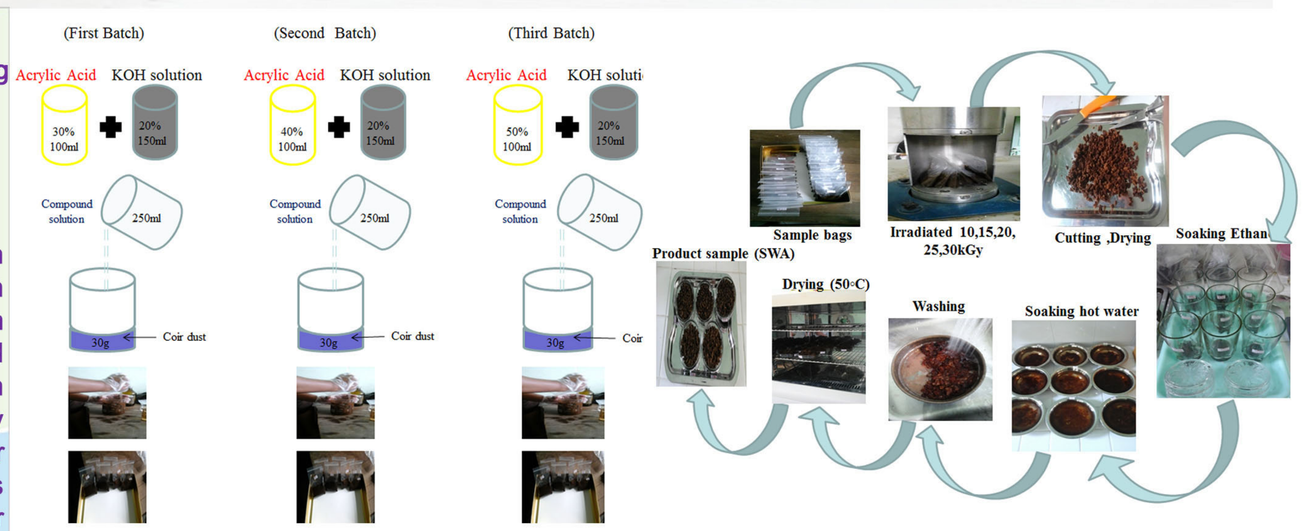
Demineralization Process


Irradiation of Chitin by using Gamma Chamber



Deacetylation Process

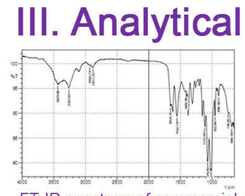
Coir Dust Production Process

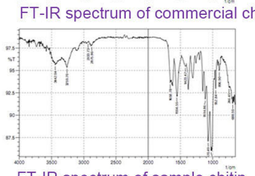


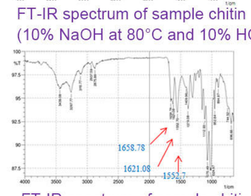
Sample Preparation for Radiation Grafting

Process of Radiation Grafting

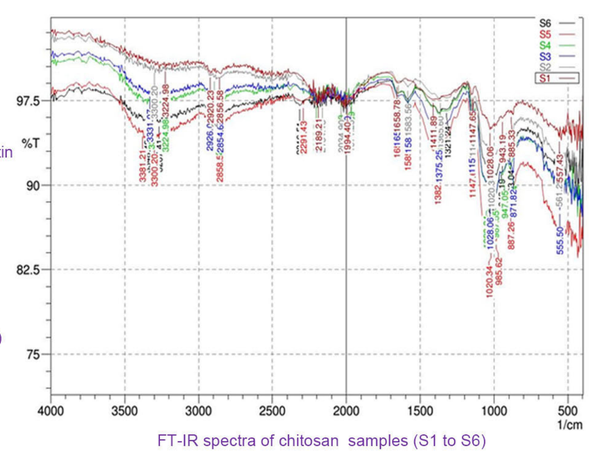
III. Analytical Results


FT-IR spectrum of commercial chitin

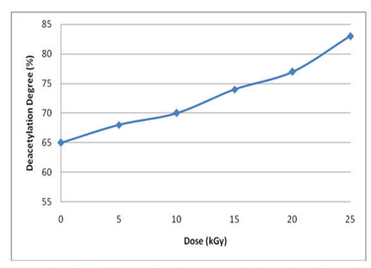

FT-IR spectrum of sample chitin (10% NaOH at 80°C and 10% HCl)



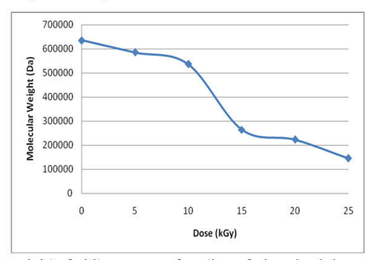
FT-IR spectrum of sample chitin (6% NaOH at 80°C and 4% HCl)



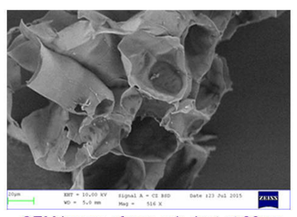
FT-IR spectra of chitosan samples (S1 to S6)



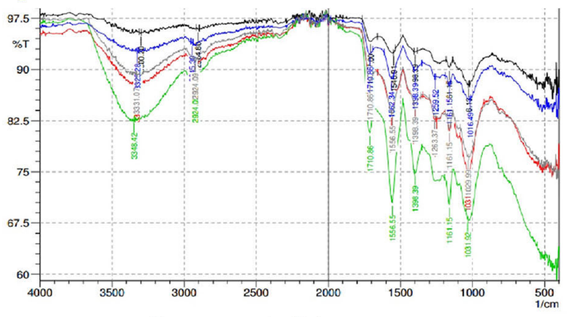
Deacetylation Degree as a function of absorbed doses



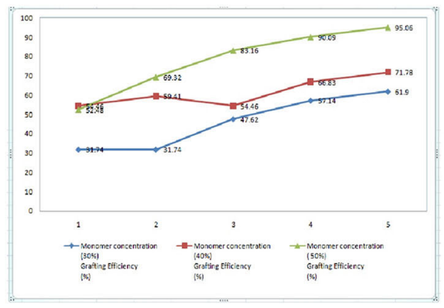
Molecular weight of chitosan as a function of absorbed doses


SEM image of raw coir dust at 20um

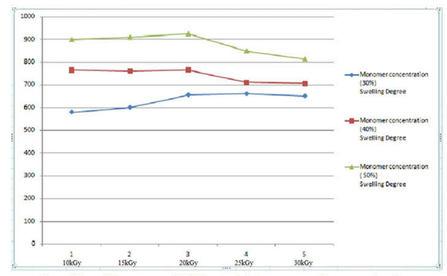

SEM image of grafted sample at 20um



Comment;F11gray,12blue,13green,14red,15black
10kGy,15kGy,20kGy,25kGy,30kGy (50% monomer)
The Combination of IR spectra of all Irradiated SWA at 50 % monomer



Grafting Efficiency (GE%) at Different Monomer Concentration



Swelling Degree at Different Monomer Concentration

IV. Field/Pot Test

Field/Pot Test for Plant Growth Promoter

Field/Pot Test for SWA

V. Discussion and Conclusion

A. Preparation of Plant growth Promoter (irradiated chitosan)

FT-IR spectra confirmed the position of molecular groups of Chitin and (Irradiated Chitosan) Plant growth Promoter. It was found that the characteristics of produced chitin are consistent with the characteristics of α-chitin from the journal of Science Direct and commercial chitin. The characteristics of produced chitosan are also consistent with the commercial chitosan and standard chitosan. It was found that degree of deacetylation increases with gamma radiation doses. In contrast, molecular weight decreases with increasing irradiation dose. According to our results, 25 kGy dose is the best condition to produce irradiated chitosan with higher degree of deacetylation and lower molecular weight. Pot test is now under study and recent test gave same trend as analytical results. Therefore, the resultant irradiated chitosan can be used as plant growth promoter for seasonal crops. As natural waste such as prawn shell was used as raw material in this research, the research can also support for monitoring of environmental wastes.

B. Preparation of Super Water Absorbent from Coconut Coir Dust

FT-IR spectra confirmed the position of molecular groups in grafted polymer SWA. By varying of temperature and concentration of reagents, cellulose could be produced from coir dust. It was confirmed by colour, yield and Scanning Electron Microscope. Cellulose was converted to grafted polymer by using Acrylic acid (monomer) and gamma radiation. Pore sizes of grafted SWA and raw coir dust were shown in Figure.by using Scanning Electron Microscope. It can be known that coir dust was successfully modified through graft copolymerization with acrylic acid monomer by using gamma radiation. Moreover, swelling degree and grafting efficiency of grafted SWAs were found to be increased with monomer concentration. Similar results were obtained for swelling degree and grafting efficiency in increasing radiation dose till 20kGy. Pot test is now under study and recent test gave same trend as analytical results. Therefore, the resultant grafted polymer can be used as super water absorbent (SWA) for seasonal crops. As natural waste such as coin dust was used as raw material in this research, the research can also support for monitoring of environmental wastes.