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Arsenic and Trace Metals in Commercially Important Bivalves, *Anadara granosa* and *Paphia undulata*

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The semi-culture of marine bivalves particularly *Anadara granosa* is of considerable economic importance in Malaysia. Currently, about 4-5000 ha of mudflats along the west coast are utilized for this purpose (Noordin, 1988). Therefore, contamination of the highly productive mudflats with heavy metals tend to be accumulated in the filter feeding organisms such as bivalve molluscs which often serve as important environmental sinks of heavy metals (Pringle et al., 1968).

Bivalve molluscs, *A. granosa* and *Paphia undulata* are commercially important seafoods and popular among the locals in Malaysia. With this point in mind, it is intended to evaluate the concentration levels of arsenic as well as trace metals (Co, Cu, Ni, Cd, Zn, Cr and Pb) in both species derived from retail outlets in the city of Kuala Lumpur. Although this analysis may not indicate the site of capture but may act as a direct check on the contamination of seafoods available to the consumers (Phillips et al., 1982).

MATERIALS AND METHODS.

A. granosa and *P. undulata* were purchased on the same day (7/3/93) from five retail markets in the city of Kuala Lumpur. Samples of approximately similar size (32.6 mm, *A. granosa*; 48.6 mm, *P. undulata*) were shucked, pooled and homogenized. 7-10 g of wet tissue were digested in 10 mL of boiling concentrated nitric acid (Analar grade) to near dryness. Additional digestion was accomplished by the addition of 10 ml of 1:1 nitric acid/deionized water. The solution mixture was then made up to 25 mL with deionized water.

Five composite samples from each species were used for the analysis of trace metals. A Baird ICP-2000 (Inductively Coupled Plasma) was employed for the analysis of trace metals.

Calibration curves from standard mixtures of 0.05, 0.1, 0.2, 0.5 and 1.0 ppm of Co, Cu, Ni, Zn, Cd and Cr and 0.5, 1.0, 2.0, 5.0 and 10 ppm of As and Pb were prepared in nitric acid solution. The accuracy of the methods was determined by preparing digestion mixture blanks and by spiking the samples with known concentrations of As, Co, Cu, Ni, Zn, Cd, Cr and Pb with mean recoveries of 91.6 ± 1.3 percent.

RESULTS AND DISCUSSION

The reported concentrations of arsenic and trace metals in *A. granosa* and *P. undulata* are in Table 1 and 2 respectively. The concentrations of arsenic in *A. granosa* and *P. undulata* were in the range of 4.65 - 5.30 μg/g wet weight and 3.84 - 4.42 μg/g wet weight respectively. These values were higher than the permissible limit in Malaysia (1 μg As/g wet wt). However, The concentration levels of arsenic in *A. granosa* and *P. undulata* in the present investigation were within the range observed in various edible molluscs in Hong Kong (Phillips et al,. 1982).

Excessive levels of cadmium in the body has been shown to result in kidney and liver damages as well as deformation of bone structures (Friberg et al., 1974). *A. granosa* and *P. undulata* accumulated cadmium in the range of 1.28 - 1.42 μg/g wet weight and 0.25-0.37 μg/g wet weight respectively. In the case of *A. granosa*, the mean concentration of cadmium was slightly above the legislative limit in Malaysia (1 μg Cd/g wet wt). The concentration level was comparatively higher than those of Huschenbeth and Harms (1975), Phillips et al. (1982) and Phillips and Mutarasin (1985) for the same species of bivalve molluscs as well as other *Anadara spp* (Won, 1973; Fabris et al., 1976; Phillips et al., 1982). However, it was in the same magnitude as those observed by Jothy et al. (1983). In the case of *P. undulata*, there was no comparable data available in this region.

Although the degree of coastal water pollution is not prevalent in Malaysia, the presence of 'hot-spots' cannot be ruled out (Broom, 1985). Therefore, it is of major concern to monitor the level of contamination of cadmium especially in the muddy coastal environment. This is due to the fact of extensive cultures of cockles are being carried out in the areas. The excessive contamination of seafoods of this nature

Table 1. Mean concentrations (standard deviations) arsenic and trace metals in *A. granosa* obtained from various retail outlets in the city of Kuala Lumpur (μg/g wet weight).

	RETAIL MARKETS			
	OLD TOWN	BANGSAR	CHERAS	SECTION 14
As	4.65 (0.08)	4.65 (0.11)	5.03 (0.37)	5.30 (0.51)
Co	0.15 (0.01)	0.14 (0.01)	0.16 (0.01)	0.15 (0.02)
Cu	0.80 (0.09)	0.68 (0.04)	0.71 (0.07)	0.70 (0.07)
Ni	0.45 (0.04)	0.41 (0.02)	0.48 (0.08)	0.54 (0.06)
Zn	12.85 (0.53)	13.52 (0.54)	14.08 (0.52)	14.73 (1.71)
Cd	1.28 (0.12)	1.23 (0.07)	1.32 (0.17)	1.42 (0.14)
Cr	0.31 (0.01)	0.15 (0.03)	0.19 (0.02)	0.35 (0.11)
Pb	0.79 (0.02)	0.82 (0.05)	0.19 (0.04)	0.84 (0.12)

will not render safe for consumption.

Phase of industrialisation and other athoropogenic activities in the vacinity of coastal areas are always positively associated with elevated level trace metals such as lead in marine biota (Eisler et al., 1978; Phillips, 1978). In *A. granosa* and *P. undulata*, the concentrations of lead in the whole soft tissues were below the permissible limit of 2 μg/g wet weight. These results were comparable with those of Phillips et al. (1982) for various species of bivalve molluscs. However, the mean concentrations of lead in *A. granosa* recorded by Huschenbeth and Harms (1975), Jothy et al. (1983) and Phillips and Muttarasin (1985) were lower than those in the present inventigation but comparable to those of Won (1973) and Phillips et al. (1982) for other *Anadara spp* (0.9 - 1.18 μg Pb/g wet wt). As increasingly greater export of trace metals into the marine environment, it is not unexpected to observe elevated levels of lead which will be manifested in the marine biota such as the commercially

important bivalves. The concentration of chromium in *A granosa* and *P. undulata* obtained from various retail outlets in Kuala Lumpur were shown to vary from 0.15 - 0.35 μg g wet weight and 0.24 - 0.42 μg/g wet weight respectively. These concentrations are comparable to those of commercially important North American molluscs where their concentrations varied from 0.1 - 0.6 g/g wet weight (Hall et al., 1978). Although there is no deleterious health effect of chromium poisoning has been recorded among consumers of molluscs, the biologically available chromium (VI) is known to be carcinogenic to man and other mammals (Phillips et al., 1982).

Table 2. Mean concentrations (standard deviations) of arsenic and trace metals in *P. undulata* obtained from various retail outlets in the city of Kuala Lumpur (μg/g wet weight).

	RETAIL MARKETS			
	OLD TOWN	BANGSAR	SECTION 14	CHOW KIT
As	4.42 (0.15)	3.84 (0.11)	4.03 (0.14)	3.80 (0.11)
Co	0.19 (0.02)	0.25 (0.02)	0.27 (0.03)	0.24 (0.12)
Cu	1.09 (0.06)	0.89 (0.08)	1.03 (0.05)	0.89 (0.04)
Ni	0.29 (0.02)	0.49 (0.02)	0.42 (0.05)	0.46 (0.02)
Zn	7.62 (0.40)	7.42 (0.68)	8.11 (0.29)	7.40 (1.13)
Cd	0.37 (0.03)	0.25 (0.02)	0.32 (0.03)	0.28 (0.03)
Cr	0.24 (0.02)	0.41 (0.03)	0.32 (0.04)	0.35 (0.03)
Pb	0.88 (0.03)	0.88 (0.04)	0.93 (0.09)	0.86 (0.09)

The biomagnification of cobalt by five marine bivalves from Greek Waters has been documented Papadopoulu (1973). The concentrations of cobalt in *A. granosa* and *P. undulata* were between 0.14 - 0.16 μg/g wet weight and 0.19 - 0.27 μg/g wet weight resoectiveky. These values were in agreement with those of other molluscs (Pringle et al., 1968).

The excessive contamination of nickel in edible marine molluscs may pose hazard to human health. When in excess, it may inhibit many enzymatic reactions which could lead to deleterious effect (Peck and Ray, 1969). With this point in mind, concentrations of nickel in sea-foods are worth investigating. In *A. granosa* and *P. undulata*, the concentrations of nickel were shown to vary from 0.41 - 0.54 μg/g wet weight and 0.29 - 0.46 μg/g wet weight respectively. These results are comparable to those of Pringle et al. (1968) for the species of *Crassostrea virginica* (0.19 μg/g wet wt), *Mya arenaria* (0.27 μg/g wet wt) and *Mercenaria mercenaria* (0.24 μg/g wet wt). As nickel is found in various forms of alloy in heavy machineries such as turbine blades as well as its variety of uses as industrial catalyst, the monitoring of nickel in the environment should be of major concern.

The mean concentration levels of copper in *A. granosa and P. undulata* from various marketplaces in Kuala Lumpur were lower than the permissible limits of 30 μg Cu/g wet weight. These concentrations were in similar magnitude as those observed in various *Anadara spp* (Shah et al., 1973; Won, 1973; Fabris et al., 1976; Phillips et al., 1982; Jothy et al., 1983; Phillips and Muttarasin, 1985). At present, the concentrations of copper in the samples of marketplace shellfishes may not considered to be of any serious threat to human health.

Filter feeding bivalve molluscs are generally shown to accumulate highest level of zinc from marine environment (Eisler, 1980). Therefore, it is not unexpected to find that *A. granosa* and *P. undulata* accumulated zinc from 12.85 - 14.73 μg/g wet weight and 7.40 and 8.11 μg/g wet weight respectively. These concentrations were comparable to those of Huschenbeth and Harms (1975), Jothy et al., (1983) and Phillips and Muttarasin (1985) for various *Anadara spp.*

As a conclusion, the present observed levels of trace metal in *A. granosa* and *P. undulata* may not pose serious consequences to human health. However, continouos monitoring of trace metals in seafoods would be of major interest to the consumers.

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