

EFFECT OF DELTAMETHRIN (DIPPING AND FEEDING TRIALS) IN BOVANS - TYPE CHICKS

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ABSTRACT

Comparative effects of Deltamethrin dipping baths and dietary levels of 0.0025, 0.05 and 1% on Bovans-type chicks were investigated.

Death caused by 1% Deltamethrin dipping bath at week 3 was preceded by clinical illness in which inappetence, paralysis of the wings and abnormal posture were observed.

Death among the chicks fed on Deltamethrin diets was not observed. Chicks fed on 1% and 0.05 Deltamethrin diet showed diarrhoea, dullness, inappetence and weakness of legs. The average body weights and weight gains were lower in the feeding trial while they were higher in the dipping trial. The feed conversion ratio was lower in both trials.

The main lesions in dipping and feeding trials were hepatoellular fatty vacuolation, degeneration off the epithelial cells of the renal tubules and catarrhal or haemorrhagic enteritis. Changes in serum constituents and hematology were also studied.

المخلص

أجريت دراسة مقارنة لمبيد الدلتاميثرين عن طريق محاليل المغاطس وفي علبه صيصان من نوع بوفان بالتركيزات 0.0025، 0.05، 1%. وقد لوحظ نفوق في الصيصان التي تم تغطيسها في تركيز 1% بعد ثلاثة أسابيع مسبقا بفقدان الشهية وشلل الأجنحة والجلسة غير المعتادة للطائر. أما الصيصان التي تناولت المبيد بتركيز

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1. 0.05% في العليقة فقد أظهرت الإسهال والحمول وضعف في الأرجل كما أن متوسط وزن الجسم وكسب الوزن قد انخفض في كلتا التجريبتين مقارنة بمجموعة السيطرة.

الأعراض الباثولوجية انحصرت في الاحتقان المنتشر في أنسجة الجسم المختلفة وفي بعض الأحيان النقاط النزفية. خلايا الكبد أصيبت بالنخر ووجود الفراغات الدهنية السابتوبلازمية أما الكلى فقد تلفت و ثلاثت الخلايا الظهارية ثلاثيبيبات اللقيفة الامامية، الالتهاب المخاطي الصديدي أو المدمم قد لوحظ في أمعاء الصيصان تحت الاختبار. في نهاية فترة النقاهة وجد أن الآثار الضارة على الأنسجة ما زالت باقية.

INTRODUCTION

As broad-spectrum pesticides, the pyrethroids are necessarily toxic to a wide range of arthropods groups such as ticks and mites are variably susceptible depending on the specific chemical and species uses of pyrethroids against pests including forestry, agriculture veterinary public health and protection of stored products. (Clarke, 1975, Humphreys 1983).

It is well known that tick *Argas persicus* transmits *Borrelia amserina* (causative agent of spirocheatosis), infectious bursal disease in fowls and Congo haemorrhagic fever virus.

The pyrethroid are considered as analogs of the natural pyrethroids of plant origin and that their potency to pests has been represented with deltamethrin, cyfluthion, cypermethin, fenvalerate and then permethrin (Clarke, 1975, Humphreys, 1983). It has been found that both deltamethrin and permethrin produced no mutagenicity but caused pulmonary and hepatic tumours in mice and embryo toxicity in poultry (Bradbury and Coats 1989). Because of the use of these major classes of pesticides and other chemicals such as formamidiens and cyclic amidines in growing and storing of agricultural commodities one can encounter residues in plant products. When present in poultry feed, the pesticides can have a negative influence on the performance of poultry (Khan, 1973).

Because the pyrethroids are generally recognized as safe mammalian species and because of the scarce information on their toxicity to

birds, experiments were performed to examine the effect on chicks of the acaricide (deltamethrin) incorporated in the basic diet at various concentrations. As the route of exposure is the main factor in causing toxicity, an experiment was planned to determine the effect on chicks of the dipping bath of the acaricide (deltamethrin) at various levels.

MATERIALS AND METHODS

CHICKS

One hundred and forty four - one-day-old male Bovans-type chicks were obtained from Coral Co. Ltd., Khartoum and reared in pens within the illumination at night and early morning. The chicks were fed on starter mash and water was provided *ad libitum*.

(A) DIPPING EXPERIMENT

At the age of 7 days, 72 chicks were allotted at random to four groups of 18 chicks each. Chicks in-groups 2,3 and 4 were dipped individually at weeks 0,3 and 6 for 30 sec in aqueous solution of deltamethrin at 0.0025, 0.05 and 1% respectively. Group 1 chicks were the control and dipped in water.

(B) FEEDING EXPERIMENT:

Seventy-two, 7 days - old male Bovans chicks were assigned to 4 groups each of 18. Deltamethrin [(s)- α -cyano-m-phenoxymethyl (1R-3R)-3-(2,2)-dibromovinyl-2,2-dimethyl-cyclopropane carboxylate, 100 EC, Agways Co. Ltd., Paris, France] was mixed with control ration and fed at 0.0025, 0.05 and 1% to groups 5,6 and 7 respectively for six weeks (feeding period). Thereafter, the test-diets were withdrawn and replaced by the control feed for two other weeks (recovery period). Group 8 chicks were fed the control mash (sorghum 58%, soyabean 9%, sesame cake 14%, ground nut cake 12% wheat bran 1%, dicalcium phosphate 1%, super concentrates 5% for 8 weeks.

Batches of 6 L groups of experimental chicks were slaughtered at weeks 3; 6 and 8. Blood samples were collected at slaughter for haematology and serum chemistry.

At necropsy, chicks were examined for gross lesions and samples of liver, kidneys, heart, proventriculus, small intestines, brain, and peripheral nerves were immediately fixed in 10% formal saline,

processed for histopathology and stained with haematoxylin and eosin (H&E).

PARAMETERS

Changes in mean body weights, weight gains and feed conversion ratio (kg feed /kg gain) were recorded weekly. Values of haemoglobin concentration (Hb), packed cell volume (PCV), red blood cell (RBC) count, mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular volume (MCV) were estimated according to Schalm *et al* (1975).

Changes in serum total lipid were measured using a kit (Bio Merieux- Laboratory Reagents and Products, Paris, France) and serum sodium (Na), potassium (K) and phosphorus (P) concentration were determined by methods of Varley (1967). Alterations in serum calcium (Ca), magnesium (Mg), Zinc (Zn), copper (Cu), and manganese (Mn) concentration were assayed using Atomic absorption spectrophotometer (Unicam, Sp. 191).

STATISTICAL ANALYSIS

Data were analysed for significance by student's T-test (Mendenhall, 1971).

RESULTS

CLINICAL SIGNS AND MORTALITY

DIPPING

In chicks dipped in 1% deltamethrin (group 4) the main signs observed within 24 hrs were shivering, dullness transient paralysis of both wings and inability to keep the up right position. These signs disappeared on day2. After the second dipping, the symptoms were more severe than the previous exposure and paralysis, off food, congestion of the cutaneous blood vessels group 4, 12 birds died or slaughtered I a moribund state within 5 days after the second exposure. The remaining 6 birds of group 4 showed the same clinical signs and died within 6 hours after the 3rd exposure. No clinical signs were observed either in the control birds (group 1) or in the birds dipped in deltamethrin at 0.0025% (group2).

FEEDING

In group 6 and 7 chicks fed deltamethrin at 0.05 and 1% of the basic diet, respectively there was diarrhoea, dullness, inappetence and weakness of legs. These signs appeared after 3 hours post dosing and continued for 2 days, then disappeared on day 3. Thereafter, the birds regained appetite for food and appeared normal. No clinical signs were seen in the control birds (group 8) or in the birds fed deltamethrin at 0.0025% (group 5)

GROWTH CHANGES

DIPPING:

The average body weights and weight gains, of chicks in groups 2 and 3 were significantly higher ($p < 0.05-0.001$) while birds of group 4 showed lower values ($p > 0.05$) than those in the control group throughout the experiment. The values of feed conversion ratio were increased significantly ($p > 0.05-0.001$) as the concentration of the insecticide increased.

Feeding:

The average body weight, weight gain of chicks in group 5 were increased ($p < 0.05$) at week 6 and decreased at week 7 and 8. In group 6, there were significant decrease ($p < 0.05$) in body weight a week 3 through week 8. In-group 7 the average body weights and weight gains were significantly lower ($p > 0.05$) than the controls (group 8) throughout the period of the experiment. The efficiency of feed utilization was significantly lower ($p < 0.05$) in controls (group 8) than the test chicks in group 5, 6, and 7 throughout the feeding and the recovery period

PATHOLOGY

A. MACROSCOPIC FINDINGS

DIPPING:

At weeks 3 and 6 the liver was congested and showed haemorrhage in-group 3 and 4. The renal cortex was studied with haemorrhage and the medulla was pale brown. In group 4 petechial or echymotic

haemorrhages were observed on the thigh and chest. The control birds (group 1) and chick's in-group 2 showed no significant lesions.

Feeding

At weeks 3 and 6 the liver and kidneys were slightly enlarged and congested and petechial or echymotic haemorrhages were observed on the thigh in-group 6 and 7. These lesions were slight on week 8. None of the control hicks' group 8 or birds in-group 5 showed significant lesions.

B. MICROSCOPIC LESIONS:

LIVER: in-group 3,4 the central veins, portal blood vessels and some of the centrilobular sinusoids were congested

KIDNEYS: In-groups 3 and 4, there was congestion and/or haemorrhage, packing of the glomeruli with lymphocytes and scattered lymphocytic infiltration among the cortical tubules

HEART: There were lymphocytic nodules and focal haemorrhages on the cardiac muscle fibres. The control birds in-group 1 and test birds in-group 2 showed no lesions.

FEEDING:

LIVER: At weeks 3 and 6 there was congestion of hepatic blood vessel and centrilobular sinusoids, hepatocellular necrosis, accumulation of lymphocytes and proliferation of bile ducts in the test groups.

KIDNEYS: Detachment of the epithelial cells of the proximal convoluted tubules, congestion of the renal blood vessels. Scattered foci of haemorrhage in the interstitial spaces, acidophilic homogeneous material in many degenerated tubules and shrinkage or necrosis of the glomerular tufts were the main lesions in the kidneys of birds in-groups 5,6 and 7.

The renal and hepatic parenchyma had not completely reverted to normal at the end of the recovery period.

HEART: In-groups 6 and 7, there was congestion of the blood vessels, focal haemorrhage, and necrosis infiltrated with lymphocytes of the cardiac muscle fibres.

Intestine: There was congestion and haemorrhage in the intestinal submucosa and haemorrhagic enteritis. No significant lesions were seen in the controls (group 8).

CHANGES IN SERUM CONSTITUENTS**DIPPING:**

Table 1 summarized the effect of various levels of deltamethrin dip on the concentration of inorganic phosphate, sodium, potassium, manganese and copper in the serum of Bovans-type chicks. No significant changes were observed in the serum concentration of total lipid, calcium, zinc and magnesium of test chicks. Slight increase ($P < 0.05$) detected in the serum concentration of phosphorus and potassium and decreases ($P < 0.05$) in serum sodium in chicks of groups 2,3 and 4 and increases ($P < 0.02$) in serum copper concentration compared to control birds and decreases ($P < 0.05$) in serum manganese in groups 3 and 4.

FEEDING:

Changes in the concentration of serum total lipid, inorganic phosphate, calcium, magnesium, sodium, potassium, zinc, manganese and copper in the serum of Bovans-type chicks fed various levels of dietary deltamethrin are given in table 2. There were significant increases ($P < 0.05$) in the concentrations of calcium and zinc and decrease ($P < 0.05$) in potassium and total lipid concentrations in chicks in group 6 and group 7. No significant changes in serum phosphorus, sodium manganese, or copper concentrations were detected in the test birds. During the recovery period, serum copper concentrations were significantly decreased ($P < 0.01$) and these of zinc, sodium, calcium and magnesium, were increased ($P < 0.05$) in the chicks in group 6, 7 and 8. No significant changes were observed in total lipid, phosphorus, potassium and manganese. No changes observed in control group during the feeding and recovery period.

Table1: Changes in some serum constituents of birds dipped in various concentrations of deltamethrin (M±SD).

Group	Phosphorus mg/100ml	Sodium mg/100ml	Potassium mg/100ml	Manganese ug/100ml	Copper ug/100ml
1(Control)	4.34±0.13	293.5±4.6	28.6±2.33	52.5±7.5	70±5.5
2(0.0025%)	5.3±0.2*	289.6±1.1*	19.6±4.2*	55±10 NS	115±11.5**
3(0.05%)	5.9±0.17*	285.2±1.3*	47.3±7.3*	30±10*	120±6.0**
4(1%)	5.5±0.2NS	286±1.6*	50±8.7*	40±5*	130±12.0**

NS = Not significant * = $P < 0.05$ ** = $P < 0.02$ M±SD = mean ± standard deviation

Table2: Changes in some serum constituents of chicks fed deltamethrin (M±SD) during the feeding and recovery period**Feeding period (6 weeks)**

Group	Total lipid (g/l)	Calcium (mg/100ml)	Magnesium (mg/100ml)	Potassium (mg/100ml)	Zinc (ug/100ml)
1(Control)	9.8±1.3	11.9±1.55	3.75±0.25	24.6±3.2	520±1.4
2(0.0025%)	10.2±2.2NS	13.6±0.65*	3.85±0.3NS	24.65±1.6NS	615±10.05NS
3(0.05%)	6.95±0.9*	15.1±1.0*	3.95±0.05NS	20.05±1.4*	830±275*
4(1%)	6.9±0.4*	17.3±1.85*	4.65±0.4*	20.3±1.15*	796±390*

Recovery period (2 weeks)

1(Control)	9.8±1.3NS	10.1±1.6	3.6±0.2	28.5±2.7	570±1.42
2(0.0025%)	7.1±0.5NS	15±2.0**	4.2±0.2*	25.1±1.6 NS	600±4.8NS
3(0.05%)	7.5±1.4NS	7.2±0.7**	4.5±0.6*	26.2±12NS	670±5.1*
4(1%)	8.0±0.0NS	18.2±0.2***	4.6±0.1*	24.2±4.7NS	670±1.4*

N.S = Not significant * = $P < 0.05$; ** = $p < 0.02$; *** = $p < 0.01$

HAEMATOLOGICAL CHANGES**DIPPING:**

In group 2,3 and 4, the values of R.B.C. were significantly lower ($P < 0.05$) and these of MCV. Was higher ($P < 0.01$) than the control group. The values of Hb, PCV and MCHC showed no significant changes in-groups 2,3 and 4. No changes deserved in control chicks.

Feeding:
In groups 5,6 and 7 the values of Hb. And MCHC was significantly decreased ($P < 0.05-0.02$), PCV and RBC values were not significantly increased in-group 5. In-groups 6, and 7, there were significant decrease ($P < 0.02-0.01$) in the values of MCHC, MCV and Hb. No significant changes recorded in the values of PCV and RBC in any of the test chicks at the end of the recovery period.

DISCUSSION:

Exposure of Bovan-type chicks to 1% deltamethrin dipping both caused nervous signs and death occurred within 3-5 days after the second application at week 3. This might have been due to a rapid rate of absorption of deltamethrin via the cutaneous route. On the other hand, feeding deltamethrin at 1% of the basic diet caused chicks to become moribund without detectable mortality even when feeding was extended to 6 weeks. The nervous signs associated with

deltamethrin poisoning were transient and accompanied with bouts of diarrhea. This might have been brought about by development of the intestinal erosions and catarrhal enteritis or the inhibition of the enzyme cholinesterase or to both.

Although the activity of cholinesterase have not been measured in the serum or tissues of Poisson chicks we believe that deltamethrin acts as anticholinesteraswe. In Nubian goats poisoned by sumiciding (fenvalerate) and cypermethrin pyrethroid products the signs reported indicated the evolvement of the central nervous system. (Mohamed and Adam 1990, Khalda and Mohamed 1993).

The lesions of deltamethrin administered on diet or dipping for chicks were generally similar and comprised hepatonephropathy enteritis, wide spread congestion and haemorrhage particularly o the heart and muscle of the thigh and chest. The presence of hepatic haematoma and widespread haemorrhages and congestion point to the endotheliotoxicity. The dipping baths or diets containing deltamethrin at 0.05% are toxic but not fatal to chicks.

In this study, the 7-day pretrial period was planned to achieve body weight uniformity, acclimatization and elimination of unhealthy ones before the commencement of the experiment.

There is almost complete lack of knowledge about the extent of poisoning of the acaricide in chicks. The different pathological lesions observed in this study especially in the liver and kidney show that these organs are sensitive to the toxic action of deltamethrin. Changes recorded in serum total lipid, calcium, inorganic phosphates, potassium, copper and zinc might probably reflected the extent of damage to the vital organs specially liver and kidneys. These results were not different to those found by Osman and Adam (1997).

The present study concluded that deltamethrin given to Bovans-type chicks on diet or dipping baths caused hepatonephrotic dysfunction. Further studies are needed to issue residues in poultry meat-trials, and also to examine the carcinogenicity of this pesticide. Lastly, investigations are needed to elucidate the mechanism responsible for the development of lesions in the vital organs.

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