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HAEMATOLOGICA ANDSERUM BIOCHEMICAL INDICES OF BROILER CHICKENS FED VARYING LEVELS OF FALSE YAM (ICACINATRICHANTHA) TUBER MEAL

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Abstract

This study evaluated the haematological and serum biochemical indices of broiler chickens fed diets containing varying inclusion levels of sun-dried false yam meal (SFYM) as a partial replacement for maize. A total of 150-day-old broiler chicks were randomly assigned to five dietary treatments (0, 4, 8, 12 and 16% SFYM inclusion) in a completely randomized design (CRD), with three replicates of ten birds per treatment. Data on haematological indices showed that increasing SFYM levels led to a significant ($P<0.05$) decrease in packed cell volume (PCV), red blood cell (RBC), MCV, MCH, MCHC, and percentage heterophil, whilst the WBC increases. The mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) declined with increasing SFYM levels, indicative of a microcytic, hypochromic effect. Percentage eosinophil and lymphocytes were significantly ($P<0.05$) higher in broiler chickens maintained in T2 and T5 respectively compared to other treatment groups. The serum biochemical indices revealed ($P<0.05$) reduction in total protein, glucose, ALP, and AST of broiler chickens as the inclusion levels of SFYM increased, while the concentration of albumin, urea and creatinine increased. These findings suggest that SFYM can be used to substitute maize partially up to 16% level without negative impact on broiler chickens health.

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Introduction:-

Broiler chickens are essential component of the global poultry industry, providing a significant source of protein for human consumption. The rapid growth and efficient feed conversion of broiler chickens have made them a popular choice for meat production. However,the insufficient production of the local feed resource coupled with high cost of importation of foreign feedstuffs for poultry have led to increase in the cost of poultry production in Nigeria, hence, researchers and poultry producers have to explore alternative feed sources. (Madubuike & Ekenyem 2006; Obidenma, 2009). Cocoa pod husk meal (Adeyeye et al., 2018), (Omoikhoje et al., 2008), (Omoikhoje et al., 2010). Thus the present study is focused on False yam (Icacinatrichantha), a drought-resistant shrub native to tropical Africa. The plant produces large, starchy tubers that can be processed into meal for animal feed. The potential of false yam meal as a partial substitute for maize in broiler diets has been investigated due to its availability, nutritional composition, and lower cost compared to conventional feed ingredients (Akinola et al., 2020). False yam has been reported to contain hydrocyanic acid, phytic acid and oxalic acid with the same bitter principle as cassava, a global staple food (Okosun et al., 2019). It is yet to gain recognition and popularity as a food crop. Processing it into stable flour and analyzing its ant nutritional composition will make the crop known to a greater majority of the people as a food crop and feed ingredients for livestock. Information on the nutrient level of Icacina tricantha has earlier been investigated (Umoh&Iwe, 2014; Okosunet al., 2018) and their findings revealed that this root tuber have a potential in terms of energy to substitute for Maize.

Materials and Method:-

The study was conducted at the Poultry Unit of the Teaching Research Farm, Ambrose Alli University, Ekpoma for a period of eight (8) weeks. The farm lies between latitude 6.4°N and longitude 6.8°E in Esan West Local Government Area of Edo State, Nigeria.

Sources of the experimental feed ingredients

Fresh tubers of false yam (Icacina trichantha) were harvested within the University community and its environs, while other feed ingredients like soybean meal, palm kernel cake,fish meal, maize, bone meal etcwere purchased from a reputable store in Benin City.

Processing of fresh tubers of false yam

Fresh tubers of Icacina trichantha were washed, peeled and chopped into small pieces or chips and then sundried for about 6-7 days using jute mat at atmospheric temperature of between 29-30ºC. Thereafter, the sundried chips of the false yam tubers were milled into a fine powder to pass through a 2mm mesh sieve and kept in an airtight container. The fine powder was designated as sun dried false yam meal (SFYM).

Management of the experimental birds

A total of 150 day-old broiler chicks were purchased from a reputable hatchery for the experiment. On arrival, the birds were placed in a brooder house and fed commercial starter diets for one week acclimatization period. The birds were mass brooded for four weeks in a well-ventilated poultry house on a deep litter compartment. After the one-week pre-experimental feeding, 30 chicks each were randomly assigned, weighed and distributed to five dietary treatments (1, 2, 3, 4 and 5) with 3 replicates of 10 chicks each in a completely randomized design (CRD). Routine medication and vaccination were carried out throughout the duration of the feeding trial.

Experimental diets

Five experimental (starter and finisher) diets (1, 2, 3, 4 and 5) were formulated. Diet 1 served as the control which contained of 100% maize and 0% SFYM, while in diets 2, 3, 4 and 5, SFYM was used to substitute maize at 4, 8, 12 and 16% inclusion levels. All the diets were formulated to be isonitrogenous (21 and 19%) and isocaloric (2800 and 2800 Kcal/kg ME) according to NRC (1994) as presented in Tables 1 and 2.

Table 1:- Percentage composition of the experimental starter diets (0-4 weeks).

	Inclusion levels of SFYM (%)				
	0	**4**	**8**	**12**	**16**
			Treatments(T)		
Ingredient (%)	**1**	**2**	**3**	**4**	**5**
Maize	55.00	51.00	47.00	43.00	39.00
Sundried false yam meal	0.00	4.00	8.00	12.00	16.00
Soyabean meal	32.00	32.00	32.00	32.00	32.00
Fish meal	1.50	1.50	1.50	1.50	1.50
Palm kernel cake	3.50	3.50	3.50	3.50	3.50
Wheat offal	3.30	3.30	3.30	3.30	3.30
Bone meal	1.50	1.50	1.50	1.50	1.50
Limestone	2.50	2.50	2.50	2.50	2.50
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25

Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Calculated values					
Crude Protein (%)	**21.25**	**21.10**	**20.96**	**20.89**	**20.68**
M.E (kcal/kg)	**2889.00**	**2876.00**	**2863.00**	**2849.00**	**2836.00**

Table 2:- Percentage Composition of experimental finisher diets (5-8 week).

	Inclusion levels of SFYM (%)				
	0	**4**	**8**	**12**	**16**
			Treatments(T)		
Ingredient (%)	**1**	**2**	**3**	**4**	**5**
Maize	58.00	54.00	50.00	46.00	42.00
Sundried false yam meal	0.00	4.00	8.00	12.00	16.00
Soyabean meal	26.00	26.00	26.00	26.00	26.00
Fish meal	1.50	1.50	1.50	1.50	1.50
Palm kernel cake	4.50	4.50	4.50	4.50	4.50
Wheat offal	5.30	5.30	5.30	5.30	5.30
Bone meal	2.50	2.50	2.50	2.50	2.50
Limestone	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Calculated values					
Crude Protein %	**19.26**	**19.11**	**18.97**	**18.82**	**18.68**
M.E (kcal/kg)	**2899.00**	**2885.00**	**2872.00**	**2859.00**	**2845.00**

Haematological study

At the end of the eight (8) weeks feeding trial,two (2) birds each were randomly selected from each treatment for haematological examination. The birds were bled through neck decapitation and 3mlsblood was collected into appropriately labelled sample bottles containing ethylene diamine tetra acetic acid (EDTA) and shaken gently to prevent the blood from clotting. Packed cell volume (PCV), was determined according to the method described by Mitruka&Rawnsley (1977). Red blood cell (RBC) and White blood cell (WBC) were determined according to the method described by Schalms et al. (1975). Blood counts such as mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), platelets, neutrophils, monocytes and eosinophil were calculated according to Jain (1986).Another 3 mls blood was collected into the plain bottle that did not contain anti-coagulant, andwasused to analyse the serum biochemical indices of the birds per treatment such as serum protein(Tietz,1995),Serum albumin (Peter et al., 1982), serum globulin(difference between total protein and albumin), serum uric acid(Fossatiet al.,1980),serum creatinine (Henry,1994), serum glucose (Tietz,1995),serum enzymes such as alanine transaminase (ALT) and aspartate transaminase (AST) (Bergmeyer,1983).

Statistical analysis

The results obtained at the end of the experiment was subjected to a one-way analysis of variance (ANOVA) and differences between mean were separated using Duncan's Multiple Range Test (DMRT) at 5% level of probability. All statistical procedures were according to Steel and Torrie (1990) with the aid of SPSS (2017) version 25.

Table 3:- Haematological indices of broiler chicken as affected by the treatments.

	Inclusion levels of SFYM (%)					
	0	**4**	**8**	**12**	**16**	
	Treatments (T)					
Indices	**1**	**2**	**3**	**4**	**5**	**SEM±**
Pack cell volume	44.67^{a}	40.00^{ab}	35.00^{b}	34.67^{b}	34.50^{b}	1.51
Hb (g/l)	16.40^{a}	15.75^{b}	15.00^{c}	14.25^{d}	13.95^{d}	0.09
RBC ($x10^{12}$/l)	4.40^{a}	3.75^{b}	3.35^{bc}	3.25^{c}	2.98^{c}	0.08

WBC ($x10^9$/l)	8.75c	9.75^b	10.50^b	12.50^a	12.70^a	0.14
MCV ($x10^{15}$/l)	12.73^a	11.43^b	11.45^b	11.22^b	11.29^b	0.12
MCH (Pg)	37.42^a	36.75^{ab}	35.90^{bc}	35.18^c	35.00^c	0.18
MCHC (g/dl)	33.80^a	33.49^b	33.48^b	33.52^b	33.35^b	0.04
Heterophil (%)	31.00^a	29.50^b	28.00^c	27.50^{cd}	26.50^d	0.25
Eosinophil (%)	0.33^b	1.00^a	0.33^b	0.33^b	0.00^c	0.14
Lymphocytes (%)	66.50^b	66.50^b	64.00^b	68.50^{ab}	77.00^a	1.64

^{abcd}Means in the same row with varying superscripts differ significantly (P≤0.05); SEM = Standard error of means; Hb= Hemoglobin; RBC= Red blood cells; WBC= White blood cells; MCV=mean corpuscular volume; MCH=mean corpuscular haemoglobin; MCHC=mean corpuscular haemoglobin concentration.**SFYM:** Sundried false yam meal

$$\text{SEM}\pm = \frac{\sqrt{\text{EMS}}}{r}$$

Table 4:- Serum chemistry of broiler chicken as affected by the treatment.

	Inclusion levels of SFYM (%)					
	0	**4**	**8**	**12**	**16**	
		Treatment (T)				
Indices	**1**	**2**	**3**	**4**	**5**	**SEM±**
Total protein (g/dl)	9.04^a	8.98^a	8.15^b	7.98^{bc}	7.35^c	0.13
Albumin(g/dl)	5.27^b	5.98^a	4.48^c	4.48^c	3.98^c	0.12
Globulin(g/dl)	3.77	3.00	3.68	3.50	3.38	0.13
Urea(kg/dl)	3.67^c	3.67^c	4.00^{bc}	4.83^{ab}	5.67^a	0.16
Creatinine (kg/dl)	0.32^b	0.37^b	0.38^b	0.47^a	0.50^a	0.01
Glucose (g/dl)	227.67^a	168.67^{bc}	179.00^b	145.00^{bc}	127.67^c	7.48
ALP(μ/l)	945.00^a	875.00^b	465.00^c	383.00^d	365.00^d	4.48
ALT(μ/l)	5.00	4.67	4.33	4.33	4.67	0.27
AST(μ/l)	134.33^a	134.67^a	134.00^{ab}	133.00^{bc}	132.67^c	0.21

abcd: means in the same row with varying superscripts differ significantly (p<0.05); SEM = Standard error of means; ALP= Alanine phosphate; ALT=Alanine transaminase and AST= Aspartate transaminase. **SFYM:** Sundried false yam meal

$$\text{SEM}\pm = \frac{\sqrt{\text{EMS}}}{r}$$

Results and Discussion:-

The findings of this study indicate that varying levels of sundried false yam tuber meal (SFYM) significantly (P<0.05) influenced haematological and serum biochemical indices of broiler chickens. The gradual decline in packed cell volume (PCV), red blood cell (RBC) and haemoglobin (Hb) concentration with increasing SFYM inclusion suggests that higher levels of SFYM may reduce the oxygen-carrying capacity of the blood, potentially leading to mild anemia (Esonu et al., 2001; Omede et al., 2017). However, these values remained within the standard physiological ranges for healthy broilers (Coles, 1986; Banerjee, 2004), indicating that SFYM can be incorporated into broiler diets at moderate levels without severely compromising blood profile. The reduction in RBC at higher SFYM levels aligns with reports that unconventional feed ingredients with anti-nutritional factors can impair erythropoiesis and nutrient utilization (Ogbuewu et al., 2013). Conversely, the significant increase in white blood cell (WBC) count at higher SFYM inclusion levels suggests an immune-stimulatory effect, which may be an adaptive response to the presence of anti-nutritional factors or dietary stressors (Ahamefule et al., 2008; Oloruntola et al., 2018). This is in agreement with the findings of Ansah and Aboagye, 2011 who reported that high-fiber diets can enhance leukocyte proliferation as a mechanism for boosting immune function. The variations observed in mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) further highlight the influence of SFYM on red blood cell morphology and function, supporting previous reports on the effects of alternative feed ingredients on haematological responses (Adekunle&Omoikhoje, 2014; Okparaet al., 2022).

Therefore, SFYM can serve as an alternative feed ingredient for broilers, its inclusion level should be carefully managed to maintain optimal haematological health and overall performance of the birds.

The result of serum albumin, creatinine, glucose, AST, ALP, globulin and ALT showed significant (P<0.05) differences across dietary treatments. These findings agree with the studies of several authors, highlighting the importance of serum chemistry indices as valuable tools for monitoring the nutritional status and health of poultry. The highest total protein value was observed in the birds administered 0% SFYM, with values ranging from 7.35 to 9.04 g/dl. This result aligns with findings of Adedokun et al., 2014; Yusuf et al., 2018). Okonkwo et al. (2017) similarly, agrees with Akinmoladunet al. (2015) who reported that serum albumin levels are highly sensitive to protein intake and reflect the nutritional status of poultry. However, the lack of significant difference in globulin levels, as observed in this study, contradicts some findings, Galli et al. (2019) and Lunde et al. (2016), who noted significant changes in both albumin and globulin with dietary variations. The finding that globulin remained unaffected by SFYM treatment could be attributed to the presence of anti-nutritional factors in the yam tuber meal, which may have influenced albumin synthesis but not globulin levels.

Creatinine levels observed in this study ranged (0.32-0.50 mg/dl) were within the normal range of 0.20-0.5 mg/dl, indicating that SFYM did not have a detrimental effect on kidney function. These results support findings by Alamodeet al. (2015) and Adegboyega et al. (2016), who found that normal creatinine levels indicate no kidney damage due to dietary interventions. On the other hand, Ibrahim et al. (2018) suggested that high-protein diets can lead to increased creatinine levels, possibly indicating kidney stress. However, the normal creatinine values in this study contradict that perspective, suggesting that SFYM is safe for the kidneys in broiler chickens, warranting the safety of false yam meal incorporation in the broiler feed. Observed significant in glucose values, with the highest level of (227.67 mg/dl) recorded in the birds administered SFYM,is consistent with the study by Mulugeta et al. (2016), who found that glucose levels in poultry can vary with dietary protein and carbohydrate content. Similarly, Adebiyi et al. (2017) noted that glucose levels reflect the energy status and metabolic processes in poultry, which are influenced by dietary composition. However, some studies, such as those of Daramola et al. (2019), have reported no significant change in glucose levels despite varying dietary treatments. These contrasting results suggest that dietary interventions may lead to different metabolic responses based on the specific nutrients provided.

The liver enzymes[Alkaline Phosphatase (ALP) and Aspartate Aminotransferase (AST)],the ALP values in this study ranged (365.00-945.00 µ/l) were significantly (P<0.05) affected by the SFYM treatment, while AST values (132.67-134.67 µ/l) showed no significant (P>0.05) difference. This suggests that SFYM treatment had some effect on the bone and liver functions, but it did not affect liver function as assessed by AST. These findings are in agreement with previous studies (Oyeyemiet al. 2017 and Mibekoet al. 2020), who found that ALP is often used as an indicator of bone and liver health in poultry. Likewise, Shuklaet al. (2019) demonstrated that AST is a reliable marker for liver function, and its levels remained stable in healthy birds. This study also in accord with Usmanet al. (2018) and Sulaimon et al. (2015) who reported that both ALP and AST are significantly influenced by dietary treatments, suggesting that dietary factors can affect liver enzymes in varying degrees.**Alanine Aminotransferase (ALT), result showed no** significant difference across the dietary treatments, which implies that SFYM did not significantly influence liver damage in broiler chickens. This finding agrees with the studies of Olaitan et al. (2016) and Okoye et al. (2019), who reported that dietary variations in protein and other nutrients did not always affect ALT levels in poultry. However, studies by Ijaiya et al. (2017) and Awotoye et al. (2019) found that high-protein diets could lead to increased ALT values, indicating potential liver damage. The absence of significant changes in ALT in this study supports the conclusion that SFYM is safe and does not pose a risk to liver function.The SFYM enhanced serum albumin and glucose levels, without causing detrimental effects on kidney or liver function. These results support the idea that serum biochemical indices are valuable tools for assessing the nutritional and health status of poultry, and they align with various studies that have highlighted the importance of these indices in poultry nutrition research. However, the variations observed in different studies underline the need for further research to better understand the specific effects of SFYM and other plant-based meals on broiler chickens.

Conclusion:-

Varying inclusion levels of sun-dried false yam meal did not has negative effect on the health status of the broiler chickens in this study; hence, it can be used as a partial substitute for maize in the broiler chickens diets.

Recommendation:-

Up to 16% inclusion level of SFYM is recommended in the diet of broiler chickens as a replacement for maize. Also, further research is highly needed to know at what highest level SFYM can be incorporated in the diets of broiler nutrition.

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