Short Communication

Sahel Journal of Veterinary Sciences

Sahel J. Vet. Sci. Vol. 21, No. 3, Pp 57-60 (2024)
https://doi.org/10.54058/ba3z3y81

Article History
Received: 23-07-2024
Revised: 21-08-2024
Accepted: 25-09-2024
Published: 30-09-2024

Effects of Dichlorvos on Pregnancy Outcomes in Wistar Albino Rats

[1]Mahuta, M. M., [2]Idris, H., [2]Sidi, S., [2]Adeyeye, A. A., [3]Idris, S. B., [4]Usman M. D., [5]Yusuf, A. and [6]Tijani, A.

[1]Department of Theriogenology and Production, College of Veterinary Medicine, Federal University of Agriculture Zuru
[2]Department of Theriogenology and Animal Production, Usmanu Danfodiyo University, Sokoto, Nigeria
[3]Department of Veterinary Pharmacology and Toxicology, Usmanu Danfodiyo University, Sokoto
[4]Department of Veterinary Medicine, Bayero University, Kano
[5]Department of Public Health and Preventive Medicine, College of Veterinary Medicine, Federal University Of Agriculture Zuru
[6]Department of Animal Science, Umaru Musa Yar'adua University, Katsina

*Author for Correspondence: mmuhammadmahuta4@gmail.com

ABSTRACT

Dichlorvos is an organophosphate widely used as an insecticide. This study determines the effect of dichlorvos on pregnancy in Wistar rats. Forty-two bred female rats were divided into 7 groups (A, B, C, D, E, F and G) comprising of 6 rats each. Rats in 3 groups received 4.45mg/kg in the 1st, 2nd and 3rd trimester of pregnancy, respectively. The other 3 groups received 8.9mg/kg in 1st, 2nd and 3rd trimester, respectively. The dam to pups' ratio decreased as the dose of dichlorvos increased except in the third trimester. The percentage birth weight of the treated groups was not different from the control except at third trimester when there was a significant ($p<0.05$) decrease in the 8.9mg/kg groups. There were no significant ($p>0.05$) differences in the crown-rump and gestation length within the groups and trimesters except in the third trimester where there was a significant difference ($p<0.05$) between 8.9mg/kg group and others. The study shows that dichlorvos is capable of altering pregnancy outcomes in female Wistar rats.

Keywords: Dichlorvos; Pregnancy outcomes; Wistar-rats

INTRODUCTION

A pesticide is a substance or mixture of substances designed to prevent, destroy, repel, or reduce the damage caused by pests, which encompass plants, animals, insects, and fungi Elhalwagy *et al.* (2008). The widespread adoption of pesticides in agricultural and non-agricultural settings, aimed at increasing crop yields and controlling disease-carrying organisms, has gained significant acceptance. However, this practice has led to an increase in cases of pesticide-related illnesses in humans and animals, as well as alterations to natural ecosystems Shittu *et al*. (2021).

Despite their beneficial effects, pesticides have adverse impacts on both the environment and the health of those exposed to them Agnandji *et al*. (2018). Concerns have been raised regarding both domestic and occupational exposure to these chemicals, with studies highlighting their toxicity in humans and animals Bodwal *et al*. (2019).

MATERIALS AND METHODS

Study Area

The study was carried out at the Faculty of Veterinary Medicine, Usmanu Danfodiyo University, Sokoto (UDUS), Nigeria. Sokoto is in the Northwestern part of Nigeria between longitude 5º and 6º E and between latitude 13º and 14ºN, with an average annual temperature of 40ºC and mean annual rainfall of 300mm – 1200mm Umar *et al.* (2015).

Experimental Animals

A total of 61 adult rats comprising 54 females and 7 males were used for this study. They weighed 100–120 grams and were aged 8 to 12 weeks old. The rats were sourced from the Department of Biochemistry, UDUS and maintained at the animal pen, Faculty of Veterinary Medicine (City Campus), UDUS throughout the study.

Ethical Statement

Ethical approval for the study was obtained from IACUC, (UDUS/IACUC/2023/ R09).

Source of Dichlorvos

Commercial grade of dichlorvos sourced from Nantong Jiangshan agrochemical and chemical LTD liability company was used for the study.

Determination of Median Lethal Dose (LD_{50})

LD_{50} was determined using 12 female rats as modified by Ambali *et al.* (2012) and Chinedu *et al.* (2013). An LD_{50} of 89mg/kg was obtained. Doses used were 5% and 10%

of 89mg/kg which is equal to 4.45 mg/kg and 8.90mg/kg, respectively.

Experimental Design

Forty-nine (42 females and 7 males) Wistar rats were used for the study. Their stages of the estrous cycle were determined by vaginal cytology Ajayi and Akhigbe, (2020). After two successful cycles, male Wistar rats were introduced during the next proestrus for a period of 14 hours at a ratio of 1:6. Presence of spermatozoa in the vaginal smear after removal of male was indicative of successful copulation and recorded as the first day of gestation based on the method of Ding *et al*. (2014). The 42 bred rats were then divided into seven groups comprising six rats each. Two groups in first, second and third trimester received 4.45 mg/kg and 8.9mg/kg each of dichlorvos, while the remaining one group served as a control. The rats were monitored for signs of embryonic death, abortion and still birth throughout the study. For those that parturated, the weight of pups, crown rump length of pups, number of live and dead pups and gestation length were determined. At 29 days post breeding, rats that didn't whelp were humanely sacrificed and reproductive tract examined for placental scar (Mowat *et al.*, 1996).

Percentage birth weight

The percentage birthweight was calculated as pup-weight divided by dam-weight multiplied by 100. The dam-weight and pups-weight were determined using constant weighing scale® (Model 14192-127B, made in China).

Data Analysis

The data obtained were analyzed using One-Way Analysis of Variance and descriptive statistics. Results are presented in tables as mean ± standard deviation. Values with $P< 0.05$ were regarded as significant.

RESULTS AND DISCUSSION

Dam to Pups ratio of Wistar Rats following Exposure to Dichlorvos during Pregnancy

The effect of dichlorvos exposure on dam to pups ratio of the Wistar rats is presented in Table Table 1. The ratio of dam to pups of rats in the dichlorvos groups is lower compared to the control. In addition, rats exposed in the first (1:1.5), (1:3) and second (1:3) (1:1) trimester of pregnancy had lower dam to pups ratio compared to those of the third (1:5.5) (1:6.2) trimester. However, placental scars and resorbed pups were seen in all the uteri of the rats sacrificed in the dichlorvos treated groups 29 days post breeding.

Sample Collection

Table 1: Dam to pups of Wistar rats following exposure to dichlorvos during pregnancy

Groups	First Trimester	Second Trimester	Third Trimester
A (Control)	1: 8.2	1: 8.2	1: 8.2
B (4.45mg/kg)	1 :1.5	1 : 3	1 : 5.5
C (8.9mg/kg)	1 :3	1 : 1	1 : 6.2

Effects of Dichlorvos on Weight of Pups, Crown Rump Length and Gestation Length of Wistar Rats following Exposure to Dichlorvos during Pregnancy

Effects of dichlorvos on Relative birth weight, crown rump length and length of gestation of Wistar rat is presented in Table 2. Relative birth weight, crown rump length and gestation length were not affected in the dichlorvos exposed except for the third trimester where percentage birth weight and gestation length were significantly ($P< 0.05$) lower compared with the control.

Table 2: Effects of dichlorvos on weight of the pups, crown rump length and gestation length of Wistar rats following exposure to dichlorvos during pregnancy(n=6)

Parameter	**Trimester**		
	First	**Second**	**Third**
Percentage birth weight (g)			
A (Control)	6.35 ± 0.24	6.35± 0.24	6.35± 0.24[a]
B (4.45mg/kg)	5.4	6.2	6.08±0.19[a]
C (8.9mg/kg)	6.2	6.1	6.02±0.15[b]
Crown-rump length (inches)			
A (Control)	4.08± 0.12	4.08± 0.12	4.08± 0.12
B (4.45mg/kg)	4.2	4.1	4.08± 0.05
C (8.9mg/kg)	4.3	4.0	4.06± 0.11
Gestation Length (days)			
A (Control)	20.83± 0.41	20.83± 0.41	20.83± 0.41[a]
B (4.45mg/kg)	20.5	20.6	20.50± 1.00[a]
C (8.9mg/kg)	21	21	19.2±0.45[b]

Columns with different superscript are significantly ($p < 0.05$) different

DISSCUSSION

In the first, second and third trimesters, there was a significant reduction in the ratio of dam to pups in the exposed groups compared to the control. Ajayi *et al.* (2022) and Schroder-vander Elst *et al.* (1999) also reported reduced liter size in rat exposed to dichlorvos and flavonoids. This could be because of altered reproductive hormones by dichlorvos leading to

pregnancy loss. This is like the report of Abebe *et al* (2022) who observed reduced liter size in Wistar rat given myrtaceae leaves. However, the results of the present study disagree with that of Gallegos *et al*. (2016) who reported no effects on liter size in rats administered glyphosate-based herbicide. Decrease liter size in the present study might have been due to exposure to dichlorvos during different trimesters of pregnancy. Several reproductive and developmental toxicity studies have associated pesticide exposure to teratogenic and negative pregnancy outcomes (Chevrier *et al*., 2011).

Organophosphorus compounds have been noted for their association with both early and late embryonic losses (Mahadevaswami and Kaliwal, 2003). The effects of dichlorvos on the pregnancy might be due to alteration in estrogen-progesterone balance, crucial for implantation and maintenance of pregnancy (Mahadevaswami and Kaliwal, 2003). The observed rise in embryonic resorptions in the exposed group might be attributed to potential modifications in uterine lining function and/or the passage of dichlorvos transplacentally, subsequently leading to acetylcholinesterase (AChE) inhibition (Akhtar *et al*., 2006).

In the present study, percentage birth weight was affected. This agrees with the findings of Iyare and Adegoke (2014) in Wistar rats administered with aqueous extract of *Hibiscus sabdariffa* and Adeyeye *et al*. (2016) in Yankasa ewe infected with *Trypanosoma evansi*. The findings of the present study disagree with the findings of Gallegos *et al*. (2016) who reported no effects on birth weight in rats administered glyphosate-based herbicide.

In the present study, the gestation length in the exposed groups was decreased in the third trimester. These findings agree with those of Kaingu *et al*. (2018). However, the current study differs from the findings of Iyare and Adegoke (2014). Adeyeye *et al*. (2016) also reported insignificant changes in gestation length of Yankasa ewe following *Trypanosoma evansi* infection.

Conclusion

Dichlorvos at 4.45mg/kg and 8.9mg/kg reduced litter size in Wistar rats. Dichlorvos at 8.9mg/kg affects gestation length and percentage birth weight but did not have effects on crown rump length.

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