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The effect of pioglitazone on performance and plasma lipids of post-peak female broiler breeders

M Heidari Amaleh[1], A Zare Shahneh[2*] and M Zaghari[2]

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[1]PhD Student, Department of Animal Science, College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran
[2] Professor, Department of Animal Science, College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran
[*]Corresponding author: Email: azareh@ut.ac.ir.

Abstract

Introduction: The accumulation of excess triacylglycerol and fatty acids in nonadipocytes results in lipotoxicity, cellular dysfunction, and cell death. Although feed restriction is an effective and practical management technique to prevent the obesity in broiler breeders, after the peak of egg production hens have propensity to be overweight. Lipotoxicity in hepatocytes and follicular cells of laying hens could cause liver disfunction, ovarian abnormalities, and therefore, decline egg production. **Aim:** This study was conducted to determine the effect of Pioglitazone on egg production and plasma metabolites in broiler breeder hens. **Material and method:** Thus, forty birds were randomly allotted to four groups with 10 birds in each and were fed standard diet supplemented with different levels of Pioglitazone at 0, 10, 20 and 40 mg/bird per day from 45 through to 51 weeks of age. **Results:** The results indicated that 20 and 40 mg levels improved egg production and quality ($P<0.05$). In regard to plasma lipids, Pioglitazone at levels of 20 and 40 mg had hypolipemic effects and could effectively decrease plasma glucose, triacylglycerol, low density lipoprotein and cholesterol ($P<0.05$). In addition, the activity of liver enzymes, as a criterion of liver health, was improved in hens receiving 20 and 40 mg Pioglitazone ($P<0.05$). Also, necropsy observations showed that liver and abdominal fat weights significantly decreased by dietary supplementation of 20 and 40 mg Pioglitazone ($P<0.05$). **Conclusion:** In conclusion, the current study indicated that Pioglitazone at levels 20 and 40 mg/bird/day could improve performance of post-peak female broiler breeders through lowering plasma lipids.

Keywords: Broiler Breeder, Post-peak, Pioglitazone, Plasma lipid

Introduction

Genetic selection for rapid growth in broiler strains is associated with a tendency for overconsumption (Richards and Proszkowiec-Weglarz 2007) and a reduction in reproductive performance (Zhang et al. 2018). Although feed restriction is an effective and practical management tool to prevent obesity of broiler breeders, after the peak of egg production, hens have propensity to increased growth. This extra growth will be mainly fat, but there will be also some muscle growth (Leeson and Summers 2000). According to parent stock (PS) management handbooks, like Ross PS management handbook-Aviagen (2013), after the peak production (217-day old), female broiler breeders begin to increase abdominal fat deposition. This problem is especially relevant in hens with positive energy balance because of excessive energy intake. Obesity quickly leads to reduced egg production, diverting even more nutrients into growth (fat) and this vicious circle is often responsible for the very sudden drop in egg production, which was seen within flocks that are overfed after the peak of egg production (Leeson and Summers 2000). In hens, obesity appears to stimulate a reduction in settable egg formation which caused by liver delivery of bioactive

fatty acids (FAs) and other bioactive lipids to peripheral circulation and ultimately peripheral tissues (Walzem and Chen 2014; Wei et al. 2019). Therefore, to maintain productive performance beyond peak production, females must gain body weight close to the recommended target. Failure to control body weight could significantly reduce persistency of lay, shell quality, and female fertility after 40 weeks of age (Aviagen 2013). Some studies used *ad libitum*-fed hens as a model for obesity and showed the role of obesity on provoking anatomical damages of ovary and follicles (Robinson et al. 1993; Yu et al. 1992). However, in subsequent published paper by Chen et al. (2006), it is revealed that ovarian dysfunction is associated with Lipotoxicity. Indeed, they indicated that unregulated feed intake impaired reproductive function through lipopenic dysregulation and lipotoxic mechanisms (Chen et al. 2006). Furthermore, they showed that feed-satiated female broiler breeders had significantly more abdominal fat, body and liver weight and also, greater plasma glucose, triacylglycerol (TAG), non-esterified fatty acid (NEFA), insulin, and leptin concentrations than feed-restricted counterparts (Chen et al. 2006). Subsequent studies discovered more details of mechanisms mediated by lipotoxicity (Liu et al. 2016; Liu et al. 2014; Pan et al. 2014; Pan et al. 2012; Xie et al. 2012). For example, Pan et al. (2012) reported that ceramide accumulation and up-regulation of interleukin-1 β mediate effects of lipotoxicity on reproductive efficacy in female broiler breeders. Then, Liu et al. (2014) for the first time showed that there is a linkage between leukocyte function and reproductive performance in broiler breeders. Their results indicated that consuming feed in unrestricted amounts led to defects in the operative machinery of immune cells and this, in turn, impaired ovarian activities. In addition, Liu et al. (2016) suggested that intracellular lipid dysregulation of leukocytes contributes to ovarian dysfunction in broiler hens fed *ad libitum*. Recent study indicated that excessive energy intake by broiler breeder hens led to alteration of lipid metabolism within the follicle wall and peripheral blood leukocytes, particularly heterophils (Liu et al. 2016). Based on the results of mentioned studies, following the obesity, elevated plasma lipid intermediates accompanied with accumulation of lipids in non-adipose tissues (the process called lipotoxicity), which lead to cellular dysfunction and cell death.

Pioglitazone is an insulin-sensitizing drug belonging to the thiazolidinediones (TZDs) class, which was proved to be effective in the treatment of Type 2 diabetes (Smith 2001). It exerts its effect as high affinity agonist of peroxisome proliferator-activated receptor (PPAR) γ (Stumvoll 2003; Yki-Järvinen 2004). PPAR γ has a wide variety of biological roles included: FA synthesis, storage and glucose metabolism, and inhibiting inflammatory mechanisms (Clark 2002; Ferre 2004). Treatment of humans, dairy cows, and rodents with TZDs increased whole-body insulin sensitivity and promote uptake and storage of circulating lipids by adipocytes. In type 2 diabetics, it is reported that Pioglitazone could improve glycemic control, reduce plasma lipid concentrations, and redistribute lipids from ectopic accumulation sites (muscle and liver) to adipose tissue (Bajaj et al. 2010; Yki-Järvinen 2004; Yousefi et al. 2016).

Therefore, the aim of the present study was to examine the effects of pioglitazone at different levels on productive performance and plasma lipids of female broiler breeders after the peak production.

Materials and Methods

Animals and experimental design

This study was conducted at the animal husbandry station in the department of animal science at University of Tehran and all procedures were approved by the animal care and welfare committee of the University. Forty Arian broiler breeders (Arian, an Iranian broiler breed) at the post-peak stage of egg laying (45 to 51 weeks of age) were housed in individual cages under controlled environmental conditions (14L:10D, 18˚C). All birds were fed the breeder-recommended feed/hen during 14-d adaptation period. Then,

they were randomly allocated into 4 groups with similar body weight (10 birds per group). Hens received a soy and corn-based diet that supplemented with 0 (control), 10, 0 and 40 mg/bird/day Pioglitazone (India; Batch No: PHD 0510001). The composition of basal diet is presented in Table 1.

Table 1- Ingredient and Chemical composition of standard diet fed by hens

Item	Content
Ingredient (%)	
Corn grain	70.95
Soybean meal	19.69
Corn oil	0.2
Limestone	6.94
Dicalcium phosphate	1.23
Vitamin and Mineral Premixes[1]	0.5
Sodium Bicarbonate	0.22
Sodium Chloride	0.18
DL-Methionine	0.09
Calculated Nutrient Content	
Metabolizable energy (Kcal/kg)	2750
Crude protein (%)	15.4
Calcium (%)	2.88
Available phosphorus (%)	0.43
Sodium (%)	0.16
Digestible Lys (%)	0.72
Digestible Met (%)	0.38
Digestible Met + Cys (%)	0.64
Digestible Thr (%)	0.55

1. Provided (per kg of diet): 11000 IU vitamin A (retinyl A acetate);
3500 IU cholecalciferol; 150 IU vitamin E (DL-a-tocopheryl acetate);
5 mg vitamin K; 3 mg thiamin; 12 mg riboflavin; 15 mg D-pantothenic
acid;55 mg niacin; 4 mg pyridoxin; 0.25 mg biotin; 2 mg folic acid.

Egg production and egg quality parameters

Eggs were collected and weighed daily throughout the experiment. Furthermore, at the last week of experiment, 20 eggs were collected per treatment to determine egg quality indices. Each egg was individually weighed (whole and yolk weight) and broken to measure eggshell weight and thickness. To measure eggshell thickness, three different places (upper and lower end, and the middle) of egg were assessed by using a micrometer screw gauge to obtain an average value. Haugh unit was calculated using formula given by Haugh in1937 (Haugh 1937).

Blood collection and preparing blood smears

Fasting blood samples were collected from wing veins of all birds into EDTA tubes at the end of experiment. Then, samples were centrifuged at 3000 rpm for 15 min to isolate plasma. Plasma was stored at -20˚C until assaying metabolites. In addition, mono-layer blood smears made by pushing approximately 3µl of blood across a standard microscope slide and were dried immediately by a hot air stream. At the end, films were stained by Giemsa stain and examined under compound microscope for cell counting to calculate heterophils: lymphocyte (H:L) ratio. Heterophils and lymphocytes were counted in each field until the number of both these cells was 100.

Necropsy

At the end of experimental period, all hens were killed and subjected to a full post-mortem examination. At necropsy, liver, abdominal fat pad, ovary, stroma and the largest yellow follicle were collected and weighed. The number of preovulatory, small yellow and large white follicles were also determined. In addition to these, Liver hemorrhage and steatosis were judged using a 5-point scale (Walzem et al.1993).

Measurement of plasma metabolites

Plasma TAG, HDL, LDL and cholesterol concentrations, and the enzyme activity of alkaline phosphatase (ALP) and aspartate aminotransferase (AST) were determined (Digital spectrophotometer, Hyperion, China) by using commercial kits (Pars Azmoon, Tehran, Iran). Whole blood glucose concentrations were measured immediately using a portable glucometer (Glucocard 01, Arkray, Japan).

Statistical analyses

Values were expressed as means ± SEM. Analysis of variance was performed on all data using General Linear Models (GLM) procedure of the SAS 9.4 software. Each bird was a replicate and each treatment had 10 replicates. The significance of differences among treatments was tested by Duncan's multiple-range test. A level of $P<0.05$ was used as the criterion for statistical significance.

Results

Production Performance and Egg Quality

According to Table 2, hens fed 20 and 40 mg Pioglitazone/day showed higher egg production in total period than other treatments (P<0.05). Furthermore, eggshell thickness was significantly higher at those levels (P<0.05). However, data relating to weights of egg and yolk and yolk percent showed higher values at 0 and 10 levels (P<0.05). Eggshell weight, and Haugh unit weren't affected by feeding Pioglitazone (P>0.05).

Table 2- Production performance and egg quality of hens fed different Pioglitazone levels

Items	Pioglitazone levels (mg/ bird /day) 0	10	20	40	SEM	P value
Number of eggs (means)	24.9 ^{b}	24.5 ^{b}	27.1^{a}	26.5 ^{a}	0.24	0.03
Egg production (%)	59.3 ^{b}	58.3 ^{b}	64.5 ^{a}	63.1 ^{a}	0.62	0.04
Egg weight (g)	67.4 ^{a}	67.3 ^{a}	64.1 ^{b}	63.7 ^{b}	0.36	0.03
Yolk weight (g)	21.04^{a}	21.1^{a}	19.28^{b}	19.21^{b}	0.25	0.02
Yolk percent (%)	31.21^{a}	31.35^{a}	30.07^{b}	30.15^{b}	0.3	0.02
Eggshell thickness (10^{2} mm)	39^{b}	39.09^{b}	39.89^{a}	39.86^{a}	0.05	0.04
Eggshell weight (g)	5.78	5.7	5.75	5.7	0.01	0.62
Haugh unit	69.8	69.63	69.34	69.42	0.82	0.71

Values in rows with different letters differ significantly (P≤0.05).

Necropsy observations and measurements

As shown in Table 3, broiler breeder hens receiving 20 and 40 mg pioglitazone exhibited significant decrease in absolute and relative liver and abdominal fat weight (P<0.05). Liver color scores indicating hemorrhage and steatosis had the best values at levels 20 and 40 mg (P<0.05). However, body weight (BW) was similar among treatments at the end of experiment (P>0.05). Also, ovary and stroma weight at levels of 20 and 40 mg, were significantly lower as compared with control group (P<0.05). In addition, ovary examination showed that feeding pioglitazone at levels of 20 and 40 mg could affect both diameter of F1 follicle and number of small yellow follicle (SYF), (P<0.05). These results indicated that Pioglitazone treatment didn't have any effect on number of large yellow follicle (LYF), (P>0.05), (Table 3).

Table 3- The effect of different levels of Pioglitazone on body and organ weights, liver health and ovarian structure Pioglitazone levels (mg/ bird /day)

Items	0	10	20	40	SEM	P value
Body weight (kg), start	3.92	3.9	3.91	3.89	0.05	0.23
Body weight (kg), end	4.15	4.13	4.15	4.16	0.06	0.45
Liver weight (g)	73.3^{a}	71.5^{a}	63^{c}	61.8^{c}	2.2	0.01
Fractional liver weight (g), (g/100g body weight)	1.76^{a}	1.73^{a}	1.52^{b}	1.48^{b}	0.02	0.01
Abdominal fat weight (g)	165.5^{a}	164^{a}	145^{b}	144.3^{b}	4.3	0.01
Fractional abdominal fat weight (g/100g body weight)	3.99^{a}	3.97^{a}	3.49^{b}	3.48^{b}	0.02	0.01
Liver color score	3.3^{a}	3.1^{b}	1.7^{c}	1.5^{d}	0.01	0.03
Ovary weight (g)	66.1 ^{a}	66.2 ^{a}	56.9 ^{b}	54.7 ^{c}	0.91	0.04
Stroma weight (g)	13.5 ^{a}	12.6 ^{b}	9.1 ^{c}	8.9 ^{c}	0.9	0.04
Diameter of F1 follicle (mm)	31.7 ^{a}	31.8 ^{a}	29.2 ^{b}	29 ^{b}	0.5	0.04
Large yellow follicle (n)	5.7	5.6	5.6	5.5	0.1	0.32
Small yellow follicle (n)	14.2 ^{b}	14.5 ^{b}	15 ^{a}	15 ^{a}	0.15	0.02

Values in rows with different letters differ significantly (P≤0.05).

Plasma biochemical parameters and H:L ratio

Values obtained from plasma biochemical parameters are presented in Table 4. Pioglitazone treatment at levels of 20 and 40

mg/bird/day had a significant effect on all of items evaluated (P<0.05). However, pioglitazone at 10 mg concentration didn't cause significant alterations in plasma parameters (P>0.05). In addition, H:L ratio were statistically different at 20 and 40 levels than 0 and 10 levels (P<0.05).

Table 4- The effect of different levels of Pioglitazone on blood and plasma parameters

	Pioglitazone levels (mg/ bird /day)					
Items	0	10	20	40	SEM	P value
Glucose (mg/dl)	217[a]	218[a]	213[b]	214[b]	0.85	0.01
Cholesterol (mg/dl)	188 [a]	189 [a]	175 [b]	171 [b]	1.58	0.03
TAG (mg/dl)	1908[a]	1894[a]	1799[b]	1792 [b]	14.34	0.01
LDL (mg/dl)	67 [a]	66 [a]	61 [b]	58 [b]	0.71	0.02
HDL (mg/dl)	51 [b]	50 [b]	56 [a]	56 [a]	1.8	0.03
ALT (units/L)	29 [a]	28 [a]	24 [b]	23 [b]	1.3	0.04
AST (units/L)	252 [a]	249 [a]	238 [b]	237 [b]	3.5	0.02
H to L ratio	0.651[a]	0.649[a]	0.601[b]	0.608[b]	0.01	0.03

TAG, triacylglycerol; LDL, low density lipoproteins; HDL, high density lipoproteins; AST, aspartate aminotransferase; ALT, alanine aminotransferase; H to L, heterophil to lymphocyte.
Values in rows with different letters differ significantly (P≤0.05).

Discussion

The present study evaluated the effects of Pioglitazone, as a synthetic drug of reducing hyperglycemia and hyperlipidemia, on productive performance and plasma metabolites of post-peak broiler breeders. As observed in results, at the end of experiment, productive performance of hens fed 20 and 40 mg Pioglitazone per day had better values. The main problems of broiler breeder farms were a reduction in laying persistency, shell quality, female fertility, and an increase in egg size after 40 weeks of age. It is reported that an increase in egg size leads to thin-shelled eggs and in turn, it causes lower fertility and hatchability (Roque and Soares 1994). On the other hand, it is shown that yolk weight is highly correlated with egg weight and size (Bennion and Warren 1933; Jull 1924). So, by the reduction of yolk weight at the final weeks of production, eggs may be formed with thicker shell and, subsequently, higher fertility and hatchability. Pioglitazone at the levels of 20 and 40 mg could decrease yolk and egg weight; and increase shell. In chickens, TAG provides 93 % of yolk lipid and 66% of yolk solids (Walzem and Chen 2014). Pioglitazone, as a lipid-lowering agent, decreased plasma TAG and it could reduce its uptake for forming yolk in follicles. Accordingly, improved egg-shell thickness observed in the present study may be due to produce of lighter yolks and, subsequently, smaller eggs. Chen et al. (2006) showed that an increase in yolk weight of feed-satiated hens coupled with declining egg production. They concluded that less egg production could result in prolonging the retention of follicles within the hierarchy that allow more internalizing of plasma yolk-targeted lipoprotein (Chen et al. 2006). On the other hand, Pan et al. (2012) suggested that ovarian activities regress with the progression of obesity. They indicated that obesity-associated ovarian dysfunction led to granulosa cell death, overt follicle atresia, and finally ovarian involution (Pan et al. 2012). TZDs could reduce insulin-driven ovarian and adrenal hyperandrogenism and it could usually restore normal LH and FSH secretion and facilitate normal ovulatory cycles (Glueck et al. 2003). In women with polycystic ovarian syndrome (PCOS), insulin-sensitizing drugs could achieve a better ovulatory rate (Nestler et al. 2002; Sangeeta 2012). Hence, improved egg production observed at levels of 20 and 40 mg may result from the beneficial effects of Pioglitazone on the secretion of sexual hormones and the improvement of follicle and ovary structure, similar to those in women with POCS.

Necropsy observations indicated that higher levels of Pioglitazone could effectively

improve liver and abdominal fat weight, as well as liver color scores. The accumulation of excess TAG and FAs in nonadipocytes results in lipotoxicity, cellular dysfunction, and cell death (Unger 2002). The beneficial effects of the thiazolidinediones, Pioglitazone as a member of this family, on metabolism are believed to be mediated by their binding to the nuclear receptor PPAR γ (Spiegelman 1998). These receptors are most abundant in adipocytes and are present in low concentrations in muscle (Vidal-Puig et al. 1997). Pioglitazone stores lipids in proper site (adipose tissue) and it can prevent lipopenic dysregulation and lipotoxic mechanisms possibly through activating PPAR γ (Yki-Järvinen 2004). Since hens receiving higher levels of treatment had lighter abdominal fat, it seems that Pioglitazone shifted fat distribution to subcutaneous (SC) adipose depots. However, our experiment didn't measure amount of stored fat in SC area. Compatible with this hypothesis, Miyazaki et al. (2002) and Rasouli et al. (2005) demonstrated that Pioglitazone-induced decreainge in visceral fat is associated with a shift of fat distribution from visceral to SC depots. Furthermore, it is reported that PPAR γ activation results in differentiation and proliferation of preadipocytes into mature fat cell, particularly in SC fat depots (Kajita et al. 2012). In addition to abdominal fat, lighter and healthier livers observed at this study may be due to less deposit of fat in this organ. Fatty liver occurs in birds when the increase in lipogenesis exceeds the capacity of synthesis and secretion of lipoproteins (Hermier 1997). Several studies reported that unbalanced feed intake in hens can cause heavier livers with fatty liver hemorrhagic syndrome (Butler 1976; Chen et al. 2006; Pan et al. 2014; Trott et al. 2013; Walzem et al. 1993). However, it has been reported that treatment with PPAR γ agonists, including pioglitazone, improved hepatic steatosis in animal models and patients with non-alcoholic fatty liver disease (Belfort et al. 2006; Sanyal et al. 2010; Wu et al. 2010). In the present study, it seems that Pioglitazone at 20 and 40 mg levels, through shifting lipids to adipose tissue, prevented depositing fat in liver and consequently, improved its color and weight. In addition, it can be concluded that ovarian and stroma weight were the lowest values at higher levels of Pioglitazone. Overall, an interesting result in our necropsy observations was lighter color of ovary and stroma in hens receiving 20 and 40 mg Pioglitazone than control hens.

Also, monitoring the levels of plasma biochemical parameters during 40 to 60 week-age showed that as hens get older, their plasma became more lipemic; the mentioned study also indicated a correlation between plasma lipids and productive and reproductive performance (Unpublished data). The present study demonstrated that levels of 20 and 40 mg/bird/day Pioglitazone could effectively decrease plasma glucose, TAG, LDL and cholesterol concentrations, while increase HDL level. The changes in plasma lipids were comparable in some aspects to those that occur in Pioglitazone-treated mammals (Aghamohammadzadeh et al. 2015; Betteridge 2007; Clark et al. 2014; Hussian et al. 2016; Thomas et al. 2007; Yousefi et al. 2016) and laying hens treated with lipid-lowering drugs (Chen et al. 2011; Mori et al. 1999). Pioglitazone alters the transcription of genes influencing carbohydrate and lipid metabolism, results in changing the amounts of protein synthesis and, therefore, metabolic changes (Smith 2001). Although insulin is the most well-defined hormonal mediator of metabolism in mammals, its role in chicken remains to be clarified (Ji et al. 2012). Therefore, it is possible that observed effects of Pioglitazone on glucose and other metabolites mediated through mechanisms beyond insulin regulation. In addition, it is well known that abdominal fat has been linked to metabolic disturbances and it directly links with higher total cholesterol, TAG and LDL but lower HDL, and insulin resistance (Fujioka et al. 1987). In agreement with the recent study, hens receiving 20 and 40 mg Pioglitazone had lighter abdominal fats and showed lower lipid concentrations. However, further investigation needs to be performed to

clarify mechanism of Pioglitazone on blood metabolites in broiler breeders.

Pioglitazone also could decrease the activity of liver enzymes indicating liver damage. Elevated liver enzymes may demonstrate inflammation or damage of hepatocytes (Giannini et al. 2005). Indeed, the excess in plasma free FAs is known to be directly toxic to hepatocytes and thus, increases ALT and AST. The possible mechanisms of improving liver enzymes with Pioglitazone treatment can not be defined from the results of the present study or the above-mentioned reports. However, it is possible that changes in plasma lipids contribute to Pioglitazone-associated improvement of liver enzymes. Damaged liver highly correlated to ovarian abnormalities and, therefore, it leads to decline in egg production of laying hens (Chen and Walzem 2006). In current study, Pioglitazone, improved liver weight, score and activity and subsequently, egg production through preventing deposit of lipids in liver.

Experimental work in animal models and some human studies suggested that synthetic PPAR γ agonists such Pioglitazone may not only regulate metabolic processes, but also might limit inflammatory responses (Scheen et al. 2015). Systemic inflammation can be measured by using a variety of biochemical and haematological markers. H:L ratio is an important indicator of inflammation in birds that could be calculated easily. Our results indicated that H:L ratio decreased in hens receiving 20 and 40 mg Pioglitazone. Mammalian neutrophils is equivalent to avian heterophils and there are studies on mammals that are compatible with the recent results (Ibáñez et al. 2007; Imamoto et al. 2004). Liu et al. (2014) suggested that the immune cells, especially heterophils, infiltrate within F1 follicular layers of lipotoxic hens (hens fed *ad libitum*) and it could lead to delay in the ovulatory process and impairment in egg formation. Hence, it could be assumed that higher egg production in hens receiving 20 and 40 mg Pioglitazone may result from the less infiltrating heterophils within layers of F1 follicle and, subsequently, the less delay in the ovulation.

Conclusion

In conclusion, results indicated that treatment at the levels of 20 and 40 mg/bird/day could improve performance of post-peak female broiler breeders through lowering plasma lipids and subsequently, modifying Lipotoxicity. However, it is important to define the exact role of Pioglitazone on fertility and hatchability of eggs.

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تاثیر پیوگلیتازون روی عملکرد و لیپید پلاسمای مرغ‌های مادر پس از اوج تولید

مهدی حیدری عمله[1]، احمد زارع شحنه[2*] و مجتبی زاغری[2]

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[1] دانشجو دکتری، گروه علوم دام، پردیس کشاورزی و منابع طبیعی، دانشگاه تهران، کرج
[2] استاد، گروه علوم دام، پردیس کشاورزی و منابع طبیعی، دانشگاه تهران، کرج
[*]مسئول مکاتبه: Email: azareh@ut.ac.ir

چکیده

مقدمه: تجمع زیادی تری‌گلیسرید و اسیدهای چرب در سلول‌های غیر چربی منجر به مسمومیت چربی، عملکرد ناقص سلولی و مرگ سلولی می‌شود. گرچه محدودیت خوراکی یک ابزار مدیریتی عملی و کارآمد برای پیشگیری از چاقی در مرغ‌های مادر است، با این وجود بعد از اوج تولید مرغ‌ها تمایل به افزایش وزن دارند. مسمومیت چربی در سلول‌های کبدی و سلول‌های فولیکولی مرغ‌های تخمگذار می‌تواند باعث عملکرد ناقص کبد، ناهنجاری‌های تخمدانی و نهایتاً کاهش تولید تخم‌مرغ شود. **هدف:** این مطالعه برای تعیین اثر پیوگلیتازون روی تولید تخم‌مرغ و فراسنجه‌های خونی مرغ‌های مادر گوشتی انجام شد. **مواد و روش‌ها:** بنابراین، ۴۰ پرنده از سن ۴۵ تا ۵۱ هفتگی به طور تصادفی به چهار گروه تیماری تقسیم شدند و جیره پایه‌ای که سطوح مختلف پیوگلیتازون (۰، ۱۰، ۲۰ و ۴۰ میلی‌گرم/پرنده/روز) را داشت به مرغ‌ها تغذیه شد. **نتایج:** نتایج نشان داد که سطوح ۲۰ و ۴۰ میلی‌گرم، تولید و کیفیت تخم‌مرغ را بهبود می‌بخشد ($P<0/05$). از لحاظ لیپیدهای پلاسمایی، پیوگلیتازون در سطوح ۲۰ و ۴۰ میلی‌گرم اثرات هایپولیپمیک داشت و توانست غلظت گلوکز، تری-گلیسرید، لیپوپروتئین کم چکال و کلسترول را کاهش دهد ($P<0/05$). همچنین، فعالیت آنزیم‌های کبدی (معیاری از سلامت کبد) نیز در مرغ‌های دریافت کننده ۲۰ و ۴۰ میلی‌گرم پیوگلیتازون بهبود یافت ($P<0/05$). علاوه بر این، مشاهدات کالبدشکافی نشان داد که وزن کبد و چربی شکمی به طور معنی‌داری با افزودن ۲۰ و ۴۰ میلی‌گرم پیوگلیتازون به جیره هر مرغ کاهش می‌یابد ($P<0/05$). **نتیجه‌گیری نهایی:** براساس نتایج این پژوهش، پیوگلیتازون در سطوح ۲۰ و ۴۰ میلی-گرم/پرنده/روز از طریق کم کردن لیپیدهای پلاسما، می‌تواند عملکرد مرغ‌های مادر را پس از اوج تولید بهبود بخشد.

واژگان کلیدی: مرغ مادر گوشتی، پس از اوج تولید، پیوگلیتازون، لیپیدهای پلاسما