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INFLUENCE OF GLYCEROL MONOLAURATE AND LYSOFORTE ON SERUM BIOCHEMICAL PARAMETERS, NUTRIENT DIGESTIBILITY, AND LIVER HISTOLOGY IN BROILER CHICKENS

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ABSTRACT

This study investigated the results of using dietary supplements with glycerol monolaurate (GML) and lysoforte (LFT) on broiler chickens' serum biochemistry, nutrient digestibility, and liver morphology. A 35-day trial was conducted using 240 newly hatched avian Cobb broiler chicks, divided into four dietary treatments at random: 1) a basic control diet (CON), 2) basal diet with 0.025% Lysoforte, 3) basal diet with 0.05% Glycerol monolaurate, and 4) a combination of 0.05% Glycerol monolaurate + 0.025% Lysoforte. Each treatment included 4 replicates with 15 chicks per replicate. The results showed no significant changes in liver enzyme activity (AST, ALT, ALP), total protein, albumin levels, or indicators of kidney function (creatinine, urea, and uric acid) among treatment groups, compared to the control. Serum lipid profiles remained largely unaffected, except for increased HDL-cholesterol in birds fed diets containing GML and LFT. Serum glucose concentration significantly decreased with GML supplementation. While dry matter digestibility was not influenced, fat digestibility improved with LFT and GML supplementation. Histological examination revealed normal and healthy liver structures across all treatment groups. These findings suggest that dietary GML and LFT enhance fat utilization without adverse effects on liver or kidney functions, offering potential benefits for broiler production.

Keywords: Glycerol monolaurate, Lysoforte, serum analysis, nutrient digestibility, liver histomorphology

INTRODUCTION

Antibiotics were widely used in large-scale poultry farming to support intestinal health, leading to healthier chickens and faster growth rates. However, since 2006, the European Union has banned antibiotics in animal feed, which has created major challenges for the farming industry. These challenges include a greater risk of disease, reduced production efficiency, increased reliance on therapeutic drugs, and rising costs (Shao *et al.*, 2021). This ban has driven the search for alternative solutions. Plant extracts have emerged as a promising option, as they can improve animal nutrition and nutrient absorption, inhibit harmful microorganisms, and promote gut health and balance (McGaw, 2013).

Glycerol monolaurate (GML), a glycerol monoester of the medium chain fatty acid (MCFA; lauric acid, C12), is a naturally occurring compound present in coconut oil

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and some American spices, and it is approved by the US Food and Drug Administration (FDA) as a plant-based feed additive (Jiang *et al.*, 2018; Schlievert *et al.*, 2019; Welch *et al.*, 2020). GML exhibits powerful antibacterial, antiviral, antioxidant, and emulsifying properties (Zhang *et al.*, 2009; Seleem *et al.*, 2016). Since it is a natural compound, it does not cause drug resistance or leave residues in animals. Recent research has highlighted its positive impact on broilers, as it significantly promotes growth, enhances antioxidant capacity, and reduces inflammation (Valentini *et al.*, 2020; Kong *et al.*, 2021).

Lauric acid monoglyceride has been demonstrated in several studies to enhance fat digestion and utilization while also considerably boosting feed returns (Decuypere and Dierick, 2003). According to (Lieberman, Enig and Preuss, 2006), monolaurin is a multipurpose substance that has the ability to operate as an emulsifier, enhance physicochemical and bioactive qualities, and have antibacterial capabilities. Emulsifiers are surfactant substances that work on the interface between two immiscible media, such as oil and water (Tan *et al.*, 2016). Lipids in the diet that creatures consume are unable to dissolve in the gastrointestinal tract's water-based environment, requiring bile as well as lipase to facilitate effective breakdown of food (Siyal *et al.*, 2017). In the initial seven days after hatching, chicks produce restricted amounts of bile in addition to lipase, which hampers their ability to degrade fats efficiently (Upadhaya *et al.*, 2017). As a result, using emulsifiers facilitates the breakdown of dietary fats and boosts lipase activity while fat breakdown is occurring (Upadhaya *et al.*, 2018). Additionally, emulsifiers provide a way to deliver fat-soluble vitamins to animals in a water-based form (Namur, Morel and Bickel, 1988). Various kinds of surfactants are utilized in livestock diets, including 1,3-diacylglycerol (1,3-DAG), polyethylene glycol ricinoleate, lysophospholipids (LPLs), Liprex, and Lysoforte booster (Melegy *et al.*, 2010; Aguilar *et al.*, 2013; Tan *et al.*, 2016; Zampiga, Meluzzi and Sirri, 2016; Upadhaya *et al.*, 2017).

Lysoforte is a commercial feed additive composed of lysophospholipids, which are derived from the enzymatic hydrolysis of soy lecithin. It functions primarily as an emulsifier, enhancing fat digestion and absorption in monogastric animals, especially poultry. Because young chicks produce limited bile and lipase, fat digestion is often inefficient during early growth stages. Lysoforte improves the emulsification of dietary fats, making them more accessible to digestive enzymes, thus improving nutrient absorption and energy utilization. Several studies have reported that dietary supplementation with Lysoforte improves growth performance, feed conversion ratio (FCR), and intestinal morphology in broilers (Zampiga, Meluzzi and Sirri, 2016). Emulsifiers have been demonstrated to boost protein absorption efficiency (Maertens *et al.*, 2010; Boontiam, Jung and Kim, 2017), enhance the digestibility of fats, along with the efficient use of apparent metabolizable energy (AME) (Roy *et al.*, 2010). However, there hasn't been any research done on using glycerol monolaurate and lysoforte together. Thus, the purpose of this experiment is to examine how feeding broiler chickens a certain quantity of glycerol monolaurate and lysoforte complexes affects their serum biochemistry, nutrient digestibility, and liver histology.

MATERIALS AND METHODS

Diets preparation and experimental design

The study's experimental protocols were authorized by the Research Ethics Committee of the Institutional Animal Care and Use Committee at the Faculty of Veterinary Medicine, Benha University, Egypt, after thorough review (BUFVTM 09-10-23). In a 35-day trial, 240 one-day-old avian Cobb broilers (males and females) were used. The feeding trial was carried out at the Poultry Research Farm, Faculty of Veterinary Medicine, Benha University, Egypt. Four experimental diets were assigned to the broilers at random, with 16 replicates of 15 broilers per replicate. The dietary treatments comprised 1) control (standard diet only), 2) a standard diet with 0.025% Lysoforte, 3) a standard diet with 0.05% GML, and 4) a standard diet with 0.025% Lysoforte + 0.05% GML. The diets were formulated following the guidelines outlined by (Dale, 1994) (Table 1). The floor of the room was lined with a 10 cm layer of wood shavings, which was turned weekly. Each replicate had continuous access to one plastic feeder and one plastic waterer. The room temperature was controlled thermostatically at 33°C ± 1°C during the primarily seven days. After that, it was gradually reduced to 24°C ± 1°C, with the humidity consistently maintained at 60%.

Table 1: The ingredients and nutrient composition of the basal diet

Ingredients%	Starter diet (0-10 days)	Grower diet (11-24 days)	Finishing diet (25-35 days)
Yellow corn	56.10	60.9	65
Soybean meal 46	35	27.8	23.8
Corn gluten meal	3.7	4.5	4
Soybean oil	0.35	2.3	3
Lime stone	1.45	1.35	1.4
Di calcium phosphate	1.75	1.7	1.35
Vit&min premix*	0.3	0.3	0.3
DL –Methionine	0.27	0.26	0.23
L –Lysine	0.3	0.35	0.31
Sodium chloride	0.25	0.25	0.25
Sodium bicarbonate	0.17	0.18	0.18
L –Threonine	0.065	0.07	0.06
Choline chloride	0.05	0.05	0.05
Anticoccidia	0.025	0.025	0.025
Toxisorb	0.05	0.05	0.05
Antimycotoxin	0.1	0.1	0.1
Chemical analysis			
ME (Kcal/g)	2.89	3.09	3.17
CP %	23.01	20.98	18.84
CF %	3.08	2.80	2.64
Calcium %	1.03	0.96	0.89
Total phosphorus %	0.68	0.64	0.55
Available phosphorus%	0.45	0.43	0.35
Sodium %	0.19	0.17	0.17
Chloride %	0.28	0.26	0.25
Lysine %	1.43	1.28	1.13
Methionine %	0.66	0.63	0.56
Threonine %	0.93	0.84	0.76
Methionine and cysteine %	1.03	0.97	0.88

*The vitamin and mineral premix provided each kilogram of feed with: Vitamin A 12000 IU; vitamin D32000 IU; vitamin E 10 mg; vitamin K32 mg; vitamin B11 mg; vitamin B25 mg; vitamin B61.5 mg; vitamin B120.01 mg; Biotin0.05 mg; pantothenic acid 10 mg; Nicotinic acid 30 mg; Folic acid 1 mg; Manganese 60 mg; Iron 30 mg; Copper10 mg; Iodine 1 mg; Selenium 0.01 mg; Cobalt 0.01 mg.

Serum biochemical analysis

On day 36, birds had been arbitrarily chosen out of each group after a 12-hour fast, and blood specimens were gathered from the brachial vein. These specimens were permitted to rest for two hrs prior to undergoing centrifugation at a speed of 3000 revolutions per minute for 15 mins. Serum concentrations were analyzed using kits from Bio diagnostic Institute (Dokki, Giza, Egypt), adhering to the manufacturer's instructions for assessing total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), ALP, ALT, AST, albumin, total protein, uric acid, urea, creatinine, and glucose.

Nutrient Digestibility

During the final 5 days of the study, three birds per replicate were retained for assessing the digestibility of nutrients using chromic oxide (Cr2O3) (0.5%) (Scott and Boldaji, 1997). Excreta was collected daily from each replicate during the study and kept at -20°C till analyses. Before analytical examination, the excreta specimens were thawed and dehydrated using a forced-air oven (model FC-610, Advantec, Toyo Seisakusho Co. Ltd., Tokyo, Japan) at 50°C just for seventy-two hours. Once dried, the samples were finely ground to filter through a 1-millimeter sieve. Every sample of feces was subsequently examined for dry matter (DM) and lipid content. Chromic oxide level was quantified by means of UV absorption spectrophotometry (UV-1201, Shimadzu, Kyoto, Japan). Digestibility was determined applying the subsequent equation:

$$Digestibility = 100 - \left(\frac{Nf \times Cd}{Nd \times Cf}\right) \times 100$$

Nf represents the concentration of nutrient in the excreta (% DM), Nd is the concentration of nutrient in the feed, Cd is the chromic oxide concentration in the feed, and Cf is the chromic oxide concentration in the excreta.

Liver Morphology

Upon finishing the experiment, five birds from each group were chosen by random selection for slaughtering by the halal method after fasting for 12 hrs to collect liver samples. Liver samples were obtained from the left lobe of slaughtered birds, as outlined by Abdul Basit *et al.*, (2020). Liver samples were fixed and preserved in 10% neutral buffered formalin solution. Once fixed, Paraffin was used to embed the tissue samples for preservation and processed according to the conventional alcohol-xylene methodology. An automated microtome was used to cut sections of the paraffin-embedded tissues to a thickness of 5 µm, and the standard hematoxylin and eosin technique was used for staining (Culling, 1974).

Statistical analysis

The recorded data was assessed through the ANOVA technique in SPSS software, version 16.0 (SPSS Inc., Chicago, IL). One-way ANOVA was used to evaluate changes caused by supplementing the diet with Lysoforte and Glycerol monolaurate, and the Tukey test was used to identify significant means. Significant statistical differences were acknowledged when $P < 0.05$.

RESULTS

Serum biochemical analysis

The enzymatic activity in the liver (AST, ALT, and ALP), along with the levels of total proteins and albumin, showed no significant changes in the serum of broilers consuming dietary treatments containing LFT plus GML as opposed to the control group ($P>0.05$). Renal activity markers (Creatinine, Urea, and Uric acid) were also unaffected by the inclusion of LFT or GML in the diet ($P>0.05$). Serum lipid profiles (Total cholesterol, Triglycerides, and LDL-cholesterol) did not show significant changes, except for HDL-cholesterol, which elevated in birds receiving a diet enriched with LFT and GML. Additionally, the serum glucose concentration significantly decreased in broilers fed a GML-supplemented diet ($P<0.05$) **(Table 2)**.

Table 2: Effect of LFT, GML and mixture of them on serum biochemistry

Parameters	G1	G2	G3	G4	P value
AST	184.23±6.14	191.50±18.28	207.07±10.90	189.27±21.67	0.755
ALT	5.16±0.40	5.00±0.15	3.40±0.41	4.66±0.69	0.093
ALP	359.48±1.21	351.73±1.87	355.63±1.60	352.81±8.24	0.615
Total protein	2.69±0.14	2.77±0.10	2.94±0.04	2.64±0.08	0.254
Albumin	1.14±0.07	1.30±0.01	1.43±0.02	1.35±0.01	0.162
Creatinine	0.36±0.03	0.37±0.02	0.36±0.01	0.43±0.01	0.133
Urea	2.54±0.32	2.67±0.12	1.98±0.28	2.90±0.12	0.104
Uric acid	10.40±2.00	6.50±2.60	8.40±1.83	8.10±2.40	0.684
Cholesterol	107.43±6.92	102.30±5.99	122.23±2.62	110.97±6.49	0.172
Triglycerides	108.33±1.76	108.00±1.73	119.67±8.96	117.00±4.35	0.325
LDL-cholesterol	30.60±4.61	16.90±5.65	32.36±1.18	24.18±1.91	0.075
HDL-cholesterol	55.76^{b}±2.20	66.50^{ab}±3.82	65.93^{ab}±3.23	77.10^{a}±1.19	0.005
Glucose	262.30^{a}±4.54	250.44^{a}±6.16	189.01^{b}±17.02	241.07^{a}±0.89	0.003

Means signified by a and b are statistically distinct ($p < 0.05$) among the groups within the same row.
G1: control; G2: 0.025% LFT; G3: 0.05% GML; G4: 0.025% LFT+0.05%.

Nutrient Digestibility

Our results observed no significant effect of LFT or GML on the DM digestibility, while lipid digestibility was boosted by LFT and GML enrichment **(Table 3).**

Table 3: Effect of LFT, GML and mixture of them on dry matter and fat digestibility

Parameters	G1	G2	G3	G4	P value
Dry matter digestibility	83.17±3.12	84.04±0.76	81.85±0.37	86.66±0.25	0.272
Fat digestibility	53.96^{b}±2.89	64.24^{a}±2.40	60.21^{ab}±1.82	67.63^{a}±0.79	0.001

Means signified by a and b are statistically distinct ($p < 0.05$) among the groups within the same row

Liver Morphology

The liver tissue from all treatment groups displayed normal and healthy structures, including well-organized hepatic cords, intact central veins, and clearly defined sinusoids with no signs of degeneration, inflammation, or cellular infiltration **(Figure 1).**

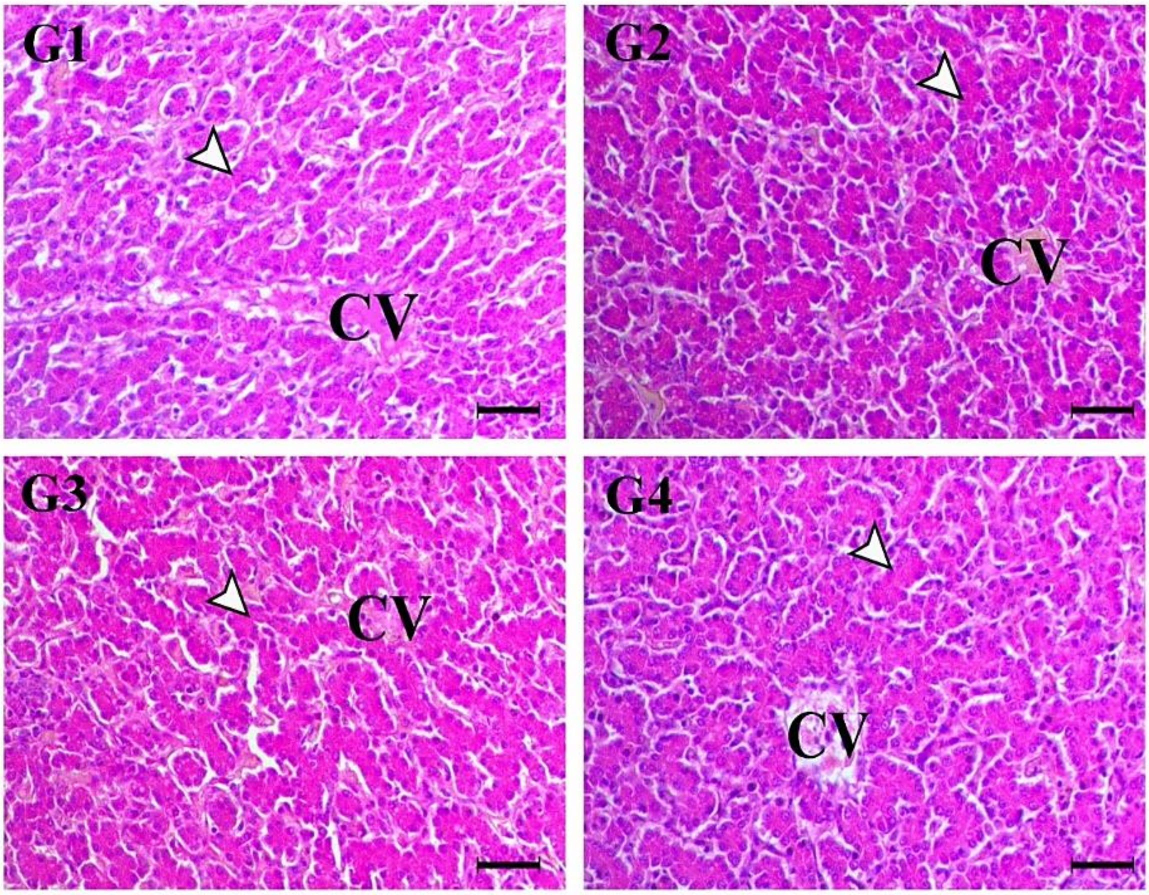

Figure 1: Representative photomicrographs of liver sections from broiler chickens in different treatment groups stained with hematoxylin and eosin (H&E).

G1: Liver of control bird supplemented with basal diet showing normal hepatocytes with decrease the diameter of the hepatic plate with dilated sinusoids in between (arrowhead) around the central vein (CV), H&E, X200, bar= 50 µm.

G2: Liver of lysoforte (LFT) supplemented group showing normal hepatocytes (arrowhead) around the central vein (CV), H&E, X200, bar= 50 µm.

G3: Liver of glycerol monolaurate (GML) supplemented group showing normal hepatocytes (arrowhead) around the central vein (CV), H&E, X200, bar= 50 µm.

G4: Liver of with LFT and GML blend supplemented group showing normal hepatocytes with increased the diameter of the hepatic plate (arrowhead) around the central vein (CV), H&E, X200, bar= 50 µm.

DISCUSSION

The liver function tests showed no differences between the treatment groups. In consistent with Ali *et al.*, (2023), no variations (P>0.05) were found in the treatments' levels comparing GML and CON of aspartate aminotransferase (AST) and alanine aminotransferase (ALT). Similarly, Ullah *et al.*, (2024) demonstrated that serum biochemical markers like TP, ALB, ALT, AST, and T-CHO showed no significant changes, suggesting that GML exposure did not heavily impact kidney or liver function. Moreover, these outcomes could be related to the normal liver tissue morphology. Hepatocellular damage is typically signaled by changes in serum concentrations of AST and ALT enzymes (Suckow, Stevens and Wilson, 2011). Comparable findings have been previously observed among rats receiving virgin coconut oil treatment (Kabara, 2000). Contradictory findings were observed in a study on rainbow trout, where emulsifiers reduced liver enzyme activity levels (Taghavizadeh *et al.*, 2020). In our study, GML and LFT had no significant effect on lipid profiles except for HDL-C, which showed an increase. The current findings align with previous studies, which reported that administering GML at a dosage of 150 mg/kg for up to 8 weeks led to significant changes in HDL-C (Jiang *et al.*, 2018; Li *et al.*, 2019). Our findings show a discrepancy with previous studies where a long-term coconut oil-rich diet was associated with lower fasting LDL-C levels (Cox *et al.*, 1995, 1998). Additionally, it has been reported that monolaurin increased triacylglycerol, VLDL, and HDL levels while decreasing LDL (Resende *et al.*, 2016). GML, a naturally occurring monoglyceride in coconut oil (Zhang, 2018), may have shown differing effects due to variations in dosage and duration of administration compared to those earlier studies. Serpunja and Kim, (2019) and Guerreiro Neto *et al.*, (2011) found that the application of emulsifiers had no discernible effect on serum TG, cholesterol, HDL-c, and LDL-c values in broilers. However, earlier findings have shown a significant drop in cholesterol and LDL-c levels when LPLs were added to broiler diets (Roy *et al.*, 2010). The variance in findings could be caused by the specific emulsifier type employed, its amount of incorporation, and differences in investigative settings between research trials. Concerning glucose level, our results revealed a lower level of glucose in the serum of birds that consume AML in the diet only. In line with Zhang *et al.*, (2022), who showed that supplementation with GMD resulted in a marked decrease in blood glucose levels, insulin resistance index, and inflammation. In contrast, Mo *et al.*, (2019) discussed that there were no notable changes in glycemic markers, including fasting blood glucose levels. Bontempo *et al.*, (2018) observed no effect of synthetic emulsifier on glucose level. Dietary treatments with emulsifier had no impact on plasma levels of LDL-c, TGs, glucose, GOT, albumin, creatinine, or uric acid (Saleh *et al.*, 2020).

Dry matter digestibility showed insignificant differences among the different groups. In contrast, fat digestibility increased with the inclusion of LFT and GML in the broiler diet. In agreement with our results,, the presence of emulsifiers in the diet has recently gained interest as an effective strategy to improve overall efficiency of fat digestion and nutrient benefit in broiler feeding programs (Guerreiro Neto *et al.*, 2011; Siyal *et al.*, 2017; Bontempo *et al.*, 2018; Upadhaya *et al.*, 2018; Ahmadi-Sefat *et al.*, 2022). These findings have shown that birds given an emulsifier experience better growth performance, largely due to improved dietary fat absorption. The presence of dietary emulsifiers can strengthen emulsification, which involves bile salts stabilizing and clarifying the fat droplet surface, enabling lipase to adhere to the surface junction (Siyal *et al.*, 2017). The adsorption-desorption equilibrium, which is impacted by amphiphilic substances including lipids, proteins, and phospholipids, may also be improved by fortifying the diet with an emulsifier (Majdolhosseini *et al.*, 2019). As a result, the modifications brought about by the exogenous emulsifier may enhance the absorption of nutrients via the intestinal cell membrane, increasing the feed's nutrient bioavailability. In contrast, Gholami *et al.* (2024) observed an improvement in DM digestibility, while the digestibility of other nutrients showed no significant changes with the addition of an emulsifier to the diet. Animal studies have shown that supplementing diets with MCFAs and the corresponding glycerides enhanced digestibility and nutrition utilization in rats, pigs, and Atlantic salmon (Takase and Hosoya, 1986; TAKADA *et al.*, 1994; Nordrum *et al.*, 2000). A potential justification for this is that MCFAs stimulate the release of cholecystokinin, a peptide hormone in the digestive tract, which triggers a release of lipase and protease (TAKADA *et al.*, 1994).

GML, a medium-chain fatty acid monoglyceride being a natural constituent of coconut oil, can advance into deeper gastrointestinal areas due to its ester linkage protection. These properties make GML special and capable of significantly influencing fish digestion and nutrient assimilation (Dierick, Decuypere and

Degeyter, 2003). An additional plausible interpretation is that dietary GML may promote a greater plenty of beneficial gut microbiota-associated bacteria that produce enzymes, as evidenced by animal studies on gilt-head sea bream, hens, and mice (Rimoldi *et al.*, 2018; Mo *et al.*, 2019; Liu *et al.*, 2020).

The liver is essential for various metabolic functions and serves as a key indicator of chemical toxicity, offering important information about its toxic effects and mechanisms(Sauer *et al.*, 2017). No changes in liver histology were found between different treatment groups, except for the increase in the diameter of the hepatic plate around the central vein in the liver of broilers that consumed GML and LFT blend. Similarly, Lonkar *et al.*, (2017) found that the histopathological analysis of the liver in emulsifier groups showed normal structure of the hepatic parenchyma, with intact hepatocytes and vascular tissue. The hepatocytes were arranged in cords and exhibited normal cellular characteristics, including cell size, nucleus, and cytoplasm. There were no signs of metabolic changes, such as fatty infiltration of the hepatocytes or inflammation of the hepatic parenchyma, in any of the sections from the groups. The current findings align with those of Kalmar *et al.*, (2012), who observed no pathological changes in the liver tissues after supplementing N,N dimethylglycine (DMG), an emulsifier, in broiler diets. In alpha monolaurin treatment groups, the liver tissues displayed normal and healthy structures, with the exception of intrahepatic pancreases encircling a branch of the portal vein (Ali *et al.*, 2023). There were no histopathological alterations found in the liver treated with GML (Fortuoso *et al.*, 2020). In contrast, Chris *et al.*, (2024) observed that a 2.5 ml/L dosage of surfactants to Guinean Tilapia caused lesions, inflammation, and necrosis.

CONCLUSION

Dietary supplementation with glycerol monolaurate and lysoforte enhances fat digestibility and improves specific serum biochemical parameters, such as HDL-cholesterol and glucose levels, without negatively affecting liver or kidney functions. Additionally, the normal liver histology observed in all groups confirms the safety of these supplements. Incorporating GML and LFT into broiler diets may be an effective strategy to optimize nutrient utilization and support healthy growth.

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تأثير الجليسيرول مونولورات واللايزوفورت على المعايير البيوكيميائية في الدم، وهضم العناصر الغذائية، وهيكل الكبد في دجاج التسمين

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تهدف هذه الدراسة إلى تقييم تأثير إضافة الجليسيرول مونولورات واللايزوفورت إلى العلف على المعايير البيوكيميائية في الدم، وهضم العناصر الغذائية، وهيكل الكبد في دجاج التسمين. تم إجراء تجربة لمدة ٣٥ يومًا علي ٢٤٠ كتكوتًا من سلالة كوب بعمر يوم واحد، وُزعت عشوائيًا على أربعة معاملات غذائية: المجموعة الاولي تلقت العلف الأساسي فقط، المجموعة الثانية تلقت علف أساسي مضاف إليه ٠,٠٢٥٪ لايزوفورت ، المجموعة الثالثة تلقت علف أساسي مضاف إليه ٠,٠٥٪ جليسيرول مونولورات ، المجموعة الرابعة تلقت علف أساسي مضاف إليه ٠,٠٢٥٪ لايزوفورت+ ٠,٠٥٪ جليسيرول مونولورات. كل مجموعة احتوت على ٤ مكررات، وضم كل مكرر ١٥ كتكوتًا.

أظهرت النتائج عدم وجود تغيرات معنوية في نشاط إنزيمات الكبد أو مستويات البروتين الكلي، الألبومين، ومعايير وظائف الكلى (الكرياتينين، اليوريا، حمض اليوريك) بين المجموعات مقارنةً بالمجموعة الضابطة. كما لم تتأثر مستويات الدهون في الدم بشكل كبير، باستثناء ارتفاع ملحوظ في الكوليسترول عالي الكثافة في الطيور التي تلقت ٠,٠٢٥ % لايزوفورت+ ٠,٠٥٪ جليسيرول مونولورات. بالإضافة إلى ذلك، أدى إضافة الجليسيرول مونولورات إلى انخفاض معنوي في تركيز الجلوكوز في الدم. أما من حيث هضم العناصر الغذائية، فلم يؤثر المكملان الغذائيان على هضم المادة الجافة، لكنهما حسّنا هضم الدهون. وأظهرت الفحوصات النسيجية للكبد البنية النسيجية الطبيعية في جميع المجموعات.

تشير هذه النتائج إلى أن إضافة الجليسيرول مونولورات واللايزوفورت إلى العلف قد تحسن من استغلال الدهون دون أي تأثيرات سلبية على وظائف الكبد أو الكلى، مما يوفر فوائد محتملة في إنتاج دجاج التسمين.