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A study on skin problems among people engaged in wastewater-fed culture of water spinach in Phnom Penh, Cambodia (preliminary result)

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Introduction: Boeng Cheung Ek lake is located west of Phnom Penh city where wastewater from industrial factories, urban area and rain-water run-off is discharged into the lake without any treatment. In the area, the farmers' main income is from growing water spinach (*Ipomoea aquatica*) in the lake. This study reports preliminary findings of skin problems among people engaged wastewater-fed culture of water spinach.

Study design: A preliminary cross-sectional study on skin problems among people engaged in wastewater-fed culture of water spinach in the Boeng Cheung Ek lake was initiated July 2004 to identify the prevalence of skin problems and associated risk factors. A total of 154 households and 46 households resided around the Boeng Cheung Ek lake and a non-wastewater control lake, respectively, were selected for the skin problem survey. The households studied were identical to those included in baseline and monitoring surveys carried out by the PAPUSSA team.

Results: Information of skin problems from 713 members of 200 selected households showed that 134 (22%) household members engaged in wastewater culture of water spinach reported skin problems while there was only 1 (1%) person living around the non-wastewater lake that reported a skin problem. Those who were having skin problems were referred to dermatologists for physical examination and treatment. The disease diagnosis made by the dermatologist showed that contact dermatitis (74%) was the most common skin disease followed by superficial fungal infection (18%) and urticaria (9%). Skin diseases mostly appeared on the hands (56%), feet (36%) and legs (34%). Major symptoms included itching (86%), dry skin with scaling or flaking (53%) and papules (51%).

Conclusion: The occurrence of skin problems among people engaged in wastewater-fed culture of water spinach was high (22%) compared with people working in non-wastewater aquaculture (1%). More data will be collected during two additional rounds of household visits scheduled between Jan-April 2005 and subsequent physical examinations by the dermatologist. The risk factors for the skin problems will be identified and their importance assessed based on uni- and multivariate data analysis.

Microbiological water quality and food safety of water spinach (*Ipomoea aquatica*) produced in peri-urban wastewater in Boeng Cheung Ek lake, Phnom Penh, Cambodia

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Introduction: A major part of the wastewater (ww) from Phnom Penh, Cambodia is discharged into the peri-urban Boeng Cheung Ek lake. Water spinach (*Ipomoea aquatica*) is cultured in most of the lake area and is the main occupation for many households living in and around the lake. Little if any formal ww treatment is taking place, except for the stabilization and biological treatment during ww passage through the lake. The microbiological food safety of water spinach produced in the lake is unknown as is the wastewater treatment capacity of the lake. Thus, the study objectives were to a) assess the reduction of numbers of *E. coli* and helminth eggs in ww in the lake at points of entry and exit and b) to enumerate *E. coli*, helminth eggs and protozoan parasites in water spinach grown in the lake. Ww (a total of 65 samples) and water spinach (a total of 8 samples) samples were collected according to international guidelines and analyzed for numbers of *E. coli* and protozoan parasites (*Giardia* spp., *Cryptosporidium* spp., and *Cyclospora* spp.) by membrane filtration-based method (*E. coli*); by microscopy using immunofluorescence monoclonal antibodies (IFA-kit) (*Giardia* spp. and *Cryptosporidium* spp.) and by auto-fluorescence microscopy (*Cyclospora* spp.). Helminth egg numbers were enumerated according to WHO standard methodology.

Results showed large variations in numbers of target organisms between different samplings underlining the necessity to do repeated samplings over lengthy time periods following standardized methods. Mean number of *E. coli* in raw ww at the lake inlet was 3.7×10^6 *E. coli* /100 ml; in ww at outlet the mean number was 35,500 *E. coli* /100 ml; and at the control site water samples contained a mean 43,300 *E. coli* /100 ml. Analyses of eight samples of water spinach revealed the presence of (o)ocysts of *Giardia* spp. and *Cyclospora* spp. in 3/8 samples (number range: 0-30 (o)ocysts/g), where as *Cryptosporidium* spp. and helminth eggs were not detected. Confirmation and speciation of isolated protozoan (o)ocysts by PCR and DNA sequencing remains to be done.

Conclusions and planned reserach: *E. coli* numbers in ww pumped into the Boeng Cheung Ek lake were significantly reduced compared with numbers of *E. coli* in ww at outlet. *E. coli* numbers in ww at the lake outlet and in water samples at the control sites were similar. Water spinach were contaminated with the protozoan parasites, *Giardia* spp. and *Cyclospora* spp.. Planned research include weekly ww and water samplings in the lake and control sites for *E. coli*, protozoan and helminth egg enumerations over an initial 3-4 month period. Additional water spinach samples with ww exposure/no exposure during harvest will be collected and analyzed for numbers of *E. coli*, protozoa and helminth eggs.

Accumulation of toxic metals in aquatic production systems receiving urban wastewater in Cambodia and Vietnam

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INTRODUCTION

The majority of the untreated wastewater from the major cities in Asia is discharged to peri-urban wetlands that serve as sites for natural treatment and extensive aquatic food production. Hence, contaminants from industrial and domestic wastewater may accumulate in fish and vegetables produced in wastewater use systems. In Phnom Penh, Cambodia 90% of all untreated urban wastewater is discharged to wetlands areas; it is estimated that 20% of the vegetables consumed in Phnom Penh are produced in these areas (Muong, 2004). In Hanoi, Vietnam untreated urban wastewater is discharged into Kim Nguu and To Lich Rivers; which supply and irrigates aquatic production systems comprising of systems of shallow lakes, ponds and fields. Water spinach (*Ipomoea aquatica*) is one of the most important vegetables produced in the aquatic systems receiving wastewater. To evaluate the food safety of aquatic products produced with use of untreated wastewater in Southeast Asia a study of concentrations of potential toxic metals in fish and vegetables, in particular water spinach, is carried out.

Aim

The objective of this study is to analyze aquatic products and fish produced in Phnom Penh and Hanoi for possible content and concentrations of potentially toxic metals. For metals present at critical concentrations accumulations in food products and mass balance studies are carried out. Metal concentrations are determined in different parts of the products, to examine the possible different accumulation pattern in fish and water spinach and to assess health risks of products for human consumption.

MATERIALS AND METHODS

Water, sediment, plant, and fish samples are collected in Hanoi, Nam Dinh and Boeng Cheung Ek lake, Phnom Penh. Water spinach samples are washed by dipping them 20 times into three sets of distilled water. Water spinach samples consist of either the whole top of the plant (the part used for human consumption) or plants separated into leaves, upper and lower stem, and roots. Fish samples are divided into meat, skin, and liver. Sediment and plant samples are dried before analyses. Water samples are filtered through a 0.45µm membrane (Millipore). All solid samples are subject to a total digestion under pressure in 70 % HNO₃, 30 % H₂O₂, 40% HF and 36 % HCl using a closed vessel microwave assisted system (Multiwave 3000, Anton Paar GmbH). The method is modified after EPA 3050B (USEPA, 1996). For screening purposes, the total concentrations of 42 elements are determined on Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) (Agilent 7500c ICP-MS equipped with an octopole reaction system, Agilent

Technologies, Tokyo, Japan), for single metal analyses graphite furnace, hydride generation and cold vapour atomic absorption spectrophotometry (Perkin Elmer) is applied.

RESULTS AND DISCUSSION

This is an ongoing study and only initial results from screening of water spinach samples from Boeng Cheung Ek lake are presented. The outcome of ICP-MS analyses of 42 different elements in water spinach from Boeng Cheung Ek lake in Phnom Penh showed that arsenic (As), cadmium (Cd), nickel (Ni) and to a minor degree lead (Pb) were accumulated at critical concentrations in water spinach used for human consumption (Table 1).

Table 1. Total As, Cd and Pb concentrations in water spinach (mg/kg wet weight) produced in Boeng Cheung Ek lake in Phnom Penh, Cambodia.

Plant part	Leaves	Leaf stalk	Upper stem
No. of samples	14	6	13
Metal concentration	Average (range)	Average (range)	Average (range)
As	0.3 (0.2 - 0.6)	0.2 (0.2- 0.4)	0.2 (0.2 - 0.4)
Cd	0.06 (0.04 - 0.08)	0.05 (0.04 - 0.07)	0.08 (0.04 – 0.1)
Pb	0.08 (<0.01 – 0.2)	0.03 (<0.01 – 0.05)	0.03 (<0.01 - 0.07)
Ni	0.3 (0.1 – 0.6)	0.2 (0.1 – 0.2)	0.3 (0.2 – 1.1)

The Provisional Tolerable Daily Intake (PTDI) for a person who weighs 60 kg is 0.13, 0.06, 0.21 mg/day for As, Cd and Pb, respectively (FAO/WHO, 2003). This means that if a person consumes more than 565, 1000 and 4200 g water spinach, the PTDIs for As, Cd and Pb will be exceeded, respectively. This indicates that there is little risks to human health related to consumption of water spinach produced in wastewater with respect to Pb, even though concern regarding this has been raised in the Ministry of Environment in Cambodia (Muong, 2004). It is uncertain if consumption of water spinach constitutes a food safety risk with respect to As and for children and pregnant women the Cd concentrations could also be of concern.

In Boeng Cheung Ek lake, Ni concentrations seem elevated in water spinach up to 0.3 mg/kg wet weight mass in leaves and 1.1 mm/kg wet weight mass in upper stem. High Ni concentrations in vegetables are not necessarily a food safety problem and no PTDI exists for Ni. However, high concentrations of Ni in water spinach indicate high nickel concentrations in the production system which may lead to skin problems for water spinach farmers exposed to wastewater.

Conclusions

The preliminary results indicate that there seem limited health risk related to consumption of vegetables produced in aquatic systems receiving non-treated wastewater with respect to toxic

metals, in particular to As and Cd. Further samples will be analyzed and the speciation and mass balance of these potential toxic metals investigated.

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Evidence of newsletter publication on Seminar “Status of aquatic production system in peri-urban Hanoi”

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