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Effect of varying levels of soybean oil on performance, hematology and serum biochemical indices of laying hens

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Target audience: *Researchers, Animal Nutritionists and Poultry Farmers*

Abstract

The study was carried out to determine the effects of soybean oil on performance, hematology and serum biochemical of laying birds. One hundred fifty (150) Isa Brown laying hens at 20 weeks of age were used and the study lasted for 10 weeks in a completely randomized design. The hens were randomly allotted to five dietary treatments namelyT_1 (0% Soybean oil), T_2 (2.5% Soybean oil), T_3 (5% Soybean oil), T_4 (7.5% Soybean oil) and T_5 (10% Soybean oil). The treatments had 3 replicates with 10 birds each. Weekly body weight, feed consumption, daily egg production and egg weight were measured to determine performance. Blood samples were also collected by the 10^{th} week of the trial for haematological and biochemical serum analyses. The results of the study showed no significant difference ($P>0.05$) on weight gain/loss, final weight and egg weight, but there was significant difference ($P<0.05$) in egg production and Feed Efficiency. PCV, Hb, RBC, WBC, Platelets, Neutrophils and Lymphocytes were significantly different ($P<0.05$). Chloride, Bicarbonate, Total Protein and Conjugated Bilirubin also showed significant differences ($P<0.05$). The study, therefore showed that the use of soybean oil affected egg production and feed efficiency and thus, it can be concluded that soybean oil at 10% inclusion level will increase egg production and also positively affect the RBC and Hb, and therefore, it is recommended to be included in layers' diets.

Keywords: *Soybean oil; Performance; Haematology; Laying hens*

Description of Problem

As poultry has grown, so has the need for producers to increase the efficiency of their birds, quality of their product and reduce the cost of production. Layers are poultry birds predominantly reared for the purpose of egg production. They require proper management to attain good weight and for the production of table eggs. Diet formulation and nutrition have an important influence on the health and production capacity of laying hens. Eggs are regarded as complete source of protein because they contain all the essential amino acids, vitamin and minerals. To increase egg consumption as a part of healthy eating, scientists are constantly searching for methods to nutritionally enrich the egg. The total protein, fat and sugar content of the egg cannot be altered much, but it is possible to manipulate fatty acid composition and levels of mineral, vitamins and certain non- nutrient chemical (like pigments and antioxidants) in egg by dietary means (1, 12).Studies have been carried out in recent years, aimed at improving productivity through the use of nutrients that can keep the quality of products and even enrich them with components beneficial to human health (1). The quality of fat ingested is defined by the ratio between saturated and unsaturated fatty acids. The higher the ratio, the greater the amount of unsaturated fatty acids, and the higher their consumption. Mono

and Poly unsaturated fatty do not increase the cholesterol in the blood and are linked to lower risks of cardiovascular diseases (12).

When lipids are added to the diet of laying hens, they increase the energy density of the diet, thereby improving palatability, increasing the metabolic energy efficiency and improving feed conversion, in addition to modifying the fatty acid (FA) profile of the egg yolk (3, 11).The high energy value of soybean oil is attributed to its high percentage of (poly) unsaturated fatty acids, which are well absorbed and utilized as a source of energy by the animal (8). Soybean oil, is composed mainly of oleic, linoleic, linolenic, and palmitic fatty acids. Soybean oil is very rich in polyunsaturated fatty acids (PUFA), particularly Omega-3- fatty acid. Many unsaturated fatty acids can be formed from saturated fatty acids by several reactions, which is followed by elongation and/or desaturation (5). Saturated and monounsaturated fatty acids (MUFA) can be synthesized by animals. The relationship between n-6 and n-3 fatty acids is important to human health because there is competition between the enzymes involved in the elongation and desaturation, for both linoleic acid and linolenic acid, and one cannot be converted into the other(5).Studies on optimal soybean oil levels in layer diets are economically important, since it contributes to enriched egg yolk, egg quality, increase egg production, improves utilization of feed nutrients, which are very important to the health of humans. Therefore, this study is carried out to evaluate the effect of different levels of soybean oil in the diet of laying hens on the performance, hematology and serum biochemicals of laying chickens.

Materials and Method

The experiment was conducted at the University of Port Harcourt demonstration farm, Choba, in Rivers State. One hundred and fifty (150) Isa Brown laying birds of 20weeks of age were used for the study. The birds were properly housed in a battery cage system, and were randomly assigned to five treatments; T_1 (0% Soybean oil), T_2 (2.5% Soybean oil), T_3 (5% Soybean oil), T_4 (7.5% Soybean oil) and T_5 (10% Soybean oil), with each treatment having 3 replicates of 10 birds each. The Completely Randomized experimental design (CRD) was used for the investigation.

The birds were subjected to the same routine management conditions. During the study, water was provided *ad-libitum*, while feed was given at the rate of 150gm per bird daily, and the left over was weighed out, and daily feed intake computed. Routine management practices such as feeding, medications, cleaning, disinfection and environmental sanitation were carried out throughout the experimental period.

The experimental diets were formulated, as shown on Table 1, and the duration of study was 10 weeks.

Initial body weight of the birds was taken at the start of the experiment and subsequently on weekly basis. The performance of the birds in terms of daily egg production and egg weights were also recorded. The blood samples of the birds in all the treatments were collected, via the wing vein and used for the haematological and serum biochemical analyses.

Data generated were analyzed, using the One-way Analysis of Variance (ANOVA) (SPSS Software 20). Duncan Multiple Range Test (DMRT) was used to separate the treatment means where significant treatment effects exist.

Table 1: Experimental Diets Composition

Ingredients	TRT 1	TRT 2	TRT 3	TRT 4	TRT 5
Maize	50	40	30	20	10
Maize offal	2	6	16.2	23.7	31.7
PKC	8.5	12	10	10	10
Soya bean cake	8	8	8	8	8
Groundnut cake	8.2	8.2	8	8	8
Fish meal	5	5	5	5	4.5
Wheat bran	11.5	11.5	11	11	11
Soya bean oil	0	2.5	5	7.5	10
Bone meal	3	3	3	3	3
D-L Methionine	0.5	0.5	0.5	0.5	0.5
Lysine	0.5	0.5	0.5	0.5	0.5
Vit/Mineral Premix	2.5	2.5	2.5	2.5	2.5
Salt	0.3	0.3	0.3	0.3	0.3
Total	**100**	**100**	**100**	**100**	**100**
ME (Kcal/Kg)	**2611.42**	**2637.91**	**2659.28**	**2681.44**	**2698.49**
Crude protein (%)	**18.44**	**18.67**	**18.41**	**18.38**	**18.09**
Oil (%)	**3.91**	**6.56**	**9.38**	**12.12**	**14.88**
Crude fibre (%)	**5.10**	**5.65**	**5.92**	**6.30**	**6.71**

Results and Discussion

In this study the values of the initial weight, final weight, weight gain/loss, and egg weights were not significantly affected by the dietary treatments. This is a positive outcome, as weight gain is not a desirable feature for laying birds. However, egg production and feed efficiency were significantly affected, such that the highest value was recorded on Treatment 5, which was higher than the control values. This is in agreement with the conclusion of (6), where he stated that increasing dietary fat significantly increased egg weight and egg production. The findings of this study also agree with the report of (5), where they did not observe worse performance and hematological changes in heavy layers fed a diet containing 2% soybean oil as compared to those fed a control diet based on corn meal. According to reports (3, 11),when lipids are added to the diet of laying hens, they increase the density of the diet, improve palatability, increase the metabolic energy efficiency, increase egg production and also improve feed conversion, which is similar to the observations made in this study.

The White Blood Cell, Packed Cell Volume, Hemoglobin, Red Blood Cell and Lymphocytes were affected by the dietary treatments, as opposed to the findings of some authors who did not find any differences in the hematology and mineral content of laying birds fed soya oil (13, 7, 9).White blood cells were significantly influenced when compared to the Control diet, as there was a reduction in the release of WBC from bone marrow pool into the blood, which justifies the report of (5), indicating the birds were not stressed in the Soya oil treatments. The report further reveals that leucocytes form an important element in the defense system of the animal body against viral, bacterial and parasitic infections (5).The Red Blood Cells level were higher in the dietary treatments when compared with the control, and agrees with the findings of (10), who stated that red blood cell count is as a result of freedom from diseases and opined that increased RBC are associated with disease free animals.

The hemoglobin levels were higher in the dietary treatments when compared with the Control. This indicated that, there was no challenge to cellular respiration and metabolic reactions.

Similarly, albumin, total bilirubin, Sodium, potassium and urea were not significantly influenced, in accordance with the findings of (2).

Table 2: Effects of Soybean oil on the performance of laying birds

Parameters	T1	T2	T3	T4	T5
Initial wt. (gm)	1300±44.72	1320±37.42	1340±74.83	1420±37.42	1340±50.99
Final wt. (gm)	1420±33.91	1420±25.50	1430±25.50	1450±27.39	1440±18.71
Wt. gain/loss (gm)	14.00 ±11.60	64.00 ±2.45	10.00 ±5.48	3.00±8.00	22.00±4.90
Egg production	14.64^{ab} ±0.45	13.12^{bc} ±0.78	13.00^{bc} ±0.79	12.20^{c} ±0.84	15.66^{a} ±0.37
Egg weight (gm)	55.40 ±1.42	56.46 ±2.12	54.47 ±0.80	58.50 ±1.14	56.58 ±1.85
Feed intake (gm)	3500±0.00	3500±0.00	3500±0.00	3500±0.00	3500±0.00
Feed efficiency	23.19^{ab} ±1.06	21.31^{b} ±2.02	20.19^{b} ±1.09	20.33^{b} ±1.24	25.25^{a} ±0.38

[abc]Means within each row that bears different superscript differ significantly

Table 3 Effects of Soybean oil on the haematological indices of laying hens

Parameters	T1	T2	T3	T4	T5
Packed Cell Volume (%)	24.00^{b}±1.22	27.40^{a} ±0.87	27.20^{a} ±0.86	28.80^{a} ±0.58	27.40^{a} ±1.08
Haemoglobin (g/dl)	7.98^{b} ±0.40	9.12^{a} ± 0.29	9.06^{a}±0.29	9.60^{a}±0.20	9.14^{a} ±0.36
Red Blood Cell ($x10^{6}$/ul)	3.46^{b} ±0.20	4.16^{a} ±0.17	4.12^{a} ±0.12	4.46^{a}±0.14	4.16^{a} ±.0.23
White Blood Cell ($x10^{3}$/ul)	13.82^{a}±0.92	10.02^{bc} ±0.48	11.00^{b} ±0.50	8.58^{c} ±0.22	9.96^{bc}±1.13
Platelets ($x10^{9}$/ul)	310.40^{a}±10.7	263.00^{b}±8.59	295.40^{a}±9.1	214.00^{c}±5.8	258.00^{b}±15.23
Neutrophils	41.00^{abc} ±1.97	35.00^{c}± 1.84	41.60^{ab}±2.34	39.40^{bc}±2.18	46.40^{a}± 1.96
Lymphocytes ($x10^{3}$/ul)	47.00^{bc}± 2.55	55.40^{a}±2.04	47.40^{bc}±2.29	52.00^{ab}±2.63	44.00^{c}±1.70
Eosinophil ($x10^{3}$/ul)	3.40±0.51	2.80± 0.37	3.00±0.32	3.00±0.55	2.60±0.25
Monocytes ($x10^{3}$/ul)	8.60±0.60	6.80± 0.58	8.00±0.55	7.60±0.81	7.00±0.55

[abc]Means within each row that bears different superscript differ significantly

Table 4. The effects of Soybean oil on Serum Biochemical of layers

PARAMETERS	T1	T2	T3	T4	T5
Chloride (mcg/l)	193^{a}.60±13.85	136.00^{b}±8.70	174^{a}.20±6.60	196^{a}.60±17.51	136^{b}.20±11.03
$^{+}HCo_3$ (mcg/l)	26.40^{ab} ±0.75	25.20^{b} ±0.80	25.60^{b}±0.75	27.20^{ab}±1.02	28.40^{a}±0.75
Total Protein (gm/l)	60.60^{b}±2.93	68.60^{a} ±1.20	63.80^{ab}±1.36	66.40^{a}± 1.36	64.00^{ab}±0.71
Albumin(gm/l)	33.20±1.02	35.02 ±1.07	32. 80±1.77	35. 00±1.00	34.00±1.07
Conjugated Bilirubin(mg/dl)	7.46^{ab}±0.88	6.74^{abc} ±0.54	4.86^{c} ± 0.53	7.86^{a}± 0.84	5.62^{bc}± 0.38
Total Bilirubin(mg/dl)	115.40±2.71	128.00±5.39	125. 40±5.84	122.40±4.12	127.80±2.22
Sodium (mcg/l)	4.56±0.24	5.10±0.46	5.22±0.46	4.92 ±0.39	5.38± 0.22
Potassium(mcg/l)	1.30±0.08	1.34±0.04	1.29±0.05	1.35±0.07	1.35±0.04
Urea(mg/dl)	63.40±1.40	65.20± 1.77	66.40±3.90	69.60± 5.35	73.60±2.42

[abc]Mean within each row that bears different superscript differ significantly

Conclusion and Applications

1. It can be concluded that the use of soybean oil, affected the performance characteristic on egg production and feed efficiency at 10%inclusion.
2. Soybean oil also positively affected haematological characteristics on hemoglobin value, White blood cells, Red blood cells count, Neutrophils and Platelets.
3. Also, the inclusion of soybean oil affected the Biochemical serum characteristics on Chloride, Bicarbonate, Total Protein and Conjugated Bilirubin at varying inclusions.
4. The inclusion of soyabean oil at 10% inclusion level in the diet of laying birds was tolerated, and is therefore, recommended.

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