## CONTENTS

### Research Papers:

1. **Green synthesis of selenium nanoparticles from sodium selenite using garlic extract and its enrichment on* Artemia nauplii* to feed the freshwater prawn *Macrobrachium rosenbergii* post-larvae**
   - Thangavelu Sathgurunathan, Periyakali Saravana Bhavan and Subramaniyam Komathi
   - 1-12

2. **Synthesis and evaluation of 2-[2-cyano-3-(substituted phenyl)acrylamido]-4,5,6,7-tetrahydrobenzo[b]thiophene-3-carboxamides for antioxidant and anti-inflammatory activities**
   - Madhavi K. and Visalakshi M.
   - 13-19

3. **Chitosan from shrimp (*Penaeus monodon*) skin waste as natural coagulant to remove heavy metal Hg**
   - Lukum Axtin and Rauf Asda
   - 20-26

4. **Soil Respiration in Rubber Tree Plantation applied with Biochar**
   - Hanpattanakit Phongthep, Wattanahemmakorn Jiranut, Sudjarit Tanakit, Jaiarree Sathaporn and Taweekij Sukanya
   - 27-34

5. **Potentiometric Determination of Lead (II) ion by using 2-[(4-Chloro-Phenylimino)-Methyl]-Phenol as an Electroactive Material**
   - Dogra P., Sharma H., Sharma J. and Sharma N.
   - 35-41

### Review Papers:

6. **Processing of nano TiO₂ and its use as adsorbent in water purification**
   - Ravindranath K. and Ramamoorthy Mylavaram
   - 42-52

7. **Recent development of graphene synthesis by physico-chemical and electrochemical methods**
   - Ravindra Bharat Kohakade, Senthilkumar Elamalai, Raghu Subash Chandrabose and Raman KalaiVani
   - 53-64
Chitosan from shrimp (Peneaus monodon) skin waste as natural coagulant to remove heavy metal Hg

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Abstract
This study aimed to isolate chitosan from waste of shrimp skin and applied as environmentally friendly natural coagulant. This study included the isolation, characterization and application of chitosan in the adsorption of heavy metal Hg. Chitosan was obtained from waste of shrimp (Peneaus monodon) skin via depigmentation, demineralization, depigmentation and deacetylation.

Optimization of adsorbent mass was carried out by varying the adsorbent mass of 0, 0.3, 0.6, 0.9, 1.2 and 1.5 g. In addition, the effect of pH was conducted by performing the adsorption under different pH of 2, 6, 7, 8 and 9. The results showed that the use of 1.2 g of chitosan gave Hg(II) removal of 99.86% or 9.936 μg/L. It could be concluded that chitosan as natural coagulant could adsorb Hg(II) in water.

Keywords: Chitosan, Peneaus monodon, Mercury, Waste, Adsorbent.

Introduction
Mercury (Hg) is one of global pollutant which may give bad impacts to human health and ecosystem4. Several techniques have been applied to remove this heavy metal such as ion exchange, solvent extraction, ultra-filtration, adsorption and coagulation5.

Coagulation is one of effective methods in minimizing the heavy metal concentration in waste water1. One of widely employed natural coagulant is chitosan (β-(1-4)-2-amino-2-dioxy-D-glucose). Chitin and chitosan could be abundantly found from crustaceans like shrimp and crab7.

Natural coagulants have several advantageous comparing to commercial ones such as availability of the raw material, cheap, environmentally friendly and biodegradable8. Both chitin and chitosan are not toxic and biodegradable9,10. Lukum et al11 reported that chitosan obtained from Gorontalo shrimp skin wastes has deacetylation degree of 80% and was able to adsorb Pb(II) from sugar factory Tolanghua, Gorontalo. Several reports demonstrated that chitosan was effective to reduce COD level and turbidity of textile industry liquid waste as much as 72.5% and 94.9%. The efficiency of chitosan in reducing the turbidity of seawater was higher than ferro sulfate and was similar with that of alum2.

Chitosan and its derivatives displayed good adsorption capacities toward arsenic12. Adsorption of Hg(II) onto chitosan probably occurred via single or mixture interaction: coordination with amino group or combination with vicinal hydroxyl group, electrostatic in acidic media or ion exchange with protonated amino group13.

According to Lertsunthiwong et al10, chitosan could be obtained from chitin via deacetylation process. It has free amino group which might be able to bind metal ions. It has been employed to remove heavy metal ion from the effluent. Chitosan and its derivatives are cheap and effective as heavy metal adsorbent14. Shrimp is abundant natural resources particularly in Gorontalo Province. In several traditional markets in Gorontalo, it was observed that the shrimp skin was discarded and was left to rod without any further treatment and may lead to environmental pollution and damage environment. These problems might be solved by applying the shrimp waste as the source of chitosan. Several reports showed that chitosan displayed good activities in the adsorption of Hg(II)15 and Pb(II)16 ions.

This research aimed to prepare chitosan from the shrimp skin waste and to apply it as environmentally friendly natural coagulant. The produced chitosan would be applied in the adsorption of Hg(II) ions. In addition, the effect of pH and mass adsorbent would be evaluated.

Material and Methods
Materials: The shrimp skin was obtained from Gorontalo. The chemicals employed for this study were standard solution of Hg(NO3)2, HCl, NaOH, hydrogen peroxide, acetic acid, ammonium, sodium sulfate, nitric acid, aquadest, filtered paper and universal indicator.

Tools: The used instruments in this study were laboratory glassware, oven, magnetic stirrer, hotplate, stirrer, centrifuge, sieve (90 mesh), desiccator, furnace, atomic absorption spectrometer (AAS, AA240FS VARIAN), infrared spectrometer (FTIR), analytical balance, mortar and pestle.

Isolation of chitosan from shrimp (Peneaus monodon) skin: Shrimp skin was washed and dried on the open air. It was then grinded by using mortar and sieved to give 90 mesh size. Isolation of chitosan11 was carried out with the...
Conclusions

Chitosan isolated from Peneaus monodon could be applied as environmentally friendly natural coagulant. It could be used as an adsorbent of 


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