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Linseed oil and coconut oil in broiler feed

Óleo de linhaça e óleo de coco na alimentação de frangos de corte

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ABSTRACT

The objective of this study was to evaluate the effect of the inclusion of 1% of linseed oil and 1% of coconut oil in broilers feeding from one to 21 days, on the performance and serum biochemical levels of cholesterol and triglycerides. A total of 75 male, one-day, Cobb-type chicks were used. Distributed in a completely randomized experimental design, with three treatments and five

replicates and five birds per experimental unit. The birds were housed in galvanized wire cages measuring 0.90m x 0.60m x 0.45m. The use of linseed and coconut oils did not influence weight gain and feed intake, but increased feed conversion over a period of one to seven days. In the period from one to 14 days only the feed intake was influenced by the inclusion of the oils. There was no significant effect on performance in the period from one to 21 days of life. Serum levels of cholesterol and triglycerides were reduced with the use of coconut oil. It is concluded that the use of linseed or coconut oils can be used to feed broiler chickens from one to 21 days, as it does not interfere with the final performance of the birds, and the inclusion of coconut oil benefits the health of the birds reducing the levels cholesterol and triglycerides.

Keywords: Cholesterol, food conversion, Lipid source, Biochemical profile.

1 INTRODUCTION

With the advances in nutrition, zootechnical indexes have improved, but they must be constantly evolving to keep up with the market, which is becoming increasingly competitive (Alves et al., 2015 and Vogado et al., 2016). Therefore, studies with oils are important, because the intake of lipids by birds is essential, not only to meet energy needs, but also to meet the requirements in essential fatty acids, improve the palatability of the feed and the digestibility of other nutrients, health and animal performance.

According to Costa et al. (2008) oils and fats are ingredients widely used as a concentrated source of energy and allow the formulation of high energy diets for poultry. Aiming the appropriate energy balance to meet the high nutritional requirements of broilers, the use of vegetable oils or animal fat in feed has been a constant practice (Murakami et al., 2009).

Vegetable oils become interesting from a feeding point of view for broilers because their use increases energy in feed, improves palatability, and facilitates digestion and absorption of non-lipid constituents in ingredients. Vegetable oils are important sources of unsaturated fatty acids and should be provided via feed to allow for adequate nutrition and production of the animals (Bernardino, 2009; Nogueira et al., 2014).

The lipids used in poultry diets have distinct chemical characteristics, which have an influence on their digestibility by the body, due to the length of the carbon chain, number of double bonds, configuration of the double bonds (cis or trans), position of the fatty acid in the glycerol molecule and the ratio of unsaturated and saturated fatty acids (Nelson & Cox et al., 2014; Bavaresco et al., 2019).

Therefore, due to the large variations of lipid sources, especially in their fatty acid content, it is necessary to know the individual action of the various lipid sources of plant origin in broiler feed in their growth and production aspects, given the scarcity of content in the current literature.

Various types of oils are used in broiler diets, the actual proportion of feed supplement in a broiler diet depends on factors such as availability, relative price and the effect on the food manufacturing process. There is limited information available on the effects of dietary inclusion of different oil sources in modern broilers selected for rapid growth (Amutha & Mani, 2016).

Therefore, it was aimed to evaluate the use of 1% flaxseed oil and coconut oil in the diet of broilers from one to 21 days of age on performance and biochemical cholesterol and triglyceride contents.

2 MATERIAL AND METHODS

The experiment was conducted in the Poultry Sector of the Instituto Federal Goiano - Campus Rio Verde, after approval by the Ethics and Research Committee on Animal Use (CEUA) of the Instituto Federal Goiano Campus Rio Verde, under protocol number 027/2012.

Before the arrival of the flocks, the usual rules were followed for both the house and the batteries, which is a period of cleaning and disinfection of the facilities (screens, curtains, floor, external area, equipment) lasting seven days, two days for cleaning with a spray of quaternary ammonia-based disinfectant and glutaraldehyde and five days for sanitary emptying.

Seventy-five one-day-old male Cobb chicks with an average initial weight of 57.20g were used. They were distributed in an experimental design entirely randomized, with three treatments and five repetitions and five birds per experimental unit. The birds were housed in 15 galvanized wire cages with dimensions of 0.90m x 0.60m x 0.45m.

The birds were fed between 1-21 days of age with a single diet, formulated to meet the nutritional requirements of each phase, following the recommendations of the Brazilian table of poultry and swine (Rostagno et al., 2011).

The treatments consisted of a control diet, without the addition of oil, and two diets in which 1% flaxseed oil and 1% coconut oil were included, "on top", respectively (Table 1).

Feed and water were provided at will throughout the experimental period. The heating was performed using electric hoods containing 60 W lamps until the birds were 15 days old, ensuring a continuous photo-period of 24 hours, guaranteed by the association between natural and artificial light.

The zootechnical performance variables evaluated were average weight, weight gain, feed consumption and feed conversion at 1-7 days, 1-14 days and 1-21 days of age. For this, birds and feed leftovers were weighed at the beginning and end of each phase. The number of dead birds was counted at the intervals as a criterion for correcting feed intake and feed conversion.

Table 1. Centesimal and nutritional composition calculated from the control diet.

Ingredients (kg)	**Centesimal Composition (%)**
Corn	55,95
Soybean Meal	38,05
Common salt	0,350
Phosphate	1,600
Limestone	3,450
Soybean oil	1,00
Cortini AE core 50kg[1]	5,00
Total	100,00
Nutrients	**Nutritional Composition**
ME (kcal/kg)	2870
Raw protein (%)	20,70
Calcium (%)	1,69
Phosphorus disp. (%)	0,62
Total lysine (%)	1,38
Met.+cist. Total (%)	0,93
Total Methionine (%)	0,60
Sodium (%)	0,22

[1]Guabi vitamin-mineral amino acid nucleus for birds: Folic acid 1.600mg, Pantothenic acid 29.000mg, Biotine 60mg, B.H.T. 5.000mg, Niacin 7.000mg, Vitamin A 20.000.000UI, Vitamin B1 3.000mg, Vitamin E 40. 500IU, Vitamin B12 27.000mg, Vitamin B2 12.000mg, Vitamin B6 6.000mg, Vitamin D3 5.000.000IU and Vitamin K3 4.800mg.Manganese 150.000 mg, Zinc 100.000 mg, Iron 100.000 mg, Copper 16.000 mg and Iodine 1.500 mg.

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At 21 days, to determine cholesterol and triglyceride levels, blood was collected from three birds per experimental unit through venipuncture of the brachial vein (wing vein) using a syringe and Vacutainer ®.

The collected sample was processed in the Laboratory of Biochemistry and Animal Metabolism of IFGoiano - Rio Verde Campus, following the methodology of Minafra et al. (2008), with centrifugation at 5,000 rpm for 10 minutes to obtain the serum, which was subjected to analysis of cholesterol and triglycerides using specific kits from the brand Doles.

The data were submitted to analysis of variance by the SISVAR 5.6 program (Ferreira, 2014) and the means were compared using the F test at 5% probability.

3 RESULTS AND DISCUSSION

The mean temperatures (°C) inside the house during the period from 1 to 21 days (Table 2) suggest that the research was carried out in an environment with mild temperatures, since the

maximum temperatures observed did not exceed the thermoneutral zone of the animals. A greater maximum temperature range was observed between 8 and 14 days of age.

According to Furlan & Macari (2008) for one-day-old chicks the thermal comfort zone within an ambient temperature should be between 33 and 35°C. With the development of the broiler, the thermal comfort zone is reduced to approximately 24°C, at three weeks of age.

Table 2. Maximum, minimum and average temperature averages recorded during the different phases of the experimental period.

Phases	Temperatura (°C)		
	Maximum	Minimum	Average
1 to 7 days	27,70	21,70	24,70
8 to 14 days	28,70	22,50	25,60
15 to 21 days	28,20	20,00	24,10
Mean	28,25	21,41	-

According to Bueno et al. (2017) cyclic heat stress affects the performance and biochemical profile of broilers in a milder way than the losses reported by chronic stress, but there are nutritional and non-nutritional strategies to try to reduce the impacts of heat on birds, but it is imperative that a more careful management becomes necessary for today's broilers.

A relevant factor about the addition of oils in feed is the influence they exert on the feed passage rate, decreasing its speed, which favors the digestibility of other nutrients, since they remain longer in the digestive tract, a process known as the extra caloric effect of oils (Furlan & Macari, 2008).

Table 3 shows the weight gain, feed consumption and feed conversion of birds from 1 to 7, 1 to 14 and 1 to 21 days of age.

Weight gain and feed consumption were not significantly influenced ($p>0.05$) by the inclusion of soybean, flaxseed and coconut oils at 7 days of age. According to Murakami et al. (2010) different types of oil added to the feed can influence characteristics such as feed consumption, weight gain and feed conversion, as well as body composition and meat characteristics of broilers. A result, which can be observed in this study where feed conversion was negatively influenced by the inclusion of flaxseed oil and coconut oil.

After hatching, the bird's digestive system is anatomically complete, but its functional capacity does not yet allow for adequate digestion and absorption of all nutrients (Valentim et al., 2020). Thus, the gastrointestinal tract of these animals will undergo morphological changes that will provide an increase in the surface area of digestion and absorption (Silva et al., 2018). Reda et al. (2020) who reported that the greater the degree of unsaturation of the fatty acids of a lipid, the greater the potential for formation of micelles in the intestinal lumen, thus resulting in

improvement in the digestive process and consequently elevation in energy values, and improved growth of the bird. Mirshekar, Dastar & Shargh (2021) evaluating the supplementation of linseed oil, verified that linseed oil guaranteed greater breast weight in the bird, and justified this result by the fact that this oil has in its composition the fatty acid C18:3 (PUFA) in majority, and this supplementation resulted in a 12-fold increase in the total content of C18:3 in the breast muscle, which was not observed in this experiment.

Results contrary to the present study were verified by Stanaćev et al. (2014) who concluded that the introduction of flaxseed oil at 4% and 8% levels in broiler feed had a positive effect on reducing feed conversion.

Table 3. Performance of broilers fed diets containing 1% linseed oil (LO) and 1% coconut oil (CO) at 7, 14 and 21 days of age.

	Treatments			**CV (%)[1]**	**p-value**	**EMP[2]**
	1% SO	**1% LO**	**1% CO**			
1-7 days						
GP (g)	122,830	110,424	115,210	6,53	0,3065	0,4723
CR (g)	162,750	164,254	172,750	6,40	0,3139	0,7692
CA	1,332 B	1,494 A	1,502 A	5,56	0,0090	0,0358
1-14 days						
GP (g)	364,784	367,914	373,502	5,60	0,7988	0,2303
CR (g)	520,800 B	525,604 AB	552,802 A	3,43	0,0360	0,1868
CA	1,420	1,428	1,466	5,20	0,5967	0,0334
1-21 days						
GP (g)	787,576	772,366	786,650	3,83	0,6764	0,4146
CR (g)	1184,882	1190,462	1208,474	8,79	0,9338	0,9700
CA	1,486	1,534	1,542	7,17	0,6878	0,0487

Means followed by different letters in the column differed by the Tukey test (5%). [1] Coefficient of variation; [2]Mean standard error.

From 1 to 14 days of age there was no effect on weight gain and feed conversion in birds fed soybean, flaxseed and coconut oils. However, there was a significant effect ($p<0.05$) for feed consumption, where birds fed diets containing coconut oil had higher feed consumption, but such consumption did not differ significantly from that of birds fed flaxseed oils. Wang et al. (2015) concluded that a 75% replacement of soybean oil in diets with coconut oil is suggested as the optimal level not to influence performance in broilers.

Contrary to this study Yuniwarti et al. (2012) found that coconut oil, can be used in feed to increase broiler productivity as it does not affect bird performance, during any of the rearing periods.

However the feed consumption the birds fed with flaxseed oil were not statistically different from the consumption of the chickens fed with soybean oil. Lopes et al. (2014) and Zhong

et al. (2014) concluded that partial or total replacement of soybean oil with flaxseed oil did not affect feed intake in the one to 14 day period, and improved tibia growth.

There was no significant effect ($p>0.05$) of the inclusion of flaxseed oil and coconut oil on broiler performance in the one to 21 day period. The inclusion of flaxseed oil to broiler feeds improves weight gain in the early (1 to 21 days) rearing stages (Murakami et al., 2009).

Results contrary to the present experiment were observed by Murakami et al. (2010) who concluded that total replacement of soybean oil with flaxseed oil in broiler feed impairs bird performance in the period from 1 to 21 days of age.

According to Khatun et al. (2018) the use of vegetable oils in broiler feed has a favorable effect on the lipid profile of blood serum by decreasing the concentration of serum triglycerides and cholesterol. In Table 4, the mean cholesterol and triglyceride concentrations of the birds at 21 days of age are presented.

Table 4. Concentrations of cholesterol and triglycerides in broiler serum at 21 days.

Treatments	**Cholesterol (mg. dL-1)**	**Triglycerides (mg. dL-1)**
1% Soybean oil	207,599 A	219,40 A
1% Linseed Oil	205,500 A	226,70 A
1% Coconut Oil	186,204 B	200,60 B
CV (%)	8,38	9,70
p-value	0,0005	0,0044
EMP	1,0166	1,5313

Averages followed by different letters in the column differ by Tukey's test (5%); [1] Coefficient of variation; [2] Average standard error.

Serum cholesterol and triglyceride levels were significantly influenced ($p<0.05$) by the use of coconut oil in broiler diets, being reduced with the inclusion of oils in the diet. Similar results were observed by Wang et al. (2015) who concluded coconut oil can reduce fat deposition and favorably affect the lipid biochemical profile without impairing performance in broilers.

Such effect can be explained because coconut oil is highly saturated and 60% of its total fatty acid composition are medium chain fatty acids with chain length of 6 to 12 carbon atoms that are absorbed directly into the portal circulation without re-esterification in intestinal cells, medium chain fatty acids are partially independent of the carnitine transport mechanism in liver mitochondria and are rapidly and exclusively oxidized for energy production (Bhatnagar et al., 2009; Ferreira et al., 2012).

As a result of their faster metabolism and less storage in adipocytes, medium-chain fatty acids reduce fat deposition and improve serum lipid profiles (Takeuchi et al., 2006).

Shunthwal et al. (2017) found that the use of flaxseed oil in broiler feed improves the blood parameters of the birds, a result that was not observed in this study where flaxseed oil had no influence on serum cholesterol and triglyceride contents.

According to Lopes et al. (2014) the partial or total replacement of soybean oil with flaxseed oil did not affect the serum blood profile in broilers. A result that can be observed in this study where flaxseed oil did not alter the levels of cholesterol and triglycerides.

4 CONCLUSION

The inclusion of 1% coconut and flaxseed oil in the diets influences the feed conversion of birds in the period from one to seven days. It increases feed consumption in the period from one to 14 days of age, but the inclusion does not affect performance at 21 days. The inclusion of coconut oil reduces the levels of serum cholesterol and triglycerides, suggesting that such oil can be added to the diet of broilers without harming the biochemical profile of the serum of the birds.

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