



RESEARCH ARTICLE

Heath Risk Assessment of Heavy Metals in Shrimp *Acetes* sp. and Cincalok Collected in 2007 from Pantai Klebang, Peninsular Malaysia

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Abstract

Samples of shrimp (*Acetes* Sp.), were collected from Pantai Klebang (Malacca, Peninsular Malaysia) in 2007. The mean metal concentrations ($\mu\text{g/g}$ dry weight) in the total tissue of the shrimps were 1.47 for Cd, 7.10 for Cu, 41.5 for Fe, 3.70 for Ni, 4.49 for Pb and 27.1 for Zn. The metal levels ($\mu\text{g/g}$ dry weight) in the shrimps are lower than Cd (1.47), Cu (8.55), Ni (4.19), and Pb (4.86). However, the levels of Fe (21.2) and Zn (11.0) in the cincalok were lower than those in the collected shrimps. For the human health risk assessment, all values of target hazard quotient for the six metals in the adults of Malaysian population were found below 1.00. This showed that there was no non-carcinogenic risk of the six metals via the consumption of *Acetes* Sp. from the present study. However, regular monitoring of heavy metals in this popular small shrimps is still needed.

Keywords

Heavy metals, Health risk assessment, *Acetes* shrimp

Introduction

In Malaysia, the geragau *Acetes* sp. (Family: Sergestidae) were focused in the present study because these wild small shrimps are heavily fished in terms of total tonnage. They are natural benthic omnivores of the coastal areas of Peninsular Malaysia and hold signifi-

cant commercial values. Hence, the human health risk of heavy metals is of public concern. Studies of heavy metals in the shrimps *Acetes* have been reported from Peninsular Malaysia [1,2] and Sarawak [3].

The objectives of this study are to: 1) Investigate the concentrations of Cd, Cu, Fe, Ni, Pb and Zn in *Acetes* sp. collected from bought from Pantai Klebang, Malacca and; 2) To determine the human health risk of heavy metals from this study in comparison to cited data.

Materials and Methods

Sampling in Pantai Klebang, Melaka was done on 12th January 2007. The samples collected were *Acetes* sp. and the cincalok. The *Acetes* sp. was bought from the fishermen, while the cincalok was bought from the roadside. All collected shrimp samples were kept frozen until dissection was carried out. The frozen samples were thawed at room temperature and later on, cleaned with double-distilled water (DDW). The shrimps selected from the analysis had body lengths between 2.00-2.50 cm. Since most literature reported the shrimp's species from Malacca is *Acetes indicus* but further validation is required for the taxonomy of the present *Acetes*. Therefore, in this study, the shrimp is



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reported as *Acetes* sp.

Determination of total tissue dry weight (dw) were conducted by drying individual total tissue at 60 °C, for 72 hours until constant dw was achieved [4]. The cincalok and the fresh samples of *Acetes* sp. were placed onto aluminum foils dried at 105 °C, for 72 hours until constant dw was achieved [4].

The dissected dried tissues (about 0.5 g each) were weighed and digested in concentrated nitric acid (AnalaR grade, BDH 69%). Digestion were carried out by heating the nitric acid treated samples at 40 °C for 1 hour and then raised to 140 °C for at least 3 hours to achieve full digestion. After the digestion process was completed, the samples were topped up with DDW to 40 ml and before filtering them with Whatman No.1 (filter speed: medium) filter papers into acid washed plastic containers. The digested samples were then sent for Cd, Cu, Fe, Ni, Pb and Zn determination by using the atomic absorption spectrophotometer (AAS) Perkin-Elmer Model 800.

All glassware and equipment used for this study were acid washed and procedural blanks were analyzed once for every five samples during analysis to ensure consistency in data collection. Standard solutions for all six metals were prepared and analyzed occasionally during the analysis for heavy metal recoveries. The heavy metal recoveries were being satisfactory with recoveries between 90-110%. The quality of the analytical procedures used for the shrimp samples were verified by using CRM for Dogfish Liver (DOLT-3, National Research Council Canada). The recoveries of the six metals for the CRMs were being satisfactory between 80-120%.

Human Health Risk Assessment

The estimated daily intake is to calculate how much of shrimps that be taken by an adult for one day. First, the dry weight (dw) basis was converted to wet weight

(ww) by using the conversion factor (0.30) as follows:

Wet weight (WW) = metal concentration (MC) × conversion factor

The mean concentrations of the samples are needed for calculation of estimated daily intake of shrimps. The estimated daily intake (EDI) (µg/kg/day) of shrimps that contain levels of Cd, Cu, Fe, Ni, and Zn were measured by using a formula:

$$EDI = MC \times CR / (BW)$$

MC represents the metal concentration (µg/g wet weight) in the shrimps. The body weight (BW; kg) for adults is 62 kg and consumption rate (CR; g/person/day) for cephalopod is 90 g, following the report for Malaysian population [5].

The human health risk assessment of the heavy metal in the guava fruits was determined by the calculation of Target Hazard Quotient (THQ). If the THQ value is higher than 1.0, this means that the daily consumption of shrimps would likely result in negative health effects during a lifetime in a human population [6]. The formula of THQ calculation was described as follow:

$$THQ = EDI / RfD$$

RfD represents the oral references dose (µg/kg/day). The reference doses used for Cd, Cu, Fe, Ni, Pb and Zn are 1, 40, 700, 20, 3.5 and 300, respectively, provided by the USEPA's regional screening level [7].

Results and Discussion

The mean concentrations of Cd, Cu, Fe, Ni, Pb and Zn in *Acetes* sp. and cincalok from Pantai Klebang are presented in Table 1. The mean metal concentrations (µg/g dry weight) in the total tissue of the shrimps were 1.47 for Cd, 7.10 for Cu, 41.5 for Fe, 3.70 for Ni, 4.49 for Pb and 27.1 for Zn. The metal levels (µg/g dry weight) in the shrimps are lower than Cd (1.47), Cu (8.55), Ni

Table 1: Concentrations (µg/g dry weight) of Cd, Cu, Fe, Ni, Pb, and Zn of *Acetes* Sp. from the present study and cited data from the literature.

DW = Dry weight; WW = Wet weight.

Sampling site	DW						WW					
	Ni	Cu	Zn	Cd	Pb	Fe	Ni	Cu	Zn	Cd	Pb	Fe
Klebang	3.70	7.10	27.1	1.47	4.49	41.5	1.11	2.13	8.12	0.44	1.35	12.5
Klebang (cincalok)	4.19	8.55	11.0	1.79	4.86	21.2	1.26	2.57	3.31	0.54	1.46	6.35
Malacca (min) ¹	NA	NA	40.7	0.07	0.17	NA	NA	NA	12.2	0.02	0.05	NA
Malacca (max) ¹	NA	NA	45.8	0.85	1.29	NA	NA	NA	13.7	0.26	0.39	NA
Kedah (min) ¹	NA	NA	34.3	0.02	0.25	NA	NA	NA	10.3	0.01	0.08	NA
Kedah (max) ¹	NA	NA	15.1	0.21	0.55	NA	NA	NA	4.53	0.06	0.17	NA
Miri coast ²	8.00	32.4	62.4	1.20	7.20	NA	2.40	9.72	18.7	0.36	2.16	NA
Malacca ³	NA	40.3	30.6	0.04	0.07	NA	NA	12.1	9.18	0.01	0.02	NA
Terengganu ³	NA	56.1	46.3	0.55	0.28	NA	NA	16.8	13.9	0.17	0.08	NA

Note: The µg/g dry weights were converted by using conversion factors of 0.30, assuming the water content is 70%.

¹Rahouma, et al. [1] for Malacca and Kedah; ²Anandkumar, et al. [3]; ³Rahouma, et al. [2] for Malacca and Terengganu.

Table 2: Values of estimated daily intake (EDI) and target hazard quotient (THQ) of Cd, Cu, Fe, Ni, Pb and Zn of *Acetes Sp.*, from the present study and cited data from the literature.

Sampling site	EDI						THQ					
	Ni	Cu	Zn	Cd	Pb	Fe	Ni	Cu	Zn	Cd	Pb	Fe
Klebang	1.61	3.09	11.8	0.64	1.96	18.1	0.08	0.08	0.04	0.64	0.56	0.03
Klebang (cincalok)	1.82	3.72	4.81	0.78	2.12	9.21	0.09	0.09	0.02	0.78	0.60	0.01
Malacca (min) ¹	NA	NA	17.7	0.03	0.07	NA	NA	NA	0.06	0.03	0.02	NA
Malacca (max) ¹	NA	NA	19.9	0.37	0.56	NA	NA	NA	0.07	0.37	0.16	NA
Kedah (min) ¹	NA	NA	14.9	0.01	0.11	NA	NA	NA	0.05	0.01	0.03	NA
Kedah (max) ¹	NA	NA	6.58	0.09	0.24	NA	NA	NA	0.02	0.09	0.07	NA
Miri coast ²	3.48	14.1	27.2	0.52	3.14	NA	0.17	0.35	0.09	0.52	0.90	NA
Malacca ³	NA	17.6	13.3	0.02	0.03	NA	NA	0.44	0.04	0.02	0.01	NA
Terengganu ³	NA	24.4	20.2	0.24	0.12	NA	NA	0.61	0.07	0.24	0.03	NA

Note: ¹Rahouma, et al. [1] for Malacca and Kedah; ²Anandkumar, et al. [3]; ³Rahouma, et al. [2] for Malacca and Terengganu.

(4.19), and Pb (4.86). However, the levels of Fe (21.2) and Zn (11.0) in the cincalok were lower than those in the collected shrimps. Overall, in comparison those reported by Rahouma, et al. [1] for samples collected from Malacca and Kedah, Anandkumar, et al. [8] for Miri samples, and Rahouma, et al. [2] for samples from Malacca and Terengganu, the present metals levels are lower. The converted wet weight basis concentrations in the present *Acetes sp.* are also lower than the Maximum Permissible Limits (MPL) sets for Cd, Cu, Pb and Zn by the Malaysian Food Regulations [8].

The values of EDI and THQ of Cd, Cu, Fe, Ni, Pb and Zn of *Acetes sp.*, from the present study and cited data from the literature, are shown in Table 2. All values of THQ for the six metals in the adults of Malaysian population were found below 1.00. This shows that there was no non-carcinogenic risk of the six metals via the consumption of *Acetes sp.* from the present study.

The results showed that the cincalok and geragau accumulated different levels of metals. Higher accumulation of Cd, Cu, Ni and Pb could be seen in cincalok rather than the geragau, which the raw *Acetes* as a major ingredient shrimp for the making of cincalok. This could be due to the preservatives added and contamination during the making of the cincalok.

Rahouma, et al. [2] reported that the concentrations of heavy metals of *Acetes* shrimp collected from Malacca, Terengganu and Johor in 2011, were safe and MPLs for the human consumption and public health. Rahouma, et al. [1] reported that the metal levels in *Acetes indicus* sampled from Kedah and Malacca were safe for human consumption since they were within the MPL.

Conclusions

Based on THQ values of the six heavy metals investigated in the present study, geragau and cincalok from Pantai Klebang was safe for human consumption. However, regular monitoring of non-carcinogenic risks of these heavy metals in this small shrimps and other species should be made to check for the possible health risks via consumption of this seafood.

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