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Journal of Animal Science and Veterinary Medicine
Volume 6(3), pages 105-112, June 2021
Article Number: 509C81341
ISSN: 2536-7099
https://doi.org/10.31248/JASVM2021.264
https://integrityresjournals.org/journal/JASVM

Full Length Research

Effect of saline processed *Icacinia manni* (earthball) on performance, egg quality, blood profiles and carcass indices of laying hens

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Received 25th April, 2021; Accepted 19th May, 2021

ABSTRACT: Twelve week feeding trial was conducted to investigate the effect of 10 and 20% replacement of maize with *Icacinia manni* meal processed in saline on the laying performance, egg quality characteristics, internal organ evaluation, hematological and serum biochemistry of laying hens. Three experimental diets were formulated in which *Icacinia manni* processed in saline replaced maize at 0% for T_1 (control) 10 and 20% for T_2 and T_3, respectively. One hundred and eighty laying hens (Isa Brown) with 6 weeks of laying life were randomly allotted to three dietary treatments with nine replicates of twenty birds per replicate in a completely randomized design. The laying performance, carcass/organs, hematology and serum biochemistry, egg quality analysis showed no significant differences ($p>0.05$) at the end of the experiment. The values for hen-day production of birds fed 10% *Icacinia manni* processed in saline showed numerical increase for hen day egg production and egg weight over the control and 20% groups (T_1 and T_3 respectively). The study revealed that *Icacinia manni* processed in saline can replace 20% maize in layers diets without detrimental effect on the performance, egg quality characteristics, internal organs, haematology and serum biochemical indices.

Keywords: Blood profile, carcass, *Icacinia manni*, laying hens, performance.

INTRODUCTION

In Nigeria, the poultry industry is one of the fastest growing segments of the livestock industry. Poultry are highly prolific and very efficient in converting feed nutrients into high quality animal protein (Smith, 2001) such as meat and eggs. Meat and egg have been a major part of the diet of people all over the world because of their nutritional value in human diet. Egg and meat provide means by which the animal protein requirement of the Nigeria populace could easily be met thus improving the state of nutrition of the Nigerian populace which is predominantly characterized by inadequate protein intake in both quantity and quality (Taiwo et al., 2005).

Feeding constitutes 60 to 80% of the total production cost for intensively raised poultry (Udedebie, 2003; Esonu et al., 2004). One major problem limiting the progress of poultry industry in Nigeria is shortage and high cost of feed ingredients particularly grains (Oluyemi and Robert, 2000). Maize serves as a major source of energy in poultry ration, unfortunately its demand outstrips its supply owing to its numerous uses, as a staple food for man, for industrial uses and as livestock feed. The pressure on maize is so much that it has become a highly prized commodity. There is need therefore to search for unconventional energy sources which are relatively cheaper and not directly consumed by man.

One such alternative source of energy for poultry is *Icacinia manni* commonly called Efik Isong in Efik and earthball in English. *Icacinia manni* is a shrub with modified tuber which is mainly carbohydrate. It is not directly consumed by man. The plant is one out of the known species of *icacinia* plant. It is an all season ever green shrub plant with well defined root, stem and leaves. Mature

tubers can weigh up to 20 kg and their shape and colour vary depending on the soil type and stage of maturity. It is abundant in the humid tropics of Akwa Ibom of Nigeria (Akobundu and Agyakwa, 1998).

One serious set-back in the use of *Icacinia manni* tuber as energy ingredient for non-ruminant is its content of some anti-nutritional factors such as hydrogen cyanide, phytic and oxalic acid (Fassiet, 1973). Ekpo and Udedebie (2012) and Scott et al. (1947) observed that fresh *Icacinia manni* tuber contain lot of gummy substance(s) believed to be galactomannan gum.

Galactomannan are group of polysaccharide with rigid hydrophilic back bone (mannan) and grafted galactose units. They exhibit surface activity and are able to stabilize emulsions. Galactomannan molecules are resistant to human digestive secretions in the small intestine and hence function as dietary fibre. Galactomannan derivative guargum lowered glucose up take from the small intensive when fed to rat due to it gel forming action (Srichamroen et al., 2019).

Different methods of feed processing techniques such as sun drying, toasting and moist-heat treatment used by Ekpo and Udedebie (2012), Asuquo and Udedibie (2012) and Owokere (2010) failed to improve the nutritive value of *Icacinia manni* when fed to non-ruminant. However, Umoren et al. (2003) reported as satisfactory growth response by broilers fed *Icacinia manni* fermented with cassava at 15% dietary in inclusion as replacement for maize.

Soaking *Icacinia manni* in saline could help to reduce or completely remove the gummy substances present in *Icacinia manni*. Saline seems to have the ability to break the adhesive forces that binds gum together since it enhances the formation of electrolyte and micelles.

Based on this, the study was done to determine the effect of *Icacinia manni* processed in saline on the performance, egg quality characteristics, carcass/organ and blood profiles of laying hens.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the poultry and research unit of the Department of Animal Science, Akwa Ibom State University, Obio-Akpa Campus. Obio-Akpa is located between latitudes 5°17'N and 5°27'N and between longitude 7°27'E and 7°58'E with an annual rainfall ranging from 3500 to 5000 mm and average monthly temperature of 25°C, and relative humidity between 60 to 90% (Wikipedia, 2020).

Source of *Icacinia manni* and processing method

Fresh *Icacinia manni* were harvested from fallow land within the university community. The tubers were washed, chopped into pieces and were sundried. The chips were milled thereafter to produce *Icacinia manni* meal. The meal was later soaked in saline prepared by dissolving common salt in water at the rate of 1 kg salt to 50 litres of water and allowed to ferment for 72 hours. Thereafter, the fermented *Icacinia manni* meal was bagged and the fermented water squeezed out. The meal was boiled with fresh water for one hour and later sundried. The sundried meal was run through a hammer mill using a 2 mm sieve to homogenized it and produced *Icacinia manni* meal process in saline.

Experimental diets

Three (3) experimental diets were formulated for laying hens. The diets labeled T_1 (control), T_2 and T_3 contained 0, 10 and 20% levels of inclusion of *Icacinia manni* meal process in saline, respectively. Ingredient and nutrient composition of the experimental diet is represented in Table 1.

Experimental birds and design

The birds were purchased from a reputable commercial poultry distributor in Uyo and breed until they started laying eggs at twenty weeks. At twenty-four weeks, the laying hens were divided into three (3) groups of sixty (60) birds each and each group randomly assigned to one of the three experimental diets using completely randomized design. Each group was further replicated three (3) times (20 birds per replicate) and each replicate housed in a pen measuring 2 mm by 2 mm. Wood shavings were used as their litter material. Feed and water were provided *ad libitum*. The temperature of the breeding house ranged 24 to 26°C, relative humidity between 50 to 75%. Additional lighting was provided by replacing few zincs with translucent plastic roofing materials. The birds were managed with all necessary routine management practices. The birds were routinely vaccinated against Marek disease, New Castle disease, infectious bursal disease and fowl pox between day 1 to 18 weeks of age. The experiment lasted twelve weeks.

Data collection

The birds were weighed at the beginning of the experiment and at the end of the trial to determine their body weight changes. Feed intake was determined by subtracting the weight of the left-over feed from the weight of the feed fed the previous day. Feed conversion ratio was determined by dividing daily feed intake by daily egg weight (gfeed/gegg). Hen-day production was determined by dividing total egg production by the number of layers multiplied by 100. Data on the laying performances of birds were collected weekly while those on egg quality were obtained five weeks to the end of the study. Eggs were collected twice daily and the trial lasted 12 weeks.

Table 1. Ingredient and nutrient composition of laying hens fed saline processed *Icacinia manni*.

Ingredients	T_1 (0%1MS)	T_2 (10%1MS*)	T_3 (20%1MS)
Yellow maize	50.00	40.00	30.00
1MS	0.00	10.00	20.00
Soya bean meal	16.00	16.00	16.00
Blood meal	2.00	2.00	2.00
Fish meal	2.00	2.00	2.00
Palm kernel cake	7.00	7.00	7.00
Wheat offal	12.00	12.00	12.00
Bone meal	10.00	10.00	10.00
Common salt	0.25	0.25	0.25
TM/Vit premix**	0.25	0.25	0.25
L-lysine	0.25	0.25	0.25
L-methionine	0.25	0.25	0.25
Total	100	100	100
Calculated chemical composition (%Dm)			
Crude protein	18.46	18.44	18.42
Ether extract	3.93	4.03	4.07
Crude fibre	2.14	3.17	3.20
Ash	3.14	3.41	3.40
NFE	72.33	70.95	70.91
ME (Mcal/kg)	2.57	2.56	2.50

***IMS:** *Icacinia manni* tuber meal processed in saline. **To provide the following per kg of fed: Vitamin A, 10,000iv, vitamin D_3, 2000iv, vitamin E, 12mg; vitamin K, 2mg; vitamin B_1, 1.5mg, vitamin B_2, 4mg, vitamin B_6, 1.5mg; vitamin B_{12}, 12mg, Niacin 1.0mg; pantothemic acid, 5mg, Folic acid, 5mg; Biotin, 2mg choline chloride, 100mg; manganese, 75mg; zinc, 5mg; iron, 2mg copper, 5mg, iodine, 1.0mg, selemum, 2.0mg; cobalt, 5mg; Antioxidant, 125mg. NFE – Nitrogen free extract.

External egg quality evaluation

Egg weight

Three eggs were collected weekly from each replicate labeled and weighed using electronic weighing balance having sensitivity of 0.01 g wit maximal capacity of 2,200 g.

Egg length

The length of each egg was measured from the pointed end to the broad and with the aid of a vernier caliper with accuracy of 0.1 mm and maximal capacity of 300 mm.

Egg width

Egg width was measured to the nearest 0.1 mm with vernier caliper. The egg width was taken as the diameter of the widest cross-sectioned region.

Egg shape index

Egg shape index was calculated as the percentage of the egg width to the length by the method of Panda (1996).

$$\text{Egg shape index} = \frac{\text{Width of egg (mm)}}{\text{Length of egg (mm}} \text{ x } 100$$

Egg shell thickness

Eggs were broken in a small petri-dish. The shell thickness of each broken egg was measured with a micrometer screw gauge to the nearest 0.01 mm with a maximal capacity of 25 mm. The measurement was taken from the pointed end, the middle and broad end of the egg and mean was obtained.

Egg shell weight

The broken egg shell was sundried for 2 days and the weight taken using sensitive top loading electric weighing balance to the nearest 0.01 g with a maximal capacity of 2,200 g. The shell weight was expressed as a percentage of the egg weigh and recorded as percent shell (% shell) for individual egg.

Internal egg quality evaluation

Three eggs per replicate were randomly selected from the

total eggs collected per week for measurement of internal quality of eggs.

Albumen index

Albumen index was determined as the ratio of the albumen height to the diameter as described by Wilhem and Heiman (1936).

$$\text{Albumen index (A1)} = \frac{H}{0.5D}$$

Where: H = Height of thick albumen at the boundary with the yolk, and D = Average of long and short diameter of albumen measured on the smooth surface.

Albumen weight

The albumen of broken fresh eggs was carefully separated from the yolk and weighed. The albumen weight was expressed as a percentage of the egg weight and recorded as percent albumen (% albumen) for individual egg sample.

Albumen height

Albumen height was determined by using p.6085 spherometer having an accuracy of 0.01 mm. The measurement was taken at albumen widest expanse and mid-way between the yolk edge and the external edge of the thick albumen.

Yolk weight

The yolk was carefully separated from the albumen using a plastic egg separator and weighed individually with an electric sensitive weighing balance to the nearest 0.01 g with a maximal capacity of 2,200 g.

Yolk width

The yolk width was measured around the widest horizontal circumference using vernier caliper measured to the nearest 0.1 mm with a maximal capacity of 300 mm.

Yolk index

This was taken as the ratio of the yolk height to the width without the removal of the yolk from the albumen.

Haugh unit

Haugh unit was determined by the formula of Haugh (1937) as given below:

$Hv = 100 \log (H + 7.57\text{-}1.7w^{0.75})$.

Where: H = height of albumen in mm and W = weight of eggs in gram

Carcass and organ weight evaluation

At the end of the 12th week feeding trial, three (3) birds per replicate (making a total of 27 birds) were randomly selected for carcass and organ parameters evaluation. The birds were starved overnight of feed to minimize the contents of the gastro-intestinal tract. The birds were weighed, slaughtered by severing the jugular vein and the carcass allowed to bleed thoroughly. The carcasses were scalded in hot water of about 80°C for a minute and the feathers plucked manually. The carcasses were eviscerated by cutting through the vent and the viscera removed. Thereafter the dressed carcass weights, the weight of the internal organs (heart, liver, kidney and gizzard) and abdominal fat were recorded. They were expressed as percentage of dressed weights.

Haematological and serum biochemical analysis

Blood samples (approximately 5 ml) per each of the slaughtered birds were collected during slaughtering using a 5 cm needle into specimen bottles with and without ethylene diamine tetra-acetic acid (EDTA). 2 ml of this blood sample was put into specimen bottle containing EDTA for analysis of hematological parameters which included packed cell volume (PVC), haemoglobin concentration (Hb), red blood cell count (RBC), white blood cell count (WBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated as shown below:

MCV (%) = PCV x 10/RBC

MCH (%) = Hbx10/RBC

MCHC (%) = Hbx100/PCV.

Using standard techniques of Schalms et al. (1975) and Coles (1986), the remaining blood samples for biochemical analysis were transferred into anti-coagulant free tubes and allowed to clot for two hours at room temperature and centrifuged for ten minutes at 200 rpm to separate the serum. The parameters determined were total protein, albumin, urea, creatinine, sodium, potassium, chloride, calcium, phosphorous serum enzyme, aspartate amino transfarase (AST), alanine amino transaminase (ALT) and alkaline phosphates (ALP).

Data analysis

Data obtained during the study were subjected to analysis

Table 2. Performance of laying hens fed saline processed *Icacinia manni.*

Parameters	T_1 (Control)	T_2 10%IM5	T_3 20%IMS	SEM
Initial body WT (kg)	1.70	1.79	1.74	0.034
Final body wt (kg)	1.88	1.85	1.89	0.024
AV. body wt charges (kg)	0.18	0.13	0.13	0.003
AV. feed intake (g/day)	133.43	115.02	115.12	3.280
Av. hen day egg Production (%)	68.45	71.29	66.99	2.210
Av. egg weight (g)	50.50	52.55	51.26	1.033
Feed conversion ratio (gfeed/eggs)	2.25	2.19	2.25	0.021

*IMS: *Icacinia manni* meal fermented in saline.

of variance (ANOVA) using SPSS version 2.0 (IBM Corporation, Armonk, USA). Significant differences among means were separated using Duncan Multiple Range test at 5% level of probability (Duncan, 1995).

RESULTS AND DISCUSSION

The results of the final weight, body weight changes, feed intake, hen-day egg production, feed conversion ratio and egg weights as influenced by dietary inclusion levels of *Icacinia manni* processed in saline are presented in Table 2. The final weight and body weight changes of the laying hens were not significantly ($p>0.05$) affected by the diet across treatments. T_3 recorded the highest final weight value (1.89) over T_1 and T_2 (1.88 and 1.85, respectively).

There was no significant ($p>0.05$) difference in feed intake though relatively highly feed intake was observed in treatments T_2 and T_3 while the least was observed in treatment T_1. The result disagrees with the report of Asuquo and Udedibie (2012) where feed intake of laying hens fed toasted *Icacinia manni* meal decreased significantly.

No negative influenced of the treatment diet was observed on hen day egg production. Treatment T_2 recorded numerical highest hen day production value (71.29) while Treatment T_3 recorded the least (66.99). This result is contrary to the report of Asuquo and Udedibie (2012) where laying hens fed toasted *Icacinia manni* meal showed a significant reduction in the values for hen-day egg production.

The result obtained in this study for hen–day egg production showed that *Icacinia manni* processed in saline at 10% dietary level was able to boost hen day egg production in laying birds.

The result for egg weight followed the same trend with treatment T_2 recording the highest numerical value for egg weight (52.55). Treatment T_1 recorded the least egg weight value (51.50). The treatment diet had no significant effect ($p>0.05$) on the feed conversion ratio of the laying hens. Treatment T_2 had the least and the best feed conversion ratio.

The result of the egg quality characteristics of the laying birds is presented in Table 3. The values for egg width, egg length and egg shape index ranged from 4.48 to 4.32, 5.68 to 5.77 and 0.79 to 0.77 respectively. There were no significant differences ($p>0.05$) among the groups with respect to the three parameters. The value obtained for egg shape index was higher than 0.75 which is regarded as the most satisfactory when eggs are to be packaged in specialized containers for transportation (Smith, 1990). Belyavin and Boorman (1981) observed that elongated eggs are more prone to breaking. Eggs with good shape enhance marketing and profitability. The values of egg shape index obtained in this study showed that processed *Icacinia manni* in saline fed to laying birds tended to produce eggs of good shape.

Albumen height, albumen weight, albumen diameter and albumen index of the laying birds were not significantly affected ($p>0.05$) by the treatments. Their values range from 0.03 to 8.75, 25.73 to 26.23, 6.77 to 7.55 and 1.13 to 1.36 respectively. The result showed that the control group T_1, recorded the least values, with respect to the four parameters. Egg with large proportion of albumen is regarded as being of high quality (Harms and Hussein, 1993). The authors further reported that albumen weight is more closely associated with egg weight than yolk weight. Egg quality is an important contributing factor for table eggs. The values obtained for albumen parameters in this study showed that *Icacinia manni* processed in saline is capable of producing egg of high quality (Esiegwu, 2012). Yolk diameter, yolk height, yolk weight and yolk index were not significantly affected ($p>0.05$) by the treatment diet. Their values ranged from 3.24 to 3.89, 3.82 to 4.09. 25.17 to 26.00 and 1.01 to 1.25 respectively. The result observed in this study showed that T_1, the control, had the least value for yolk diameter yolk height, yolk weight and yolk index. The ability of the egg yolk to remain firm without spreading when broken is a desirable quality to the consumer (Essien, 2015).

Table 3. Effect of saline processed *Icacinia manni* meal on egg quality indices of laying hens.

Parameters	T_1 (Control)	T_2 10%IM5	T_3 20%IMS	SEM
Egg width (cm)	4.48	4.31	4.32	0.041
Egg length (cm)	5.68	5.64	5.77	0.062
Egg shape index	0.79	0.78	0.77	0.013
Albumen height (cm)	8.03	8.33	8.05	0.211
Albumen weight (gm)	25.80	26.23	25.97	0.221
Albumen diameter (cm)	7.55	7.39	6.77	0.203
Albumen index	1.36	1.13	1.19	0.024
Yolk diameter (cm)	3.24	3.87	3.47	0.132
Yolk height (cm)	3.98	4.09	3.88	0.051
Yolk weight (gm)	25.08	25.17	25.27	0.172
Yolk index	1.25	1.06	1.12	0.022
Shell thickness (mm)	0.55	0.59	0.55	0.034
Shell weight (gm)	7.07	7.07	7.03	0.061

The treatment diets did not have any significant ($p>0.05$) effect on shell thickness and shell weight. The values obtained in this study for the afore-mentioned parameters were 7.07, 7.07, 7.03 and 0.53, 0.59, 0.55 respectively for T_1, T_2, and T_3. Shell thickness and weight affect the egg economic value whether as hatching egg or food product. Breakage or cracking of egg shell in market channel is a serious concern to commercial egg producers (Ogunleye et al., 2019). Ketta and Tumova (2016) grouped factors influencing egg shell quality into internal and external actors. Among the external factors was nutrition or diet composition of laying hens.

The non-significant difference ($p>0.05$) in shell thickness and weight observed in this study showed that the diet composition was adequate in calcium and phosphorous. More so, the result showed that *Icacinia manni* meal processed in saline did not negatively interfere with calcium metabolism. Haugh unit is the measure of egg white or albumen quality. There were no significant ($p>0.05$) differences among the groups. The values obtained for Haugh unit in this study were 95.12, 95.99, and 95.61 treatment T_1, T_2 and T_3 respectively. The values obtained for Haugh unit in this study were higher than 72. Haugh unit of 72 and above is regarded as an indicator of freshness in eggs and a grade AA quality egg (North 1990). Enyenihi et al. (2009) reported that wetted and unwetted sun-dried cassava tuber meal fed to layers enhanced Haugh unit of the eggs. In a similar work with cassava, Udedibie and Asoluka (2008) did not observed any effect of dried cassava fufu meal on Haugh unit.

Hematological and serum biochemical indices of the laying hens

The results of the hematological and serum biochemical indices of the laying hens are presented in Table 4. The results of all the hematological parameters determined in this study were statistically similar ($p>0.05$). The values recorded for packed cell volume (PCV), red blood cell count (RBC) hemoglobin concentration (Hb) were 29.77, 29.87 and 28.93; 2.18, 2.14 and 2.28; 9.40, 8.97, and 8.83 for T_1, T_2 and T_3 treatment groups respectively. Adejumo (2004) reported that packed cell volume (PCV) and hemoglobin concentration (Hb) are correlated with the quality of the diet and the nutritional status of the animal.

The values for white blood cell counts (WBC) were 6.55, 6.62 and 6.58 for the T_1, T_2 and T_3 treatment groups respectively. White blood cells play a major role in defending the body against disease causing micro-organism. The non-significant values ($p>0.05$) recorded in the results of white blood cells count obtained in this study is suggestive of a well adapted immune system.

The values for mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin count (MCHC) of the laying hens were 137.07, 133.33 and 133.53; 43.00, 40.87 and 40.47; 29.13, 30.10 and 30.30 g/dl for T_1, T_2 and T_3 treatment groups respectively. Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin count (MCH) is use in the diagnosis of anemic condition in animals.

All the serum biochemical parameters determined in this study showed no significant differences ($p>0.05$) in their values. The values for sodium, potassium and chloride in Mmol/l were 9.87, 8.78, and 9.82; 3.00, 2.53 aid 2.93; 177.08, 168.75 and 175.00 for T_1, T_2 and T_3 treatment groups respectively. These ions are needed to maintain proper osmotic and electrolyte balance in the body fluid of animals (Machebe et al., 2009). The similarities of serum electrolyte levels of the groups indicated that the diets were capable of supplying adequate proportion of ions.

The values for calcium and phosphorous were 2.08, 2.06 and 2.09; 6.60, 6.41 and 6.52 for T_1, T_2 and T_3 treatment groups respectively. Calcium and phosphorus are constituent of skeletal structure in the body and also help in egg shell formation.

Table 4. Haematological and serum biochemical Indices of laying hens fed Saline Processed *Icacinia manni* meal.

Parameters	T_1 (Control)	T_2 10%IMS	T_3 20%IMS	SEM
WBC ($x10^5$/ul)	$6.55x10^3$	$6.62x10^5$	$6.58x10^5$	$2.01x10^3$
RBC. ($x10^6$/ul)	$2.18x10^6$	$2.14x10^6$	$2.48x10^L$	$1.09x10^5$
HB (g/dl)	9.40	8.97	8.83	0.33
PCV. (%)	29.77	29.87	28.93	0.88
MCV (%)	136.07	133.33	133.33	1.63
MCH (pg)	42.43	40.87	40.47	1.43
MCHC(g/dl)	29.13	30.10	30.30	0.87
Bio-chemical indices				
Sodium (Mmol/L)	9.87	8.78	9.82	0.96
Potassium (Mmol/L)	3.00	2.53	2.93	0.21
Chloride (Mmol/L)	1.77	1:68	1.71	0.13
Calcium (mg/dl)	6.60	6.65	6.71	0.16
Phosphorus (mg/dl)	2.08	2.06	2.09	0.09
Total Protein (g/dl)	4.65	6.51	6.61	0.65
AST (u/l)	31.33	31.61	32.41	0.16
ALP (u/l)	14.07	15.73	15.91	3.18
ALT (u/l)	16.28	16.71	15.91	0.02

ALP - Alkalinephosphatase**,** AST – Aspartate amino transferase, ALT – Alanine amino transferase.

Table 5. Internal organs evaluation of laying hens fed saline processed *Icacinia manni* meal.

Parameters (% Lw)	T_1 (Control)	T_2 10%IMS	T_3 20%IMS	SEM
Liver	1.06	1.70	1.63	0.18
Heart	0.37	0.41	0.38	0.03
Kidney	0.26	0.21	0.19	0.02
Gizzard	1.43	1.56	1.51	0.27
Abdominal fat	2.32	2.34	2.31	1.43

The total protein values for T_1, T_2 and T_3 treatment groups were 6.51, 6.61 and 6.72 respectively. Wilson and Brigstoke (1981) reported that high total protein is an indicator of sufficient protein intake. The values obtained in this study for total protein is suggestive of a balance protein intake.

The enzymes alkaline phosphates (ALP), aspartate amino transferees (AST) and alanine amino transaminase (ALT) were not significantly ($p>0.05$) affected by the treatment diets. These enzymes are considered to be the markers of liver function. The non-significant difference ($p>0.05$) obtained in this study for the enzymes determined showed the absence of anti-nutritional substances in the diet. All the values obtained for haematological and serum biochemical parameters determined in this study were within the normal range for chicken (Mitruka and Rawnsley, 1977).

Carcass and organ weight evaluation

Results of the internal organ weights of the laying hens are shown in Table 5. The values obtained for liver, gizzard, heart and kidney were statistically similar. A similar study by Asuquo and Udedibie (2012) showed a non-significant ($p>0.05$) liver value in laying hens fed moist-treated *Icacinia manni* meal. Liver and kidney are involved in the elimination of toxins and metabolic wastes from animal's body. The heart functions in the pumping of blood throughout the body via circulatory system. The result obtained in this study showed that the heart was able to perform it proper circulatory functions. The abdominal fat of the laying hens showed non-significant values in their difference ($p>0.05$). These results agree with the reports of Enyenihi et al. (2013) where laying hens fed fermented and gelatinized cassava developed more abdominal fats.

Conclusion

The study revealed that *Icacinia manni* fermented in saline greatly reduced the phytochemical compounds present in *Icacinia manni*, and has improved the nutritive value of the

meal, thereby rendering it acceptable to laying hens. Also, *Icacinia manni* processed in saline enhance the performance, carcass, blood profiles, egg quality characteristics of laying hens at 20% dietary inclusion.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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