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PHYSIOLOGICAL AND IMMUNOLOGICAL RESPONSES OF DUCKS (*CAIRINA MOSCHATA DOMESTICA)* TO SILYMARIN SUPPLEMENTATION

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ABSTRACT: The current study was conducted to investigate the effect of Silymarin extract on productive performance and the immune-physiological status of growing (*Cairina Moschata Domestica)* ducklings. A total number of 200 - day old ducklings were obtained from a commercial hatchery. Upon arrival they were brooded at 33^0C for one week and then individually weighed and divided randomly into four treatments of 50 birds in five replicates 10 ducklings each. The first group was served as a control and fed the basal diet without any supplementation, while the second, third and fourth groups were fed the basal diet supplemented with silymarin extract at levels of 0.6, 0.9 or 1.4 g/ kg dietlevels, respectively. The duration of the experiment was 70 days. Results showed that silymarin at 0.6 g/kg diet level positively affected feed conversion ratio, live body weight and body weight gain compared with the control one. Moreover, silymarin recorded highly significant values of globulin fractions (α, β, and γ-globulin), immunoglobulins and thyroid hormone concentration. Additionally, silymarin had significantly improved liver functions markers (ALT, AST and ALP) and serum lipid profile and significantly decreased lipid fractions (cholesterol, low density lipoprotein and triglycerides). In a similar way, silymarin induced significant improvement in the antioxidant status including low malondialdehyde (MDA) concentration and higher total antioxidant capacity, glutathione peroxidase and superoxide dismutase enzymes activity. Additionally, pathogenic bacterial counts were significantly reducedgrowth compared with control group.

Conclusion: silymarin extract at 0.6 g/kg diet, may be useful for improving growth performance, antioxidant status, liver functions. Notable linear decrease in the serum lipid profile concentration and pathogenic bacteria were observed in treated growing ducks.

Key words: silymarin, lipids, immunity, antioxidant, duck.

INTRODUCTION

Phytogenic plants are known as a good source of antioxidants. Additionally, they are safe for both living organisms and the environment, but the phytogenic composition may vary widely due to botanical origin, agronomic factors, mode of processing or environment factors (Windisch et al., 2008). Wu et al. (2009) reported that *Silybummarianum* had been identified as a source of various phytochemicals. *Silybum marianum* is one of many plants that has been used medicinally as growth enhancers in nutrition (Radko & Cybulski, 2007 and Andrzejewska et al., 2015) and also inhibits tumor necrosis factor alpha (TNF-α) induced production of free radicals and lipid peroxidation in cell membranes and modulates T-cell function Mannaet al., 1999 and Nazemian et al., 2010 . The active extract isolated from the seeds of *Silybum marianum*has mixture of several flavonolignans isomers called, silymarin, silychristin, silydianin, silybin, and isosilybin (Kummeret al., 2001 and Abenavoli et al., 2010). Pradhan and Girish (2006) and Rajiha (2012) reported that the active component of milk thistle known as silymarin, which represent4-6% of the dried seeds or in the aerial parts of milk thistle plant.Silymarin hasdifferent properties like inhibit lipid peroxidation, hopeful complementary medication in diabetes, hepatoprotective activity,anti-inflammatoryandanti-cancer activity and acts as an excellent antioxidant (Dixit et al., 2007 and Kshirsagar et al., 2013). Silymarin also led to modulates T-cell function and acts as and acts as scavenging reactive oxygen species (ROS) and thereby protecting cells against ROS(Kshirsagar et al.,2013), via its effect improved the concentrations of the endogenous antioxidant enzymes like superoxide dismutase, glutathione peroxidaseand catalase (Fehér et al., 1988 and Pradhan and Girish 2006), activates antioxidant enzymes that protect DNA from degradation(Kiruthiga etal., 2007), cyclooxygenase and lipoxygenase pathways (Gupta et al., 2000) and inhibited lipid peroxidation, and restricts the regular increasing in blood glucose induced by alloxan (Khazim et al., 2013). Previousreports demonstrated that silymarine had possitive effects on Glycemic control and has got some anti-diabetic potential (Maghrani et al., 2004 and Huseini et al., 2006). Silymarin clinically used to amelioration the liver functions like therapy of liver disorders in the chronic, ischemic injury, hepatitis, liver cirrhosis, radiation toxicity and alcoholic liver disease (Saller et al., 2001), detoxification, metabolism of carbohydrates and fats and protein synthesis. In addition, liver is contributory keeping homeostasis within the body (Ward and Daly, 2003). Silymarin has the efficiency to maintain the phagocytic function of avian macrophages (Grizzle et al., 2003) and modify indices of liver functions (Wellington and Jarvis, 2001; Bean, 2002 and Amiridumari et al. 2013). Silymarin improved body weight and feed intake in broilers (Kalorey et al. 2005) and has been shown effective in preventing negative effects on the productive performance of poultry (Tedesco et al.,2004 and Amiridumari et al. 2013). silymarin is effective against all bacterial species, and effectiveness against coliform bacteria (Abed et al., 2015). Despite wide use of silymarin and its active components in conventional and modern medicine, there is not enough information about this material.

Therefore, the current study was designed to evaluate effects of silymarin on productive performance, blood lipid profile, antioxidant status, immune responses, and liver function of growing ducks.

MATERIALS AND METHODS

- **Birds and Management:**

This study was performed in the Poultry Research Unit (El-Bostan Farm),

Department of Animal and Poultry Production, Faculty of Agriculture, Damanhour University, Damanhour, Egypt, during the period from April to July 2020.

A total of 200 un-sexed - day old ducklings (*Cairina Moschata Domestica)*were obtained from a commercial hatchery. Upon arrival they were brooded at 33^0C for one week and then individually weighed and randomly divided into four treatment groups of 50 ducklings in five replicates 10 ducklings each.The initial body weight (BW) of all ducklings was 203±4.6 gram at the beginning of the experiment (7 days of age). They were housed in floor pens (1.5*1.5m) in a semi-opened room equipped with two exhausted fans to keep normal ventilation and fed *ad libitum* throughout the whole experiment. The ingredients and nutrient composition of diets fed during starter period (7-35d of age) and grower (36-70d of age)period are shown in Table-1.

The average of silymarin yield was extracted 57.4 mg /g from milk thistle seeds according to Zheng et al. (2009) and Abou-Zida et al. (2016).Silymarin was added as a powder extract toducks' diet(7-70 d of age) as follows.

Groups 1^{st}, 2^{nd},3^{rd} and 4^{th} were fed basal diets supplemented with silymarin extract at levels of 0.0, 0.6, 0.9 and 1.4 g/Kg diet, respectively.

Growth Performance:

Individual live body weight (LBW, g) of ducks and feed intake (FI, g) were weekly recorded throughout the experimental period (7-70 d of age). Also, body weight gain (BWG, g) and feed conversion ratio (FCR) were calculated for each replicate within treatment groups. Feed conversion ratio was calculated according to the equation: FCR = FI (g) / BWG (g).

Slaughter traits and blood parameters

At the end of the experimental period, before blood sample collections, feeders were removed from all ducks for a period of 6 hrs. to allow constancy of blood constituents. Five fasted ducks from each treatment at 70 d of age were randomly taken for slaughter. Blood samples (about 5 ml) were collected from each duck into weatherman tubes. Blood samples were centrifuged at 3500 rpm for 20 min and stored at –20°C.

Fasted ducks were individually weighed. After scalding and evisceration carcass and some internal organs (i.e., liver,spleen, thymus gland and abdominal fat) were weighted. Percentage of carcass and organs were calculated based on live body weights. Five serum samples were obtained also from each treatment at 70 d of age for biochemical analysis using commercial kits. Serum total protein and albumin were measured according to guidelines and recommendation of Grant et al.(1987) and Doumas et al. (1981), respectively. Globulin values were obtained by subtracting albumin values from the corresponding values of total protein, since the fibrinogen usually comprises a negligible fraction (Sturkie, 1986). In addition, biochemical determinations included different types of globulin (α-globulin, β-globulin and γ-globulin) according to Bossuyt(2006). Blood glucose was estimated by the glucose oxidase method (Trinder, 1969).Some lipids profile (total cholesterol, triglycerides, high density lipoprotein (HDL-C), low density lipoprotein (LDL-C)) and alkaline phosphatase (ALP) concentrationwere measured according to Stein (1986), Fossati and Prencipe (1982), Lopez-Virella et al.,(1977), Friedewald et al.(1972) and Kind and King (1954). Moreover, serum levels of uricacid and creatinine were also determined using method of Patton and Crouch (1977) and Henry (1974), respectively, besides, the activity of serum aspartate aminotransferase (AST), and serum alanine aminotransferase (ALT), were estimated according to Reitman and Frankel (1957). Serum samples were assigned also for determination of total antioxidant capacity (TAC) according to

Koracevicet al. (2001), superoxide dismutase (SOD) activity according to Misra and Fridovich (1972), Glutathione (GSH) determined according to (Marzal et al. 2006) and malondialdehyde(MDA) according to the method of Buege (1978).Serum immunoglobulins (IgY, IgM and IgA) were determined using ELISA kits according to Bianchi et al.(1995). Tri-iodothyronine (T3) and thyroxin (T4) were determined in sera using ELISA technique according to Walker (1977) and Wisdom (1976), respectively.

Microbiological examination:

The contents of the ceca from 5 broiler per treatment group were sampled and pooled according to intestinal segment Ceca content from each segment was immediately transferred under a stream of CO2 into tubes containing 9 mL of a sterilized water (El Said, 2017). Total count bacteria were counted on Nutrient Agar. Coliform bacteria on MacConkey agar (MacConkey, 1908),while Lactobacilli SP. were anaerobically assessed on selective agar MRS. *(De-MAN et al., 1960)*incubated aerobically at 37º C for 24 h.

Statistical analysis:

Data obtained were analyzed using the GLM procedure (Statistical Analysis System (SAS, 2006), using one-way ANOVA using the following model: $Y_{ik}= \mu+ T_i + £ik$.

Where, Y_{ik} the dependent variable; µ is the general mean; T_i is the effect of experimental treatments; and £ikis the experimental random error. Before analysis,all percentages were subjected to logarithmic transformation ($log10^x+1$) to normalize data distribution. The differences among means were determined using Duncan's new multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth performance

As shown in Table (2) the initial body weight (7 days old) was not significantly different among all groups. In addition, live body weight, body weight gain, feed consumption and feed conversion ratio (FCR) of ducklings during growing period interval 7-70 days of age are summarized in Table. 2. The growth performance of ducks was significantly improved by silymarin dietary treatments ($p \leq 0.05$). Supplementation with silymarin diet significantly increased body weight and weight gain in comparison to control group. Differences in body weight gain due to supplementation were significant, the treated groups of silymarin surpassed the non–treated group in respect of body weight gain by about 13.4, 11.7and 7.71%, respectively at the 70 days of age. Also, the results for LBW and WG displayed a linear decreased ($p \leq 0.05$), as a result of increasing levels of silymarin treatments, with a minimum for the control group ($p \leq 0.05$) during growing period 7-70 days of age. On the other hand, no levels-related effects on feed consumption were observed obtained in the different groups (Table. 2). However, variations were observed for feed conversion ratio among the groups treated ($p \leq 0.05$). FCR has been observed increased in the low level of silymarin group than the other groups.

Feed consumption of Silymarin groups did not significant effects compare to control group ($P \leq 0.05$) during days 7–70 of age. While, supplementation ofducklings'diets with silymarin significantly improved FCR during the whole experimental period (7-70) days of age. Throughout the growing period interval (7-70) days of age low concentration of supplementation dietary of silymarin has better effects on LBW, WG and feed conversion ratio than the other groups.

The current results agree with those of **(**Chand et al., 2011 and Abdalla et al., 2018) who confirmed that supplementation milk thistle plant had positive effect on feed conversion ratio and body weight gain. Silymarin prevent fat accumulation in the liver and increases the elimination of toxins directly from the intestines without absorption in which toxins absorbed from

the digestive tract first enter the liver resulting in a variety of liver disorders (Karimi et al., 2011). Therefore, silymarin acts as growth promoter and improving productive performance of broiler, particularly body weight gain, feed conversion ratio and immune system (Ershidat, 2017 and Kalorey et al., 2005)and attributed its effects to antioxidant activity in the protein synthesis stimulation by the bird's enzymatic system Gowda and Sastry (2000). In addition, the findings result suggest that silymarin may increase the metabolic rate, improvement in liver function, muscle protein synthesis and protein deposition Noorani et al. (2010).

Carcass characteristics and lymphoid organs:

Results indicated that the relative weights of carcass significantly increased for the groups supplied with different levels of silymarin compared with control treatment (Table 3). Moreover, the group supplied with low level of Silymarin significantly increased relative weight of carcass compared with the other treated groups. On the other hand, supplementation with different levels of silymarin haddecreased significanteffectson relativeweight of abdominal fat. Nevertheless, all supplementations had no significant effects on the relative weightof thymus,spleen and liver organs. Abdalla et al., 2018 illustrated that, milk thistle plant supplementation diets had no significant effects on relative weight of thymus and abdominal fat.This is may refer to that silymarin retains water in the cytoplasm of hepatocytes conducive to enlargement of liver cells, fulfilling in raising total liver mass and volume, this is compatible with results which obtained by (Noorani et al., 2010).

Blood Traits

Table.4.Reports the results for triglycerides, total cholesterol, high- and low-density lipoprotein (HDL and LDL) levels were positively affected by the dietary treatment compare to control group. Lipids profile (TG, Chol. and LDL) displayed a linear decrease ($p \leq 0.05$), as a result of increasing dietary levels of silymarin, with a maximum for the control group ($p \leq 0.05$). Despite, a linear increase in the HDL values ($p \leq 0.05$) was identified. These results are in accordance to Abdalla et al., 2018 who reported that supplementing diet with milk thistle plant has positive effects on activity of total lipids, triglycerides cholesterol, and LDL significantly decreased, however, HDL significantly increased compared with control group.The addition of silymarin treatments show significant decrease of serum total cholesterol and triglyceride levels, this may attribute to unsaturated fatty acids in the levels of silymarin, which may stimulate cholesterol secretion into the intestine, and the oxidation of cholesterol to bile acids. Silymarin is used in helpful therapy of liver diseases and its cytoprotective activity is believed to be based on antioxidant properties. Škottová et al. (1999) reported that silymarin inhibites the dietary induced hypercholesterolemia in rats (Krečman et al., 1998), significantly decrease the lipid profiles and LDL levels in vitro.

Moreover, serum liver and renal function parameters reported in (Table 4). The parameters associated with the renal function wasn't influenced by silymarin treatments. No significant changes in the levels of creatinine and uric acid values were observed.

These results are in line with what has been reported by Talebi et al., 2015 who reported that creatinine values were not significant among values of the groups.

Despite, the parameters associated with the liver functions, including ALK. P, ALT and AST were showed a linear decrease significant effects for all treated groups compare to control one ($p \leq 0.05$),which was in agreement with findings of Neshatgharamaleki and Mohajeri (2014). Dietary levels of silymarin were reported to protect the liver induced hepatic injury

through its potent antioxidant activity in vivo. The addition of silymarin may improve the liver functions (AST, ALT and ALP) were significantly decreased, these results indicate that treating with silymarin did not have any adverse effect on the function of kidney and liver. In this respect, El-Gazayerly et al., 2014 noted that the liver enzymes activities were significantly decreased in female rats exposed to silymarin drug. Silymarin had beneficial effects and improves indices of liver function(Wellington & Jarvis, 2001, Huseini et al., 2006, Pradhan and Girish, 2006 and Jose et al., 2011 and Talebi et al., 2015) and kidney cells, where it aids in repair and regeneration by increasing protein and nucleic acid synthesis (Kaur et al., 2010). Previously reported which decreased the levels of ALT, AST and ALP levels after treatment with silymarin. Similarly, Simanek et al. (2000), Shaker et al. (2010) and Abdalla et al., 2018 who reported that supplementing diet with milk thistle plant significantly improved the liver function and, since the activity of AST, ALT and ALP significantly decreased compared with control group. In addition, Shaker et al. (2010) and Bhattacharya (2011) indicated that silymarin used for relieving the liver diseases and its mechanism of action mainly as anticarcinogenic and antiradical that may be due to decrease in liver enzyme levels. Moreover, silymarin shows an improvement in serum liver enzymatic levels and strong antioxidant that has been reduce blood cholesterol and enhance liver cell regeneration. Moreover, Silymarin may be decreasing cholesterol and phospholipids, may be in part due to decreased liver cholesterol synthesis.

Liver is the key organ which leads various physiological functions in Poultry. The nutritional state of birds is not only determined by what they feed, but also depends on the function and status of the liver and it plays a physiology function of poultry (Saeed et al., 2017a&b). The ingested toxins absorbed from the guts, firstly enter the liver and can accumulate, resulting in disease (Shaker et al., 2010). Although the mechanism of action silymarin still unclear, silymarin has been reported to have antioxidant activity, antifibrotic and antiviral properties to combat such problems (Karimi et al., 2011). Silymarin has fast conjugation in the liver and is primarily secreted in bile to control hepatic inflammation in vivo (Morishima et al., 2010). No levels-related effects on total protein and albumin were observed in blood serum obtained from the different groups (Table 5). However, variations were observed for globulin, α–globulin, β –globulin and γ -globulin concentrations among the groups ($p \leq 0.05$). Moreover, globulin, α–globulin and γ -globulin levels displayed a linear decrease ($p \leq 0.05$), as a result of increasing levels of dietary silymarin (Table 5).

These results are in line with Abdalla et al. (2018) and Lutsenko et al. (2008) who stated that diet supplied with silymarin significantly increased total protein, albumin and globulin compared with control group.

The results in Table 5. related for humoral immune response of ducks showed significant increases in immunoglobulin G in silymarin groups compared with control group. The results for the serum immunoglobulins' G (IgM and IgA) were unaffected by dietary treatments, however, a linear increase in IgG levels was noticed by silymarin treatments. IgG showed a linear decrease because of the increasing dietary inclusion silymarin, with a minimum for control group ($p \leq 0.05$). Mojahedtalab et al. (2013) reported that Silymarin improved productive performance and increased humoral immunity in broilers and increased IgG titer in treated groups compared to control group ($P \leq 0.05$). Previous studies have shown that silymarin has different immunomodulatory activities and has anti-inflammatory effects. As an immunomodulator agent, silymarin inhibits

T-lymphocyte function at low doses while stimulates inflammatory processes at high doses (Wilasrusmee et al., 2002 and Esmaeil et al., 2017). Also, Wilasrusmee et al., 2002 showed that silymarin has helpful immunostimulatory effects of increasing the immunity to infectious diseases.

As reported in Table 6. thyroxin and tri-iodo thyronine were partially influenced by the dietary supplementation, moreover, concerning T3/T4 ratio, results in Table 6. Showed that *silymarin* improved T4 conversion to T3 hormone. This result suggests that silymarin facilitated the conversion of T4 to T3. In special, the hepatic enzyme is importantly thought that participate to peripheral T3 production and in addition to the bioactivation of T4 to T3 (Robin et al., 2000).Kummer et al., 2001 reported that silymarin increased the serum concentrations of thyroid hormones. This study showed effects of silymarin on increasing oxidative metabolism of steroid hormones in hepatic tissue and demonstrated modulation of metabolizing enzymes. This attributed the stimulatory effects of silybin, which is the principal component of silymarin on ribosomal RNA and DNA synthesis resulting from direct interaction with RNA-polymerase were demonstrated repeatedly (Fraschini et al., 2002 Kummer et al., 2001).

Data in Table (6) revealed a significant ($P \leq 0.05$) decrease in serum glucose concentration in treated groups compared with the control diet. In this respect, (Talebi et al., 2015 and Huseini et al., 2006) have reported that silymarin had a beneficial effect on improving the glycemic profile improved the glycemic control system in diabetic. The hypoglycemic of silymarin may be due its antioxidant activity by reducing insulin resistance (Soto et al. 2004 and Jose et al., 2011). Silymarin promoted repair and renovation of the pancreatic tissue, protecting pancreatic tissue against damaging elements, thereby hypoglycaemic effect are among mechanisms pointed out for silymarin beneficial effects on health and productive performance of quail (Soto et al. 2003; Behboodi et al. 2017).

The antioxidant enzymes activities were influenced by silymarin treatments as reported in table. 6.Results revealed that silymarin supplementation to silymarin treatments ducks' significantly increased TAC in duck's serum compare with control group but, better response was for ducks fed 0.6g/kg silymarin/diet than other groups. Similarly, MDA significantly decreased by adding silymarin. Moreover, TAC, GPX, GSH and SOD values were remained constant between silymarin groups, which, showed a linear decrease with increasing dietary levels of silymarin ($p \leq 0.05$). Treated groups produced an antioxidant activity as evident by reducing lipid peroxidation byproduct (MDA), restoring activities of TAC and SOD enzymesand increasing of glutathione activity. Moreover, previous studies have attributed the protective effects of silymarin to antifibiotic effects (Jia et al. 2001), free radical scavenging capacity (Saller et al. 2001) and enhance glutathione activity in peripheral blood cells (Par et al. 2000, Lucena et al. 2002), improvement the activity of catalase and super oxide dismutase levels (Lee et al., 2003 and Fanoudi et al., 2020) and significantly diminishing malondialdehyde levels (Brown et al., 2004 and Draz et al. 2015).

The adverse relation between HDL- chol and MDA attributed a synergetic effect of both, where, HDL has a preventative function in protecting from atherosclerosis, while, MDA activity acts as a reliable indicator of antioxidant activity. These results agree with (Bhattacharya, 2011 and Kshirsagar et al., 2013) who reported that silymarin has been act as an effective antioxidant and preventing free radicals reactive oxygen species (ROS) generating enzymes, which scavenges excessive (O2-) thus reducing and preventing its harmful effect to cells in addition to inducing lipid peroxidation in vivo(El-Far et al., 2009

a&b). Silymarin maintains an optimal equilibrium in the cell by activating a range of enzymatic and non-enzymatic antioxidant defense systems of cells involving restore and augment antioxidant status by significantly enhancing gene expression of antioxidant enzymes (Upadhyay et al., 2010; Surai, 2015; Tan et al., 2015; Zhao et al., 2015 El-Far et al., 2018).

The populations of total viable bacterial count (cfu x 10^6⁄g sample), lactobacillus and E. coli of cecal contents (cfu x 10^3⁄g sample), were affected by silymarin dietary supplementation (Table 7). The results revealed that silymarin supplementation significantly decreased count of total bacteria and coliform bacteria compared with control treatment. which had more effective on decreasing intestinal total count and count of *coliform bacteria.*It is likewise believed that silymarin supplementation displayed significant decrease ($p \leq 0.05$) total bacterial count, as a result of increasing *lactobacillus Sp*., while *E. coli* showed a linear decreased ($p \leq 0.05$). Silymarin supplementation has enhanced positive effects on growth performance, controlling and inhibition of growth of pathogenic microorganism.However, dietary supplementation significantly increased count of *Lactobacillus Sp.* bacteria. The results revealed that the highest lactobacillus bacterial count was recorded to dietary's silymarin. groups. Silymarin has enhanced effects of benefit bacteria in the large intestinal tract and improve the production of lactic acid and may provide an energy source of intestinal epithelial cell growth that improves nutrient absorption in duck intestine.Bajwa et al., 2016 showed that silymarin was showed minimal activity against resistant E. coli and good activity against total bacteria. silymarin has been used as anti-carcinogenic because of their cytotoxic activity. So, these phytochemicals may also be toxic to bacterial cell and may be responsible for the antibacterial activity. This in agreement with Abed et al., 2015 and Lahlah et al., 2012, who observed that silymarin was effective against all bacterial species, however, its effectiveness against *Escherichia coli* was higher than others. The antibacterial activity of flavonoids can be explained by the toxicity of this component towards nonspecific interactions in showed susceptibility, such as the establishment of hydrogen bonds with the cell walls proteins or enzymes, the chelation of metal ions, inhibition of bacterial metabolism, sequestration of substances necessary for the growth of bacteria. Also, the β ring of flavonoids is important in the intercalation with nucleic acids, thus inhibits DNA and RNA synthesis. It can also inhibit the DNA gyrase of *Escherichia coli*(Lee et al., 2003 and Bessam and Mehdadi, 2014). The microbes serve a number of important functions including energy extraction from food through a variety of mechanisms through effect both sides of the energy balance equation that monitoring and control of energy consumption and storage, digests plant polysaccharides and complex carbohydrates (Davis, 2017). In addition, the gut microbes can metabolize short chain fatty acids, producing vitamins such as biotin, folate and vitamin K; preventing colonization by pathogens; and assisting in the development of immune system (Clarke et al., 2012).

CONCLUSION

Generally,itcanberecommendedthat silymarin extract at 0.6 g/kg diet has enhanced positive effects on growth performance, enhanced antioxidant enzymes andimproved immuneresponses and liver functions.Moreover, silymarin extractsignificantly decreasedcount of pathogenic bacteria of growing ducks (CAIRINA MOSCHATA DOMESTICA).

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Table (1): Composition and calculated analysis of the basal diets:

Ingredients (%)	**Starter (7-35 d)**	**Grower (36- 70d)**
Yellow corn	56.80	68.70
Soybean meal (44%)	38.00	26.00
Limestone	1.00	1.05
Dicalcium phosphate	1.90	1.95
Salt (NaCl)	0.30	0.30
Vit+Min.premix1	0.30	0.30
DL-Methionine	0.11	0.15
Sunflower oil	1.50	1.50
Antifungal	0.09	0.95
Total	100.0	100.0
Calculated analysis (NRC, 1994)		
ME,kcal/Kg	2884	2999
Crude protein, %	21.6	17.34
Crude fiber, %	3.92	3.37
Ether extract, %	3.95	4.30
Lysine, %	1.18	0.90
Methionine %	0.44	0.39
Meth. + Cyst., %	0.79	0.69
Calcium, %	0.92	1.60
Total phosphorus, %	0.78	0.47
Available phosphorus%	0.52	0.31

[1]Vit+Min mix. /Kg diet Vit. A: 6000 IU, Vit. D3: 2000 ICU, vit. E (dl-α-tocopheryl acetate: 10 IU, , calcium pantothenate: 10 mg , menadione: 2.5 mg, nicotinic acid: 12 mg, thiamine: 3 mg, vit. B_{12}: 4 μg, vit. B_6: 5 mg, riboflavin: 2.5 mg, Choline chloride: 300 mg, folic acid: 0.50 mg and biotin: 0.02 mg. Trace mineral (mg/ kg of diet: Fe: 35 mg, , Mn: 80 mg, Cu: 8 mg Se: 0.1 mg and Zn: 60 mg).

Table (2): Effect of different levels of silymarin on growth performanceof growing ducks.

Items	Control	Silymarin 0.6g	Silymarin 0.9g	Silymarin 1.4g	SEM	P-Value
Live body weight (g)						
7d	206	201	200	205	4.60	0.748
35d	1250^{b}	1561^{a}	1552^{a}	1400^{ab}	74.89	0.030
70d	3204^{b}	3600^{a}	3550^{a}	3434^{ab}	86.69	0.024
Body weight gain (g)						
7-35 d	1044^{b}	1360^{a}	1352^{a}	1195^{ab}	75.08	0.027
36-70d	1954	2039	1998	2034	81.78	0.873
7-70d	2998^{b}	3399^{a}	3350^{a}	3229^{ab}	87.17	0.023
Feed consumption (g):						
7-35d	3111	3090	3108	3094	181.40	0.990
36-70d	7010	6690	6790	6860	230.01	0.798
7-70d	10121	9780	9898	9954	307.52	0.887
Feed conversion ratio (g feed/g gain).						
7-35d	2.98^{a}	2.27^{c}	2.30^{c}	2.59^{b}	0.025	0.001
36-70d	3.59^{a}	3.29^{b}	3.40^{ab}	3.37^{ab}	0.077	0.056
7-70	3.38^{a}	2.88^{c}	2.95^{c}	3.08^{b}	0.040	0.001

^{a,b,c} Means in the same row followed by different superscripts are significantly different at ($p \leq 0.05$); SEM= Standard error of means.

Table (3): Effect of different levels of silymarin on carcass characteristics and some lymphoid organs of growing ducks.

Items	Control	Silymarin 0.6g	Silymarin 0.9g	Silymarin 1.4g	SEM	P-Value
Carcass characteristics (%)						
carcass yield %	66.84^{c}	71.51^{a}	70.91^{ab}	68.32^{bc}	0.91	0.007
Liver %	2.22	2.34	2.18	2.22	0.06	0.26
Abdominal Fat %	1.00^{a}	0.76^{b}	0.85^{b}	0.85^{b}	0.03	0.001
Lymphoid organs (%)						
Spleen %	0.277	0.313	0.284	0.282	0.013	0.22
Thymus %	0.126	0.131	0.123	0.125	0.001	0.40

^{a,b,c} Means in the same row followed by different superscripts are significantly different at ($p \leq 0.05$); SEM= Standard error of means.

Table(4): Effect of different levels of silymarin on serum lipids concentration, liver and kidney functionof growing ducks

Items	Control	Silymarin 0.6g	Silymarin 0.9g	Silymarin 1.4g	SEM	P-Value
TG, (mg/dl)	120.6[a]	98.2[b]	95.0[b]	87.2[b]	5.69	0.0049
Chol., (mg/dl)	200.9[a]	166.9[b]	164.9[b]	160.8[b]	7.40	0.0051
HDL, (mg/dl)	49.0[c]	60.5[a]	56.1[ab]	54.1[b]	1.68	0.0017
LDL, (mg/dl)	127.7[a]	86.7[b]	89.8[b]	89.2[b]	4.79	0.001
Uric, (mg/dl)	3.47	3.39	3.46	3.50	0.05	0.532
Creatinine, (mg/dl)	0.37	0.34	0.37	0.39	0.05	0.934
AST, (U/L)	61.45[a]	55.29[b]	54.90[b]	53.40[b]	1.54	0.0026
ALT, (U/L)	31.10[a]	24.92[b]	24.08[b]	23.38[b]	1.79	0.0283
Alk. P,(U/100ml)	17.95[a]	12.80[b]	11.58[b]	11.67[b]	0.93	0.0013

[a,b,c] Means in the same row followed by different superscripts are significantly different at($p \leq 0.05$); SEM= Standard error of means, Chol.= total cholesterol; TG= triglycerides; HDL=high-density lipoprotein; LDL=low-density lipoprotein, AST=aspartate amino transferase; ALT=alanine amino transferase; Alk. P =Alkaline phosphatase

Table(5): Effect of different levels of silymarin on serum protein fraction and immunoglobulins of growing ducks

Items	Control	Silymarin 0.6g	Silymarin 0.9g	Silymarin 1.4g	SEM	P-Value
Total protein (g/dl)	5.87	5.97	5.96	5.97	0.04	0.193
Albumin, (g/dl)	3.10	3.01	3.04	3.06	0.04	0.277
Globulin (g/dl)	2.77[b]	2.97[a]	2.92[a]	2.90[a]	0.03	0.003
Albumin/globulin	1.12[a]	1.01[b]	1.04[b]	1.06[ab]	0.02	0.013
α–globulin, (mg/ml)	56.20[c]	67.05[a]	66.78[a]	62.07[b]	0.76	0.0027
β -globulin (mg/ml)	85.64[b]	96.20[a]	95.81[a]	93.11[a]	1.12	0.0014
γ -globulin, (mg/ml)	115.09[b]	128.27[a]	127.75[a]	124.14[a]	1.50	0.001
IgA, (mg/100 ml)	72.9	74.6	78.9	79.9	0.987	0.098
IgM, (mg/100 ml)	221[b]	260[a]	276[a]	276[a]	2.45	0.001
IgG, (mg/100 ml)	958[b]	997[a]	988[a]	995[a]	9.77	0.002

[a,b,c] Means in the same row followed by different superscripts are significantly different at($p \leq 0.05$); SEM= Standard error of means, IgA= Immunoglobulin A; IgG= Immunoglobulin G; IgM= Immunoglobulin M.

Table (6): Effect of different levels of silymarinon thyroid hormones, glucose and antioxidant status of growing ducks.

Items	Control	Silymarin 0.6g	Silymarin 0.9g	Silymarin 1.4g	SEM	P-Value
T3, (ng/ml)	3.23^{c}	5.47^{a}	5.08^{b}	4.86^{b}	0.12	0.002
T4, (ng/ml)	16.84^{b}	21.04^{a}	19.11^{ab}	18.70^{ab}	0.94	0.044
T3/T4 ratio	0.194^{b}	0.261^{a}	0.272^{a}	0.262^{a}	0.02	0.010
Glucose (mg/dl)	198.4^{a}	192.4^{ab}	181.2^{b}	187.4^{ab}	4.23	0.063
TAC, (mmol/L)	1.32^{b}	1.78^{a}	1.65^{ab}	1.66^{ab}	0.12	0.083
GPX (U/L/h)	0.218^{b}	0.414^{a}	0.372^{ab}	0.356^{ab}	0.05	0.069
GSH (mg/ml)	920^{b}	985^{a}	977^{a}	977^{a}	16.95	0.052
SOD (U/ml)	232.8^{b}	269.8^{a}	270.0^{a}	281.0^{a}	9.46	0.013
MAD (pmol/ml)	164.7^{a}	133.0^{b}	138.4^{b}	137.1^{b}	8.16	0.054

^{a,b,c} Means in the same row followed by different superscripts are significantly different at ($p \leq 0.05$); SEM= Standard error of means. T3= triiodothyronine; T4=thyroxine, TAC=total antioxidant capacity; GPX =glutathione peroxidase; GSH= glutathione; SOD=superoxide dismutase, MAD= malondialdehyde

Table (7): Effect of different levels of silymarin on Bacterial counts of growing ducks

Items	Control	Silymarin 0.6g	Silymarin 0.9g	Silymarin 1.4g	SEM	P-Value
TBC (cfu x 10^6)	244.0^{a}	180.8^{b}	183.8^{b}	181.6^{b}	11.38	0.003
Lactobacillus Sp. (cfu x 10^3)	105.0^{b}	168.8^{a}	168.8^{a}	164.2^{a}	13.14	0.008
E.Coli (cfu x 10^3)	153.4^{a}	94.4^{b}	102.0^{b}	100.4^{b}	9.14	0.001

^{a,b} Means in the same row followed by different superscripts are significantly different at($p \leq 0.05$); SEM= Standard error of means .TBC = Total Bacterial Count

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تأثير مستخلص السليمارين على الاستجابات الفسيولوجية و المناعية لسلالة البط الفرنساوى (Cairina Moschata Domestica)

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أجريت هذه الدراسة لمعرفة تأثير مستخلص السيليمارين على الأداء الإنتاجي والحالة المناعية والفسيولوجية لسلالة البط الفرنساوى .

تم استخدام عدد ٢٠٠ كتكوت من البط الفرنساوى عمر يوم من معمل تفريخ تجاري. عند وصولهم ، تم تحضينهم على درجة حرارة ٣٣ درجة مئوية لمدة أسبوع ثم تم توزيعهم وزنهم بشكل فردي وتقسيمهم بشكل عشوائي إلى أربع مجموعات عند عمر ٧ ايام كل مجموعة مكونة من ٥٠ طائرًا مقسمة الى خمسة مكررات و كل مكررة بها عشرة طيور.

المجموعة الأولى (مجموعة الكنترول) تم تغذيتها على عليقة ضابطة بدون اضافات بينما المجموعة الثانية والثالثة والرابعة تم تغذيتها على العليقة الضابطة مضاف إليها السيليمارين بمستويات ٠.٦، ٠.٩ ، ١.٤ جم / كجم عليقة على التوالى حتى عمر ٧٠ يوم مدة التجربة .

.أوضحت النتائج أن مستوى السيليمارين ٠.٦ جم / كجم أثر إيجابياً على متوسط وزن الجسم الحي والزيادة الوزنية ومعدل التحويل الغذائى مقارنة مع مجموعة الكنترول. علاوة على ذلك، سجل السليمارين زيادة معنوية فى صور الجلوبيولين(α, β, and γ-globulin) ، ومستوى هرمونات الدرقية بالدم. بالإضافة إلى ذلك ، كان للسيليمارين نتائج ايجابية فى تحسين كلاً من وظائف انزيمات الكبدALT, AST and ALP() وصورة الدهون في الدم حيث أدى بشكل ملحوظ لانخفاض مستوى الدهون بالدم (الكوليسترول الكلى والكوليسترول منخفض الكثافة والجلسريدات الثلاثية).وفى هذا الاتجاه أيضاً وجد أن للسيمارين تأثير ايجابى على خفض مستوى malondialdehyde (MDA) بالدم. بالاضافة إلى تحسن مستوى مضادات الأكسدة والاستجابات المناعية وتثبيط نمو بكتريا القولون فى معاملات السليمارين مقارنة بمجموعة الكنترول.

الخلاصة، ، تركيز ٠.٦ جم سيليمارين / كجم من العلف، أدت لتحسن الأداء الانتاجى ومضادات الأكسدة وتحسن وظائف الكبد. ومن جهة أخرى أدى لانخفاض تركيز الدهون بالدم وتثبيط نمو البكتريا المسببة للأمراض فى مجموعات البط المعاملة بالسليمارين مقارنة بمجموعة الكنترول.