Kafrelsheikh Vet. Med. J. Vol. 12 No. 1 (2014) (213-231)

EFFECT OF GRADED LEVELS OF COTTONSEED MEAL WITH AND WITHOUT FERROUS SULPHATE ON GROWTH PERFORMANCE, HEMATOBIOCHEMICAL PARAMETERS IN WHITE PEKIN DUCKS

Abd-Allah Ahmed Mokhbatly[1*], *Mohamed Fahmy Abou-Elazab*[1], *Mabrouk Ragab El-Sabagh*[2], *Sahar Samir El-Masry*[3] *and Sara Ali Gad*[3].

[1]Clinical Pathology and [2]Nutrition and Clinical Nutrition Departments, Faculty of Veterinary Medicine, Kafr El-Sheikh University and [3]Animal Health Research Institute, Zagazig

[*]**Corresponding author:** Abd-Allah mokhbatly.

ABSTRACT

A six weeks feeding trial was conducted to evaluate the effect of replacement of soybean meal (SBM) with cottonseed meal (CSM) with or without ferrous sulphate supplementation on the growth performance and hematobiochemical parameters of white Pekin ducks. One hundred, one-day old white Pekin ducks were randomly divided into five groups. The first group was fed standard basal diet (control group). The second group was fed diet where 20% of soybean meal was replaced with cottonseed meal (CSM20). The third group was fed diet where 20% of soybean meal was replaced with cottonseed meal and supplemented with ferrous sulphate ($CSM20^+$). The fourth group was fed diet where 41% of soybean meal was replaced with cottonseed meal (CSM41). The fifth group was fed diet where 41% of soybean meal was replaced with cottonseed meal and supplemented with ferrous sulphate ($CSM41^+$). On the 42 days of age, blood samples were collected from the different groups (6 birds randomly selected/each group). Dietary replacement of either 20% or 41% soybean meal with cottonseed meal had no encouraging effect on the growth performance and feed conversion rate from the 1^{st} week to *the end of the experiment. Furthermore, there was a significant decrease in red blood cells (RBCs) count, hemoglobin (Hb) level, packed cell volume% (PCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), total protein (TP), albumin (ALB), and reduced glutathione (GSH) in CSM20 and CSM41 groups compared with control group. Meanwhile, there were a significant increase in the same two groups (CSM20 and CSM41) in serum alanine aminotransferase activity (ALT), aspartate aminotransferase activity (AST), creatinine (Cr), cholesterol, triacylglycerol (TG), and malondialdehyde (MDA) compared with control group. Addition of ferrous sulphate to diets of ducks in which soyabean protein replaced by 20% or 41% of cottonseed meal protein groups (CSM20$^+$ and CSM41$^+$) alleviate the adverse effect of gossypol on growth performance, blood picture and organ functions.*

Key words: Cottonseed meal, growth performance, Hematobiochemical Parameters, Pekin duck.

INTRODUCTION

In poultry industry, Soybean meal (SBM) is the most widely used protein source in poultry diets. However, its prices have increased substantially over the past few years. Hence, securing alternative cost-effective protein sources for poultry nutrition is of utmost importance. Cottonseed meal (CSM), a by-product remaining after oil extraction from whole cottonseeds, could be used to replace SBM in poultry diets as an alternative, valuable, and cheap protein source ***(Pattanaik et al., 2003 and Nagalakshmi et al., 2007).*** However, CSM contains a toxic polyphenolic reactive pigment (gossypol) that rapidly binds minerals and amino acids when it is in its free form ***(Guedes & Soto-Blanco, 2010).*** Monogastric animals and young ruminants are highly susceptible to gossypol in CSM ***Nagalakshmi et al., (2007).***

For better utilization of CSM in poultry diets great efforts have been devoted to developing practical methods to reduce and detoxify the free gossypol. The dietary addition of iron (as sulphate) can help to ameliorate the negative effects of free gossypol in CSM ***(Henry et al., 2001)***. It has been found that ferrous sulphate could be added to the diets containing cottonseed meal in order to reduce the adverse effect of gossypol on poultry ***(Adeyemo and Longe, 2007 and Anwar et al., 2008)*** It is thought that the iron binds to the free gossypol ***(Soltan et al., 2008).***

There were no available studies for evaluation of the efficacy of CSM with or without ferrous sulfate in white Pekin ducks. Therefore, The objectives of this study was to determine if ferrous sulfate would reduce the toxic effects of gossypol in CSM and evaluate the effect of ferrous supplementation to diets containing different levels of CSM on growth, hematobiochemical profiles of Pekin ducks.

MATERIALS AND METHODS

Experimental design and animal management:

A total of one hundred one-day old white Pekin ducks were obtained from local company, Zagazig, Egypt. Ducks were housed in experiment room with initial temperature set at 38°C then gradually decreased during the first 20 days of life to 25°C. These chicks were exposed to a photoperiod of 24 h of light that was then gradually changed to 16 Light: 8 Dark. Feed and water were provided ad libitum. The birds were fed formulated ration that meet the nutritional requirements according to the (National Research Council) ***NRC (1994)*** as shown in Table (1). Ducks were randomly divided into five groups.

Each group were received one of five treatments: basal standard diet (CSM0); basal diet plus 20% CSM(CSM20); basal diet plus 20%CSM and ferrous sulphate (CSM20^{+}); basal diet plus 41% CSM (CSM41) and basal diet plus 41%CSM and iron sulphate (CSM41^{+}). Iron sulphate added by 0.04% from protein percent of CSM. CSM was obtained from local company, Kafr El-Sheikh, Egypt. Body weights (BW), feed conversion ratio (FCR) and feed intake (FI) were recorded weekly.

Blood Sampling:

After 42days, blood was collected from six randomly selected birds from each group through the brachial vein. Approximately 4 ml of blood were collected per animal. 1 ml of this blood was mixed immediately in Ependorf tubes with EDTA (Anticoagulant) and used for hematological analysis. The rest of blood was kept in sterilized Ependorf tubes overnight at 4°C. Serum was separated from clotted blood by centrifugation at 3,000 rpm for 15 minutes and stored at -20°C until use.

Hematological parameters:

Red blood cell (RBC) counts were performed using an improved Neubauer hemocytometer and Natt and Herrick solution according to ***Harrison and Harrison, (1986).*** The hemoglobin concentration is measured spectrophotometrically by using cyanomethemoglobin method after centrifugation according ***Dein, (1986).*** Hematocrit (PCV) was determined using a micro-hematocrit centrifugation (10,500 ×g for 5 min) and a micro-capillary reader ***Coles, (1986).*** The values found were used to calculate the mean corpuscular hemoglobin concentration (MCHC), the mean corpuscular hemoglobin (MCH), and the mean corpuscular volume (MCV) ***Feldman et al., (2000).***

Serum biochemistry:

Total protein was determined according to ***Tietz, (1995).*** Albumin was determined according to ***Burtis, (1999).*** Serum globulin was determined by subtraction of the obtained albumin level from the level of total proteins as described by ***Doumas and Biggs, (1972).*** ALT activity was determined according to ***Murray, (1984).*** AST activity was determined according to ***Murray, (1984).*** Creatinine was determined according to ***Murray, (1984).*** Cholesterol was determined according to ***Natio, (1984).***Triacylglycerols were determined according to ***Kaplan, (1984).*** Plasma malondialdehyde (MDA) was colorimetrically determined according to the method adapted by ***Esterbauer et al., (1982)*** and reduced glutathione (GSH) were determined according to the method of ***Beutler, (1975).***

Histopathological examination:

Tissue specimens were taken from liver and kidney of ducks in different groups at 42 days of age, fixed in neutral buffered formalin (10%) processed, sectioned at 4 microns and stained by hematoxylene and eosine stains ***Bancroft et al., (1996).***

Statistical analysis:

The data obtained from these investigations were statistically analyzed by F-test according to ***Tamhane and Dunlop, (2000)*** using "MSTAT-C" computer program. Means in the same raw followed by different letters were statistically significant (P· 0.05) and the highest values were represented with the letter (a).

Table (1): Formulation and analysis of different group's diets

Ingredients	Starter			Grower-finisher		
	Control	**CSM8%**	**CSM16%**	**Control**	**CSM8%**	**CSM16%**
Corn grains	50	47	45	54	50	48.5
Corn gluten meal 60%	7	7	7	5	5	5
Soybean meal, 44%	25.00	20.00	17.00	22.00	17.50	13.00
Cottonseed meal	0.00	8.00	16.00		8.00	16.00
Rice Polishings	14	14	10	12	12	10
soybean oil	0	0	1	2.5	3	3
monocalcium phosphate	1.4	1.4	1.4	1.54	1.54	1.54
limestone	1.7	1.7	1.7	1.7	1.7	1.7
Sodium chloride	0.2	0.2	0.2	0.15	0.15	0.15
Sodium bicarbonate	0.18	0.18	0.18	0.34	0.34	0.34
DL-Methionine	0.08	0.08	0.08	0.1	0.1	0.1
Lysine	0	0	0	0.16	0.16	0.16
Minerals & Vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25
additives	0.1	0.1	0.1	0.1	0.1	0.1
ferrous sulfate	-	-	-	-	-	-
total	**99.91**	**99.91**	**99.91**	**99.84**	**99.84**	**99.84**
Analysis						
DM						
Moisture						
CP	21.16	20.89	21.13	18.73	18.61	18.46
Fat	3.82	4.41	5.62	6.15	7.21	7.65
Ash						
NDF						
CF	3.6	4.14	4.68	3.34	3.9	4.43
NFC						
ME	2925	2893	2914	3081	3076	3048
Ca	0.98	0.98	0.99	0.99	1	1
Av.P	0.43	0.44	0.45	0.44	0.46	0.47
Lys	0.94	0.93	0.95	0.84	0.84	0.83
Met	0.45	0.46	0.47	0.41	0.41	0.42
Na	0.16	0.16	0.16	0.18	0.18	0.18
Cl	0.17	0.17	0.17	0.14	0.14	0.14
Linolenic acid	1.64	1.78	2.31	2.85	3.23	3.33

In our study we treated the diet of group 3 and 5 by addition ferrous sulfate 98% by (0.0013 kg/100kg ration and 0.0026 kg/100kg ration) respectively which purchased from El-Goumhouria Co. Cairo, Egypt.

RESULTS AND DISCUSSION

Data presented in table (2) showed the effect of CSM on body weight gain, feed consumption and feed conversion in all groups. There was significant decrease in growth performance values in comparison with negative control group ($p<0.05$). Previous studies reported controversial findings about the effect of CSM on growth performance in birds. ***Bamgbose, (1995)*** reported that high level of CSM in the finisher diets resulted in significant depression in the performances of broilers. On the other hand, ***Ryan et al., (1986)*** stated that feeding CSM up to 30-50% as replacement for SBC in broiler diet had no significant effect on performance of broiler chicken. Also, ***Adeyemo and Longe, (2007)*** stated that CSC can replace up to 75% SBC without adverse effects on performance of the birds. This reveals CSC as a potent source of protein for meeting the crude protein requirements of chickens. Also, ***Afshin and Mahdi, (2011)*** stated that adequate supplementation of ferrous sulfate; CSM can be used in broiler diets without a reduction in performance. A potential reason that the CSM fed duck did not perform as well as SBM-fed ducks is that CSM may not be as digestible as SBM. Therefore, when feeding CSM, higher protein levels are required to supply the same levels of amino acids for absorption. Moreover, ***Reid et al., (1987)*** reported the poor utilization of the protein of CSM due in part to amino acid imbalance associated with un-supplemented CSM diets. Furthermore, ***Yannapoulis and Tserveni-Gousi, (1989)*** indicated that as the ration CSM levels increased feed efficiency ratio declined significantly.

Table (2): Effect of CSM supplementation on general performance of ducks.

Item	CSM0	CSM20	CSM20^{+}	CSM41	CSM41^{+}
Initial weight (g)	60.27	60.00	60.07	60.00	60.47
Final weight (g)	1607.00	1463.00	1337.00	1330.00	1550.00
Gain (g)	1546.73	1403.00	1276.93	1270.00	1489.53
Feed intake (g)	5740.00	4826.00	4518.00	4598.00	5113.00
FCR	3.71	3.44	3.54	3.62	3.43

The hematological parameters of ducks fed CSM-based diets for 6 weeks are presented in Table (3).The data revealed that CSM20 and CSM41 groups showed a significant decrease in the RBCs count, Hb level, PCV, MCH, and MCHC compared to control group ($p < 0.05$). But, CSM20^{+} and CSM41^{+} groups showed a non significant decrease in the RBCs count compared to control group ($p > 0.05$). Furthermore, CSM20^{+} group showed a non significant decrease in the PCV % compared to control group ($p > 0.05$). Similar results are reported by ***(Nagalakshmi et al., 2000 and Henry et al., 2001).*** Diets have been reported to have significant influence on hematological variables ***Veulterinora, (1991).*** The decrease in PCV and Hb values may be explained by an adverse effect of gossypol on intestinal iron absorption as the reduction of hematological values was one of the most common physiological phenomena of gossypol toxicity. The reduction in PCV and RBC values indicate a low protein intake or mild anemia as reported by ***(Maxwell et al., 1990 and awotwi, 1990).*** The decrease in red blood cells count, Hb and PCV is in disagreement with ***(Nagalakshmi et al., 2001 and Adeyemo and longe, 2007).***

Table (3): Effect of supplementation of CSM on hemogram in ducks.

Item	CSM0	CSM20	CSM20^{+}	CSM41	CSM41^{+}
RBCs (X 10^6/µl)	3.09 ± 0.05^{a}	2.83 ± 0.05^{bc}	2.95 ± 0.07^{ab}	2.65 ± 0.11^{c}	2.88 ± 0.07^{ab}
Hb (gm %)	12.56 ± 0.30^{a}	10.68 ± 0.42^{bc}	11.28 ± 0.56^{b}	9.84 ± 0.41^{c}	10.48 ± 0.26^{bc}
PCV (%)	41.60 ± 1.03^{a}	37.60 ± 1.03^{b}	39.00 ± 0.95^{ab}	36.60 ± 1.21^{b}	37.20 ± 0.86^{b}
MCV (fl)	34.60 ± 1.92^{ab}	132.64 ± 2.33^{b}	132.29 ± 0.84^{b}	140.39 ± 2.76^{a}	129.22 ± 1.39^{b}
MCH (pg)	40.65 ± 0.73^{a}	37.65 ± 1.04^{b}	38.17 ± 1.03^{b}	37.16 ± 0.56^{b}	36.39 ± 0.20^{b}
MCHC (%)	30.20 ± 0.20^{a}	28.37 ± 0.34^{b}	28.85 ± 0.73^{b}	26.86 ± 0.36^{c}	28.17 ± 0.24^{b}

Values are means ± SD. Values in the same raw with different superscripts are significantly different ($P < 0.05$).

From the present study, it was clearly observed that there was a significant decrease in TP and ALB levels and increase in ALT and AST activities in CSM20 and CSM41 groups when compared to control group

(P<0.05) as shown in table (4). CSM20$^+$ group showed a significant decrease of ALT and AST compared to control group (p<0.05). Significantly increase of the serum levels of ALT and AST indicate liver cell damage and this may be due to increasing the toxic factors presented in CSM. Acute hepatic disorders causing membrane damage or cell necrosis usually results in an appreciable increase in plasma AST activity ***Kaneko, (1980).*** AST, although not used as an organ specific enzyme, nonetheless could be useful in conjunction with other enzymes as an index of hepatic and muscular cell damage ***Kaneko, (1980).*** In monogastric gossypol consumption has been correlated with hypoproteinemia involving hypoalbuminemia ***Jarquin et al., (1966).*** This may be attributed to an impaired liver function. ***Zelski et al. (1995)*** observed lower serum total protein accompanying a significant drop in albumin in young calves affected with gossypol toxicosis, and attributed this to a severely impaired liver function.

Creatinine value were significantly increased in CSM20 and CSM41and this result is similar to those of ***Warren et al., (1988)*** who stated this in wethers after127 days of feeding 50% whole cottonseed and attributed this to muscle damage because of gossypol toxicity. Increased creatinine levels are generally seen in degenerative muscular diseases ***Prasse, (1986).***

Also, it was clearly observed that there was a pronounced increase in cholesterol and triglycerides in the serum samples of CSM20 and CSM41 groups compared to control group (p < 0.05). CSM20$^+$ group showed a non significant decrease in cholesterol level compared with control group (p>0.05). Serum cholesterol besides being influenced by thyroid activity also varies with a variety of factors such as the nature of the diet and hepatic function among others ***Kaneko, (1980).***

Table (4): Effect of CSM supplementation on serum biochemistry in ducks.

Item	CSM0	CSM20	$CSM20^{+}$	CSM41	$CSM41^{+}$
T.protein (gm/dl)	3.74 ± 0.14^{a}	3.06 ± 0.06^{b}	3.14 ± 0.18^{b}	2.58 ± 0.20^{c}	3.20 ± 0.09^{b}
Albumin (gm/dl)	1.83 ± 0.19^{a}	1.38 ± 0.11^{b}	1.64 ± 0.09^{ab}	1.26 ± 0.10^{b}	1.55 ± 0.11^{ab}
Globulin (gm/dl)	1.91 ± 0.07^{a}	1.68 ± 0.07^{ab}	1.50 ± 0.13^{bc}	1.32 ± 0.13^{c}	1.65 ± 0.14^{abc}
ALT activity (U/L)	27.32 ± 1.82^{d}	35.97 ± 2.85^{bc}	32.39 ± 2.70^{cd}	45.54 ± 1.91^{a}	42.17 ± 1.15^{ab}
AST activity (U/L)	23.00 ± 1.29^{b}	25.02 ± 1.68^{b}	22.87 ± 1.63^{b}	37.70 ± 1.02^{a}	23.72 ± 1.18^{b}
Uric acid (mg/dl)	4.29 ± 0.25^{c}	6.27 ± 0.23^{b}	6.00 ± 0.20^{b}	7.57 ± 0.36^{a}	5.91 ± 0.24^{b}
Creatinine (mg/dl)	1.07 ± 0.08^{c}	1.42 ± 0.12^{ab}	1.33 ± 0.12^{bc}	1.65 ± 0.09^{a}	1.24 ± 0.07^{bc}
Cholesterol (mg/dl)	182.46 ± 10.01^{b}	250.44 ± 14.66^{a}	182.54 ± 11.89^{b}	261.87 ± 10.36^{a}	200.11 ± 8.81^{b}
Triacylglycerol (mg/dl)	97.58 ± 2.22^{c}	112.89 ± 3.15^{b}	108.32 ± 2.30^{b}	128.77 ± 2.51^{a}	116.20 ± 3.65^{b}

Values are means ± SD. Values in the same raw with different superscripts are significantly different ($P < 0.05$).

Regarding to the antioxidant status, data presented in table (5) showed that there was a significant decrease in serum reduced glutathione (GSH) content and increase in malondialdehyde (MDA) level in the serum samples of all groups fed diet containing CSM (with or without iron sulphate supplementation) compared with control group($P<0.05$). Antioxidant enzymes were an important indicator of animal's physical health and reaction in response to external stimuli ***Johnson, (2002).*** Oxidative stress occurs when there is an imbalance between the generation and removal of radical species within an organism. This result may be due to gossypol adversely affected health status.

The biochemical results were confirmed by the histopathological investigation as the liver of (CSM20 and CSM41) groups showed degeneration of hepatocytes characterized by vacuolation of cytoplasm and pyknotic nuclei with biliary hyperplasia and sinusoidal dilation (Fig.1). However, hepatocytes in ducks of ($CSM41^{+}$) group showed moderate degeneration and no extensive histological changes to the liver were seen in ($CSM20^+$) group. The forementioned results partially coincided with those obtained by ***Henry et al., (2001)*** who reported sever cases of perivascular lymphoid aggregate formation, biliary hyperplasia and hepatic cholestasis in day-old broiler chicks fed 800 and 1600 mg/kg of gossypol in feed for 23 days. In contrast to our result ***Nagalakshmi et al., (2000)*** did not report any histopathological lesion in liver of lambs fed raw or processed CSM. The destruction of cells in the liver may be due to accumulation of gossypol in this organ ***Kim et al., (1996).*** Kidney from (CSM20, CSM41 and $CSM41^+$) groups showed some areas with tubular epithelial degeneration and necrosis characterized by vacuolation of cytoplasm, pyknotic nuclei and glomerular congestion with focal lymphocytic infiltration (Fig.2). However, no extensive histological changes to the kidneys were seen in ($CSM20^+$) group. This result is in agreement with ***Holmberg et al., (1988)*** who reported that kidney of young calves fed high level of CSM had scattered individual cell degenerative changes or necrosis throughout the proximal convoluted tubules and hemoglobin casts in collecting ducts. While ***Elangovan et al., (2006)*** did not reveal any gross pathological changes in kidney of broiler chickens fed diet supplemented with CSM for 7 weeks.

Table (5): Effect of CSM supplementation on reduced glutathione and malondialdehyde in ducks.

Item	CSM0	CSM20	$CSM20^+$	CSM41	$CSM41^+$
Glutathione (mg%)	38.93 ± 0.78^b	35.36 ± 1.64^a	39.55 ± 0.51^b	32.15 ± 1.55^a	32.79 ± 0.59^a
Malondialdehyde (mg%)	41.36 ± 1.06^b	50.41 ± 1.83^a	48.18 ± 1.32^a	53.49 ± 2.34^a	50.12 ± 1.47^a

Values are means ± SD. Values in the same raw with different superscripts are significantly different ($P < 0.05$).

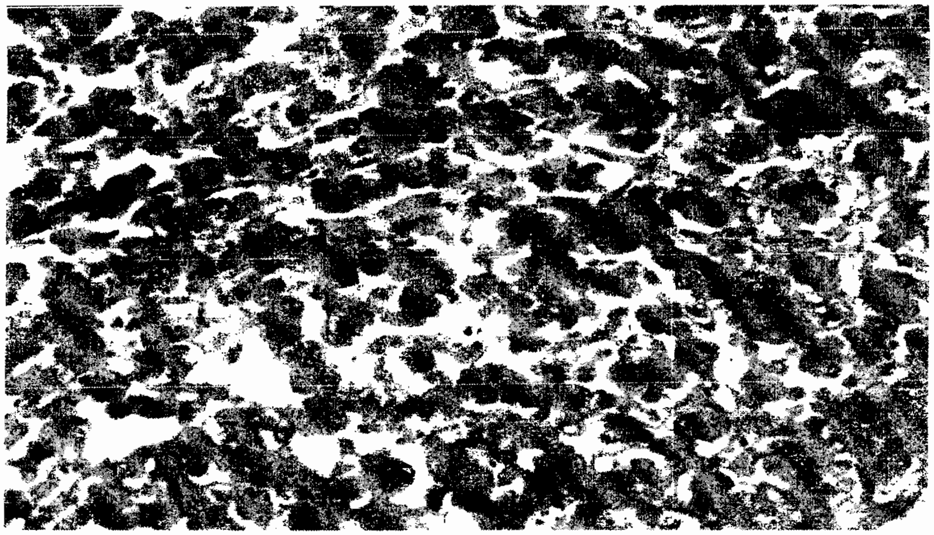

Fig. (1): Section in the liver of duck in group 2 and 4 at 6 weeks of age showing increase in degenerated hepatocytes and sinusoidal dilation H&E stain, X 100.

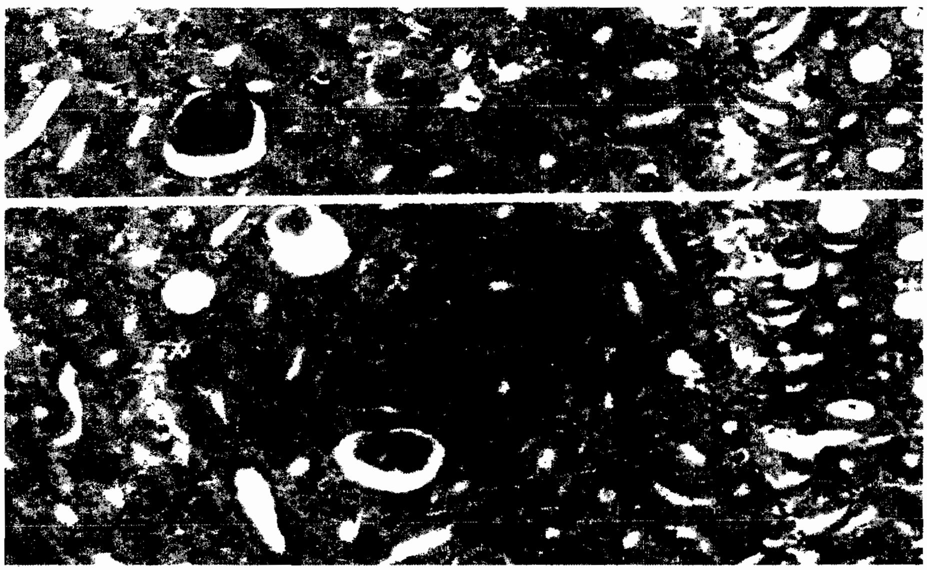

Fig. (2): Section in the Kidney of duck in group 4 at 6 weeks of age showing some areas with tubular epithelial degeneration with vacuolated cytoplasm and lymphocytic infiltration. H&E stain, X40.

CONCLUSIONS

In the light of the present study, we can conclude that: Addition of iron sulphate to diets of ducks in which soyabean protein replaced by 20% or 41% of cottonseed meal protein is extremely indicative. As, iron sulphate alleviate the adverse effect of gossypol. However, the obtained results from diets containing soyabean protein replaced by 20% cottonseed meal seem to be more safe and applicable.

REFERENCES

- ***Adeyemo, G. O. and Longe, O. G. (2007):*** Effects of graded levels of cottonseed cake on performance, hematological and carcass characteristics of broilers fed from day old to 8 weeks of age. African Journal of Biotechnology. 6(8):1064–1071.

- ***Afshin, H. and Mahdi, M. (2011):*** Nutritional Evaluation of Cottonseed Meal with and Without Ferrous Sulfate for Broiler Chickens. Research Journal of Poultry Sciences. 4(1): 14-17.

- ***Anwar, M. S.; Khan, M. Z. ; Javed, I.; Khan, A. and Saleemi, K. M. (2008):*** Pathological effects of cottonseed meal with and without ferrous sulphate in male Japanese quails *(Coturnix Japonica)*. Pakistan VeterinaryJournal. 28:51–56.

- ***Awotwi, E. K. (1990):*** A study of baseline hematological values of domestic and commercial chickens in Ghana. Bull. Anim. Health. Prod. Af. 38: 453-458.

- ***Bamgbose, A. M. (1995):*** Full-fat extruded soyabean meal in diet for laying hens performance and egg quality characteristics. Trop. Oil Seeds J. Vol., 3129-138. Duncan, D. B., 1955. Multiple Range Biometrics, 1142.

- ***Bancroft, D. J.; Cook, C. H.; Stirling, R. W. and Turner, D. R. (1996):*** Manual of histopathological techniques and their diagnostic application. (3rd ed.) Chuchill Livingston, Edinburg.
- ***Beutler, E. (1975):*** red cell metabolism–a manual of biochemical methods 2nd edition Publ. Grune and Stration New York, PP 69-70.
- ***Burtis,A.(1999):*** Tietz Textbook of Clinical Chemistry, 3rd ed AACC.
- ***Coles, E. H. (1986):*** Veterinary Clinical Pathology. 4th ed., WB Saunders Company, Philadelphia, London, Toronto, Mexico City, Rio de Janeiro, Sydney, Tokyo, Hong Kong.
- ***Dein, F. J. (1986):*** Hematology. In Avian Medicine and Surgery. Philadelphia WB Saunders, pp. 174-191.
- ***Doumas, B.T. and Biggs, H. G. (1972):*** Determination of serum globulin. In Standard Methods of Clinical Chemistry. Vol. 7 edited by G.R. Cooper, New York, Academic Press.
- ***Elangovan A. V.; Praveen, K. T.; Shrivastav, A. K.; Pramod, K. T. and Mandal, A. B. (2006):*** GMO(Bt-Cry 1 Ac gene) cottonseed meal is similar to non-GMO low free gossypol cottonseed meal for growth performance of broiler chickens. Anim. Feed Sci. and Tech. (129) 3-4:252-263.
- ***Esterbauer, H.; Cheeseman, K. H.; Dianzani, M. U.; Poli, G. and Slater, T. F. (1982):*** separation and characterization of the aldehydic products of lipid peroxidation stimulated by ADP-Fe2+ intra liver microsomes. Biochem. J. 208(1):129-40.
- ***Feldman, B. F.; Zinki, J. G. and Jain V. C. (2000):*** Schalm' s Veterinary Hematology.5th ed.Lippincott Williams and Wilkins.Canada.
- ***Guedes,F.C. B.and Soto-Blanco, B. (2010):*** Sperm Quality of Sheep Fed Cottonseed Cake. Acta Scientiae Veterinariae. 38(4): 415-418.

- ***Harrison, G. J. and Harrison, L. R. (1986):*** Clinical Avian Medicine and Surgery W.B. Saunders Company. Philadelphia, London.
- ***Henry, M. H.; Pesti, G. M.; Bakalli, R.; Lee, J.; Toledo, R. T.; Eitenmiller, R. R. and Phillips, R. D. (2001):*** The performance of broiler chicks fed diets containing extruded cottonseed meal supplemented with lysine. Poultry Science 80:762-768.
- ***Henry, M. H.; Pesti, G. M. and Brown, T. P. (2001):*** Pathology and histopathology of gossypol toxicity in broiler chicks. Avian Dis. 45 (3):598 – 604.
- ***Holmberg, C. A.; Weaver, L. D.; Guterbock, W. M. and Montgomery, P. (1988):*** Pathology and toxicological studies of calves fed a high concentration cottonseed meal diet. Vet. Pathol. 25:147.
- ***Jarquin, R. R.; Bressani, L. G.; Elias, C.; Tajada, M. G. and Braham, J. E. (1966):*** Effect of cooking and calcium and iron supplementation on gossypol toxicity in swine. J. Agric. Food Chem. 14:275-279 .
- ***Johnson, P. (2002):*** Antioxidant enzyme expression in health and disease: effects of exercise and hypertension. Comp. Bio-chem. Physiol. Part C133:493–505.
- ***Kaneko, J. J. (1980):*** Clinical Biochemistry of Domestic Animals . 3rd ed. Academic Press Inc. Orlando, Florida.
- ***Kaplan, A. (1984):*** Triglycerides. Clin. Chem. The C.V. Mosby Co. St Louis. Toronto. Princeton. 437 and Lipids 1194-1206.
- ***Kim, H. L.; Calhoun, M. C. and Stipanovic, R. D. (1996):*** Accumulation of gossypol enantiomers in ovine tissues. Comp. Biochem. Physiol. 113:417-420.

- ***Maxwell, M.H.; Robertson, W.; Spence, S. and Machorquodale, C.C. (1990):*** Comparison of hematological parameters in restricted and ad libirum fed domestic fowls. Br. Poult. Sci., 31: 407-413.

- ***Murray, R. (1984***): Alanine aminotransferase. Kaplan A. et al., Clin. Chem. The C.V. Mosby Co. St Louis. Toronto. Princeton. 1088-1090.

- ***Murray, R. L. (1984):*** Creatinine. Kaplan A. et al., Clin.Chem.The C.V. Mosby Co. St Louis. Toronto. Princeton. 1261-1266 and 418.

- ***Nagalakshmi, D.; Sharma, A. K. and Sastry, V. R. B (2000):*** Pathology lesions in lambs fed raw or processed cottonseed meal. Veterinary Research Communications. 24:349 – 359.

- ***Nagalakshmi, D.; Sastry, V. R. B.; Agrawal, D. K. and Katiyar, R. C. (2001):*** Hematological and Immunological response in lambs fed on raw and variously processed cottonseed meal. J. Anim. Sci. 14:1 21 – 29.

- ***Nagalakshmi, D.; Savaram, V. R. R.; Arun, K. P. and Vadali, R. B. (2007):*** Cottonseed Meal in poultry diets. The Journal of Poultry Science 44: 119 – 134.

- ***Naito, H. K. (1984):*** Cholesterol. Kaplan A. et al., Clin.Chem.The C.V. Mosby Co. St Louis. Toronto. Princeton. 1194-11206 and 437.

- ***National Research Council (NRC) (1994):*** Nutrient Requirement of Poultry, 9th rev. ed. National Academy Press. Washington, DC.

- ***Pattanaik, A. K. ; Sastry, V. R. B. ; Singh, D. K. ; Goswami, T. K. and Mohanty, D. N. (2003):*** Effect of gossypol from cottonseed meal diets on some clinico-biochemical parameters and humeral immune response of crossbred calves fed barely or sorghum. Asian-Aust. J. Anim. Sci. 16:1291-1296.

- ***Prasse, K. W. (1986):*** Clinical pathology. Proceeding of the post-graduate Committee in Veterinary Science No. 93. University of Sydney, New South Wales, Australia. PP. 33-52.
- ***Reid, B. L. ; Galaviz-Moreno, S. and Maiorino, P. M. (1987):*** Evaluation of isopropanol-extracted cottonseed cake for laying hens. Poult. Sci. 66 :1452-1459.
- ***Ryan, J. R.; Kratzer, F. H.; Grau, C. R. and Vohra, P. (1986):*** Glandless cottonseed meal for laying and breeding hens and broiler chicks. Poult. Sci. 65 :949-955.
- ***Soltan, M. A. ; Hanafy, M. A. and Wafa, M. I. A. (2008):*** Effects of replacing fish meal by a mixture of different plant protein sources in Nile Tilapia *(Oreochromis niloticus L.)* diets. Global Veterinaria 2 (4) 157 – 164.
- ***Tamhane and Dunlop (2000):*** Statistics and Data Analysis from Elementary to Intermediate. Upper Saddle River, USA.
- ***Tietz, N. W. (1995):*** Clinical Guide to Laboratory Tests, 3rd ed AACC.
- ***Veulterinora, M. (1991):*** Nutrition and Erythropoiesis. In: CRC Handbook of Nutritional requirements in functional context. M. Rechcigi ed. Boca Ration, CRC Press Pp 65-74.
- ***Warren, H. M. ; Neutze, S. A. ; Morrison, J. M. and Nicholls, P. J. (1988):*** The value of whole cottonseed in a wheat-based maintenance ration for sheep. Aus. J. Exp. Agric. 28:453-458.
- ***Yannakopoulos, A. L. and Tserveni-Gousi, A. S. (1989):*** The effect of Greek cottonseed meal on the performance of laying Japanese quail. Anim. Feed Sci. Technol. 27:77-82.
- ***Zelski, R. Z. ; Rothwell, J. T. ; Moore, R. E. and Kennedy, D. J. (1995):*** Gossypol toxicity in pre-ruminant calves. Aust. Vet. J. 72:394-398.

تأثير كسب بذرة القطن مع إضافة أو عدم إضافة كبريتات الحديد على النمو والمؤشرات الدموية والكيميائية فى البط الأبيض.

أ.د/ عبد الله مخبطلى ، د./ محمد ابو العزب ، د/مبروك الصباغ

أ.د/ سحر سمير المصرى ، د/ ساره جاد

أقسام الباثولوجيا الإكلينيكية ، التغذية والتغذية الإكلينيكية ، معهد بحوث صحة الحيوان فرع الزقازيق.

أجريت هذه الدراسة لمدة ستة أسابيع لتقييم تأثير استبدال بروتين فول الصويا ببروتين كسب بذرة القطن على أداء البط وأيضاً لتقييم التغيرات فى خلايا الدم والمؤشرات الكيميائية الحيوية حيث أجرى هذا البحث على عدد 100 بطه من البط الأبيض البيكينى عمر يوم وتم تقسيم البط الى 5 مجاميع متساوية وتم معاملتها كالتالى:

- **المجموعة الأولى:** وهى الضابطه ولم تتعرض لأى معاملات.
- **المجموعة الثانية:** تم أستبدال بروتين فول الصويا فى العليقة ببروتين كسب بذرة القطن بنسبة 20%.
- **المجموعة الثالثة:** تم استبدال بروتين فول الصويا فى العليقة ببروتين كسب بذرة القطن بنسبة 20٪ مع إضافة سلفات الحديد بنسبة 0.04٪ من بروتين كسب بذرة القطن.
- **المجموعة الرابعة:** تم أستبدال بروتين فول الصويا فى العليقة ببروتين كسب بذرة القطن بنسبة 41٪.
- **المجموعة الخامسة:** تم استبدال بروتين فول الصويا فى العليقة ببروتين كسب بذرة القطن بنسبة 41٪ مع إضافة سلفات الحديد بنسبة 0.04٪ من بروتين كسب بذرة القطن.

تم وزن البط وقياس الأستهلاك الغذائى لكل مجموعة اسبوعيا لمدة 6 أسابيع .وتم ذبح ستة بطات من كل مجموعة بعد أخذ عينات الدم منها عند عمر 42 يوم .

وكانت نتائج البحث ملخصة في الأتي:

استبدال 20%أو 41% من بروتين فول الصويا ببروتين كسب القطن لم يكن له تـأثير علـى معدل النمو والتحول الغذائى من الأسبوع الأول وحتى نهاية التجربة.

وقد أظهر الفحص الخلوى للدم عند عمر 42 يوم نقص معنـوى فـى العـدد الكلـى لخلايـا الـدم الحمراء ونسبة الهيموجلوبين فى كل المجاميع ولكن هذا الـنقص ظهـر بـصور ء أكبـر فـى الـبط الـذى تغذى على العليقه التى تحتوى على 41٪ كسب بذرة القطن عن النـسبه 20٪. وأيـضا نقـص معنـوى فى البروتين الكلى ونسبة الالبيومين. وبقياس معدل وظائف الكبد وجدت زيادة معنوية فى نشاط انزيم الألانين أمينوترانسفيريزوظهرت الزيادة بنسبة أكبر فى المجموعة الرابعـة ولكـن الزيـادة فـى انـزيم الأسبرتات أمينوترانسفيريزظهرت فى المجموعة الربعة فقـط. وبقيـاس معـدل وظـائف الكلـي وجـدت زيادة معنويه في نسبة الكرياتينين. وبتحليل مصل الدم لقياس تركيـز الـدهون فـي الـدم وجـدت زيـادة معنوية في نسبة الكوليستيرول والجليسيريدات الثلاثيه وبقياس نشاط مضادات الأكـسدة (الجلوتـاثيون المختزل وأنزيم المالونديالديهيد) وجدت زياده معنوية فى نشاط هذة الأنزيمات فى كل المجاميع.

أظهرت الصفة التشريحية للكبد وجود مـوت للخلايـا الكبديـة مـع تـضخم بـسيط فـى القنوات المرارية وأتساع فى الجيوب الدموية فى البط الذى تغذى على كسب بذرة القطن بدون أضافة الحديد وأظهر الفحص المجهرى للكلى تكسر فى النسيج الطلائى للانابيب فى الـبط الـذى تغـذى علـى كسب بذرة القطن بدون أضافة الحديد.

وخلص البحث بأن أضافة كبريتات الحديدوز الى علائق البط التى تحتـوى علـى مـستخلص بذرة القطن مهم جدا ويقلل من الأثار الضارة على صورة الدم وكفاءة الكبد والكلى وسـلامة الأنـسجة اذا ما قورنت بمجاميع البط الذى تغذى على مستخلص بذرة القطن بدون معالجة.