STUDIES ON PATHOLOGY OF CHLORPYRIPHOS TOXICITY IN CHICK EMBRYOS

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Abstract: The Chlorpyriphos was inoculated to seven day-old chick embryos of Girirani strain at the rate of 750, 1000 and 1250 μg per embryo. The embryo pathology was studied on 12th, 15th and 18th day of incubation. Chlorpyriphos produced degeneration and necrosis of hepatocytes in the liver, degeneration of tubular epithelium in the kidney, swelling of cardiac myocytes, degeneration and desquamation of mucosal epithelial cells of proventriculus indicating the potential cause of multiorgan toxicity.

Key words: Chlorpyriphos, Chick embryo

INTRODUCTION

Poultry feed ingredients are exposed to number of pesticides at different stages of harvest and their residues are likely to be carried in such commodities. Chlorpyriphos is widely used organophosphorous compound, which specially affects cholinesterase enzyme system. It is a broad spectrum insecticide commonly used in agricultural and veterinary practice to control pests, mites, fleas and lice affecting livestock and poultry. Chlorpyriphos (O, O-diethyl O-[3, 5, 6-trichloro-2-pyridyl] phosphorothioate) is categorized as class II toxicity by U.S. Environmental Protection Agency. Because of its widespread use and the frequent applications, it always poses a threat to the livestock and poultry.

Chlorpyriphos is known to produce pathological lesions in multiorgan systems. Though the developmental toxicity studies were carried out in different laboratory animals, the studies in chick embryos is very scanty. Hence the present study was undertaken to characterize gross and histopathological lesions in chick embryos.

MATERIALS AND METHODS

A total of three hundred, seven day-old chick embryos of Girirani strain were randomly divided into five groups comprising of sixty embryos each. Chlorpyriphos was administered at the rate of 750, 1000 and 1250μg/embryo to groups III, IV and V respectively as a single dose through yolk sac route on seventh day. Group I kept as control and II as diluent control. The chick embryos were sacrificed on 12th, 15th and 18th day of incubation to study gross and histopathological changes. Organs were collected for histopathology in 10 per cent neutral buffered formalin and the tissues were processed by routine paraffin embedding technique. The 5μ thickness sections were cut and stained with Haematoxylin and Eosin stain for microscopic evaluation.
Fig 1: Liver- showing congestion and dilation of sinusoids and massive hepatocyte degeneration and necrosis with stray infiltration of inflammatory cells -12th day of incubation (H&E X200). Fig 2: Liver - showing fatty change, perivascular hepatocyte degeneration and necrosis with infiltration of few inflammatory cells, bile duct hyperplasia - 18th day of incubation (H&E X200). Fig. 3: Kidney - Group IV (1000µg/embryo) - tubular epithelial cells showing swelling, degeneration and necrosis with presence of eosinophilic material in the tubular lumen with congestion and hemorrhage -12th day of incubation (H&E X200). Fig 4: Heart - Group V (1250µg/embryo) showing congestion and hemorrhage in myocardium with infiltration of inflammatory cells - 18th day of incubation (H&E X200). Fig 5: Proventriculus - Group III (750µg/embryo) showing degeneration of villous epithelium with increased mucus secretion into the lumen -18th day of incubation (H&E X200)
RESULTS AND DISCUSSION

Gross and microscopic pathology: Chlorpyriphos inoculated chick embryos showed grossly hemorrhages on the head and thigh regions. Hemorrhages observed on head were progressive in nature with mild degree in group III and severe in group V. Grossly, the liver showed congestion and streaks of pale areas with distended gall bladder in chick embryos inoculated with Chlorpyriphos. This is in agreement with the earlier reports of Mehta et al. [1] and Krishnamurthy [2]. The paleness of liver could be due to increased fat accumulation in liver which was also evident microscopically. Mild degree of congestion in kidney was observed, it concurs with the findings of Malik et al. [3] and Yadav et al. [4].

Microscopically the liver of embryos showed dilation of sinusoids, congestion, hepatocyte degeneration and necrosis with infiltration of inflammatory cells, fatty change and biliary epithelial hyperplasia. The severities of lesions were in dose dependent manner (Fig 1 and 2). Earlier workers were recorded such lesions in broiler chickens. Which is agreeable with the findings of Malik et al. [3]. Similar lesions were also documented in other species of animals like rats, mice, rabbits, goats, buffaloes and fishes exposed to Chlorpyriphos [5-7]. Thus Chlorpyriphos can cause disruption of hepatocytes through induction of membrane lipid per oxidation and reactive oxygen species generation as in the case of rat hepatocytes [8].

Kidney revealed congestion and hemorrhages in all the treatment groups. The tubular epithelial cells showed varied type of degeneration characterized by granular eosinophilic cytoplasm with vacuoles and occlusion of tubular lumen with eosinophilic debris in higher dose group (Fig 3). These lesions are comparable to the kidney damage due to oral feeding of Chlorpyriphos in broiler chicks. These findings are in conformity with those of Malik et al. [3].

Heart showed congestion, oedema and infiltration of inflammatory cells between the cardiac muscle fibres. In addition cardiac myocytes exhibited swelling and mild vacuolar change with granular cytoplasm (Fig 4). Such lesions were recorded in broiler chickens due to Chlorpyriphos toxicity [4] and amply supports the present findings.

Proventriculus showed degeneration and desquamation of mucosal epithelial cells along with infiltration of mononuclear cells into lamina propria (Fig 5) which are in accordance with findings of Krishnamurthy [2]. This indicates the cytotoxic effect of Chlorpyriphos.

A chick embryo model is used to study the chlorpyriphos toxicity. Overall study shows that this insecticide produced multiorgan toxicity causing degeneration and necrosis of hepatocytes, infiltration of inflammatory cells and fatty change in the liver. The kidney showed degeneration of tubular epithelial cells, while the heart revealed oedema, hemorrhage with swollen cardiac myocytes. The proventriculus showed degeneration and desquamation of mucosal epithelial cells. Thus chlorpyriphos is highly toxic and should be avoided or used with precaution.

REFERENCES