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Assessment of heavy metals contamination and human health risk in shrimp collected from different farms and rivers at Khulna-Satkhira region, Bangladesh

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ABSTRACT

This study is aimed to assess the heavy metals contamination and health risk in Shrimp (*Macrobrachium rosenbergii* and *Penaeus monodon*) collected from Khulna-Satkhira region in Bangladesh. The results showed that the Pb concentrations (0.52–1.16 mg/kg) in all shrimp samples of farms were higher than the recommended limit. The Cd levels (0.05–0.13 mg/kg) in all samples and Cr levels in all farms except tissue content at Satkhira farm were higher than the permissible limits. The individual concentration of Pb, Cd, and Cr between shrimp tissue and shell in all rivers and farms were not statistically significant ($P > 0.05$). Target hazard quotient (THQ) and hazard index (HI) were estimated to assess the non-carcinogenic health risks. Shrimp samples from all locations under the current study were found to be safe for consumption, the possibility of health risk associated with non-carcinogenic effect is very low for continuous consumption for 30 years.

1. Introduction

The processed frozen shrimp industry is one of the largest export industries in Bangladesh, earning about $448 million per year. Shrimp exports represent 80% of the frozen food exports from Bangladesh and also 2.5% of world shrimp market [9]. The shrimp consumption has increased in recent years. The change shifted towards better understanding of healthy diet and nutritional importance of seafood consumption, for example high protein source, vitamin D, vitamin B_3 and zinc being beneficial for health [5]. Heavy metals are potentially gathered in aquatic environments including water, sediments, fish and shrimp. These are later transmitted into human body through the food chain [11,21]. Increased levels of heavy metals like Pb, Cd, and Cr in shrimp may constitute a food safety risk. However, heavy metals pollution in shrimp has become an important worldwide concern, not only because of the threat to shrimp, but also due to the non-carcinogenic health risks related with shrimp consumption. For example, renal failure and liver damage may occur due to the presence of lead in food [10]. Prolonged exposure to lead can result in coma, mental retardation and even death [2]. Cadmium injures the kidneys and causes symptoms of chronic toxicity including impaired kidney function, infertility, hypertension, tumours and hepatic dysfunction [15]. Likewise, Chromium could attack proteins and membrane lipids, thereby disrupt cellular integrity and functions [12,13]. Therefore, the global attention is increasing on the heavy metals contamination in shrimp.

The increased urbanisation, fast industrial development and population explosion contributed to rapid pollution growth. Owing to their persistence and bio accumulative nature, the discharge of heavy metals into the marine environment can reduce the biodiversity of marine ecosystems [15,18]. The consumption of such polluted marine based food by human may result in health risks such as liver damage and hepatic dysfunction. Likewise, tannery and poultry wastes are often used as a cheap source of fish feed in Bangladesh. The use of such feed stocks may theoretically increase

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the accumulation of toxic contaminants such as lead, cadmium and chromium in cultured fish and may cause a food safety risk [19].

Many studies have been performed to examine the heavy metals contamination in fish. In a recent study, concentration of heavy metals (Pb, Cd, Ni, Cr, Cu, Zn, Mn and As) in some fish species was measured in two different seasons from Bansi river in Bangladesh [16]. They reported no probable health risk to consumers under the current consumption rate. In another study, Ahmed et al. [1] studied the human health risk assessment of heavy metals in tropical fish and shellfish collected from the Buriganga river, and reported probable cancer risk. However, the evaluation of heavy metals such as Pb, Cd, and Cr in shrimp has not been reported at Khulna and Satkhira region in Bangladesh.

Although shrimp is one of the most important protein sources its contamination can be dangerous to public health. Therefore, the objective of this study is to assess the contamination status and health risk of lead, cadmium and chromium in two shrimp species of different farms and rivers at Khulna and Shatkhira region in Bangladesh.

2. Materials and methods

2.1. Materials

All chemicals were of analytical reagent grade.

2.2. Study area

Rupsha is an important river in southwestern region of Bangladesh formed from Bhairab and Atrai rivers and flowing by the side of Khulna city. Rivers are being polluted by increasing concentration of various types of contaminants including heavy metals causing tremendous health complications to the community in surrounding area. Above mentioned contaminants come from chemical industries, poultry farms, textile manufacturers and printing units established in this area. This fact leads to selection of Rupsha and Bhairab rivers for this study. Shrimp species were collected from various shrimp farms in Khulna and Shatkhira area in Bangladesh (Fig. 1). Two species of shrimp available in Rupsha and Bhairab rivers and some aquaculture were collected directly from professional fishermen from July to September 2013. The species were *Macrobrachium rosenbergii* (common Bengali name Golda) and *Penaeus monodon* (Bagda).

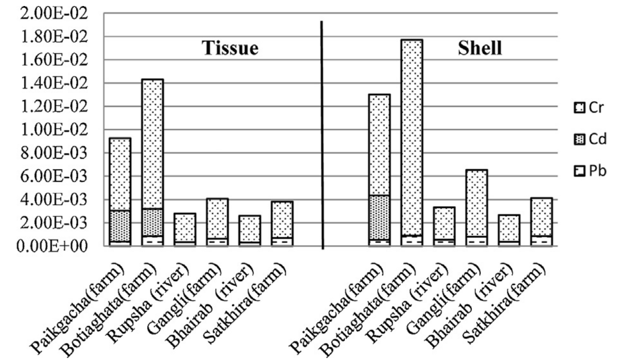

Fig. 2. Hazard index of three heavy metals from different locations at Khulna-Satkhira zone.

2.3. Preparation of shrimp sample

For the preparation process, 10 gm tissue and 1 gm shell of shrimp sample were taken and cut into small pieces using a clean knife and clean polyethylene sheet. The samples were then dried on the hot plate and placed in the Muffle furnace at 450 °C for 8 h. The samples were then cooled until white or grey colour ashes were obtained. 5 ml of 6 M HCl was introduced and the mixture was heated slowly on the hot plate with the addition of 5 drops of water. This step was repeated until all of the ash came into contact with the acid. The samples were heated again to evaporate. The residue was filtered with 50 ml of 0.1 M HNO_3. Filtered solution was preserved in plastic container and the solution was used for AAS analysis (Fig. 2).

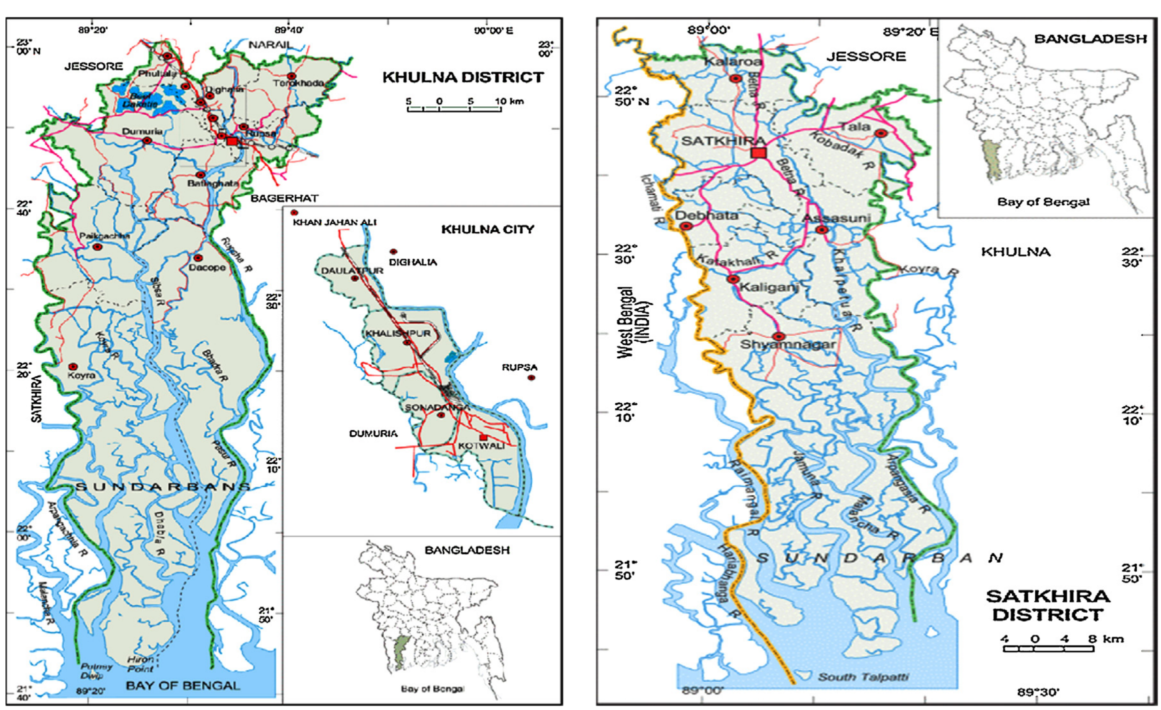

Fig. 1. Sample collection area.