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Haemato-Serological Indices of Weaner Pigs Fed Fermented and Pressed *Icacinia Manni* in the Humid Tropics

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Abstract

Blood is a key physiological indicator of feed quality, animal health, and bodily functions. An experiment evaluated the haematological and serum biochemical profiles of weaner pigs fed diets containing fermented and pressed Icacina manni meal. Twenty-four hybrid (Landrace x Large White) weaner pigs, aged 8–10 weeks, were sourced and randomly assigned to four treatment groups in a Completely Randomized Design. Diets were formulated with 0%, 8%, 10%, and 12% Icacina manni meal, with each treatment comprising three replicates of two pigs. The experiment spanned 56 days. Data were analyzed using one-way ANOVA, with Duncan's Multiple Range Test used to separate significant means Haematological analysis revealed significant differences (P<0.05) in white blood cells, neutrophils, monocytes, eosinophils, basophils, and mean corpuscular haemoglobin, all within normal ranges for healthy weaner pigs. Serum biochemical indices showed no significant differences except for cholesterol, which varied significantly (P<0.05) but remained within normal limits. This indicates that 8–12% Icacina manni inclusion poses no adverse effects on physiological health and may enhance tissue development, making it a safe non-conventional feedstuff for weaner pigs. Further studies are recommended to explore inclusion levels above 12% to determine its safe upper limit.

Keywords: Haematology, Serum biochemistry, *Icacinia manni*, Weaner pigs

1.0 Introduction

Pig farming encounters major economic challenges due to high feed costs, which constitute 75–80% of total production expenses. These costs stem primarily from the escalating prices of conventional feed ingredients such as soybean meal, groundnut cake, and fishmeal, which also compete directly with human consumption and industrial applications (Amaefule *et al*., 2019; Emiola *et al*., 2011).

To mitigate these issues, farmers have turned to non-conventional feed resources that have minimal competition with human food needs. However, the effects of such alternative ingredients on animal health and physiology must be thoroughly evaluated. Blood analysis serves as a vital diagnostic tool in this regard, as hematological and serum biochemical indices reveal the animals' nutritional status, overall health, and responses to dietary changes or environmental stressors (Okon *et al.,* 2023; Madubuike and Ekenyem, 2006; Olafedehan *et al*., 2010; Etim *et al*., 2014).

Hematological studies are particularly valuable for assessing the safety of novel feedstuffs, diagnosing potential toxicities, identifying nutritional deficiencies, and understanding physiological impacts on blood formation and function (Isaac *et al.*, 2013; Amusa *et al*., 2015). These parameters vary across species and breeds and are strongly influenced by feed quality (Alphonsus *et al*., 2012; Okah and Ehuriah, 2015).

Icacina manni (false yam or earth ball), a member of the *Icacinaceae* family, has been explored as a promising non-conventional feed ingredient, especially for addressing forage shortages during the dry season. Its large tubers (30–100 cm long, weighing 3–25 kg) are drought-resistant, capable of surviving up to a year without rainfall, and offer substantial yields (Sam *et al*., 2020; Umoh, 2013; Gabriel *et al*., 2018). Nutritionally, the tubers contain 3.45–6.25% crude protein and metabolizable energy values of 2817.89–3265.78 kcal/kg (Ekeno, 2014; Essien and Sam, 2018). Despite these benefits, *Icacina manni* contains anti-nutritional and toxic compounds such as cyanogenic glycosides, phytic acid, and galactosamine that can impair digestibility and nutrient utilization (Ekpo and Udedibie, 2012).

Subsequent research has therefore focused on processed forms (fermented and pressed) of *Icacina manni* as a partial replacement in weaner pig diets. These studies utilize hematological and serum biochemical profiling to monitor potential toxicity, evaluate impacts on physiological and nutritional status, and determine the ingredient's overall suitability for sustainable pig production (Gabriel *et al*., 2018; Udo *et al*., 2024; Emiola *et al*., 2011; Etim *et al.*, 2014).

2.0 Materials and Methods

2.1 Experimental Location

The study was carried out at the Piggery Unit of the Teaching and Research Farm, Department of Animal Science, Akwa Ibom State University, Obio Akpa Campus, located in Oruk Anam Local Government Area, Akwa Ibom State, Nigeria. Obio Akpa lies between latitudes 5°17'N and 5°27'N and longitudes 7°27'E and 7°58'E, within Nigeria's tropical rainforest zone. The area experiences annual rainfall of 3500–5000 mm, average monthly temperatures of 75°C, and relative humidity of 60–90% (Essien and Sam, 2018).

2.2 Feedstuff and Processing of *Icacina manni* Tubers

Fresh Icacina manni tubers were collected from fallow lands in Ntak Ibesit, Oruk Anam Local Government Area, Akwa Ibom State, Nigeria. The tubers were processed into fermented and pressed *Icacina manni* meal (FPI) using anaerobic fermentation, as described by Umoren *et al*. (2007). Peeled and sliced tubers were placed in a sealed plastic bucket and fermented for 72 hours at an optimal temperature of 35°C. Post-fermentation, the tubers were grated into a mash, packed into porous jute bags, and pressed using a hydraulic jack for 12 hours to remove excess water. The resulting material was manually sieved to produce fermented and pressed Icacina manni meal suitable for use in feeding trials.

2.3 Experimental Animals and their Management

A total of twenty four (24) hybrid (landrace x large white) weaners pigs of about 8-10 weeks of age were procured for the study. The pigs were held in quarantine and treated with ivomectin injection at the rate of1ml /50kg body weight, then weighed and assigned to four (4) dietary treatments in each of the phases. Each treatment had three (3) replicates of two (2) pigs in each of the replicate. The experiment lasted for a period of 56 days. The pigs were managed in a well-ventilated concrete pen equipped with concrete feeding and watering troughs. The pigs were feed daily at 5% of the pig's body weight. These quantities were adjusted based on weekly weight of each treatment. Clean water was provided ad-libitum, routine and regular cleaning of the pens was carried out throughout the experimental period. Observation of sick pigs, isolation and adequate medication were carried out.

Table 2.1: Proximate Composition of Fermented *Icacina manni* Meals

Parameters	FIM
Crude protein (%)	4.63
Ether extract (%)	1.10
Crude fibre (%)	17.48
Ash (%)	2.81
NFE (%)	52.33
Dry Matter (%)	78.34
Gross Energy (Kcal/g)	4.14

FPI= Fermented and pressed *Icacina manni* meal

2.4 Experimental Diets

2.4.1 Fermented and Pressed *Icacina manni* Meals

Weaner's pig ration formulated using fermented and pressed *Icacina manni* meals were fed at 0%, 8%, 10%, and 12% levels as shown in Table 2.2.

Table 2.2: Composition of experimental diets using fermented and pressed *Icacina manni* meals (FPI)

Ingredients	**T1 (0%) Control**	**T2 (8%)**	**T3 (10%)**	**T4 (12%)**
Maize	47.00	39.00	37.00	35.00
Soya bean meal	21.50	21.50	21.50	21.50
Fermented and processed				
Icacina manni meals (FPI)	-	8.00	10.00	12.00
Palm kernel meal	22.30	22.30	22.30	22.30
Wheat offals	5.50	5.50	5.50	5.50
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Calculated composition				
Crude protein (%)	18.00	17.58	17.47	17.37
Metabolizable energy (kcal/kg)	2829.50	2766.30	2750.50	2734.70
Crude fat (%)	4.16	3.97	3.87	3.81
Calcium (%)	1.16	1.17	1.17	1.17
Phosphorous (%)	0.68	0.69	0.68	0.69
Crude fibre (%)	5.44	6.68	6.99	7.29

1kg of Premix contains: Vitamin A (5,000,000I.U), Vitamin D3 (1,000,000I.U), Vitamin E (16,000mg), Vitamin K3 (800mg), Vitamin B1 (1,200mg), Vitamin B2 (22,000mg).

2.5 Data Collection

2.5.1 Haematological and Blood Chemistry Analysis

Blood samples from three (3) weaner pigs were randomly selected from each treatment at the end of each phase of the experiment, through the jugular vein puncture using sterilized needle and syringes into blood collection bottles. Two sets of blood samples were taken from each pig to determine the haematological indices and serum metabolites.

Blood samples meant for haematological parameters were emptied into sample bottles containing ethylene diamine tetra-acetic acid (EDTA) as anti-coagulant. The sample bottles were immediately capped and the contents mixed gently for about 1 minute by repeated inversion. The samples were then taken immediately to the laborator to determine packed, cell volume (PCV), haemoglobin (Hb), Red blood cell (RBC), white blood cell (WBC) and differential white blood cell counts using standard procedure as described by Jain (1986).

Blood samples meant for serum metabolites were collected in sample collection bottles without anticoagulants and sent to the laboratory. The tubes were kept in a slanting wooden rack and the blood samples were allowed to clot overnight. The serum (supernatant) was separate clearly by decanting after the blood samples were spun in a centrifuge at 3000 rpm for 10 minutes. The serum samples were kept deep frozen at -10^{0}C prior to analysis to determined total protein, albumin, alkaline phosphatase, cholesterol and creatinine content.

2.5.2 Experimental Design and Statistical Analysis

The design was Completely Randomized Design. The data collected was subjected to analysis of variance (ANOVA). The means were separated using the Duncan's Multiple Range Test from SPSS (2025), version 25.

The statistical model of this design was:

Yij = µ + Ti + eij……………………………………………………………Equation 2.1

Where:

Yij = single observation

µ = overall mean

Ti = Effects of treatment

Eij = Error of term, which is independently identically normally distributed with a zero mean and constant variance.

3.0 Results and Discussion

3.1 Haematological Indices of Weaner Pigs Fed Fermented and Pressed *Icacina Manni* Meals (Fpi)

Results on the Haematological indices of weaner pigs fed fermented and pressed *Icacina manni* meals is presented in Table 3.1. Significant differences (P<0.05) were observed in white blood cell (WBC) counts, neutrophils, monocytes, eosinophils, basophils, and mean corpuscular hemoglobin (MCH). These parameters fell within normal ranges for healthy weaner pigs, as established by Jozica *et al.* (2018). Elevated MCH values, exceeding normal ranges, suggested macrocytic anemia, likely due to increased red blood cell destruction and subsequent enhanced erythropoiesis in the liver, spleen, and kidneys (Irekhore *et al.*, 2015).

Packed cell volume (PCV) was analyzed, which measures the proportion of red blood cells in the blood and is crucial for assessing oxygen transport and nutrient absorption. Normal PCV in weaner pigs ranges from 26-43% (Smith *et al*., 2019). No polycythemia symptoms were observed, as PCV values remained within this range, despite the potential for increased primary or secondary polycythemia with elevated PCV (Isaac *et al.*, 2013). Low PCV levels can indicate anemia due to nutritional deficiencies or parasitism, while high levels suggest dehydration (Brown, 2023). Reduced PCV may also reflect toxic factors or physiological adjustments impairing blood formation (Esonu *et al.*, 2001).

Hemoglobin and red blood cell (RBC) counts were also evaluated, with normal hemoglobin levels of 9-14 g/dL and RBC counts of 5-8 million/μL (Smith *et al.*, 2019). Low values often indicate anemia caused by iron deficiency, parasitism, or weaning stress, leading to lethargy, poor growth, and increased disease susceptibility (Taylor, 2020; Jones & Allison, 2021). High hemoglobin or RBC counts may signal dehydration, polycythemia, or hypoxia, potentially straining the cardiovascular system (Wilson & Carter, 2022; Brown, 2023). These parameters are essential for early diagnosis and guiding interventions like iron supplementation (Miller, 2021).

White blood cells and neutrophils differed significantly (P<0.05). WBC, neutrophil, and lymphocyte counts were critical for assessing immune status. Normal ranges are 8.7 37.9 × 10^3/μL for WBC, 30-50% for neutrophils, and 40-60% for lymphocytes (Smith *et al.*, 2019). Low WBC or lymphocyte counts may indicate immunosuppression from viral infections like porcine circovirus or weaning stress, reducing disease resistance (Taylor, 2020). Low neutrophils suggest bone marrow suppression or severe infections (Jones & Allison, 2021). High WBC or neutrophil counts indicate bacterial infections or inflammation, potentially causing tissue.damage if prolonged; while elevated lymphocytes may reflect chronic infections, straining energy reserves (Wilson & Carter, 2022; Adams & Lee, 2020). Regular monitoring of these indices ensures early detection of health issues, guiding treatments to enhance weaner pig welfare and farm productivity.

In weaner pigs, monocytes, eosinophils, and basophils are key white blood cell types indicating immune status. Normal ranges are 2-10% for monocytes, 0-4% for eosinophils, and 0-2% for basophils (Smith *et al.*, 2019). High monocyte levels suggest chronic inflammation or bacterial infections (Jones & Allison, 2021). Elevated eosinophils point to parasitic infections or allergies, while low levels may indicate immunosuppression (Taylor, 2020). Increased basophils, though uncommon, can reflect allergic or inflammatory conditions (Wilson and Carter, 2022). Low counts may occur during severe infections or stress (Adams and Lee, 2020). Tracking these parameters helps diagnose health issues and inform treatment strategies.

3.2 Blood Chemistry of Weaner Pigs Fed Fermented and Pressed *Icacina manni* Meals (FPI)

A study on weaner pigs fed fermented and pressed *Icacina manni* (FPI) diets, as shown in Table 3.2, first revealed significant differences (P<0.05) only in cholesterol among serum biochemical parameters. Pigs on diets 1 (control) and 2 had comparable cholesterol levels (P>0.05), but these differed significantly from diets 3 and 4 (P<0.05). However, all cholesterol values fell below the normal range of 80-120 mg/dL established in prior research (Adesehinwa, 2007; Fasuyi *et al.*, 2013). Cholesterol is crucial for cell membrane formation, hormone synthesis, vitamin D metabolism, and bile acid production for fat digestion (Jennifer, 2018). Low cholesterol may result from a dilution effect due to increased dietary fat storage or reduced synthesis (Jennifer, 2018). Fasuyi *et al.* (2013) noted that ascorbic acid supplementation reduces cholesterol synthesis, increases catabolism, and enhances bile acid excretion from the liver, contributing to hypocholesterolemia.

Table 3.1: The haematological indices of weaner pigs fed fermented and pressed *Icacina manni* meals

Parameters/Pig	T1 (Control)0%	T2 (8%)	T3 (10%)	T4 (12%)	SEM	Normal Range
Packed cell volume (%)	39.00	28.25	27.75	30.88	5.80	26-43
Haemoglobin (g/dl)	10.25	10.75	11.00	9.25	1.00	9-14
Red blood cell ($x10^6/mm^3$)	6.45	6.35	6.78	7.05	0.66	5-8
Whitebloodcell ($x10^3/mm^3$)	25.50^a	17.50^b	20.50^{ab}	17.50^b	2.88	8.7- 37.9
Neutrophils (%)	36.50^b	38.00^a	33.00^c	33.75^c	0.60	16.6-73.10
Lymphocytes (%)	55.00	51.50	41.50	45.75	5.81	12.5-70.10
Monocytes (%)	2.75^b	4.00^a	3.00^b	3.00^b	0.37	0 -5.0
Eosinophils (%)	3.00^a	1.00^b	3.75^a	3.33^a	0.81	0-6.0
Basophils (%)	1.00^a	1.00^{ab}	1.00^{ab}	0.50^a	0.21	0-3.0
MCV(fl)	61.75	61.25	58.25	60.85	1.96	42 -62
MCH(pg)	29.32^b	30.25^{ab}	31.80^{ab}	32.50^a	1.24	14 -24
MCHC(g/dl)	21.50	22.00	21.25	22.00	1.05	29 - 36

a-c means in a row with different superscripts are significantly different (P<0.05). SEM =Standard error of mean, MCV=Means corpuscular volume, MCH=Means corpuscular haemoglobin, MCHC=Means corpuscular haemoglobin concentration.

Table 3.2: Blood chemistry of weaner pigs fed fermented and pressed *Icacina manni* meals

Parameter/Pig	T1 (Control) 0%	T2 (8%)	T3 (10%)	T4 (12%)	SEM	Normal Range
Total protein (g/dl)	6.15	6.49	6.95	6.75	0.72	4.4 -7.4
Albumin (g/dl)	3.65	3.46	3.50	3.50	0.34	1.9 – 3.9
Globulin (g/dl)	2.96	2.76	2.89	2.65	0.18	2.5-3.5
Cholesterol (mg/dl)	96.10^{a}	97.05^{a}	86.19^{b}	86.89^{b}	2.97	81.4– 134.1
Alkaline phosphate (μ/l)	100.20	107.60	100.80	103.90	9.33	14.2 -89.10
Creatinine (mg/dl)	1.13	0.97	0.96	0.94	0.10	0.80 – 2.30

a-b, means in a row with different superscripts are significantly ($P<0.05$)different, SEM = Standard error of mean

Subsequently, a broader assessment of serum biochemical parameters was conducted to evaluate metabolic health, nutritional status, and organ function. Total protein, ranging from 6.0-8.0 g/dL, indicates liver protein synthesis capacity. High levels suggest dehydration or inflammation from infections, while low levels point to malnutrition or liver dysfunction, hindering growth (Smith *et al.*, 2019; Etim *et al*., 2014). Albumin, at 2.5-4.0 g/dL, reflects nutritional and hepatic health. Elevated albumin indicates dehydration, while low levels suggest protein deficiency or liver disease, leading to edema and poor performance (Taylor, 2020; Etim *et al.*, 2014). Globulin, ranging from 2.5-4.5 g/dL, assesses immune function. High levels indicate chronic infections or parasitism, diverting energy from growth, while low levels suggest immunosuppression, increasing disease risk (Wilson and Carter, 2022; Jones and Allison, 2021).

Alkaline phosphatase (ALP), ranging from 50-150 μ/L, was evaluated for its role in bone growth and liver health. Elevated ALP may indicate rapid skeletal development in weaners or hepatic stress from toxins or infections, while low levels suggest nutritional deficiencies affecting bone health (Taylor, 2020; Jones and Allison, 2021). Creatinine, at 0.5-1.5 mg/dL, assesses kidney function and muscle metabolism. High levels indicate renal dysfunction or dehydration, while low levels suggest muscle loss or inadequate protein intake, impacting growth efficiency (Brown, 2023; Miller, 2021).

These parameters, measured using spectrophotometry or automated analyzers, facilitate early detection of health issues like infections, nutritional imbalances, or organ dysfunction. For instance, low total protein and albumin from poor diet can stunt growth, while elevated globulin may signal parasitic infections requiring treatment (Etim et al., 2014). Monitoring cholesterol and ALP optimizes dietary fat and skeletal development, while creatinine analysis supports renal health through hydration and nutrition adjustments (Adams and Lee, 2020). Regular biochemical analysis ensures timely interventions, enhancing weaner pig welfare and farm productivity (Wilson and Carter, 2022).

5.0 Conclusion

The study demonstrated that weaner pigs fed diets with 8%, 10%, and 12% fermented and pressed *Icacina manni* meal maintained normal haematological and serum biochemical parameters, indicating no negative impact on health. The fermentation and pressing processes likely mitigate anti-nutritional factors, making *Icacina manni* a safe and cost-effective alternative to conventional feeds. Pig farmers are encouraged to include 8–12% fermented and pressed *Icacina manni* meal in weaner pig diets to reduce feed costs while ensuring animal health. Further research is advised to optimize inclusion rates and assess long-term effects for sustainable pig farming.

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