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Heavy Metals Residues in Soil and Vegetables from Agricultural Area in Wangkanai District, Kanchanaburi Province, Thailand

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Abstract: This study aim to investigate the heavy metals residues in soil and vegetables from agriculture area in Wangkanai District, Kanchanaburi Province. The concentration of Zn, Cd and Cu found in soil of all vegetable gardens were higher than the standard of contaminated heavy metals in Thailand soil but lower than the standard of contaminated heavy metals in European soil. The determination of heavy metal residues in Chinese Kale, Celery and coriander showed that Cu and Zn were below the notification of the Ministry of Public Health No. 98 and World Health Organization (WHO). The safety level of pesticide residues in vegetables showed that only 10% of Chinese Kale and Celery found organophosphate and carbamate residues were in unacceptable level.

Key words: Heavy metals, pesticides, residues, wangkanai, agriculture, Thailand

INTRODUCTION

Thailand has been developing on base an agricultural country. The major exported goods of Thailand were agricultural product and food. The exportation income of agricultural products and food of Thailand was the key contributor of Thailand's economy. The increasing of agricultural products consumption in the world has affected to agricultural growth. The pesticides and chemical fertilizer have been using for supporting agricultural growth to increase agriculture products. The importation of pesticides and chemical substances of Thailand are also increasing (Anonymous, 2015a, b). The rising of pesticides and chemical fertilizer usage in agriculture has an effect on environment (soil, water, sediment, etc.), agricultural products and human health. Even thought, the organic agriculture has been promoting but the pesticides and chemical fertilizer are still using in agriculture. Lately, European Union rejected agricultural products of Thailand because the prohibit pesticide residue was found in vegetable and fruit. The agriculture products prohibition of European Union made an impact on exportation of Thailand and affected the Thailand image.

Kanchanaburi Province is predominantly an agricultural province which is an area of sugar cane, cassava, pomelo, lemon and rubber tree garden, etc., Wangkanai District is a one of agricultural area in Kanchanaburi Province which has many vegetable gardens. This agricultural area has been using pesticide and chemical fertilizer for long time. Heavy metals were well known that they were commonly used as an ingredient in pesticides and chemical fertilizer. These heavy metals may contaminate in environment and food web which can affecte human health and creature. Therefore, this area need to consider the contamination of pesticides and heavy metals in agricultural products which might be harm to and creature and human health.

The aim of research: This study aim to investigate the heavy metal residues in soil and vegetables from agriculture area in Wangkanai district, Kanchanaburi Province. To examine safety level of pesticide residues in soil and vegetables from agriculture area in Wangkanai District, Kanchanaburi Province.

MATERIALS AND METHODS

Soil from coriander garden, Chinese Kale garden and Celery garden and vegetables (Coriander, Chinese Kale and Celery in agricultural area were collected to examine the heavy metals residues. All vegetables were tested for the safety level of pesticides residue (organophosphate and carbamate).

Study area: Wangkanai District, Kanchanaburi Province is an agriculture area which has been using the pesticide (fungicide, herbicide, insecticide and vermicide) and chemical fertilizers for long time. So, this area was chosen as the study area.

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Soil Sample collection and preparation: Soil samples from coriander garden, Chinese Kale and Celery garden were collected and then dried for 3-4 days. Dried soil samples from each garden was ground and sieved through 200 mesh size. About 0.5 g of dries fine soil samples from each garden was weighted into beakers. About 0.5 mL of $HClO_4/HNO_3$ (2:1) was add into all samples and then left overnight. All samples were heated at 85±5°C until the brown smoke disappeared. Afterward, digestion was continued at 128 ±3°C for 3-4 h and then gradually increased temperature to 200±20°C and digested until the final volume of sample was 1 mL. All Sample were left overnight. The 5mL of DI water was added into all samples and then, filtered the samples with Whatman No. 42. All samples were adjusted the volume by adding DI water until the volume was 25 mL (Anonymous, 2010).

Vegetable collection and preparation: Vegetable samples (Coriander, Chinese Kale and Celery) were cleaned with tap water to eliminate soil particles. Vegetable samples were dried in oven at 70°C. Dried vegetable sample was ground to pass a 60 mesh sieve. Approximately 0.5 g of fine powder and dried moss samples were weighted and placed into tube. $HClO_4/HNO_3$ (1:2) 5 mL was filled in tube for digestion by leaving it overnight. Then continue the digestion process at 85±5°C until the brown smoke disappeared. Afterward, digestion was continued at 128±3°C for 3-4 h. Then, gradually increased temperature to 200±20°C and digested until the final volume of sample was 1 mL. Then, left samples overnight. Added DI water 5 mL and then, filtered the samples with Whatman No. 42. Adjusted the volume by adding DI water until the volume was 25 mL (Anonymous, 2010).

Heavy metal residues in soil and vegetable analysis: Samples from section soil sample collection and preparation and section vegetable collection and preparation were analyzed the concentration of heavy metals (Pb, Cd, Zn and Cu) by atomic absorption spectrometry (GBC, Avanta O system 2000/3000).

Safety level of pesticide residues test: The pesticides residues (organophosphate and carbamate) in vegetables were investigated by using GT-pesticide test kit (produced by Ministry of Public Health) to determine the safety level of pesticide residues.

RESULTS AND DISCUSSION

Heavy metals residues in soil and vegetable analysis: The analytical results of heavy metals residues found in soil and vegetable were shown in Fig. 1a, b, respectively). Heavy metals residues found in soil from Chinese Kale garden and Celery garden were Cd (14.69±4.98, 14.67±4.88 mg/kg, respectively), Zn (79.77±12.73, 73.20±11.44 mg/kg, respectively) and Cu (13.00±3.06, 13.77±3.25 mg/kg, respectively). The concentration Cd found in soil from Chinese Kale and Celery garden were also over than the standard of heavy metal contaminated in Thailand soil (0.15 mg/kg) (Department of Agriculture) and the standard of heavy metal in European soil by EU legistration (3 mg/kg) (Anonymous, 1986a). For soil from coriander garden, only Zn 70.43±13.19 mg/kg and Cu 15.45±5.57 mg/kg were detected. The concentration of Zn found in soil of all vegetable garden were higher than the standard of heavy metal contaminated in Thailand soil 70 mg/kg (Department of Agriculture) but were below the standard of heavy metal in European soil by EU legistration 300 mg/kg (Anonymous, 1986b). The concentration of Cu found in soil of all vegetable garden were lower than the standard of heavy metal contaminated in Thailand soil 45 mg/kg (Department of Agriculture) and the standard of heavy metal in European soil by EU

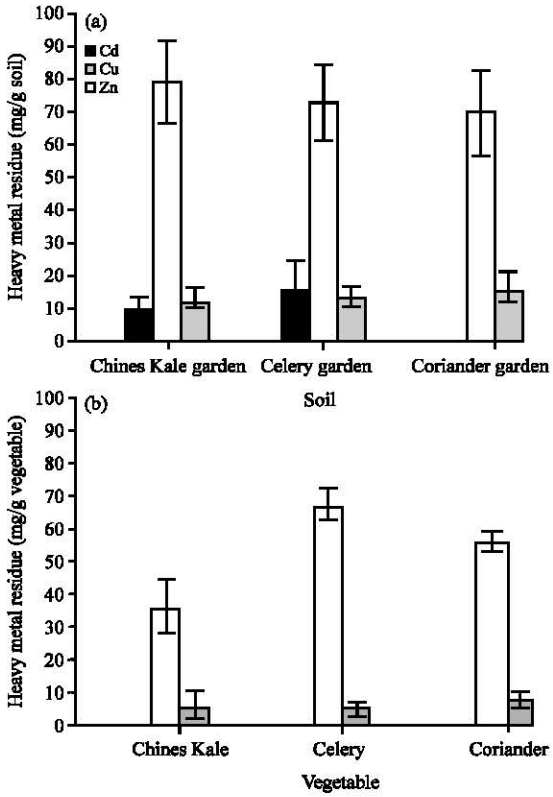

Fig. 1: Heavy metals residue: a) Soil from garden and b) Vegetable

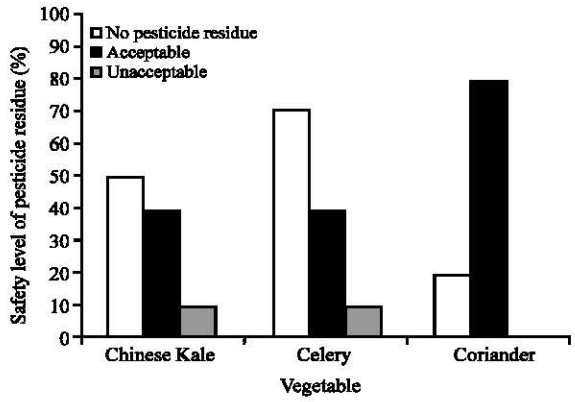

Fig. 2: Safety level of pesticide residues in vegetable

legistration 100 mg/kg (Anonymous, 1986a, b). Pb was not found in soil from all gardens. The determination of heavy metal residues in Chinese Kale, Celery and coriander showed that only Cu (6.28±4.51, 5.93±1.64 and 9.52±2.55 mg/kg, respectively) and Zn (36.12±8.00, 66.84±4.90 and 55.62±3.03 mg/kg, respectively) were detected. The concentration of Zn and Cu found in vegetables this study was higher than the other studies (Kawashima and Soares, 2009). However, the concentrations of heavy metals residue in all vegetables were not over the standard of Thailand (Anonymous, 1986; WHO, 1993). The concentrations of all residual heavy metals in vegetables were relatedwith the concentration of all residual heavy metals in soil.

Cd was used as an ingredient substance in fungicide, insecticide and vermicide (USEPA., 2016; Krieger, 2001). Zn is a component substance used as fungicide. Furthermore, Zn was widely used to blow on vegetable for protecting the lack of Zn. Cu is a constituent of fungicide (Fishel, 2005). The presence heavy metals in chemical fertilizer was also well established (MDH, 2016). Therefore, the heavy metals found in soil and vegetable in this study may come from pesticides and chemical fertilizers.

Safety level of pesticide residues test: The result of safety level of pesticide residues (organophosphate and carbamate) test shown in Fig. 2. No pesticide residues in Chinese Kale, Celery and coriander were 50, 70 and 20%, respectively. The acceptable level of pesticide residue found in Chinese Kale, Celery and coriander were 40, 20 and 80%, respectively. The 10% of Chinese Kale, 10% of Celery were found pesticide residue in unacceptable level. Therefore, coriander was the safest vegetable because no found pesticide residue in unacceptable level.

CONCLUSION

Most of heavy metals residues found in soil and vegetables in this study were below the international standard. However, the heavy metals contamination in this area should be concern for protecting human health and creature. The residual pesticides were also detected in vegetables. Even though, the concentrations of pesticides residues were in acceptable value but agriculturist could aware about the safety of consumers by chancing from inorganic agriculture to organic agriculture which good for environment and safe to human health.

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