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Haematological Profile of Rat Offspring Exposed To Beta Cypermethrin during the Perinatal Period

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Original Research Article

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Abstract: Cypermethrin, a broad spectrum insecticide, has been extensively used for pest management and animal husbandry practices. Previous studies have shown that cypermethrin has teratogenic effect on rat foeti born to exposed dam or buck with no information on its effect on their haematological profile. The present study was aimed to assess the haematological profile of rat offspring exposed to beta cypermethrin during the perinatal period. Fifteen pregnant animals (Day 0 = day of mating, average body-weight = 190g) were randomly divided into 3 groups. Group A (Control) received 0.5ml olive oil, Group B (15 mg/kg β-cyp) and Group C (30 mg/kg β-cyp,) by oral gavage from gestational day (GD) 1 – post natal day (PND) 20. The litter size and foeti weights were taken on PND 0, 7, 14 and 21. On GD 21, blood samples were collected from 5 pups from each group for haematology. β-cyp caused a significant ($p< 0.05$) decrease in the packed cell volume, haemoglobin concentration, platelets and red blood cell count. Significant ($p< 0.05$) decrease in foeti weights were observed on PND 14 and 21. It is concluded that β-cyp has a dose-dependent toxic effects on the haematology of albino rat offspring exposed during the perinatal period.
Keywords: Beta-cypermethrin, Haematology, rat offspring, perinatal, litter size, foeti weights.

INTRODUCTION

The widespread use of pesticides worldwide for public health protection and agricultural pest control has resulted in severe environmental pollution and health hazards.

Animal studies on pyrethroids such as cypermethrin, deltamethrin and fenvalerate have demonstrated insecticide-related reproductive adverse effects both in male, female and foetal organisms [1-6]. Other studies also showed growth retardation and/or foetal loss due to exposure to pyrethroids to pregnant animals [7-10].

Although no human data are available regarding the potential for pyrethroids to cross the placental barrier and enter a developing foetus, limited animal data indicate that transfer of pyrethroids across the placenta to the foetus may occur. The placenta may provide some protection, but many industrial chemicals like pesticides, organic solvents or metals, such as lead and mercury, can cross the placenta and concentrate in the foetal nervous system, sometimes in even higher concentrations than in the maternal organism [11]. Some of these chemicals are lipophilic and therefore are likely to be retained in organs with higher lipid concentrations, such as the brain [12]. The foetal blood-brain barrier is unlikely to provide protection against industrial chemicals, and the same applies to immature detoxification mechanisms [13-14]. Many studies that considered the teratogenic effect of pyrethroids on rodents limited the maternal exposure to pregnancy only; but the present work, using beta cypermethrin as an example, extended the maternal exposure to the period of lactation (PND 0 – 21). Secondly, from previous researches, the effect of the beta cypermethrin has not been studied beyond the PND 0 of rat offspring. The aim of the present study therefore is to assess the haematological profile of rat offspring exposed to beta cypermethrin during the perinatal period.

MATERIALS AND METHODS

Chemicals and Reagents

Beta cypermethrin (a mixture of the alpha and theta forms of the insecticide) at 95.8% purity was purchased from Haihang Industry Company, Limited, China as white to light yellow crystalline powder with CAS No: 52315-07-8 and Batch No: 20140517. The desired doses were prepared in olive oil which was purchased from the supermarket. All other chemicals were of the finest analytical grade.

Animals and Treatment

Fifteen mature female albino rats weighing an average of 190g, procured from the Animal House of Department of Pharmacology, College of Health Sciences, University of Port Harcourt, Nigeria were used for the study. The rats were acclimatized for two (2) weeks before commencing the study. They were fed *ad libitum* with commercially sourced feed (Top Feeds Nigeria Limited) and supplied with clean drinking water all through the study.

Following acclimatization, one female was paired with a male in a cage overnight. Mating was confirmed the following day by the presence of sperm cells in vaginal smear or presence of vaginal plug and designated gestational day (GD) 0. They were then grouped into 3, each group housed in a cage. Group A (Control) received 0.5 ml olive oil, Group B (15 mg/kg β-cyp) and Group C (30 mg/kg β-cyp,) by oral gavage from gestational day (GD) 1 – post natal day (PND) 20. Animal's weight was taken daily and the dose adjusted accordingly. On post-natal days (PNDs) 0, 7, 14 and 21; the litter size and weights of foeti were taken.

Sample collection

On PND 21, five (5) pups were randomly selected from each of the three (3) groups and anaesthetized under chloroform. Blood samples were collected from the retro orbital plexuses by inserting a microhaematocrit capillary tube into the medial canthus of the eye until the bony orbit was contacted; the tube was gently rotated and withdrawn slightly to allow the blood to flow through the capillary tube into the sterile EDTA bottles. The Collected blood was used for the estimation of haematological parameters such as packed cell volume (PCV), haemoglobin concentration (HB), red blood cell count (RBC), white blood cell count (WBC), platelets count, lymphocyte and neutrophil levels.

Statistical Analysis

Statistical analysis was done using SPSS 21. All values were expressed as mean ± SEM and data were assessed by one-way ANOVA followed by the Tukey post-test. The significance level was set at $p<0.05$.

RESULTS

Exposure of rat offspring to beta cypermethrin during the perinatal period did not cause significant *(p>0.05)* change in the litter size (Table 1).

Table-1: Litter size of rat offspring exposed to β-cyp during the perinatal period

Parameters	GROUPS		
	A	B	C
PND 0	8.20±0.49	6.50±1.19	8.60±0.68
PND 7	7.40±0.75	6.00±1.29	8.40±0.60
PND 14	7.40±0.75	6.00±1.29	7.00±0.32
PND 21	7.40±0.74	6.00±1.29	6.60±0.40

Values are given as mean ± SEM for each group

Beta cypermethrin significantly (*p<0.05*) decreased the foeti weights of the rat offspring on post-natal days (PND) 14 and 21 in the group treated with the high dose of 30mg/kg (Group C). However, there was a non-significant (*p>0.05*) decrease in the foeti weights of the rat offspring on post-natal days (PND) 0 and 7 in Group C. Exposure of rat offspring to beta cypermethrin during the perinatal period did not cause significant *(p>0.05)* change in the foeti weights of the rat offspring in group B treated with the low dose of 15mg/kg (Table 2).

Table-2: Foeti weights of rat offspring exposed to β-cyp during the perinatal period

Parameters	GROUPS		
	A	B	C
PND 0	5.73±0.32	5.61±0.18	5.32±0.14
PND 7	12.41±1.12	14.10±0.78	9.95±0.51
PND 14	22.46±1.58	23.97±1.72	16.91±0.80*****
PND 21	35.68±1.83	34.43±1.54	26.29±1.75*****

Values are given as mean ± SEM for each group. * indicate significant difference ($p<0.05$) relative to group A.

Beta cypermethrin significantly (*p<0.05*) decreased the Hb conc., PCV and RBC count of the rat offspring in group C; other changes in the haematological values seen in the group were insignificant ($p>0.05$). In group B, β-cyp has no significant (*p>0.05*) effect on the haematology of rat offspring except in platelets where it caused a significant (*p<0.05*) reduction in the value (Table 3)

Table-3: Haematological values of rat offspring exposed to β-cyp during the perinatal period

Parameters	GROUPS		
	A	B	C
Hb (g/dl)	10.26±0.28	10.53±0.18	9.40±0.20 *
PCV (%)	30.80±0.86	31.50±0.50	28.20±0.58 *
RBC (X 10^{12}/L)	4.56±0.14	4.60±0.09	4.14±0.10 *
WBC (X 10^{9}/L)	5.38±0.36	4.70±0.85	4.16±0.41
Platelets (X 10^{9}/L)	230.00±13.04	175.00±10.41*	266.00±12.08
Neutrophil (%)	24.40±1.69	25.00±1.78	30.00±1.70
Lymphocyte (%)	75.60±1.69	75.00±1.78	70.00±1.70

Values are given as mean ± SEM for each group. * indicate significant difference ($p<0.05$) relative to group A

DISCUSSION

Haematological parameters have been associated with health indices and are of diagnostic significance in routine evaluation of health status [15]. Alteration in haematological profile may be due to changes in cellular integrity, membrane permeability and metabolism or even exposure to toxic chemicals [16]. Studies have shown that direct exposure to high doses (40mg/kg, 50mg/kg, 80mg/kg and 120mg/kg) of Cypermethrin depletes the haematological profile of rats [17] and Guinea pigs [18]. The present study evaluated the haematological profile of rat offspring exposed to lower doses of β-cyp during the perinatal period. Several studies have demonstrated that maternal pesticides exposure can cause damage to the foeti such as increased mortality of offspring, organ and skeletal abnormalities and other forms of teratogenesis [19, 9, 20].

The result of the present study shows that β-cyp caused a significant decrease in HB conc., PCV, RBC count and Platelets in the exposed offspring. This is in line with the findings by Manna *et al*. [21] and Sayim *et al*. [22] that erythrocyte count, PCV, Hb conc., thrombocyte and MCH values were decreased by oral cypermethrin intoxication in wistar rats. This result suggests that β-cyp has the potential to inhibit erythropoietin secretion from the kidneys which resulted in the decrease in the rat RBC production (erythropoiesis) which could in turn induce anaemia. There is a direct relationship between RBC, PCV and HB concentration since PCV represents the percentage of RBC in blood; an alteration in one parameter, alternately alters another [23].

Sadowska *et al*. [24] have reported that pyrethroid exposure is associated with oxidative stress, through lipid peroxidation, protein oxidation and depleted multiple antioxidant enzymes. Kale *et al.* [25] added that during pyrethroid metabolism, reactive oxygen species (ROS) are generated and result in oxidative stress in intoxicated animals. Oxidative stress can disrupt normal physiological pathways and cause erythrocyte destruction as observed by Kanter *et al*. [26] who studied cadmium toxicity. It is therefore possible that this oxidative stress enhanced the quantity of oxygen in the tissue which invariably decreased the rate of RBC production. Hall [27] stated that any condition that causes the quantity of oxygen transported to the tissues to decrease ordinarily increases the rate of red blood cell production.

The non-significant change in total WBC count, neutrophil count and lymphocyte count suggests that the immune responses of the body to infection have not been compromised. Similar report was given by Oyedeji and Bolarinwa [28] in metronidazole treated rats. The chronic exposure of the rat offspring to β-cyp during lactation resulted in the decreased foeti weights observed in PND 14 and 21. This suggests that the pesticide can be transmitted to the foeti through breast milk.

CONCLUSION

This study has shown that the chronic exposure of the rat offspring to β-cyp during gestation and lactation periods has the potential to cause teratogenesis. This was seen in the reduced foeti weights on PND14 and 21; and the reduction in PCV, RBC count, Hb concentration and platelets. We therefore conclude that beta cypermethrin has a toxic effect on the haematological profile of albino rat offspring exposed during the perinatal period.

REFERENCES

1. Husain, R., Gupta, A., Khanna, V. K., and Seth, P. K. (1991). Neurotoxicological effects of a pyrethroid formulation, fenvalerate in rats. *Research communications in chemical pathology and pharmacology*, *73*(1), 111-114.
2. Husain, R., Malaviya, M., Seth, P.K. and Husain, R. (1992). Differential responses of regional brain polyamines following in utero exposure to synthetic pyrethroid insecticides: a preliminary report. *Bull Environ Contam Toxicol*; 49:402–409.
3. Malaviya, M., Husain, R., Seth, P.K. and Husain, R. (1993). Perinatal effects of two pyrethroid insecticides on brain neurotransmitter function in the neonate rat. *Vet Hum Toxicol*; 35: 119–122.
4. Meeker, J.D., Barr, D.B. and Hauser, R. (2008). Human semen quality and sperm DNA damage in relation to urinary metabolites of pyrethroid insecticides. *Hum Reprod*; 23(8):1932-1940.
5. Oda, S. S., and El-Maddawy, Z. K. (2012). Protective effect of vitamin E and selenium combination on deltamethrin-induced reproductive

toxicity in male rats. *Experimental and toxicologic pathology*, *64*(7-8), 813-819.

6. Suresh, C. J., Bhawna, B. and Nakuleshwar, D. J. (2011). Evaluation of reproductive and developmental toxicity of cypermethrinin male albino rats. *Toxicological and Environmental Chemistry*.; 93(3): 593-602.
7. Abdel-Khalik, M.M., Handfy, M.S. and Abdel-Aziz, M.I. (1993). Studies on the teratogenic effects of deltamethrin in rats. *Dtsch Tierarztl Wochenschr*; 100: 142–143.
8. Ullah, M. S., Ahmad, M., Ahmad, N., Khan, M. Z., & Ahmad, I. (2006). Toxic effects of cypermethrin in female rabbits. *Pakistan Veterinary Journal*, *26*(4), 193.
9. Assayed, M.E., Khalaf, A.A. and Salem, H.A. (2010). Protective effects of garlic extract and vitamin C against in vivo cypermethrin-induced teratogenic effects in rat offspring. *Food and Chemical Toxicology*. ScienceDirect. Elsevier Ltd; 48: 3153-3158.
10. Sallam, M. A., Ahmad, M., Ahmad, I., Gul, S. T., Idrees, M., Bashir, M. I., and Zubair, M. (2015). Toxic effects of cypermethrin on the reproductive functions of female rabbits and their amelioration with vitamin E and selenium. *Pak Vet J*, *35*(2), 193-196.
11. Andersen, H.R., Nielsen, J.B., and Grandjean, P. (2000). Toxicologic evidence of developmental neurotoxicity of environmental chemicals. *Toxicology*;144: 121–127.
12. Eskenazi, B., Gaylord, L., Bracken, M.B. and Brown, D. (1988). In utero exposure to organic solvents and human neurodevelopment. *Dev Med Child Neurol*; 30:492–501.
13. Adinolfi, M. (1985). The development of the human blood-CSF-brain barrier. *Dev Med Child Neurol* ; 27, 532–537.
14. Grandjean, P. and Landrigan, P.J. (2006). Developmental neurotoxicity of industrial chemicals. *Lancet* ; 368:2167–2178
15. Hoeney, M. (1985). Introduction to Clinical Immunology, Butterworth, London; 3.
16. Brosche, T., Platt, D. and Dorner, H. (1990). The effect of garlic preparation on the composition of plasma lipoproteins and erythrocyte membranes in geriatric subjects. *Br. J. Clin. Pract*., 69: 12-19.
17. Nair, R.R., Abraham, M. J., Nair, N. D., Lalithakunjamma, C.R. and Aravindakshan, C.M. (2010). Haemtological and biochemical profile in sub lethal toxicity of cypermethrin in rats. *Int. J. Biol. Med. Res.*; 1(4): 211-214.
18. Omonona, A.O. and Jarikre, T.A. (2015). Comparative toxicity of cypermethrin following oral and dermal routes in guinea pigs and the ameliorative effect of ascorbic acid. *Research Journal of pharmaceutical, Biological and Chemical Sciences*; 6(1):1552-1556.
19. Elbetieha, A., Da'as, S.I., Khamas, W. and Darmani, H. (2001). Evaluation of the toxic potentials of cypermethrin pesticide on some reproductive and fertility parameters in the male rats. *Arch Environ Contam Toxicol*; 41: 522–528.
20. Huang, C., and Li, X. (2014). Maternal cypermethrin exposure during the perinatal period impairs testicular development in C57BL male offspring. *PLoS One*, *9*(5), e96781.
21. Manna, S., Bhattacharyya, D., Basak, D. K., and Mandal, T. K. (2004). Single oral dose toxicity study of a-cypermethrin in rats. *Indian journal of pharmacology*, *36*(1), 25.
22. Sayim, F., Yavasoglu, N.U.K., Uyamkgil, Y., Aktug, H., Yavasoglu, A. and Turgut, M. (2005). Neurotoxic effects of cypermethrin in Wistar rats: a haematological, biochemical and histopathological study. *Journal of Health Science*; 51:300-307.
23. Schalm, O. W., Jaivi, N. C. and Caroll, E. J. (1975). *Veterinary Heamatology* (3rd ed.) Lea and Febiger, London.; Pp 385 – 390.
24. Sadowska, W.I., Wojcik, N., Karowicz, B.A. and Bieszczad, B.E. (2010). Effect of selected antioxidants in beta-cyfluthrin-induced oxidative stress in human erythrocytes in vitro. *Toxicol In Vitro;* 24(3):879-84.
25. Kale, M., Rathore, N., John, S. and Bhatnagar, D. (1999). Lipid peroxidative damage on pyrethroid exposure and alterations in antioxidant status in rat erythrocytes: a possible involvement of reactive oxygen species. *Toxicol. Lett.*; 105 (3): 197-205
26. Kanter, M., Aksu, B., Akpolat, M., Tarladacalisir, Y. T., Aktas, C., and Uysal, H. (2015). Vitamin E protects against oxidative damage caused by cadmium in the blood of rats. *European Journal of General Medicine*, *6*(3), 154-160.
27. Hall, J. E., and Guyton, A. C. (2011). Female physiology before pregnancy and female hormones. *Guyton and Hall Textbook of Medical Physiology. 12th ed. Philadelphia: WB Saunders*.
28. Oyedeji, K. O., and Bolarinwa, A. F. (2013). Effect of Metronidazole on Haematological Parameters in Male Albino Rats. *Parameters*, *5*, 0-05.