Jurnal Intelek (2015) Vol 10(1): 33-36
ISSN 2231-7716

Determination of Metals Contamination in Rock Melon (*Cucumis melo*) and Coco Peat

*Nur Firdaus Abdul Rashid and Adzmi Yaacob

Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia.

nurfirdaus@melaka.uitm.edu.my

Abstract:

Fresh fruit is one of the sources of these trace metals which can be obtained easily with reasonable price. Trace metals content when exceed certain concentration can however contribute to harmful effect to human. This study analyzes the concentration of selected metals that include Aluminum (Al), Boron (B), Cobalt (Co), Chromium (Cr), Copper (Cu), Iron (Fe), Manganese (Mn), Nickel (Ni), Lead (Pb) and Zinc (Zn) in rock melon (*Cucumis melo*) randomly selected from 5 different locations as well as in the coco peat used as growth media for the crop. The results were compared with the maximum allowable limits (MAL) set by Malaysian Food Act (1983), Malaysian Food Regulation (1985) and Federal Food Drug Administration (FFDA) 1997. The finding from the study showed that there are six elements were found to be exceed the maximum allowable limits (MAL) in *Cucumis melo*. They are Al, Cr, Cu, Fe, Pb and Zn, 60.14±0.393 ppm, 6.42 ±0.170 ppm, 17.4 ± 0.079 ppm, 102.62 ± 0.114 ppm, 1.82 ± 0.235 ppm and 11.97± 0.821 ppm respectively. B, Mn and Ni were not exceeding the MAL. However, Co barely detectable by ICP (OES). Heavy metals content in Cucumis melo should be of great concern because of its popularity in Malaysia (The Star, 2013). In addition, heavy metals are toxic to human and usually accumulate in organs such as kidney, liver and heart. This study indicates that there are six elements of metals in rock melon and coco peat exceed the MAL.

Keywords: Heavy metals, rock melon, coco peat and locations.

Introduction

Rock melon (*Cucumis melo L.*) is a commercially important crop in many countries. It is mostly cultivated in the temperate regions of the world due to its good adaptation to soil and climate. Rock melon fruits are consumed in summer and are popular because of its sweet pulp and pleasant aroma (Villanueva et al.., 2004).

In Malaysia, the cantaloupe type, especially the cultivar 'Glamour' with the striking golden yellow color is the most popular. Like other melons, cantaloupes grow best in sandy, well-aerated, well-watered soil and in weed-free conditions. Fertilizer is the major cost in agriculture sector in the world. In fertigation system, the plants are fed by water including fertilizer by drip system in soilless media. Fertigation is defined as the use of fertilizers in the appropriate combination, concentration and pH, for every irrigation cycle (usually inorganic for commercial greenhouse hydroponics and smaller systems, though some hobbyists use organic mixtures). The application of nutrients through irrigation systems is called "fertigation," a combination of fertilization and irrigation. The most common nutrient applied by fertigation is nitrogen. Elements applied less often include phosphorus, potassium, sulfur, zinc and iron (Ieuan & Elston, 1998 ; Vailliers et al., 2010).

Some heavy metals are needed for living organism in minimal amounts such as Cu, Fe, Zn, Cr, Mg and Mn (Pacyna et al., 2009), whereas, some of them are toxic even at low concentrations such as; Pb, Hg, As and Cd (Samara, 2008). Under certain conditions, these metals can act as mildly to highly toxic substance and impart pronounced effects on the normal physiological activities. Once accumulated, these are not degradable or transformed into harmless products and they have the possibility to accumulate into human body (Samara, 2009).

Exact needs vary among species and the commonly required plant micronutrients include copper, boron, zinc, manganese, and molybdenum. Lack of a necessary

plant micronutrient in the soil may lead to deficiency symptoms which exposed plants to diseases (Medical Dictionary, 2009).

Heavy metal toxicity refers to the excessive build-up of heavy metals in the body. Our environment comprises of several such metals like arsenic, bismuth, antimony, uranium, vanadium and zinc which are classified as heavy metals. While some of these metals are necessary for the human body, an excessive dosage of some others in one's immediate environment and body results in heavy metal toxicity (Kathle, 2010).

Heavy metals studied are Aluminum (Al), Boron (B), Cobalt (Co), Chromium (Cr), Copper (Cu), Iron (Fe), Manganese (Mn), Nickel (Ni), Lead (Pb) and Zinc (Zn). I used the term heavy metals for these elements in my study which is also use in the medical term for elements that become toxic to human if consumed beyond certain limits (Yap et al., 2009).

The objectives of this study is to determine the metals contamination in rock melon and coco peat grown at different location.

Material and method

The experiment was conducted in a completely randomized sampling design (CRD), comprising of fourteen replications using 2 materials which is rock melon (*Cucumis melo*) samples and coco peat samples. For rock melon samples, 14 fruits are taken randomly from the 5 different locations stated. The total sample are 70 fruits samples. Coco peat samples were collected also 70 samples from the same locations, and there are 14 fresh samples of coco peat before farmers used for planting also become samples.

The experiment focus on of determining the heavy metal content in Rock Melon grown at five different locations which is three farms at Mantin, Negeri Sembilan and two farms at Jalan Kebun, Klang. This location had been chosen because of the preliminary test on the fruits samples showed the metals content in the fruits samples were exceed the MAL.

The contents of the selected metals in rock melon and coco peat were analyzed by using Inductively Coupled Plasma (ICP) for selected heavy metals in soil laboratory at Faculty of Applied Science in UiTM, Shah Alam.

Data analysis and results

Based on the coco peat results (see Table 1) the following elements Al, Cu, Fe, Mn, Ni and Pb were significantly high compared to MAL. Co, Cr and Zn were significantly lower that MAL. And B barely undetectable by the machine due to the low concentrations of heavy metals content available in the samples.

Based on the *Cucumis melo* results (see Table 2), Al, Cr, Cu, Fe, Pb, and Zn indicates that were significantly higher than MAL. This element may affect human health if taken regularly. It is a similar report on heavy metals that were found abundantly in fruit plants were Fe, Mn, Zn, and Cu, and the highest value that exceeds maximum allowable limits is Zn. It is due to the application of pesticides (Samara, 2007; Ahmad Razali & Norasyikin, 2001).

There are reports on Al found in a fruit sample that is lower than allowable limits, but Al may retain in blood cells and accumulate and can become a cancer cell to liver, pancreas and lungs (Aziz et al., 2011; Jibrin et al., 2008).

There are reports on B accumulation that is moderate in pepper fruit based on long-term cocoa peat medium. Boron is a naturally occurring compound, usually found in various inorganic forms in sediments and sedimentary rocks (Jiusheng et al., 2004 ; Mehmet & Neslihan, 2007).

And there is not detected element by ICP that is Co in *Cucumis melo* and B in coco peat. The element must be lower than standard solution, so that the ICP cannot detect the element, but the element is at safety limit for human consumption.

Table 1: Heavy metals concentration in Coco peat samples.

Element		Al	B	Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn
Allowable limits in coco peat (ppm)		100	25	25	75	40	100	20	2.0	0.5	50
Locations	Mantin 1	1094 ***	ND	0.92 NS	35.06 NS	54.77 ***	208 ***	75.07 ***	4.06 **	8.33 ***	49.36 NS
	Mantin 2	1423 ***	ND	1.17 NS	40.91 NS	48.57 **	237 ***	87.91 ***	4.59 **	9.06 ***	40.39 NS
	Mantin 3	955 ***	ND	1.14 NS	35.14 NS	53.00 ***	191 ***	80.00 ***	4.23 **	7.32 ***	37.46 NS
	Klang	1408 ***	ND	1.07 NS	36.26 NS	55.49 ***	206.10 ***	83.72 ***	4.84 ***	8.45 ***	41.76 NS
	mean	1220	ND	1.08	36.84	52.96	210.53	81.68	4.43	8.29	42.24

ND = Not detected, NS = No significant, * Significant at 0.05, ** significant at 0.01, *** Significant at 0.001. Significant levels calculated for value exceeding MAL only.

Table 2: Heavy metals concentration in *Cucumis melo* samples.

Element		Al	B	Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn
Allowable limits in plants (ppm)		50	18	15	5	4	50	20	8	0.5	1.2
Locations	Mantin 1	59.26 **	14.56 NS	ND	6.12 *	16.51 ***	101.99 ***	5.4 NS	2.89 NS	1.81 ***	11.43 ***
	Mantin 2	59.38 **	15.05 NS	ND	6.18 *	17.32 ***	102.29 ***	5.54 NS	2.96 NS	1.87 ***	11.63 ***
	Mantin 3	60.92 ***	15.76 NS	ND	6.52 *	18.20 ***	103.05 ***	5.71 NS	3.05 NS	1.89 ***	11.87 ***
	Klang 1	61.13 ***	14.78 NS	ND	6.32 *	17.49 ***	103.12 ***	5.43 NS	3.95 NS	1.78 ***	12.34 ***
	Klang 2	60.02 ***	14.83 NS	ND	6.84 *	17.48 ***	102.63 ***	5.12 NS	3.42 NS	1.74 ***	12.59 ***
	mean	60.14	15.00	ND	6.42	17.4	102.62	5.44	3.25	1.82	11.97

ND = Not detected, NS = No significant, * Significant at 0.05, ** significant at 0.01, *** Significant at 0.001. Significant levels calculated for value exceeding MAL only.

Table 3: Mean levels (ppm) of Al, Cu, Fe and Pb in *Cucumis melo* and cocopeat samples.

Samples	Al		Cu		Fe		Pb	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Cucumis melo	60.14±0.393	59.26-1.13	17.4 ±0.079	16.51-18.20	102.62±0.114	101.99–103.12	1.82±0.235	1.74 – 1.89
Coco peat	1220±0.163	955-1423	52.96±0.021	48.57–55.49	210.53±0.119	191-237	8.29 ± 0.080	7.32 – 9.06

Discussions

Based on the results both in *Cucumis melo* and coco peat (see Table 1 and 2), these elements (Al, Cr, Cu, Fe, Mn, Ni, Pb and Zn) have exceeded the MAL. Heavy metals detect in the fresh samples of coco peat is one of the source for the heavy metals occurrence in the fruits. The fresh coco peat highly probably because of it grown at contaminated area. However this study need further research for confirmation.

Based on the result (Table 3), Al in both samples are exceed the MAL. There are studies relate human health with the heavy metals content in fruits. If a person keep taking fruits or vegetables that has high content of Al in the long run with the continues consumption of contaminated foods, they may get Diabetes, hypopigmentation or hyperkeratosis, cancer such as lung, bladder, skin and encephalopathy (Samara, 2008).

Tables 3 also showed that the concentrations of Cu in both samples are exceed the MAL. Cu in *Cucumis melo* was found 4 times higher than the MAL and this is toxicity for our body. In the long run with the continues consumption of high content of Cu the persons may get vineyard sprayer's lung, Wilson disease that hepatic and basal ganglia degeneration (Samara, 2008).

Table 3 also showed that the concentration of Fe in both samples are exceed the MAL. Fe in *Cucumis melo* was found twice higher than the MAL, and this become toxicity for the human consumption. If we keep taking fruits that have high content of Fe, we may get Hepatic cirrhosis and will enhance the production of cancer cell. (Villanueva et al., 2004; Samara, 2008; Samara, 2009).

Last elements in the result (see Table 3), Pb in both samples are exceed MAL. Pb in *Cucumis melo* was found to be triple higher than the MAL. And this will become toxic to human health which the person may get encephalopathy, anemia, abdominal pain, nephorathy, foot-drop or wrist-drop in the long run consumption (Samara, 2009).

Conclusions

The finding from the study showed that there are six elements were found to be exceed the maximum allowable limits (MAL) in *Cucumis melo* they are Al, Cr, Cu, Fe, Pb and Zn, 60.14 ± 0.393 ppm, 6.42 ± 0.170 ppm, 17.4 ± 0.079 ppm, 102.62 ± 0.114 ppm, 1.82 ± 0.235 ppm and 11.97 ± 0.821 ppm respectively. This findings can be further studies to know how to overcome the metals contaminations and to monitor the metals contamination of the fruits follow with the world standard.

Recommendations.

Toxic heavy metals such as arsenic, cadmium, lead, mercury and uranium are pervasive in much of the environment. While it may not be possible to completely avoid exposure there are many safe, organic and affordable products that help detoxify and eliminate these toxins from the body. There are some organic material that can be used to cleansed heavy metal toxicity such as Bentonite, Bladderwrack, blue green algae and many more (Mohamad et al., 2009 ; Holmgren et al., 1993).

Next, by applying chemicals in excess of what is needed may not only harm plants but pollute the soil. There are some of fertilizers made from mineral compounds or from compounds produced in the industry (Patrick, 2009). However, fertilization can effect on the accumulation and transfer of heavy metals in soil-plant system (Atafar et al., 2010).

And for farm management, farmers need to test the planting medium before planting. Based on the results, the fresh coco peat had already contained high amount of heavy metals and exceed the MAL. So as a safety measure, the farmers need to know the exact content in the medium before they use it. Since, coco peat is widely used in fertigation system as planting medium. In the *Cucumis melo* production 100% of farmers are using coco peat as their planting medium (Mortvedt, 1996). Further reasearch need to be done in order to know the prime factor of heavy metals occurence in the fruits and also in the coco peat.

This element is very toxic to the human body if consumed in this level. So, some action should be taken by the farmers and authority to solve this problem. Authority concern in food security must take action in this serious matter. Further research should be done in order to know what the main causes of these heavy metal occurrences are.

Acknowledgement

The authors highly thank PM. Dr. Adzmi bin Yaacob, Zainuri Mohd Salleh, Aidil Adha, Zubir Othman, Rozaini Manah, Siti Nordinah and Mohd Khairul Azuan for their kind help in the experimental field and laboratory assays.

References

Ahmad Razali and Norasyikin. (2001); *Modeling and data analysis on the absorption of heavy metals by selective vegetables*. UKM Bangi . Kuala Lumpur.

Atafar Z, Mesdaghinia A, Nouri J, Homaee M, Yunesian M, Ahmadimoghaddam M, Mahvi H (2010) *Effect of fertilizer application on soil heavy metal concentration.* Environ Monit Assess 160: 83–89.

Aziz A. Fallah., S. Siavash Saei-Dehkordi., Amin Nematollahi., Tina Jafari. (2011) ; *Comparative study of heavy metal and trace element accumulation in fruits and vegetables using ICP-OES technique*. Microchemical Journal.

Holmgren, J., Wilson, P. and Dick, R. (1993); *Herbs Remediation*. Medication Journal. New York.

Ieuan Evans and Elston Solberg (Revised November 1998) Agdex 531-3 *Minerals for Plants, Animals and Man*. Alberta Agriculture, Food and Rural Development, 6903 - 116 Street, Edmonton, AB

Jibrin Sabo Suleiman, Bin Hu, Chaozhang Huang, Nan Zhang. (2008) ; *Determination of B, Cd, Co, Ni and Pb in biological samples by microcolumn packed with black stone (Pierre noire) online coupled with ICP-OES.* Department of Chemistry, Wuhan University, Wuhan 430072, China.

Jiusheng, L., Jianjun, Z. and Minjie, R. (2004) ; *Wetting patterns and nitrogen distributions as affected by fertigation strategies from a surface point source.* Agricultural Water Management.

Kathle, W. (2012); *Heavy metals Toxicity.* American Association for the Advancement of Science.

Medical Dictionary. (2010) The Cleansing Clinic a preventive medicine clinic. Millburn Ave., Suite 201, Millburn

Mehmet Sayım Karacan and Neslihan Aslantas. (2007) ; *Simultaneous preconcentration and removal of iron, chromium, nickel with N, N -etylenebis-(ethane sulfonamide) ligand on activated carbon in aqueous solution and determination by ICP-OES.* Gazi University, Arts and Science Faculty, Chemistry Department, 06500 Ankara, Turkey.

Mohamad-Hadi, Karbasia., Babak , Jahanparast., Mojtaba, Shamsipurb., Jalal, Hassanc. (2009); *Simultaneous trace multielement determination by ICP-OES after solid phase extraction with modified octadecyl silica gel*. Department of Chemistry, Faculty of Science, Tarbiat Modares University, Tehran, Iran.

Mortvedt, J. J. (1996) ; *Heavy metal contaminants in inorganic and organic fertilizers Department of Soil and Crop Sciences*, Colorado State University, 80523, Fort Collins, CO, USA.

Pacyna, J.M., Munch, J., Axenfeld, F., Duiser, J., and Veldt,C., (2009).*Europaische Modell – Emissions daten basis fur die Spurenelemente As, Cd, Hg, Pb, Zn und fur spezielle organische Verbindungen Lindan, HCB, PCB und PAK.* Umweltforschungsplan des Bundesministers fur Umwelt Naturschutz und Reaktorsicherheit, Luftreinhaltung: 104 02 588, Berlin, Germany.

Patrick, W., (2009) ; *Heavy metals remediation*. Organic medication. New York.

Razak, Ahmad. (26 Feb 2013). *Najib reveals own melon project earning RM500,000 a year*. The Star.

Samara, S., (2007) ; *Heavy Metals absorption in fruits and vegetables*. New York University School of Medicine, Bellevue Hospital.

Samara, S. (2008) ; *Heavy Metal effect on human health*. New York University School of Medicine, Bellevue Hospital.

Samara, S. (2009); *Toxicity, Heavy Metals*. New York University School of Medicine, Bellevue Hospital.

Vailliers, R. A., Ancellet, G., Pelon, J., Quennehen, B., Schwarzenboeck, A., Gayet, J. F., and Law, K. S.(2010): *Airborne measurements of aerosol optical properties related to early spring transport of mid-latitude sources into the Arctic, Atmos*. Chem. Phys., 10, 5011–5030, doi:10.5194/acp-10-5011-2010,

Villanueva MJ, Tenorio MD, Esteban MA, Mendoza MC (2004). *Compositional changes during ripening of two cultivars of muskmelon fruits.* Food Chem 87:179-185.

Yap, D.W., Adezrian, J., Khairiah , J., Ismal, B.S. and Ahmad, M. R. (2009) ; *The uptake of heavy metals by Paddy plants in Kota Marudu*, UKM Bangi. Kuala Lumpur.