CHEMICAL TOXICOLOGY RESEARCH DIVISION

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The Chemical Toxicology Research Division is engaged in Poison Information Services and Research concerned with environmental health. Chemical Toxicology laboratory provides the information regarding chemical poisoning. Currently, research related to environmental health including removal of heavy metal, accumulation and distribution of heavy metals into rice grains, soil and water, arsenic removal method and promoting environmental health in arsenic contaminated areas are being conducted in collaborating with other organizations and departments.

RESEARCH PROJECTS

1. ENVIRONMENTAL HEALTH

1.1 Promoting environmental health in arsenic contaminated areas in Myanmar

The quality of drinking water is particularly serious problem for the people residing in rural areas where arsenic (As) contaminated underground water is the main source of drinking water. This baseline study focused on identification of As contamination of ground water drinking sources in 7 villages of Thabaung Township in 2015. A total of 183 drinking water samples from tube well, dug well and ponds were collected. Arsenic concentration was determined by field kits and validated in the laboratory. Among the 183 tested wells, 67.2% had As content above Myanmar National Standard of 50 ppb (0.05 mg/L). At the initial stage, over 0.05 mg/L of As concentration was found in all tube wells with the depth between 100-200 ft and those with the depth between 200-300 ft in Konetangyi village. In the remaining 6 villages, over 0.05mg/L of As concentration was found in tube wells of depth between 100-200 ft: 84.0 % (21/25) in Thayattaw village, 80.0 % (32/40) in Htanzinhla village, 79.2 % (19/24) in Latechaung village, 75.0% (12/16) in Shannkwin village, 50.0 % (5/10) in Dale-et village and 45.0% (18/40) in Yaylegyi village.

Table. Arsenic concentration in tube wells by depth

Village	Depth of wells	No. of tube wells	≤ 0.05mg/L	> 0.05mg/L	As > 0.05 mg/L (%)
Konetangyi	Depth<100 ft	2	2	0	0.0
	100ft < Depth < 200ft	15	0	15	100.0
	200ft < Depth < 300ft	1	0	1	100.0
Shannkwin	Depth<100 ft	1	1	0	0.0
	100ft < Depth < 200ft	16	4	12	75.0
Latechaung	Depth<100 ft	3	3	0	0.0
	100ft < Depth < 200ft	24	5	19	79.2
Thayattaw	Depth<100 ft	2	2	0	0.0
	100ft < Depth < 200ft	25	4	21	84.0
Yaylegyi	Depth<100 ft	1	1	0	0.0
	100ft < Depth < 200ft	40	22	18	45.0
Dale-et	Depth<100 ft	2	2	0	0.0
	100ft < Depth < 200ft	10	5	5	50.0
Htanzinhla	Depth<100 ft	1	1	0	0.0
	100ft < Depth < 200ft	40	8	32	80.0

Arsenic mitigation programs should focus on tube wells with depth between 100-200 ft. Early mitigation measures should be a high priority.

2. OTHERS

2.1. Heavy metal hyper accumulator Fern *Angiopteris evecta* and its antioxidant activity

Angiopteris evecta Hoffm., (the Giant Fern) is an ancient species, reputedly known to be the largest fronds of any fern on earth. The Giant Fern is the only species of the genus *Angiopteris* found in Australia. Many antioxidant compounds, naturally occurring in plant sources have been identified as free radical or active oxygen scavengers. Since this species is also known to be of importance for its ethnomedicinal uses, this is a matter of great concern. The rhizome of *Angiopteris evecta* was also taken with honey for longevity. Some fern species and some *Cissus* species have good possibility for using in phytoremediation process. The objectives of this research were to determine the accumulation of heavy metals (Cd, Pb, As, Cr, Cu, Fe, Zn and Mn) of rhizome of the giant fern by inductively coupled plasma optical emission spectrometry (ICP-OES), to evaluate its antioxidant activity, and to compare the content of heavy metals in two types of rhizome *Angiopteris evecta* (giant fern) (ဆေးမြင်းခွာ), and *Cissus repens* Lam. (တပင်တိုင်မြနန်းအနီ) from various sites; Myitkyina, Moegoke, Aungban, and Pyin Oo Lwin and their soils for awareness among the public regarding its safer use and collection areas, containing high level of heavy metals and their adverse health effects. The watery extract of *Angiopteris evecta* rhizome (ဆေးမြင်းခွာ) showed antioxidant activity with IC_{50} value of 1.5595 μg/ml and IC_{50} value of ascorbic acid was 1.104078 μg/ml. Flavonoids, polyphenols, tannins, saponins, amino acid, glycosides, carbohydrate and reducing sugar were detected in this *Angiopteris evecta* rhizome. It contained high amount of Fe (25.28±0.02 ppm)and Zn (51.32±0.01 ppm) which were above the permissible limits set by WHO, 2008 in edible plants (Fe=20 ppm and Zn=27.4 ppm). Whereas rhizomes of *Cissus repens* Lam. (တပင်တိုင်မြနန်းအနီ) collected from Myitkyina contained Fe (284.96±7.63 ppm), Moegoke origin contained Fe (112.27±4.37 ppm), Aungban rhizomes contained Fe (150.51±25.05 ppm) and Pyin Oo Lwin contained Fe (102.91±3.82

ppm), which were above the permissible limits set by WHO, 2008 in edible plants (Fe=20 ppm). Rhizomes of *Cissus repens* Lam. from Myitkyina contained Mn (364.73±73 ppm), and Moegoke origin contained Mn (228.35±4.76 ppm) which were above the permissible limit of WHO determined in 2005 (Mn=200ppm). Most of the selected rhizomes and all their soils from four different locations contained metals which are within permissible limit. This study revealed that the respective soil and rhizomes of *Angiopteris evecta* and *Cissus repens* Lam**.** from different sites were free from toxic contaminant (Cd, Cr, As and Pb). In conclusion, the role of *Angiopteris evecta* and *Cissus repens* Lam. in bioremediation process is important to alleviate concentration of heavy metals from the environment. It also highlighted that monitoring of heavy metal distribution in soil and plant samples is very useful as references or guidelines to assess the quality of soil and safe level for medicinal plant to be consumed.

2.2 Uptake and accumulation of heavy metals into rice grains, soil and water

The uptake and accumulation of nine heavy metals in rice grains, their soil and tube well water were investigated in Kyon-Pyaw Township which was contaminated with heavy metals. The concentrations of As, Cd, Pb, Cr, Zn, Cu, Ni, Fe and Mn in these samples were determined by Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES) in March, 2015. Zn was detected in 8 of 14 rice samples and 7 were above the maximum allowable concentration (MAC) (Zn=50 µg/g, GB 2762-2005) whereas Cu was accumulated in 8 and 5 showed above the MAC (Cu=10 µg/g, FAO/WHO, 1992). Ni was detected in 9 and 4 showed above the MAC (Ni=1.5 µg/g, FAO/WHO, 2001). Mn was present in 11 and 8 had above MAC (Mn= 5µg/g, USEPA 2007). Fe was detected in 10 and 5 had above MAC (Fe=5 µg/g, CODEX standards). In 8 Pb accumulated samples, 6 had above MAC (Pb=0.2 µg/g, GB 2762-2005). As was detected in 2, Cr in 5 and Cd in 6 but all were lower than their respective MAC. The order of metal concentrations in rice grain samples was Zn >Pb>Mn>Cu >Fe >Ni> Cd > Cr > As. In 14 soil samples, the concentrations of As, Cd, Pb, Cr, Zn, Cu, Fe and Mn were within MAC. However, the concentration of Ni in 8 samples were above MAC (Ni=40 µg/g). Fe and Mn were found in all 23 water samples whereas 19 Fe and 16 Mn samples had above MAC (Fe=0.3 ppm & Mn= 0.4 ppm, WHO, 2006). Among 23 As detected samples, 12 were higher than Myanmar Drinking Water Quality Standard (As=50 ppb). Cr in 18 and Pb in 6 were detected. However, concentration of one Cr and two Pb samples showed higher than MAC (Cr =0.05 ppm and Pb=0.01 ppm, WHO, 2006). The concentration of Zn, Cu and Ni were within MAC (Zn=3 ppm, Cu=2 ppm, Ni=0.07 ppm, WHO, 2006). Cd was detected in 14 but 4 were above MAC (Cd=3 ppb, WHO, 2006). The order of metal concentrations in water was Fe >Mn>As >Cd >Pb>Cr> Zn=Cu> Ni.

2.3 Arsenic contamination of ground water and development of arsenic iron removal method

Chronic exposure to arsenic greater than 0.05 mg/L in drinking water can result in serious health problems such as melanosis, keratosis, skin lesions, skin cancers, and kidney failure. The consumption of arsenic contaminated water is one of the burning issues in the rural area. Therefore, the aim of this study was to measure the extent of arsenic contamination by field kit (Arsenator) and confirmed by Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES) in 97 tube wells at Kyon Pyaw Township in 2015, and to develop the Arsenic Iron Removal Method. Arsenic was removed by co-precipitation of iron, resolved in the groundwater after aeration generally known as Arsenic Iron Removal Method. The results showed that 29% (28/97) of tube wells exceeded 0.05mg/L of arsenic, the permissible value in Myanmar by field kit and 33% (32/97) of tube wells exceeded 0.05mg/L, the permissible value in Myanmar by ICP-OES. Iron concentration was also measured. Most

of the groundwater 73.19% (71/97) contained the concentration of Fe greater than 0.5 mg/L indicating the presence of As level above 0.05 mg/L in these tube well water. The arsenic-contaminated tube wells showed As level less than 0.20 mg/L. Iron concentration of the tube well water was to satisfy the ratio of Fe/As greater than 20 by removing arsenic with co-precipitation method. Aeration causes a photochemical oxidation of iron and arsenic, which reduced the iron and arsenic level by co-precipitation for 7 days. These samples were then filtered by iron and sand. The filtrate was measured by ICP-OES. The results finally showed arsenic level becomes zero and 30% of iron was also reduced. Over 0.05 mg/L of arsenic concentration was found in 43.24% (32/74) of tube well with the depth between 100 ft to 200 ft and 7.69% (1/13) of tube well with the depth between 300ft to 400 ft.

SERVICES PROVIDED

ACADEMIC

Sr.	Name	Course	Responsibility
1.	Dr. San San Htwe	MMedTech (MedLabTech)	Teaching
		MMedSc (Med Juris)	Teaching

Poison Information Service

The Poison Information regarding chemical poisonings, chemicals used in the commercial products and chemical safety in the residential and the working environment was given by telephone using Poison Information Monograph, International Programme on Chemical Safety (IPCS) and Micromedex.