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Comparing the Effects of Washing and Processing on Nutrient Levels of Plant and Animal Foods Contaminated by Heavy Metals Cd, Pb

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Food cultivation is not environmentally friendly, triggering the exposure of heavy metals polluting roommates' agricultural areas will have an impact on the ecosystem and the environment. It affects the food chain and health. The character of bioaccumulation and biomagnification of heavy metals are essential to be managed, even though it is low. It must be anticipated so that the effect is minimal. The study was carried out in Lampung's agricultural area, which was predicted to be exposed to heavy metals, through observation, interviews, and experimental with a completely randomised design, doing variations in washing and processing of long beans and vegetable water spinach as well as snails and mussels animal foods. To be Analysed for the absorption of Cd, Pb, protein, Vitamin A, Vitamin C, and Ca, with the hope of finding the right technique to reduce Cd, Pb, but can maintain its nutrition. Samples were analysed by UV-Vis spectrophotometry for Cd, Pb, Ca, semi-micro for protein, HPLC for vitamins. Data were Analysed with Anova. The Results Showed: washing can reduce levels of Cd, Pb, Relatively does not reduce nutrition; processing can reduce Cd, Pb, and nutrition. Conclusions: 1) Washing and processing have a very significant effect on the reduction in Cd, Pb; 2) Washing Relatively does not Affect nutrient content, whereas processing significant Reduces nutrition; 3) To reduce Pollutants, the food needs to be washed and processed; 4) To maintain nutrient content, it needs to be treated most precisely by steaming; 5) There is no difference in the washing and processing effects between vegetable and animal foods.

Keywords: *Washing and Processing, Nutrient Content, Vegetable, and Animal Foods Contaminated With Heavy Metals Cd and Pb*

Introduction

Advances in technology and the growth in population changed way of life which impact pollution, and the spread of pollutants environment. One kind of pollutant that is harmful and is vital to control heavy metals. Based on the list of B3 waste from specific sources found in Appendix PP No. 18 of 1999, some types of business, human activity, and the industry can produce a by-product of the activities carried out. By-products are categorised as waste B3 and potentially pollute the environment and endanger human health. Some by-products are heavy metals, among them is arsenic (As), Mercury (Hg), Lead (Pb), Copper (Cu), zinc (Zn), Cadmium (Cd), Nickel (Ni), Chromium (Cr), Barium (Ba), silver (Ag), Selenium (Se), cobalt (Co) (Marganov, 2003). Among the heavy metals that are close to human life are Cd and Pb, Cd, and Pb toxic effect to life in the high category and efficiently move through the food chain cycle, through the transport and transformation processes in biota (Connell & Miller, 2006; Wuana, 2011). Various human activities present many heavy metal pollutants Cd and Pb. Agriculture, farming, industry, transport, and households provide opportunities for massive metal waste Cd and Pb. Even natural activity in rocks of the earth, water, or air allows increasing heavy metal pollutants. Changes in lifestyle, natural processes required in almost all human activities, and nature bring many pollutants Cd and Pb. The ability of the environment to conduct self-purification, can not be done again, because of contaminants in the environment has exceeded the threshold to hold a self-contained process is carried out.

In the agricultural environment, pollution to be particularly difficult to control. Aquatic farming allows pollutants such complex distributed from the upstream to the downstream carrying and being gatherers pollutants in a river body that ends at a dam on the downstream or sea. These processes always occur, because to get maximum production and profitable, many farmers apply cultivation techniques that are less environmentally friendly farming, including during the preparation of the land farmed by hijacking techniques with the help of a tractor. When the plant begins to grow, the presence of pests requires farmers to use pesticides, insecticides, fungicides, herbicides. When the rice or vegetable is growing, the snail attack requires farmers to eradicate it quickly using chemical molluscicides. When crops need fertiliser, synthetically already contains heavy metals, including Cd and Pb, even because of the process in the food chain, compost, which is assumed to be natural and pollutant-free, becomes a source of pollutants. It is also known to contain pollutant metals, including Cd and Pb (Erfandi & Iskak, 2014), which in the end, food production becomes contaminated and not safe for consumption (Pasaribu & Marbun, 2017). The limited land force also located in the area of agricultural land that presents a dense transport of pollutants Cd and Pb triggers the exposure of heavy metals pollution in agricultural areas. Heavy metals

have been widely detected in vegetables, especially those grown close to the highway and vulnerable to air pollution, including smoke coming from the plant and fossil-fueled vehicles (Widyaningrum, 2007). Characteristics of crops are generally high absorption rate and rooting dense and robust, allowing the body to accumulate into bigger plants.

Similarly, on vegetable crops, which generally has a dense root, hollow stems, broad leaves are thin, with high transpiration, so the absorption of water and nutrients in a great surrounding. The effect is not only to provide agricultural products, for example, vegetables and rice contaminated with heavy metals, but through the food, chain cycle will pollute the water, soil, even the biotic environment, including animals and humans. Snails and mussels living in the agricultural environment, rivers, and waters are generally not free from the influence of heavy metals Cd and Pb. Moreover, both types of macroinvertebrates known as non-selective filter feeders**.** According to Wenner (1988), Biota that lives in waters with low mobility base or even settles on the base as a mediator danger of poisoning of the waters polluted so that it can be an indicator of contamination. Darmono (2001) stated shells metals accumulate larger than other water animals because it is settled, slow to avoid the effects of pollution, and have a high tolerance to the concentration of a particular metal. Karneli (2010) agrees that the mussels are filter feeders non-selective and thus potentially contaminated heavy metals and microbes that are harmful to consume.

On the other hand, both these macroinvertebrate known food sources of protein and high calcium beat Ca animal on meat, eggs, milk. In the present era, snails and mussels into high nutrition foods that are very promising, both for humans and livestock. Because of the potential for significant pollutant absorber, especially foodstuffs, when living in a polluted environment and will be used as a source of food, it is essential to manage. So no matter how small these pollutants are to be anticipated, the effect on all parts of the environment can be minimised (Widiowati, Sastiono, & Jusuf, 2008). The purpose of this study was to determine differences in the effect of washing and processing of decreased levels of Cd, Pb, protein, vitamin A, vitamin C, and Ca in foodstuffs of vegetable and animal contaminated with heavy metals Cd, Pb, and find the most appropriate technique to reduce pollutants but can still maintain nutrition. With the hope of exploiting vegetables, golden snail, and potentially accumulation kijing mussel heavy metal pollutants as a source of food of high nutritional bargain prices can still be done wisely.

Methods

The experiment was conducted in the Lampung provincial agriculture department predicted heavy metal exposure because technique cultivation potentially brings pollutants Cd and Pb, through observation, interviews, and experimental design with complete randomised trials. Trial techniques to minimise the effects of heavy metals pollutants by washing variation (not washed/control; 1 @ 5 seconds; 2 @ 5 seconds ; 3 @ 5 seconds) And a variety of processing

(fresh/untreated/control; steamed on steel pans non-magnetic for five minutes after the boiling water of 100 °C + 2 minutes; boiled in steel pot non-magnetic for two minutes of boiling water at a temperature of 100 ° C + 2 mins; pan-fried in a hot pan with a little cooking oil for three minutes) on the type of vegetable kale and long beans, as well as meat and shells golden snail (*Pomacea caniculata*) and kijing mussel (*Anodonta woodiana*). Samples were analysed levels of uptake of heavy metals Cd, Pb, protein, vitamins A and C, as well as its, Ca, with UV-Vis spectrophotometry for Cd, Pb, Ca; semi-micro for protein, and HPLC for vitamin. Data were analysed with Variant Analysis, Regression, and Correlation with SPSS version 21.

Results and Data Analysis

Environmental conditions related to levels of heavy metals Cd and Pb water upstream and downstream areas are still below the threshold. In contrast, the overall sediment upstream and downstream sectors have exceeded the limit. Thus need to be aware of its existence to be able to accumulate in biota in the environment in large quantities, especially the effect to organisms that are filter feeders such as mussels golden snail and gravestones.

Data on vegetables compared to effectiveness with animal food, can be seen in diagram image 1, 2, and 3. Effect of Washing and Processing Data on the levels of Pb, Protein, Calcium Animal Food Ingredients (Golden snail and Kijing mussel gravestone) in the Agricultural Region. Based on Figure 1, 2, 3 more times, there is a tendency to wash more decreased levels of Cd, Pb. Processing at most lowers Cd Pb in vegetables by sautéing, while the animal food by boiling.

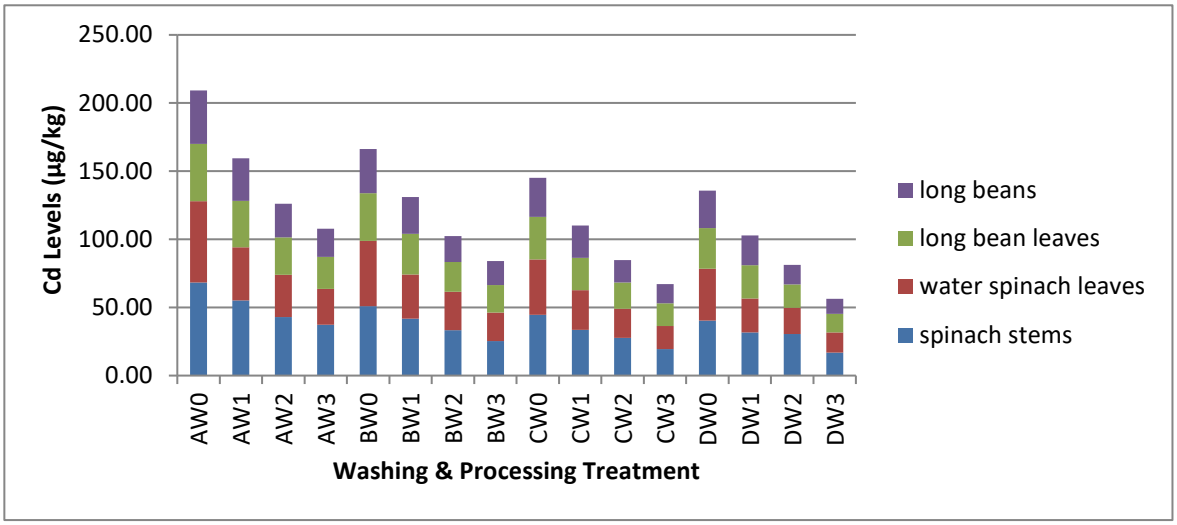

Figure 1. Effect of washing and processing of the content of Cd Vegetables

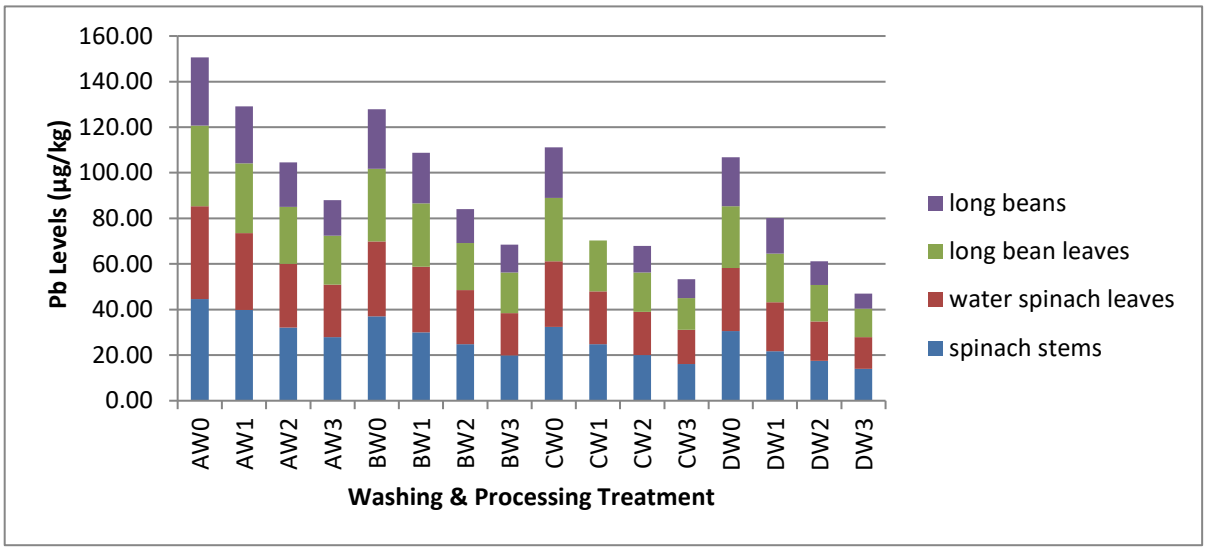

Figure 2. Effect of washing and processing of the content of Pb Vegetables

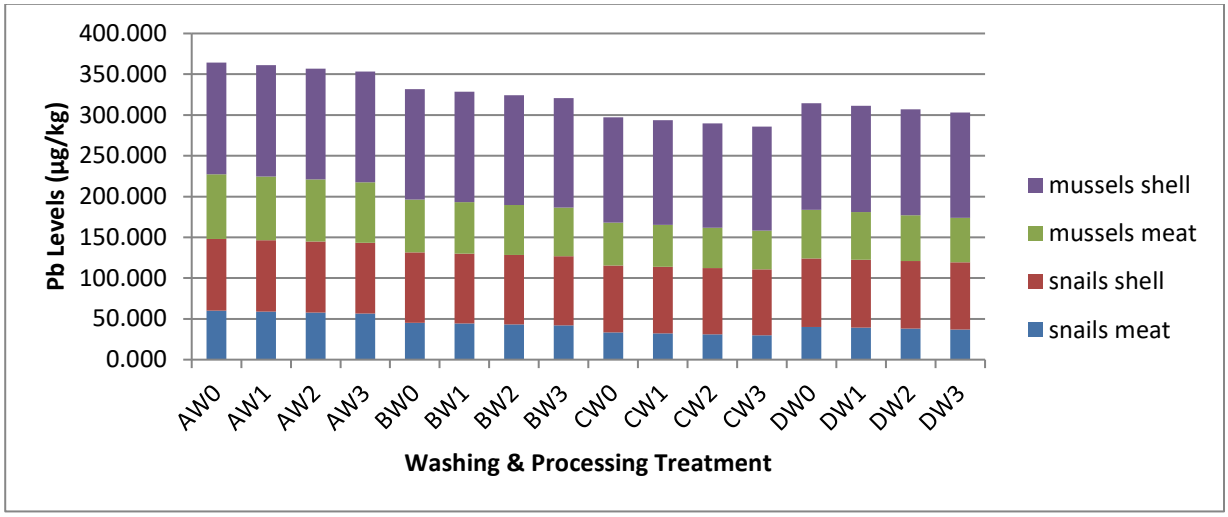

Figure 3. Effect of washing and processing of the content of Pb (ppb) (µ / kg) Meat and Shells on Golden Apple Snails and mussels Kijing

Illustration of the effect of washing and processing on nutrient levels can be seen in Figure 4, 5, 6, 7, and 8. Based on Figure 4, 5, 6, 7, and 8, variations in relative wash does not affect the nutritional decline in vegetable and animal food. At the same time, there is a tendency to lower processing levels of protein nutrition, Ca, vitamin A and C.

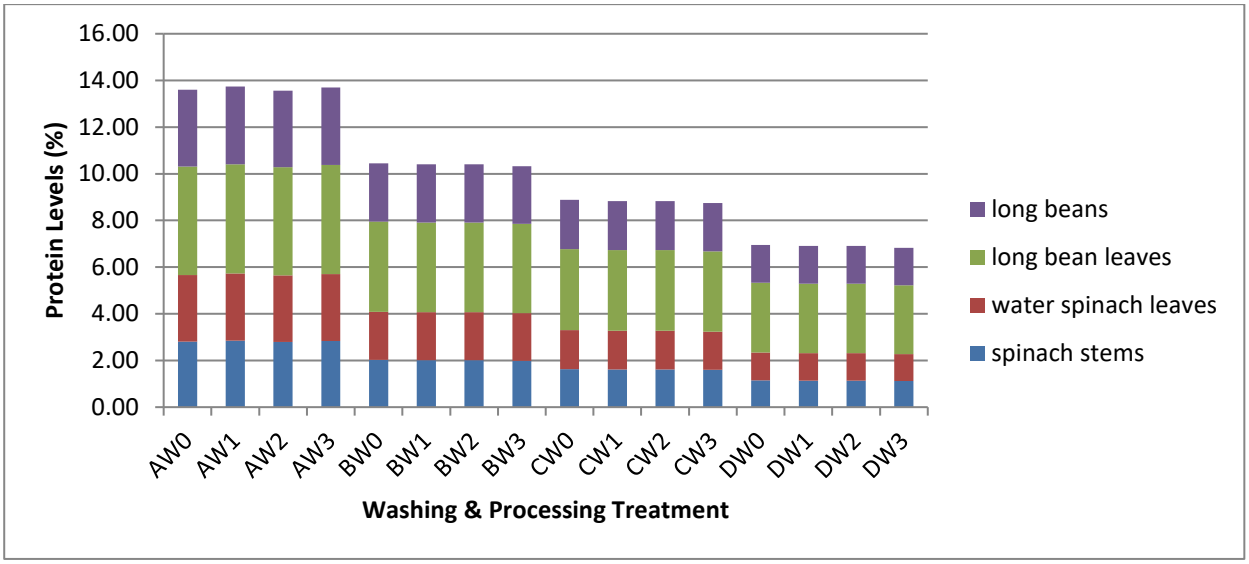

Figure 4. Effect of washing and processing of the protein content (g / 100g) Vegetables

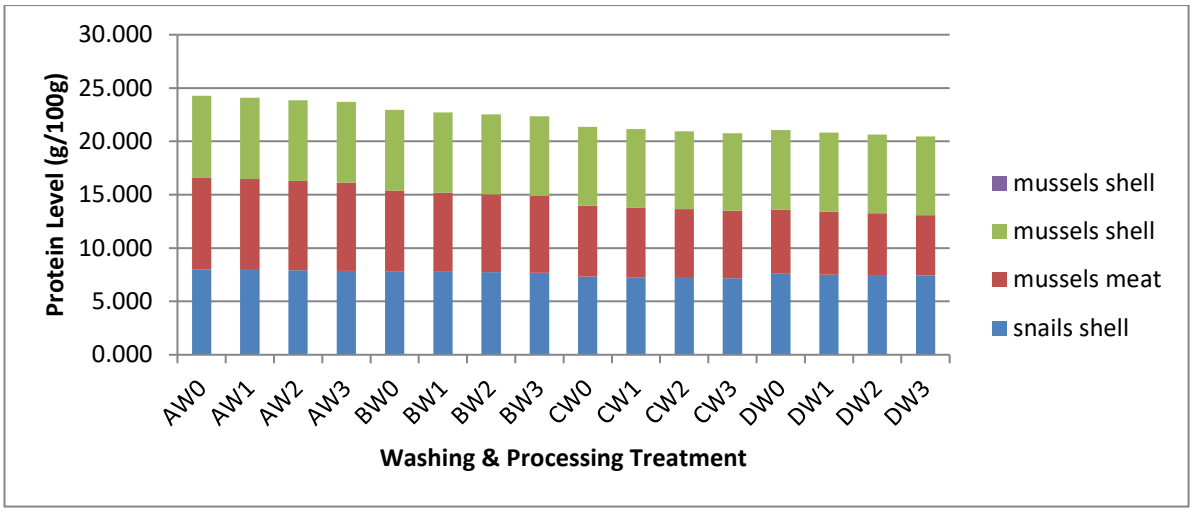

Figure 5. Effect of washing and processing of the protein content (g / 100g) and Conch Shells

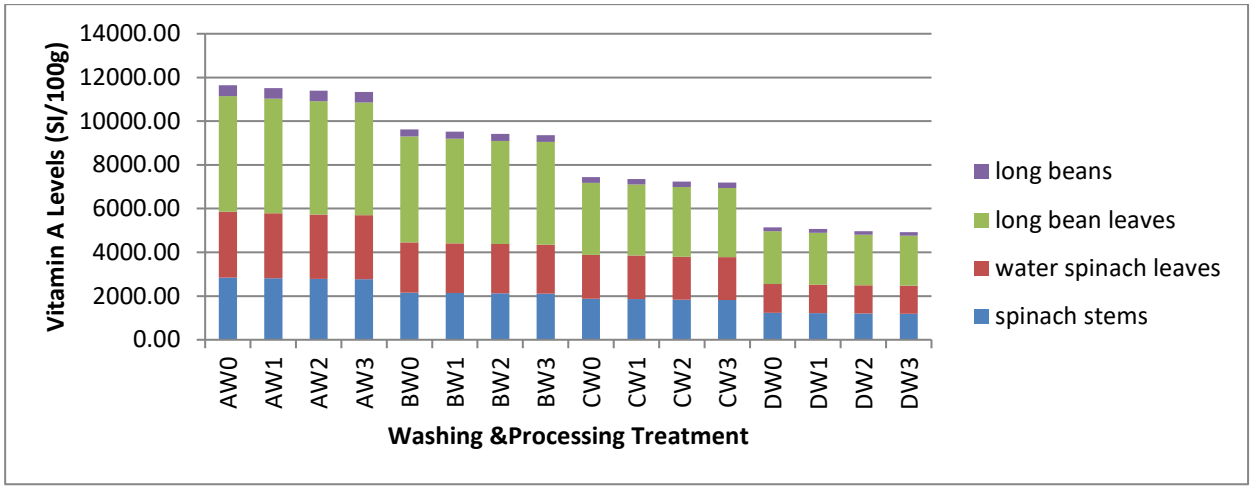

Figure 6. Effect of washing and processing of the content of Vitamin A Vegetable

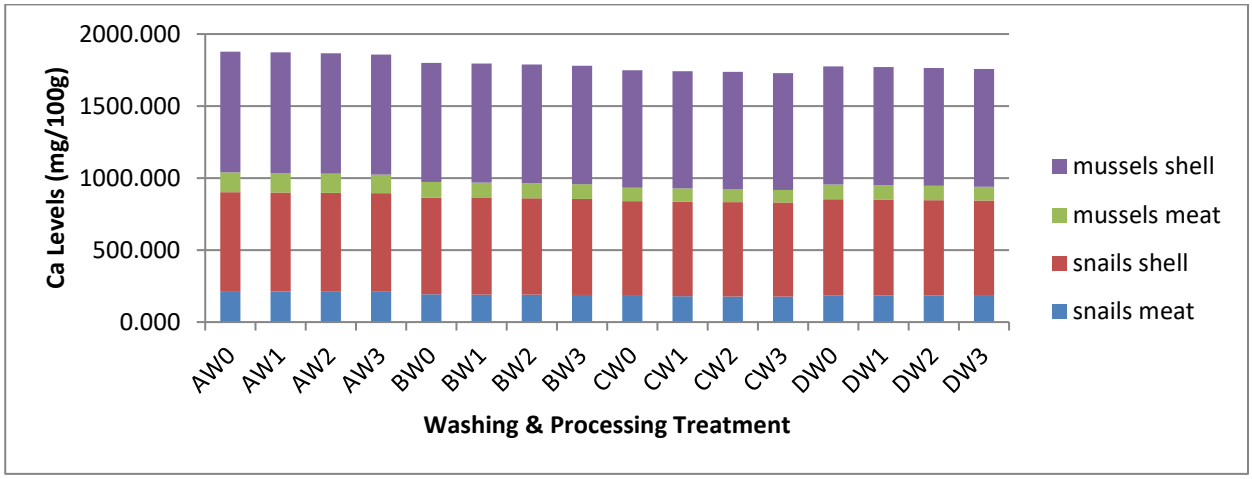

Figure 7. Effect of Washing and Processing Diagram of the concentration of Ca (mg / 100g) Meat and Shells on Golden Apple Snails and mussels Kijing

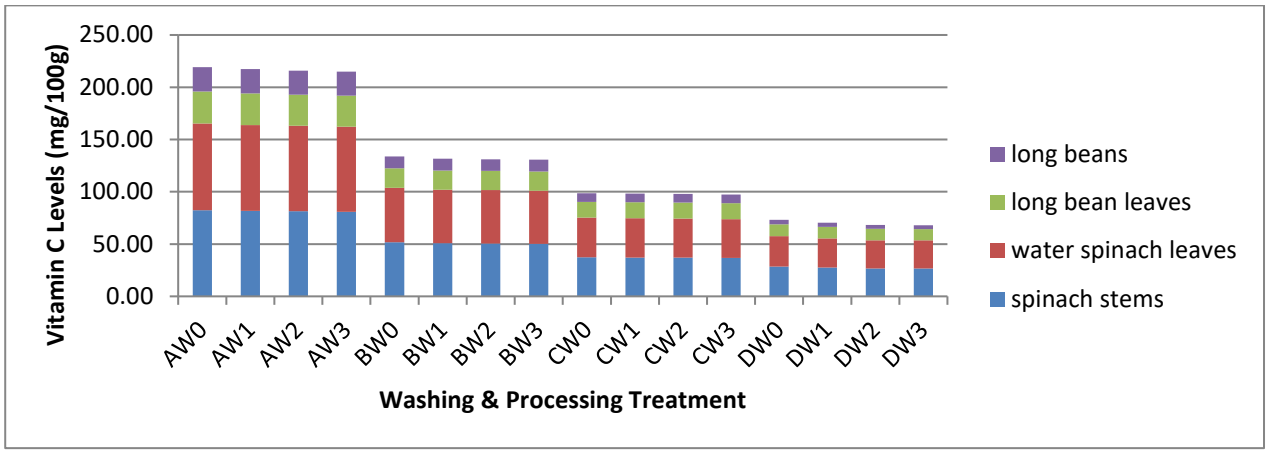

Figure 8. Effect of washing and processing of the content of Vitamin C Vegetables

From the study tested the treatment, in general, show a tendency that the more times washed, the more significant the decline in the levels of Cd, Pb. Processing of the most lowers the standards are, in order from the most was boiling, sauteing, steaming, except for clam meat protein gravestone was the most decline the request from the largest is by sautéing, cooking, and the lowest drop by heating. The results of data analysis and hypothesis testing using analysis of variance can be seen in Table 1.

Table 1. Summary of Results of Analysis of Effect of type Variant Food Ingredients (X1), Laundering (X2), Processing (X3) against the decline of Cd, Pb, Protein, Ca, Vitamin A, Vitamin C Food Ingredients Vegetable (Vegetables) and animal (conch and Kijing mussel)

EFFECT OF Y	SIGNIFICANCE EFFECT (ANOVA)							% CONTRIBUTION TO INFLUENCE (Regression -CORELLASI)			
	PARTIAL			INTERACTION				REGR	% CORELLASI		
	X1	X2	X3	X1-X2	X1-X3	X2-X3	X1-X2-X3	X1-X2-X3	X1	X2	X3
Y1 (Cd levels)	0,000 **	0,000 **	0,000 **	0,013 *	0,000 **	1,000 ns	1,000 ns	95.3	0.909 ** (90.9%)	0.958 ** (95.8%)	0.865 ** (86.6%)
Y2 (Pb)	0,000 **	0,000 **	0,000 **	0,462 ns	0,000 **	1,000 ns	1,000 ns	76.3	0,816 ** (81.6%)	0,833 ** (83.3%)	0.801 ** (80.1%)
Y3 (protein levels)	0,000 **	0,000 **	0,000 **	.857 ns	0,000 **	1,000 ns	1,000 ns	96.5	0,981 ** (98.1%)	0.842 ** (84.2%)	0.962 ** (96.2%)
Y4 (Vitamin A))	0,000 **	0,000 **	0,000 **	0,462 ns	0,000 **	1,000 ns	1,000 ns	76.3	0,816 ** (81.6%)	0,833 ** (83.3%)	0.801 ** (80.1%)
Y5 (vitamin C)	0,000 **	0,000 **	0,000 **	.857 ns	0,000 **	1,000 ns	1,000 ns	96.5	0,981 ** (98.1%)	0.842 ** (84.2%)	0.962 ** (96.2%)

Information:
X1 (type and organ parts vegetable / animal food and vegetable)
X2 (washing W0 / not washed, W1 / once, W2 / 2X, W3 / 3X)
X3 (processing A / Fresh / untreated, B / Steamed, C / Boil, D / sauteed)
Y1 levels of Cd
Y2 levels of Pb
Y3 Protein Levels
Y4 levels of Ca
Y5 Levels of Vitamin A
Y6 Levels of Vitamin C.

From the data analysis and hypothesis testing showed that the variation of the washing and processing of very significant influence on decreased levels of Cd, Pb, protein, and Ca, vitamin A, and C. The percentage of contribution in reducing Cd, Pb, Ca, protein, vitamins A and C different, and for all treatments, including large, i.e., above 80%. From the advanced test, Tukey HSD shows. In essence, the more times washed effect progressively decrease, while processing sequentially. The lowering is to boil, then stir-frying, and the last steaming, except for meat protein shells gravestone where most decreased its order from the biggest that the sautéing, cooking, and the lowest decline by steaming, as was the case at the food processing plant/vegetable.

Discussion

The results showed: doing the washing can reduce levels up to 28.509% of Cd, Pb up to 6.353%, protein 3.797%, 6.044% Ca; treatment can decrease 45.75% Cd, Pb up to 44.391%, 22.761% protein, Ca 31.593%, 56.13% vitamin A, and 66.16% vitamin C. Conducting a combined treatment process provides an opportunity to wash once the decline becomes larger. As Munarso, et al. (2005) states, at the family level, the business can be done to cope with the heavy metal contamination such as by washing food, so particularly heavy metal contamination is still attached to the surface of the food can be eliminated. This method is essential before food is consumed or processed further. From the data obtained, the metal content before the animal food remains relatively high washable. After washing, especially with repeated washing, decreased levels up to 28.509% of Cd, Pb 6.353%, 3.797% protein, Ca 6.044%. In a general decrease in nutrients by leaching relatively low compared to the decline in heavy metal. This data also gives the meaning of that, heavy metals Cd and Pb can partially exist on the surface of the food, so it is reduced when washed, as well as Cd, Pb absorbed in kale, beans, golden snail and barnacle shells have more soluble character. For that, it is essential to wash food before consumption. As known, metal into the body of the organism can be a variety of ways, which in turn enters the organ or limited to the surface. Thus, the washing can be an alternative to reduce the heavy metal attached to the surface.

The results of this study reinforced by research Riyadi (2016) showed that blood clams soaking for 24 hours could reduce levels of as much as 54.05% Pb, 42.17% Cd. Whereas if the digestive tract as well weeded food reduction can reach 89.76% Pb, 94.15% Cd. They were further strengthened by the opinions Umbara and Suseno (2006) which states that the blood clam, most of the heavy metals contained in the digestive tract by 66.1%, meat 5.87%, and 28.03% shell. Thus, in such research, Pb has been much reduced because part predicted as the accumulation of metals has been separated, which is demonstrated the very significant difference between the internal organs and the meat and shell golden snailkijing mussel. Metals accumulate more shells because, at the moment they enter the network, in this case, the round plays a role in Ca rid of the knot. Thus when heavy metals are entering the system golden snail and kijing mussel, it will directly reduce the proteins or Ca, with Pb lines act as free radicals damage cell proteins, whereas the Ca compound Pb will replace bond.

As Munarso et al. (2005) and Nopriansyah, Baehaki, and Nopianti (2016) mentioned, at the family level, a business can be done to cope with the heavy metal contamination in addition to the washing can also be by the administration of heating in boiling temperature in a short time (1-5 minutes), which aims to reduce heavy metal contamination. According to Williams (1979), that involves cooking with heat is one of the many food processing is done either at a household or industrial scale. Some standard cooking method is boiling, steaming, and sautéing. Boiling is a process of cooking in boiling water about 100 °C, with water as the medium of heat, as well as a metal-solvent. Steaming is a medium cooking process with steam generated by boiling water.

Further, boiling can cause the metal-binding compounds in plants untied, so that Pb heavy metal compounds bound to the plant tissue can be detached, then Pb can evaporate or dissolve in water (Winarno, 2004). Research by Triani, et al. (2011), discovered by boiling, Pb levels in spinach can be decreased from 1,494 ppm, after cooking for 3, 5, 7 minutes, reduced to 1,302, 1,300 and 1,287ppm. Although the effect on the decrease in sensory quality (colour, texture, overall acceptance) subjectively panellists who consume it (Budiarta et al., 2015). The longer washing and boiling, the levels of Pb decreases. It is due to damage to the plasma membrane and the membrane of organelles in vegetables by boiling, making it easier for a heavy metal compound that accumulates in it decomposes from plant tissue (Kustina, 2006). Boiling can also break the metallic bond in plant tissue, and high temperatures may also cause heavy metal-binding compounds in plants untied so that the mixture bound to the plant can be separated (Winarno, 2004). The same condition can occur in animal food.

Based on the expected properties owned by the plant beans and kale, metal uptake showed the data was below the threshold, but if it is not done, then the treatment will accumulate over time, affect the body organs, and it would be dangerous to human health. So the need for processing that involves heat is to be steamed, boiled, and pan-fried so as not to affect human health adversely. Of note, because the weather can also damage the nutrition, it is essential to

have a strategy to cultivate it, in particular, to be able to lower the pollutants, and on the other hand, can maintain its nutritional value.

The absence of differences in average levels of heavy metals leads to bean leaves and spinach due to some predictions based upon pre-survey research. First, long beans and kale vegetables are planted close to the highway. Second, long grains and kale vegetables during the maintenance process can not be separated from the provision of fertilisers and pesticides. Then, the third is the fumes passing around the greens resulted in heavy metal attached to the leaf organs through smoke in motor vehicles. So that the facts on the ground, providing opportunities that the influx of heavy metal lead in vegetable string beans and kale are not only caused by nutrients such as fertilisers that exist on the ground and then absorbed through the roots to the leaves organ. But, the involvement of motor vehicle fumes and pesticides are also considered necessary. Motor vehicle fumes and pesticides provide an opportunity metal leaf is attached to the organ so as not to enter into long bean vegetable tissues and kale. Some of the facts that make the basis of different types of vegetables not affect the difference also levels of metals absorbed.

Although invisible, when seen, both of these vegetables have a different leaf structure. The plant leaves leaf kale has a structure that is thinner and finer than beans. The structure of bean leaves is coarse provides opportunities little to accumulate heavy metals Pb because the cell wall is capable of inhibiting the threat of metals into the organ bean leaves. In contrast, the structure of leaves of kale was thin, and no rough surfaces allow absorbing heavy metals more than the bean plants. Hemicellulose and lignin contained in the cell wall, which are not able to dispel the threat of heavy metals into the kale leaf organs. Leaves' differences affect uptake levels of heavy metals that can be found in researchErdayanti, Hanifah, and Anita (2015). which states that in a sample of vegetable kale leaves are slippery, Pb metal particulates contained in the air will be less absorbed compared to spinach, which has a rougher surface of the leaves.

In contrast to the structure of the leaf, leaf surface area is known to affect the levels of metals in the organs of plant leaf vegetable kale and beans. It reinforced the statement Eka, Evi, and Nurmaini (2015), which states that the surface area of vegetables also affects the levels of uptake of Pb attached to plants. In the vegetable lettuce, Pb was higher than Pb in vegetable cabbage. It can be caused by vegetable lettuce that has a surface area higher than cabbage vegetables. Lettuce leaf surfaces more bumpy and rough texture are also more likely to stick to the veggie lettuce Pb. When done processing, the leaves of kale are considered more readily release heavy metals trapped in the organs of the stomata close to the cell wall, while long bean leaves are considered more challenging to let go of the heavy metal. But, overall processing can reduce the levels of heavy metals that have already entered into the organs of the plant leaf vegetable(Widowati, Sutanto, & Sulistiani, 2018). Age of plants is also an important factor in the number of uptake by plants. It is in line with the opinion Arimby,

Lestari, and Aziz (2014) that the factors that affect the plant to absorb metals among which the exposure time, the number of roots, plant weight, temperature, growing media, and plant age. One of the essential factors that affect the absorption of the metal is the age of the plant. Vigiyanti, Chamisijatin, and Susetyarini (2017) said that the plant would absorb pollutants to the maximum period. Increasing the absorption of the age of the plant will also increase until at a particular time and will fall back. Age older plants will have higher weight and density of the denser so that the concentration of the metal also absorbs greater. Increasing the age of the plant also affects the number and size of the roots, stems, and leaves. The more so, the more effectively absorb and accumulate high levels of heavy metals.

Hypothesis test against animal food shows, in very significant variations in the processing of lower levels of Cd, Pb, protein, Ca, vitamin A and C. Sequence of the most significant losses is boiling, sauteing, and the smallest decline by steaming. In fresh, unprocessed state levels are still high and decreased to 45.759% Cd, Pb 44.391%, 22.761% protein, Ca 31.593%, 56.13% vitamin A, and 66.16% vitamin C.

The results also hint that there is a difference between the effect of processing variations on the reduction of Cd, Pb, protein, Ca, vitamin A and vitamin C in food animal and vegetable. Wherein the animal materials are more experienced, a decline in animal food is boiled as we know that the structural run private, between plant and animal tissues are very different. Plant cells from the cell wall covered with cellulose material that allows a variety of different things that cause the tissue of animals that just membranous cells, and thus more easily damaged when animal foods than when treated with boiled (Iriyani, 2014).

Cell wall tissue vegetable materials made from cellulose, lignin, and derivatives allow accumulation heavy metals in this section, as well as metal when trapped within cellulose plants, become more difficult to decompose and release bonding chemistry, because of which also required certain enzymes to break it down from the trap in cellulose network. For this reason, then the plant material more easily stripped off by heating the pan so that predictable bound metal is a metal in a form that can be evaporated show Cd, Pb can be in the form of volatiles. So predictable pollutant metals Cd, Pb absorbed much in the way of volatile, allows the vegetable material much evaporated when food was pan-fried (Widowati, Sulistiani, & Sutanto, 2017). In contrast to the animal material, heavy metals Cd, Pb is not bound or trapped in the womb of cellulose. It is natural that the animal material, heavy metals more easily separated and ultimately lost more weight when boiled, which is when the process is dissolved in boiling water and immediately precipitated/deposited in the cooking liquid. This condition is also reinforced by previous studies (Ramadhan & Aminah, 2014; Putra & Kencana, 2009; Sundari, Almasyhuri, & Lamid, 2015) that good cooking process using boiling or steaming to reduce levels of cyanide found in bamboo shoots.

Conclusion

Management of food contaminated with Cd, Pb can be concluded:
1) Foodstuffs vegetable (vegetable) contaminated with heavy metals through a variety laundering and processing/cooking shows results as useful as animal food golden snail and kijing mussel gravestones, very significantly lower the heavy metals Cd, Pb. The more times washed lower. The processing successively reduced the heavy metal is boiled, then stir-frying and steaming past. Heavy metal without being cleaned and processed, the levels are still relatively high. With just painted heavy metals, Cd can be decreased to 28.509%, Pb 6.353%, while the prepared can be reduced to 45.759% of Cd, Pb, and at 44.391%. While the vegetable food materials, washing Cd lowered to 45.521%, 37.531% Pb. The processing can be reduced to 67.086% of Cd, Pb 62.282%. In vegetable foods highest reduction of heavy metals using pan-fried, while the steepest decline of animal foods by boiling;
2) To reduce levels of heavy metal pollutants and retains its nutrient levels, more precise before the food is consumed, then washed first in running water, and processed by steaming, so that heavy metals had decreased and nutrients, can still be maintained. By doing the washing can reduce levels up to 28.509% of Cd, Pb up to 6.353%, protein 3.797%, 6.044% Ca; treatment can decrease 45.75% Cd, Pb up to 44.391%, 22.761% protein, Ca 31.593%, 56.13% vitamin A, and 66.16% vitamin C. being the highest reduction of animal foods by boiling;
3) To reduce levels of heavy metal pollutants and retains its nutrient levels, more precise before the food is consumed, then washed first in running water, and processed by steaming, so that heavy metals had decreased and nutrients, can still be maintained. By doing the washing can reduce levels up to 28.509% of Cd, Pb up to 6.353%, protein 3.797%, 6.044% Ca; treatment can decrease 45.75% Cd, Pb up to 44.391%, 22.761% protein, Ca 31.593%, 56.13% vitamin A, and 66.16% vitamin C being the highest reduction of animal foods by boiling; and
4) To reduce levels of heavy metal pollutants and retains its nutrient levels, more precise before the food is consumed, then washed first in running water, and processed by steaming, so that heavy metals had decreased and nutrients, can still be maintained. By doing the washing can reduce levels up to 28.509% of Cd, Pb up to 6.353%, protein 3.797%, 6.044% Ca; treatment can decrease 45.75% Cd, Pb up to 44.391%, 22.761% protein, Ca 31.593%, 56.13% vitamin A, and 66.16% vitamin C and processed by steaming so that heavy metals had decreased and nutrients, can still be maintained. By doing the washing can reduce levels up to 28.509% of Cd, Pb up to 6.353%, protein 3.797%, 6.044% Ca; treatment can decrease 45.75% Cd, Pb up to 44.391%, 22.761% protein, Ca 31.593%, 56.13% vitamin A, and 66.16% vitamin C and processed by steaming so that heavy metals had decreased and nutrients, can still be maintained. By doing the washing can reduce levels up to 28.509% of Cd, Pb up to 6.353%, protein 3.797%, 6.044% Ca; treatment can decrease 45.75% Cd, Pb up to 44.391%, 22.761% protein, Ca 31.593%, 56.13% vitamin A, and 66.16% vitamin C.

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