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Hematological Parameters Alteration in Thai Garlic Farmers Exposed to Mixed Pesticides

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Abstract

Fungicides, herbicides, and insecticides are commonly agrochemicals used to eliminate pests during garlic cultivation. Occupational exposure to mixed pesticides can cause hematological abnormalities. The aim of this study was toassess the adverse effects of chronic mixed pesticide exposure in the garlic farmers by using the hematological parameters. The blood sample was collected from 137 Thai farmers who chronically exposed to mixed pesticide and 59 control group who were not a history of exposure to mixed pesticide. Complete Blood Count (CBC) analysis was performed to investigate the hematological parameters alteration pattern of Thai farmers. Statistical analysis also performed by using Mann-Whitney U test. Our investigations revealed thatthe mean values of white blood cell (WBC) count, lymphocyte, basophil, platelet distribution width, mean platelet volume and platelet large cell ratio significantly decreased in the chronic exposed group but did not affect when compared with the normal reference ranges. The results clearly demonstrated that chronic exposure to the mixed pesticides during garlic cultivation alters the hematological parameters. The farmers should be aware and check their health to prevent the adverse effects from pesticide intoxication.

Keywords: Hematological change; Pesticides; Public Health; Toxicology; Agrochemicals.

Introduction

Pesticides are group of synthetic chemicals that have been used for control weeds, insect infestation and diseases. Herbicides, insecticides and fungicides are major type of pesticides and have been highly imported for agriculture in Thailand(1). Inhalation during spraying, skin absorption during preparation of pesticide solutions and cleaning of agriculture instruments are major causes of occupational exposure. The adverse effects can be enhanced by various factors, including type of pesticides, lack

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of personal protective equipment, duration and frequency of exposure.[2] The high intensity uses of pesticides contribute to morbidity and mortality in agriculture farms and their families through acute and chronic toxicity.[2-4] Chronic low-level exposure to pesticides may be a cause of serious health problems, including metabolism dysfunction, neurotoxicity, carcinogenesis, reproductive and immunological effects which need to be investigated.[4, 5]

In Northern Thailand, fungicides (particularly mancozeb, azoxystrobin, difenoconazole), herbicides (2,4-D, glyphosate, atrazine and paraquat) and insecticides (chlorpyrifos, carbaryl, cypermethrin, abamectin) have been used during garlic cultivations. It is critical to evaluate health problems, especially metabolism dysfunction and hematological toxicity after mixed pesticides exposure. The aim of this study was to assess the adverse effects of chronic mixed pesticide exposure in the garlic farmers by using the hematological parameters.

Materials and Methods

In this cross-sectional study, One hundred and thirty seven individuals (64 male and 73 female) who were occupationally exposed to mixed pesticides including fungicides, insecticides and herbicides at least 15 years (Chronic exposure group) and fifthly nine individuals (24 male and 35 female) who were not a history of occupational exposure to mixed pesticides or any other industrial chemicals (Control group) were recruited from Lee district, Lamphun province, Thailand with age group ranging from 30 to 70 years. The participants who had hematological diseases, autoimmune, infectious diseases, hypertension, diabetes, thyroid disorders, parkinson, alzheimer, cancer, asthma, chronic obstructive pulmonary disease, alcoholic and heavy smoking were excluded from this study. The Ethics Committee of the Faculty of Medicine, Chiang Mai University, Thailand approved this study (study code: FOR-2562-06349). All participants were informed about the protocol of this study and signed the consent before study.

Complete blood count was determined on the fresh EDTA blood samples by using an automatic analyzer (Sysmex XS-800i hematological analyzer). Hematological parameters including WBC differential, white blood cells (WBC) count, red blood cells (RBC) count, platelet count (PLT), hemoglobin (HGB), hematocrit (HCT) and plateletcrit (PCT) were performed. In addition, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC), red blood cell distribution width (RDW), platelet distribution width (PDW), mean platelet volume (MPV) and platelet large cell ratio (P-LCR) were also calculated from the hematological data.

Data were analyzed using statistical package for social science (SPSS) version 22. The descriptive analyzes were done through mean ± standard deviation (S.D). Significant differences between mean values of chronic exposure and control group were statistically analyzed using the Mann Whitney U test. Results were considered significant when *p*-value is less than 0.05 ($p<0.05$).

Results and Discussion

A total of 137 farmers and 59 controls were recruited in October 2020. They lived in the same environmental conditions including rural town, similar nutritional habits and lifestyle. The garlic farmers had highly contacted to pesticides and averaged approximately 6 hours per week. The fungicides, especially mancozeb, azoxystrobin, fluopyram and trifloxystrobin had been used at least once a week continuously four months per year. Herbicides (glyphosate, oxyfluorfen and paraquat) had been sprayed for two to three times per year to prepare the planting area. Insecticides had been used once a month. The types of pesticides are classified in Table 1. The types of personal protective equipment reported by farmers included boots, gloves, hoods, long sleeve shirts, and trousers.

Table 2. demonstrates the hematological parametersthat were evaluated in the chronic exposure group and the control group. The values of each parameter in both the control and the exposure group appeared to be normal when compared with the reference range. The WBC count, lymphocyte, basophil, PDW, MPV and P-LCR significantly decreased in the chronic exposed group when compared with the control group (p = 0.039, 0.010, 0.014,0.042, 0.016 and 0.016, respectively). Arafa[6,] Ismail[7] and Jazayerri[8] and their colleagues revealed that WBC count significantly decreased ($p< 0.01$) in the farmers who exposed to pesticides.Similarly, it significant differences decrease in WBC count between farmers and control groups.[9-11] However, mean values of monocytes, HCT andHb presented lower but mean values of granulocytes, lymphocytes, and platelets presented higher levels in the male

pesticides appliers.[12] The study of Ayi*et al*. showed that MCH and MCHC in the pesticide-exposed group were similarly values compared with the control group.[13] Some studies found a significant decrease in hematological parameters, especially HGB, HCT, MVC and RBC in the sprayers.[14,15]

Table 1: The types of pesticides used by garlic farmers.

Insecticides	Herbicides	Fungicides
Organophosphate	Glyphosate	Azoxystrobin
Benzamide	Paraquat	Difenoconazole
Chlorpyrifos	Atrazine	Mancozeb
Phosphonate	Glufosinate	Fluopyram
Sulfotep	Paraquat	Trifloxystrobin
Carbamate	Oxyfluorfen	Iprodione
Benfuracarb		Carbendazim
Carbaryl		Procymidone
Carbosulfan		Fosetyl-aluminium
Methomyl		
Organochlorine		
Endosulfan		
Pyrethroid		
Abamectin		
Cyhalothrin		
Cypermethrin		
Emamectin		

Divergences of hematological response to the pesticides exposure might attributed to types of pesticides, duration and frequency of use. The progression of hematotoxicity is induced by pesticideshave been established in animal models for evaluating to human toxicity but its mechanism of action in hematopoiesis still need to understand.[16-19]

Table 2: Hematological parameters of blood samples from the study groups.

Parameters	Reference range	Control (n=59)	Chronicexposure (n=137)	p-value
		Mean ± SD	Mean ± SD	
WBC (x 10^3 cells/µL)	4 – 10	7.85 ± 1.93	7.28 ± 2.04	0.039*
RBC (x 10^6 cells/µL)	4.10-5.60	5.07 ± 0.65	5.03 ± 0.66	0.595
HGB (g/dL)	12.5-17.0	13.51 ± 1.35	13.48 ± 1.52	0.812
HCT (%)	36.0-50.0	41.50 ± 3.70	41.28 ± 4.04	0.961
MCV (fL)	83-97	82.85 ± 10.49	83.02 ± 10.35	0.880
MCH (pg)	27 -33	27.00 ± 3.50	27.10 ± 3.66	0.650
MCHC (g/dL)	31 -35	32.54± 1.08	32.61 ± 1.15	0.564
PLT (x 10^3 cells/µL)	150 - 450	266.32 ± 65.01	273.19 ± 62.56	0.475
RDW(%)	11.7-15.0	14.32 ± 2.03	14.22 ± 2.28	0.555
PCT(%)	0.15-0.62	0.29 ± 0.07	0.29 ± 0.06	0.800
MPV (fL)	8.6-15.5	10.87 ± 0.76	10.60 ± 0.73	0.016*
PDW (fL)	8.3-25.0	12.34 ± 1.97	11.70 ± 1.52	0.042*
P-LCR (%)	11.9-66.9	30.73 ± 6.02	28.51 ± 5.76	0.016*
Neu (cells/µL)	1800-7800	4489 ± 1398	4291 ± 1644	0.171
Lym (cells/µL)	700-4500	2512 ± 646	2258 ± 735	0.010*
Mono (cells/µL)	100-1000	482 ± 196	431 ± 145	0.113
Eos (cells/µL)	0-400	325 ± 297	267 ± 264	0.271
Baso (cells/µL)	0-200	43 ± 25	33 ± 15	0.014*
%Neu (%)	40 – 70	56.82 ± 7.18	57.98 ± 9.14	0.506
%Lym (%)	20 – 50	32.48 ± 6.08	31.82 ± 8.41	0.600
%Mono (%)	2- 10	6.09 ± 1.55	6.03 ± 1.57	0.607
%Eos (%)	1-6	4.07 ± 3.58	3.69 ± 3.32	0.693
%Baso (%)	0-1	0.55 ± 0.31	0.48 ± 0.23	0.344

* Statistically significant difference from the control group at $p< 0.05$.

Conclusion

This study discovered that chronic exposure to mixed pesticides during garlic cultivation affected to complete blood count of farmers. Hematological parameters were not differ comparing with the normal range. However, WBC, MPV, PDW, P-LCR, lymphocytes and basophils were lower in the chronic exposure group. The hematological parameters should be annually evaluated for prevalence of the side effect of chronic mixed pesticides application.

Conflicts of Interest: The authors declare no conflicts of interest.

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