Original Research

Effect of aflatoxin on kidney pathology in broilers

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ABSTRACT

Aflatoxin (AFB1) causes toxic effects and leads to organ damage in broilers. This study was conducted to evaluate the pathological effect of aflatoxin B1 on the kidneys of broilers and mitigate its effect by using Saccharomyces yeast cell walls (YCW) extract and nano curcumin (NC) as dietary supplements. A total of 150 one-day-old, unsexed Cobb broiler chicks were allocated into 5 groups. The experimental feeding was designed as follows: Group A: control diet, group B: control diet with 0.25 mg/kg aflatoxin (AFB1), group C: control diet with 0.25 mg/kg AFB1+ YCW 1 kg/ton, group D: control diet with 0.25 mg/kg AFB1+ NC 400 mg/kg, and group E: control diet with 0.25 mg/kg AFB1+ YCW 1 kg/ton + NC 200 mg/kg. Histopathology of the broiler kidneys was shown. Group A showed normal histology, whereas GB showed marked degenerative, necrotic, and desquamative of the renal tubular epithelium, glomerulus, and renal tubule. On the other side, GC, GD, and GE showed normal histology in which the nephron consists of the glomerulus and the renal tubule. The addition of YCW extract and nano curcumin can be an alternative to counteract the negative effect of AFB1 in broiler diets.

Keywords: Aflatoxin, Yeast cell wall, Nanocurcumin, Broiler, Kidney, Pathology.

INTRODUCTION

Aflatoxins are a potent class of mycotoxins produced by Aspergillus flavus and Aspergillus parasiticus that are everywhere in nature and occur frequently in feed ingredients (Basmacioglu et al., 2005). Among all the types of mycotoxins, AFB1 is the most toxic one, as chronic exposure to AFB1 causes weight loss, immunosuppression, mutagenesis, reproductive alterations, hepatotoxic, renal damage, and carcinogenesis in many species, including broilers (El-Ghany et al., 2013). Gupta & Sharma. (2011) investigated the histological effect of aflatoxin B1 (2 µg/30 g b.wt, orally) on the kidneys of albino mice. They found that kidneys from AFB1-treated mice exposed vacuolar degeneration of epithelial cells of renal tubules. Many recent studies have been performed on curcumin nanoparticles alone or with other feed additives in the diets of broiler chickens. Curcumin is a yellow pigment component of turmeric (Curcuma longa) (Sandur et al., 2007) that has a wide range of favorable effects, including antioxidants, and protection of biological membranes against peroxidative damage, free radical capture, and increased immune function (Rahmani et al., 2018). Moreover, Shaikh et al. (2009) proved that using curcumin nanoparticles improves the bioavailability of curcumin, thereby increasing its absorption. Previous studies have shown that curcumin detoxification mechanisms, including inhibition of AFB1 phase I enzyme-mediated biotransformation and phase II enzyme activity up-regulation, can control the carcinogenic effects induced by AFB1 and the toxic effects attributed to the positive regulation of cells (Li et al., 2019). Chattopadhyay et al. (2018) investigated the effect of nano curcumin on nicotine-induced toxicity in albino rats. They found that the supplementation of nano curcumin restored the normal arrangement of the glomerulus, the bowman space, and the proximal/distal tubules of kidney tissue more successfully. Recently, more experiments have been conducted on the YCW. Yeast (Saccharomyces cerevisiae) cell wall as a feed additive containing two main prebiotic components (mannan oligosaccharides and 1,3/1,6 β-glucans) has recently been used in poultry production, improving performance by increasing average daily gain, improving feed conversion, and enhancing immunological response (YALÇIN et al., 2014). Yıldırım et al. (2011) evaluated the effect of yeast glucomannan (0.75 g/kg GM) on pathological changes in the kidneys of experimentally aflatoxicated broiler chickens. They found that no specific lesion was observed in kidney tissue from the control and yeast glucomannan treated birds. The objective of this study

was to evaluate the toxic effects of aflatoxin on the kidneys of broiler chickens as well as to determine the preventive effects of nano curcumin and Saccharomyces cerevisiae cell wall extract.

MATERIALS AND METHODS

150 one-day-old unsexed Cobb broiler chicks were allocated into five groups: The experimental feeding was designed as follows: Group A: Control diet Group B: Control diet with 0.25 mg/kg AFB1 (Salem et al., 2018) Group C: Control diet with 0.25 mg /kg AFB1+YCW 1kg/ton according to IBEX group dose Group D: Control diet with 0.25 mg /kg AFB1 + NC 400 mg/kg (Rahmani et al., 2018) Group E: Control diet with 0.25 mg /kg AFB1+ YCW 1kg/ton + NC 200 mg/kg (Rahmani et al., 2018) The broilers were reared for 35 days. After that, five birds from each group were euthanized by intraperitoneal injection of sodium pentobarbital (50 mg/kg) and cervical dislocation. After scarification, sections of the kidneys were immediately fixed in 10% formalin for histopathological examination (Bancroft & Gamble, 2008).

RESULTS

Histopathology of the broiler kidneys was shown in Figures (1, 2, 3, 4, and 5), which were fed on an aflatoxin-free diet, aflatoxin alone, aflatoxin with nano curcumin, and/or Saccharomyces cell wall. It was observed that the broiler chick group that was fed an aflatoxin-free diet showed normal histology in which the nephron consists of the glomerulus (G) and the renal tubule (T) (Figure 1). Conversely, the addition of aflatoxin had an adverse effect on kidney nephron structures and tissue histopathology, where a photomicrograph of the kidney of the aflatoxin group showed a marked degenerative, necrotic, and desquamative of the renal tubular epithelium, the glomerulus (G), and the renal tubule (T) (Figure 2). Meanwhile, the photomicrograph of the kidneys of broiler chicks that were fed aflatoxin with Saccharomyces cell wall showed a marked decrease of degenerative changes within the renal tubular epithelium with mild congestion of the renal capillaries (arrowhead) (Figure 3). On the other side, the photomicrograph of the kidney of the aflatoxin+ Nano group showed a decrease of degenerative changes within the renal tubular epithelium with mild vacuolation within the renal tubules (arrowhead), the glomerulus (G), and the renal tubule (T) (Figure 5). Meanwhile, a photomicrograph of the kidney of the aflatoxin with two treatments (combination group) showed normal histology in which the nephron consists of the glomerulus (G) and the renal tubule (T) (Figure 5).

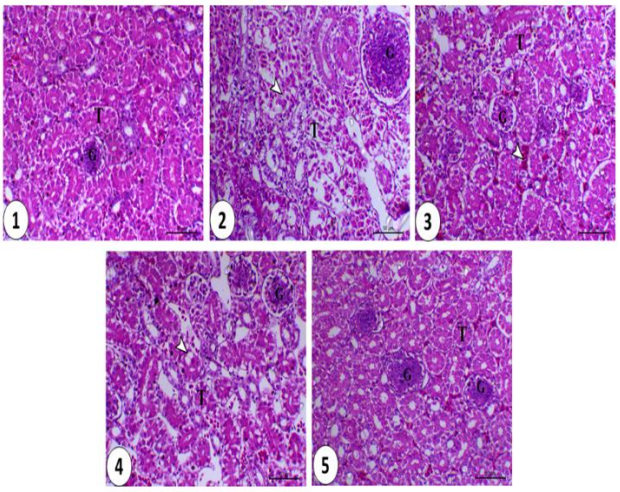

Fig (1): Photomicrograph of kidney of group A stained with hematoxylin and eosin (H&E) showing normal histology in which the nephron consists of the glomerulus (G) and the renal tubule (T). Bar= 50 µm. Fig (2): Photomicrograph of kidney of group B stained with hematoxylin and eosin (H&E) showing marked degenerative, necrotic, and desquamative of the renal tubular epithelium, the glomerulus (G), and the renal tubule (T) with vascular degeneration of renal tubular epithelium (arrowhead). Bar= 50 µm. Fig (3): Photomicrograph of kidney of group C stained with hematoxylin and eosin (H&E) showing a marked decrease of degenerative changes within the renal tubular epithelium with mild congestion of the renal capillaries (arrowhead). Bar= 50 µm. Fig (4): Photomicrograph of kidney of group D stained with hematoxylin and eosin (H&E) showing a decrease of degenerative changes within the renal tubular epithelium with mild vacuolation within the renal tubules (arrowhead), the glomerulus (G) and the renal tubule (T). Bar= 50 µm. Fig (5): Photomicrograph of kidney of group E stained with hematoxylin and eosin (H&E) showing normal histology in which the nephron consists of the glomerulus (G) and the renal tubule (T). Bar= 50 µm.

DISCUSSION

The present study revealed that the addition of aflatoxin had an adverse effect on kidney nephron structure and tissue histopathology where a photomicrograph of the kidney of the aflatoxin group showed marked degenerative, necrotic, and desquamative of the renal tubular epithelium, glomerulus (G), and renal tubule (T). This result agrees with Śliżewska et al. (2019), who reported that aflatoxin triggered many histological changes in the kidneys of broilers, including renal glomeruli hypertrophy and a rise in the mezangium matrix, in addition to thickening of the basal membrane in the glomeruli with wilder staining. Moreover, Salem et al. (2018) reported significant damage in the kidneys of chickens that were fed diets contaminated with AFB1 (0.25 mg/kg diet) that involved very mild congestion, mild focal hydropic degeneration of the tubular epithelial cells, focal nuclear pyknosis of the renal tubular cells, and mild tubular basophilia. On the other hand, a photomicrograph of the kidney of broiler chicks that were fed aflatoxin with Saccharomyces cell wall showed a marked decrease of degenerative changes within the renal tubular epithelium with mild congestion of the renal capillaries. This result is in line with Karaman et al. (2005), who reported that

the addition of yeast glucomannan (0.5 g/kg) to the aflatoxin-containing diet has a slight effect on the inhibition of the degenerative changes in the kidneys while adding 1 g/kg of yeast glucomannan to the aflatoxin-contaminated diet, reduced the severity of lesions in this organ. On the other side, our results revealed that the photomicrograph of the kidney of the aflatoxin+ Nano group showed a decrease in degenerative changes within the renal tubular epithelium with mild vacuolation within the renal tubules, glomerulus, and renal tubule. This result is consistent with that reported by Sandhiutami et al. (2019), where nano curcumin can decrease injury to renal histology caused by cisplatin. Regarding the results of the combination group with aflatoxin (group E), the photomicrograph of the kidney of that group showed normal histology in which the nephron consists of the glomerulus and the renal tubule. To our knowledge, there is no publication on the combination of both nano curcumin and Saccharomyces cell wall on aflatoxicated birds.

CONCLUSION

Results of the present study concluded that dietary inclusion of nano curcumin and/or yeast cell wall extract has protective effects against aflatoxin causing kidney damage in broiler chickens. However, few reports on the effect of the combination between YCW and nano curcumin against kidney damage due to

CONFLICT OF INTEREST

The authors declare no conflicts of interest related to this report.

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