Health Risk Analysis Due to Vegetable Consumption of Cabbage, Carrot and Chili which Contain Organophosphate Pesticides Residue to the Horticulture Farmers in District of Cikajang, Garut, West Java, Indonesia 2017

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ABSTRACT--- ***-The agricultural sector is a very dominant sector in District of Cikajang, Regency of Garut, Province of West Java. The main commodities are chili, cabbage, carrots, tomatoes and potatoes. Agricultural activities cannot be separated from the use of pesticides. Ordinary farmers consume vegetables from agricultural produce so as to pose a risk of health problems. This study aims to determine the health risks due to consumption of vegetables containing with pesticide residues in the District of Cikajang, Regency of Garut. The research method is an observational study with the design of Environmental Health Risk Analysis. Social-demographic and dietary surveys with interviews of 99 farmers were conducted from March to May 2017. Chili samples were extracted using the* QuEChERS *technique and calculated by gas chromatography equipped with a flame photometric detector (FPD). The results showed that vegetables containing with pesticide residues were chili with the highest Profenofos concentration i.e. sample number III, that is 11.193 mg/kg, and the mean concentration of 5.235 mg/kg, while the pesticide residues are not found in cabbage and carrots. Intake of Profenofos through chili at farmers in the District of Cikajang is 0.05867 mg/kg/day, with duration of exposure of 33.4 years, weight of 57.37 kg. Intake rate of 0.3571 gr/day and exposure frequency of 52 days/year. The profenofos concentration in chili has exceeded the normal limit according to EPA (2006) that is 0.00005 mg/kg/h. The results show that non carcinogenic RQ have a risk for exposure to the disease. Therefore the health risk reduction management needs to be done.***

Keywords--- Risk Analysis, Cabbage, Carrot, Chili, Organophosphate, Profenofos

1. INTRODUCTION

The use of pesticides contributes to increased agricultural production, as well as the impact of environmental and health risks that increases. Increased vegetable demand coupled with consumer concerns about the quality and safety of food and the perception that the vegetables produced are healthy and safe. Comparing the organic vegetables and conventional vegetables of carrots, tomatoes, lettuce, spinach and potatoes, the concentration of synthetic pesticide residues is significantly higher in conventional products[1]. In agricultural cultivation studies, examined the level of exposure measured, and estimated the amount of pesticide dose absorbed compared to Admissible Daily Intake (ADI). The findings suggest more investigation, so a statistically significant picture of cultivation can be established in order to increase workers awareness about health risks and how to prevent them[2]. Pesticides in their use can have undesirable

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effects on human health and the environment in general. It has been reported that 60-90 percent of applied pesticides will be left behind on a target or target, while the rest drift with the wind or reach the ground[3].

Regency of Garut has a strategic location as a vegetable development area. Garut can be regarded as agriculture-based Regency. The main commodities in the District of Cikajang include vegetable crops of cabbage, carrots, chili and tomato[4]. Ten major outpatient diseases based on data from the Community Health Centre include: Acute Respiratory Infections (ISPA), Gastritis, allergic cough, dermatitis, myalgia, allergic skin diseases, gastroenteritis, hypertension, headache that most have diseases associated with exposure to pesticides.

Research in West Java found pesticide residues in cabbage, tomato and carrot vegetables. The analysis of pesticide residues on cabbage, and carrots showed the discovery of pesticide residue content which was analyzed from samples taken from farmers in Cianjur[5]. Research on garut in 2016 by Luthfiah found the consumption of tomatoes by farmers containing profenofos residue in the Village of Cikandang, District of Cikajang, Regency of Garut[6]. Samples in tomato vegetables have exceeded the normal limit according to EPA i.e. 0.00005 mg/kg/h[7]. The need to know the health risks of eating cabbage, carrot and chili vegetables containing pesticide residues. Calculates daily intake indicator (CDI) of pesticide residues due to consumption of cabbage, carrot and chili vegetables containing pesticide residues. To calculate the amount of residual residue of orghanophosphate pesticide on cabbage, carrot and chili vegetables. And Calculate the value of the forecast is likely to risk suffering from health problems due to consumption of cabbage, carrots and chili vegetables containing pesticide residues on horticulture farmers in the District of Cikajang, Regency of Garut in 2017.

2. RESEARCH METHODS

This research was an analytical observational cross-sectional study using the Environmental Health Risk Analysis (ARKL) method, by calculating or predicting the risk of exposure to harmful substances. In this study, the harmful substances in question are pesticide residues that are in cabbage, carrot and chili vegetables. This research will be conducted in the District of Cikajang, Regency of Garut. This research was conducted from April to June 2017. The study population used is all farmers of pesticide users who are members of farmers group and are domiciled in the District of Cikajang, Regency of Garut. The sample in this research is non random sampling with quota sampling method. This research used estimation of population proportion as formula in calculation of the number of sample[8]. Then from the total samples, plus 10% of the total sample to avoid the dropout of respondents to 99 samples. Primary data includes direct observation or observation on horticulture farmers in the District of Cikajang, Regency of Garut with questionnaires, interviews, sampling of cabbage, carrot and chili vegetables on cultivated land in the District of Cikajang, Regency of Garut, put into plastic or sterile container before being brought to the laboratory for pesticide exposure testing. Pesticide residues in cabbage, carrots and peppers are known by conducting checks through the laboratory. So it is obtained levels of pesticide residues in the vegetables. Samples of cabbage, carrot and chili vegetables were taken at 3 points and each weighed 2 kg, the sample was weighed directly at the location of the farmer's plantation, put into aluminum foil paper and wrapped in plastic, and thereafter the samples were sent to the Central Laboratory of Quality Testing and Promotion of Agricultural Products in Cibubur, East Jakarta in order to check the level of Pesticide residues. Residue test is performed to determine the residue content in cabbage, carrot and chili vegetables.

3. RESULTS

3.1. Pesticide Residue Concentration of Organophosphate Group on Vegetable Cabbage, Carrots and Chili

Examination of residual pesticide residues test of organophosphate includes examination with active ingredients Dichlorvos, Dimethoate, Diazinon, Fenitrothion, Chlorpyrifos, Parathion, Methidathion and Profenofos. The test report found only detected chili vegetables containing pesticide residues with active ingredients profenofos, while for cabbage and carrot vegetables undetectable residues class of organophosphates.

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Table 1: Concentration of pesticides in red chili at horticulture farmers, in the district of Cikajang, Regency of Garut Regency, 2017

No	Sample	Concentration of Pesticides (mg/kg)	Sampling Location
1	Sample I, Chili	Detected with Profenofos 3.3065	Farmers' garden
2	Sample II, Chili	Detected with Profenofos 1.2045	Farmers' garden
3	Sample III, Chili	Detected with Profenofos 11.193	Farmers' garden
4	Sample I, II, III, Cabbage	Not Detected	Farmers' garden
5	Sample I, II, III, Carrot	Not Detected	Farmers' garden
Sample rate-average of Chili		5.235	Farmers' garden

Source: Primary Data of 2017

Based on these results, the concentration of profenofos in chili vegetables is above BMR established by the Indonesian National Standard in 2015, namely 3.0 mg/kg.

3.2. Characteristics of Anthropometry and Activity Patterns

Pattern intake of chili consumption, frequency of profenofos exposure of vegetables and duration of exposure horticulture farmers in the District Cikajang, Regency of Garut shall be as follows:

Table 2 : Characteristics of Anthropometry and Respondent Activity Pattern (n = 99)

Variable	Mean	Median	SD	Min	Max	Dist
Age (year)	40.3	38	13.29	17	77	TN
Weight (Kg)	57.37	56.4	7.73	42.8	83.7	N
Intake rate of chili (mg)	0.4053	0.3571	0.2756	0.01	1.43	TN
Intake rate of cabbage (mg)	14.3814	8.33	16.73	.00	71	TN
Intake rate of carrot (mg)	30,3348	17,85	45,84	,71	250	TN
Exposure Frequency (day/year)	40	52	15.2125	12	52	TN
Exposure Duration (year)	33.40	32	15,67	3	71	N

Source: Primary Data of 2017

3.3. CDI Calculation (Daily Intake)

The calculation of intake uses the following equation: [***]

Profenofos concentration used is the concentration of laboratory examination results in chili. The weight (kg) used is 57.37kg, i.e. the mean value of the farmer population because the data of body weight is normally distributed. The exposure frequency (days/year) is 52 days/year, namely the median value because the data is not normally distributed. The duration of exposure (year) is 33.4 years i.e. the median value because the data is not normally distributed. The intake rate is 0.3571 because the data is not normally distributed. From the calculation of this risk is non-carcinogenic, the average duration which is used for non carcinogenic exposure is 365 x 30 years. The result of daily intake (CDI) for the farmers is 0.005169 mg/kg/day.

3.4. Risk Characteristics

Risk characterization is expressed in Risk Quotient (RQ) to obtain the value of individual risk based on received intake resulting from the following equation: [***]

With the standard value of RfD US-EPA (2006) that is 0.00005 mg/kg/day, it is categorized into risky. The result of calculation will get the value of RQ of > 1 and RQ value is <1. A state is expressed risk if the value of RQ is >1 so that this situation need control and not risk if RQ is <1.Based on the calculation results obtained RQ value in 99 populations of horticulture farmers is 103 which means included at risk category.From the calculation of RQ value can be concluded that the District of Cikajang, Regency of Garut has risk due to profenofos exposure because the value of RQ is >1.

3.5. Risk Management

Based on the risk characteristics, the risk management options to minimize the RQ value so that it is equal to or less than 1. The way that can be done is to manipulate the value of exposure factors in the equation so that the value of

intake (Ink) becomes smaller or equal in value with the dose Reference (Rfd) toxicity. In this research the most appropriate way is to reduce the amount of consumption or in other words decrease the rate of intake. Decrease the intake rate using the following equation: [***]

With CDIaman of 0.00005 according to standard limit obtained the calculation result of safe limit of pepper intake rate is 0.00345 mg/kg.

Maximum concentration (Cmax).

By creating a scenario of exposure patterns can be made to determine safe concentrations for 10 years, 15 years, 20 years and 25 years old just as for the 30 year scenario for each population with anthropometric characteristics and different activity patterns. The results of this simulation can be seen in the following Table:

Table 3 : Scenario of Exposure

Weight (Kg)	Exposure Duration (year)				
	10	**15**	**20**	**25**	**30**
45	1.326794	0.884529	0.663397	0.530718	0.442265
50	1.474215	0.98281	0.737108	0.589686	0.491405
55	1.621637	1.081091	0.810818	0.648655	0.540546
60	1.769058	1.179372	0.884529	0.707623	0.589686
65	1.91648	1.277653	0.95824	0.766592	0.638827
70	2.063902	1.375934	1.031951	0.825561	0.687967

That those who are lower in weight will be more vulnerable exposed with profenofos health risks than those who are fatter. However, since the risk is a probability, it does not mean that a less skinny person will automatically get sick of being exposed while the fatter person is not.

4. DISCUSSION

4.1. Concentration of Pesticide Residue in Vegetables

Based on the measurement of pesticide residue concentration on vegetables found only detected active ingredient profenofos in chili vegetables, with an average concentration of 5.235 mg/kg, pesticide residue in chili is known by doing the checking through the laboratory. The results show that it is exceeded the BMR established by the Indonesian National Standard in 2015[9] is 3.0 mg/kg, then it is categorized to be risky and with concentrations exceeding the dose response limit by EPA is 0.00005 mg/kg/day.

Pesticide residues in vegetable products, mainly due to excessive use of pesticides during production processes in terms of type, composition, dose, time, and interval[10]. Farmers' perception of pest attack as the main cause of crop failure has encouraged excessive use of pesticides[11]. Informs that preventive control is done by about 80% of vegetable farmers by spraying pesticides 1-7 days after planting in the field.

4.2. Profenofos Intake Rate In Chili

More and more farmers consume chili vegetables containing profenofos residue increasingly at risk of non-carcinoma disease. Farmers are at risk of being contaminated by toxic substances in the human body. If these toxic substances accumulate in the human body until several years later will cause cancer that will result in death[12].

4.3. Duration of Profenofos Exposure in Chili

The duration of exposure is defined as the length of stay of the farmer in the research location and consuming chili containing the profenofos residue in a matter of years. Based on the results of questionnaires interviews long lived farmers research location between 2 years to 74 years. The longer a person consuming chili that contains profenofos residue the more at risk of suffering from disease[13].

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4. 4. Frequency of Profenofos Exposure in Chili

The frequency of exposure is the number of days of the year in which the farmer lives or is in the study site and consumes chili containing a profenofos residue. Based on the results of research frequency of farmers exposure based on chili consumption containing the highest profenofos residue that is 52 days per year while the lowest 12 days per year. From RQ calculation results known farmers with a large exposure frequency value has a higher RQ value than the respondent with a small frequency value because RQ and exposure frequency is directly proportional. The more often farmers consume chilies containing profenofos residues increasingly at risk of developing illness[13].

4.5. Respondent Weight Characteristics

Weight is a component that determines the size of the intake received by farmers from an exposure. Farmers' weight of the results of this study varies between 42 kg to 83 kg, and an average of 57 kg. From the calculation of RQ is known, the higher the farmer's weight the lower the value of RQ obtained. In other words, the higher the peasant's weight, the less exposed with risk of disease[13].

4.6. Risk Analysis

Risk characteristics that farmers may experience as a result of consuming chili containing profenofos residue. The results showed that based on the calculation result obtained RQ value in 99 populations of horticultural farmers is 103 which means including risk category. Risk is a probability, so it does not mean that people who are thinner will automatically get sick of exposure while the fatter people do not[13].

4.7. Risk Management

Control of RQ value in this study by reducing the rate of intake of chili such as diversifying vegetables consumed alternately, washing chili before eating. This is in accordance with research conducted by (Fitriadi, Bayu Refindra, and Ayutia Ciptaningtyas Putri)[14]. Prevention is done on the source of pollutants. Therefore the prevention can be done in a way that is ecological selectivity. During the process the flow of energy and matter is not disturbed, so long as the environmental order remains in the "ecological balance"[15].

5. CONCLUSION AND SUGGESTION

5.1. Conclusion

Based on the results obtained can be concluded:

Daily intake (CDI) of profenofos in chili at farmers of 0.005169 mg and has crossed the threshold according to the EPA. The average concentration of profenofos in chili is 5.235 mg/kg, which is above the BMR set by the Indonesian National Standard in 2015 that is 3.0 mg/kg. Calculation of RQ (level of health risk) is known that horticulture farmers in the District of Cikajang have health risks due to consumption of chili due to profenofos exposure on chili vegetables.

5.2. Suggestion

1. Do not eat chili before washing such chili.
2. Wash your hands with soap when going to lunch on the farm.
3. Conducting agricultural centralization technology for the Cikajang community.
4. In order to examine the residual content of pesticides at the level of traders and consumer levels after washing of vegetables so that they can compare the remaining content of pesticides.

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