



## **Hematology and Blood Serum Chemistry of Albino Rat Fed Various Processed False Yam (*Ipomoea batatas*) Root Tuber at Varying Replacement Levels for Maize**

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### **Authors' contributions**

This work was carried out in collaboration between all authors. Author SEO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ASE and ETEE managed the analyses of the study. Author SEO managed the literature searches. All authors read and approved the final manuscript.

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### **ABSTRACT**

The experiment was conducted at the Animal science laboratory, Teaching and Research Farm, Ambrose Alli University to evaluate the effect of feeding differently processed false yam tuber meal on the hematology and blood serum chemistry of Albino rats. Fresh tubers of *Ipomoea batatas* were collected from Ekpoma environ. The tubers were washed then chopped and were differently processed by oven drying, sun drying as well as parboiling and sun drying. All processed tubers were then milled and an aliquot was collected and labeled before taken to the laboratory. 36 unsexed albino rats of an average age of 6 weeks were randomly allotted to four treatment namely: Corn starch-egg mixture as the control while diet 2, 3 and 4 were Oven dried, Sun dried and parboiled-sun dried *Ipomoea batatas* in a completely Randomized Design with three replicates. The result on the hematology showed that Hb and PCV were higher ( $P < 0.05$ ) among rats fed oven dried false yam. WBC was higher ( $P < 0.05$ ) among rats fed parboiled sundried false yam comparable to control. MCH, MCHC, and RDW were higher ( $P < 0.05$ ) in that fed oven dried false yam. Platelet

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value was higher ( $P<0.05$ ) in those fed sun-dried false yam. MPV, PWD, and neutrophil values were higher ( $P<0.05$ ) among rats fed parboiled sundried false yam. lymphocyte was higher among those fed diet 3. Serum chemistry showed that globulin, urea, and creatinine were significantly affected. It is concluded therefore that the inclusion of oven dried false yam meal as the substitute for maize in the diet enhances the blood quality of Albino rats.

**Keywords:** Haematology; serum chemistry; albino rats; false yam; Maize.

## 1. INTRODUCTION

False yam is seldom cultivated and grows in the forest and most common under palm plantation all over Nigeria. It remains freshly green all year with no pests and diseases reported [1]. It is not grazed by cattle or any other ruminant animal even when no other green plant is available and is yet to gain recognition and popularly as a food crop like cocoyam, potato or cassava. Its root resembles turnip or beet but can grow to giant size sometimes in two or three connecting tubers, weighing more than 30 kg. The words "false yam" confer a sense of illegitimacy and much better educated consider it as a creeping plant or even a starchy weed. The roots are difficult to lift from the soil unlike cocoyam, potato or cassava and their preparation are tough. It is renowned for its enormous tuber and penetrating root for destroying not only shovels and plows but people's patience. Despite the need for processing first, since it contains hydrocyanic acid, phytic acid, and oxalic acid the same bitter principals as cassava, a global staple [2] and sometimes as slightly bitter flavor icacina flour is commonly used to make pastes or porridges in local communities of some West African countries. Composed mainly of starch, the flour nonetheless can contain up to 10% protein, [3] reported 10.21 and 10.04% for sundried and oven dried respectively; while [1] reported a protein value for false yam tuber flour 10.3% a remarkable amount for a root crop five times that in cassava flour and twice that in potato, for example. It can be stored until needed [3]. Earlier nutritionist have reported work on false yam (*Icacina oliviformis*) leaf meal [4] false yam seeds (*Icacina oliviformis*) on growth performance of Albina rat [5] while [6] carried out study on effects of processing on nutrition composition of false yam (*Icacina trichantha*) flour. There has been a dearth of information on false yam incorporation in the diet of livestock. This study, from the nutritionist point of view, is designed to evaluate the hematology and blood serum chemistry of Albino rat fed variously processed false yam (*Icacina trichantha*) root tuber at varying replacement level for maize in livestock diet.

## 2. MATERIALS AND METHODS

### 2.1 Location and Duration of the Study

The experiment was carried out at the Animal science laboratory, Ambrose Alli University, Ekpoma for a period of 28 days.

### 2.2 Sourcing and Processing of Raw Materials

Fresh tubers of *Icacina trichantha* were collected from Ekpoma environ in Esan West Local government area of Edo state, Nigeria. The tubers were washed, chopped into small pieces and were differently processed by oven drying (OD), sun drying (SD) as well parboiling and sun drying (PBSD). For the oven, dried sample *Icacina trichantha* was chopped and placed in the oven for optimum drying at 60°C to constant weight as described by [7]. For a sun-dried sample, the test material was equally chopped and spread on the polythene mat then placed in the sun for optimum drying as described by [8]. For parboiled-sun dried samples, *Icacina trichantha* after slicing were boiled for about 30mins and subsequently dried in the sun as described by [8]. All the chopped, processed tubers were then milled into a fine powder to pass through a 2mm mesh sieve, and an aliquot was collected from the differently processed false yam and was well labeled then were taken to the laboratory for proximate analysis. The image below (Figs. 1 and 2) shows the root and leaves of false yam (*Icacina trochanter*).

### 2.3 Proximate Analysis of the Differently Processed Raw Materials

The moisture content, ash, crude fiber and crude fat, were determined using the method described by [9]. The crude protein was also be determined by the Kjeldahl method. The energy value was determined using an Adiabatic Oxygen Bomb calorimeter (12149 Adiabatic calorimeters, PARR instrument Co. Illinois USA as reflected in Table 1.



Fig. 1. Root of false yam



Fig. 2. Leaves and root of false yam

**Table 1. Proximate composition of differently processed false yam meal and corn starch-Egg white mixture**

Parameters (%)	CSEWM	ODFYM	SDFYM	PSFYM
Dry matter	5.73	10.79	9.49	7.61
Crude protein	21.03	5.32	6.03	5.38
Crude fiber	0.47	1.27	1.31	1.32
Ether extract	3.24	2.04	1.77	2.63
Crude Ash	1.46	2.23	2.34	2.26
NFE	68.07	78.35	79.06	80.80
Carbohydrate	81.66	87.27	87.53	88.39

CSEWM: Corn starch- Egg white mixture, ODFYM: Oven-dried false yam meal, SDFYM: Sundried false yam meal, PSFYM: Parboiled sundried false yam meal

#### 2.4 Experimental Animals, Management, and Design

A total of thirty-six white rats of same average weight were purchased from the animal house unit of College of Medicine, Ambrose Alli University Ekpoma, Edo State, for the experiment. The rats were kept under a standard temperature (25°C), relative humidity (45%-55%), dark/light cycle (12 hours), and were fed with the diet containing (oven dry, parboiled/sundried and sun-dried of *Icacina tricantha* meal) and rain water ad libitum. The rats were placed on 10 days acclimatization period before the commencement of the experiment, while giving free access to water. The thirty-six mixed sexed rats of an average age of 6 weeks that were obtained from the College of Medicine Ambrose Alli University, Ekpoma, Edo State for the experiment and were randomly allotted to four dietary treatment namely: Corn starch-egg mixture (CSEM) as the control diet while diet 2, 3 and 4 were Oven dried *Icacina tricantha* (OD), Sun dried *Icacina tricantha* (SD) and parboiled-sun dried *Icacina tricantha* (PBSD) in a Completely Randomized Design with 3 replicates of nine rats per treatment.

#### 2.5 Hematology and Serum Chemistry Study

At the 28<sup>th</sup> day of the feeding trial, two sets of fresh blood samples of 1ml each were collected via neck slit from one (1) rat selected from each of the replicates into 2 bottles per rat, one of the bottles contained ethylene diamine tetraacetic acid (EDTA) to prevent clotting, while the other bottle was without EDTA for the serum biochemistry study. The haematological parameters such as packed cell volume (PCV), haemoglobin (Hb), red blood cell (RBC), white blood cell (WBC), platelets, neutrophils, lymphocyte, etc. were determined using improved Neubauer's haematometer after dilution and cyanmethemoglobin method as described by [10] while mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC), were calculated according to [11]. Serum biochemistry parameters such as total protein, albumin, and serum glucose were determined by the method of [12] while globulin values were estimated by the subtraction of albumin value from serum protein value [10].

## 2.6 Statistical Analysis

All the data collected were subjected to analysis of variance (ANOVA) and the difference between means and treatments were determined using Duncan's multiple range test (DMRT) at 5% level of probability. All statistical procedures were according to [13] using [14] package.

## 3. RESULTS

### 3.1 Hematological Indices of Albino Rats Fed the Dietary Treatments

Hematological indices of albino rat fed treatment diets shows that hemoglobin, red blood cell, white blood cell, mean corpuscular haemoglobin concentration, red blood distance with, platelet, mean platelet volume, platelet distance with, neutrophil and lymphocyte were all significantly influenced ( $P < 0.05$ ) by the differently processed dietary treatments. However, packed cell volume and mean corpuscular volume were not significantly affected ( $P > 0.05$ ) by the dietary treatments. Haemoglobin was highest ( $P < 0.05$ ) with value of 13.40 g/dl in rats fed diet 2 (Oven dried false yam) followed by similar values (11.50 and 11.57 g/dl) recorded in rats fed the control diet and diet 4 (Parboiled and sun-dried false yam) respectively and least numerical value 10.50 g/dl was recorded in rats on a diet 3 (Sundried false yam.) Packed cell volume was however similar ( $P > 0.05$ ) among rats fed the treatment diets with the highest value of 37.36% from those fed diet 2 and lowest value of 35.00% was recorded in rats fed diet 4. Red blood cell was significantly highest ( $P < 0.05$ ) in diet 2 ( $6.81 \times 10^6 \mu\text{c}$ ) followed by ( $6.33 \times 10^6 \mu\text{c}$ ) in diet 4 and least ( $5.32 \times 10^6 \mu\text{c}$ ) in diet 3. White blood cell values were significantly highest ( $P < 0.05$ ) in rats fed diet 4 (parboiled and sun-dried false yam) ( $13.71 \times 10^6 \mu\text{c}$ ) comparable to ( $13.62 \times 10^3 \mu\text{c}$ ) recorded in rats fed the control diet and lowest ( $8.31 \times 10^3 \mu\text{c}$ ) in diet 3 (sundried false yam). Mean corpuscular volume had similar ( $P > 0.05$ ) values of 57.97, 57.45, 59.24 and 55.77 recorded in rats that ate treatment diets 1, 2, 3 and four respectively. Mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration were significantly highest ( $P < 0.05$ ) in rats fed diet 2 (oven dried false yam) (19.61 pg and 35.25 g/dl), followed by (19.46 pg and 34.70 g/dl) in rats fed the control diets and lowest in those fed diet 4. Red blood distance width was significantly highest ( $P > 0.05$ ) in diet 4 (18.09%)

followed by similar values of (17.50%) recorded in diet 1 and 2 and lowest in diet 3 (16.79%). Platelet value was highest ( $P < 0.05$ ) in rats placed on diet 3 ( $5.06 \times 10^3 \mu\text{c}$ ), similar to ( $4.84 \times 10^3 \mu\text{c}$ ) recorded in diet 4 and least value ( $3.47 \times 10^3 \mu\text{c}$ ) in diet 2. Mean platelet volume and platelet distribution width were significantly influenced ( $P < 0.05$ ) by the treatment diets with highest mean values (6.62 fl and 9.02% in diet 3 and lowest values (5.72 fl and 6.63%) were recorded in rats fed diets 2. The neutrophil value was also significantly highest ( $P < 0.05$ ) in rats fed diet 4 (19.10%) followed by similar values 17.37 and 17.34% recorded in rats fed diets and 1 and two while the least numerical value of 15.71% was recorded in rats on a diet 3. Lymphocyte also showed significant variation ( $P < 0.05$ ) among rats fed dietary treatments with the highest value of 78.84% recorded in diet 3, followed by statically similar values 76.30 and 75.71% recorded in rats that ate the control diet and diet four while least value of 73.12% was recorded in menu 2.

### 3.2 Serum Chemistry Study

The serological studies of albino rats fed dietary treatment (Table 3) revealed that total protein and albumin were not significantly influenced ( $P > 0.05$ ) by the dietary treatments but globulin, urea and creatinine showed a significant ( $P < 0.05$ ) variation among rats fed the treatment diets. The total protein had similar ( $P > 0.05$ ) values of 4.53, 4.43, 4.51 and 4.42 g/dl among rats fed diets 1, 2, 3 and four respectively. Albumin followed the same trend having a statistically similar values ( $P > 0.05$ ) of 2.60, 2.43, 2.50 and 2.53 g/dc in rats fed diet 1, 2, 3 and four respectively. Globulin, on the contrary, was significantly highest ( $P < 0.05$ ) in rats fed diet 3 (Sun dried false yam) (2.01 g/dl) followed by the comparable value of 2.00 g/dl in diet 2, and lowest value of 1.89 g/dl was recorded in rat fed diet 4. Urea was also significantly highest ( $P < 0.05$ ) in rats placed on diet 2 (4.17 mg/dl), followed by those on control diet (3.60 mg/dl) and lowest (3.50 mg/dl) in diet 3, Creatinine was also significantly influenced ( $P < 0.05$ ) by the dietary treatment with highest (0.81 mg/dl) value recorded in rats fed diet 2, followed by similar values of 0.71 and 0.70 mg/dl in rats fed diet 3 and the control while least numerical value of 0.63 mg/dl was recorded in rats fed diet 4.

**Table 2. Hematological indices of albino rats fed treatment diets (differently processed false yam)**

Parameters	Differently processed false yam meal				SEM±
	CSEWM	ODFYM	SDFYM	PSDFYM	
	1	2	3	4	
Haemoglobin (g/dl),	11.50 <sup>b</sup>	13.40 <sup>a</sup>	10.50 <sup>c</sup>	11.57 <sup>b</sup>	0.12*
Packed cell volume (%)	34.80	37.36	36.60	35.00	0.94 <sup>NS</sup>
Red blood cell (x10 <sup>6</sup> µc)	6.50 <sup>b</sup>	6.81 <sup>a</sup>	5.32 <sup>c</sup>	6.33 <sup>ab</sup>	0.18*
White blood cell (x 10 <sup>3</sup> µc)	13.62 <sup>a</sup>	12.37 <sup>b</sup>	8.31 <sup>c</sup>	13.71 <sup>a</sup>	0.25*
MCV (fl)	57.97	57.45	59.24	55.77	1.86 <sup>NS</sup>
MCH (pg)	19.46 <sup>ab</sup>	19.61 <sup>a</sup>	19.25 <sup>b</sup>	18.55 <sup>c</sup>	0.21*
MCHC (g/dl)	34.70 <sup>ab</sup>	35.25 <sup>a</sup>	31.80 <sup>b</sup>	32.73 <sup>b</sup>	0.66*
RDW (%)	17.40 <sup>a</sup>	17.50 <sup>a</sup>	16.79 <sup>b</sup>	18.09 <sup>a</sup>	0.18*
Platelet (x 10 <sup>5</sup> /mm <sup>3</sup> )	4.36 <sup>b</sup>	3.47 <sup>c</sup>	5.06 <sup>a</sup>	4.84 <sup>b</sup>	0.10*
MPV	5.85 <sup>c</sup>	5.72 <sup>c</sup>	6.23 <sup>b</sup>	6.62 <sup>a</sup>	0.10*
PDW	7.99 <sup>b</sup>	6.63 <sup>c</sup>	9.02 <sup>ab</sup>	12.95 <sup>a</sup>	0.22*
Neutrophil (%)	17.37 <sup>b</sup>	17.34 <sup>b</sup>	15.71 <sup>c</sup>	19.01 <sup>a</sup>	0.22*
Lymphocyte (%)	76.30 <sup>b</sup>	73.12 <sup>c</sup>	78.84 <sup>a</sup>	75.71 <sup>b</sup>	0.26*

NS: No significant difference ( $P>0.05$ ). \*: significantly different ( $P<0.05$ ) a,b,c: mean along the same row with different superscripts are significantly different ( $P<0.05$ ), µl: international unity per liter, g/dl: gram per deciliter, Fl: (picolitre) = fraction of one. A millionth of a liter pg: (pictograms) – one – trillion out of a gram SEM± standard error of means, MCV: mean corpuscular volume; MCH: mean corpuscular hemoglobin; MCHC: mean corpuscular hemoglobin concentration. RDW: red blood distance width; MPV: mean platelet volume PDW: platelet distance width, CSEW: cornstarch-egg with mixture; OVD: oven-dried false yam SUD: sun-dried false yam; PBSD: parboiled and sun-dried false yam

**Table 3. Serum chemistry of albino rats fed treatment diets (false yam meal)**

Parameters	Differently processed false yam meal				SEM±
	CSEWM	ODFYM	SDFYM	PSDFYM	
	1	2	3	4	
Total protein (g/dl),	4.53	4.43	4.51	4.42	0.03 <sup>NS</sup>
Albumin (g/dl)	2.60	2.43	2.50	2.53	0.08 <sup>NS</sup>
Globulin (g/dl)	1.93 <sup>ab</sup>	2.00 <sup>a</sup>	2.01 <sup>a</sup>	1.89 <sup>b</sup>	0.08*
Urea (mg/dl)	3.60 <sup>b</sup>	3.70 <sup>b</sup>	3.50 <sup>b</sup>	4.17 <sup>a</sup>	0.13*
Creatinine (mg/dl)	0.70 <sup>b</sup>	0.81 <sup>a</sup>	0.71 <sup>b</sup>	0.63 <sup>c</sup>	0.02*

NS: Not significant ( $P>0.05$ ); \*: Significantly different ( $P<0.05$ ) abc: Means along the same row with different superscripts are significantly different ( $P<0.05$ ) g/dl: gram per deciliter mg/de: Milligram per deciliter, CSEW: cornstarch-egg with mixture; OVD: oven-dried false yam, SUD: Sun-dried false yam; PBSD: Parboiled – sun-dried false yam

## 4. DISCUSSION

### 4.1 Hematological Indices of Albino Rats Fed Treatment Diets

The health status of all experimental animal used in the various trial is expedient, and one of the ways of assessing it is to evaluate its blood quality [15]. Hemoglobin value of the rats as reflected in Table 3 was significantly ( $P<0.05$ ) influenced by the treatment diets. The lower hemoglobin value recorded in this study could be as a result of the residual anti-nutritional factor present in *Icacina trichantha* (false yam) which had a greater affinity for metals such as iron and copper and make them unavailable thereby

reducing the hemoglobin count and hence effective oxygen transportation. This is in tandem with the findings of [16] who reported 40% whole cassava root meal feed to cockerel resulted in significantly lower hemoglobin value at the finisher phase. The values obtained are within the recommended range by [11]. The similarities observed in packed cell volume is a pointer to the fact that these dietary treatments have good nutritional qualities and rats maintained on them had low susceptibility to infections. Red blood cell was significantly highest in rat fed oven dried false yam; this shows that there was a significant reduction in the anti-nutritional factor in false yam when oven dried and this brings about nutrient availability in the test diet. The significant

( $P < 0.05$ ) variation and the similar value recorded in rat fed the control diet, parboiled and sun-dried false yam could be related to the nutritional adequacy of the test diet and its safety for consumption. This is in agreement with the report of [17]. The mean value recorded for white blood cell of albino rat fed treatment diet are within the range of hematological value reported by [18]. The similarities in the values of mean corpuscular volume in this study could also be related to the nutritional adequacy and safety of the processing methods used for the test diets. MCV is an important trait which determines the cell size of the erythrocyte and thus an important factor in determining the ability of the rat to withstand oxygen starvation for a long time [19]. Mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration and red blood cell distance width were of better quality in rats that ate oven dried false yam and this could be adduced to the nutritional adequacy and safety of the test diet which also is in corroboration with the report of [17]. Platelet, mean platelet volume and platelet distance width was significantly ( $P < 0.05$ ) influenced in rats fed parboiled and sun dried false yam, This implies that the rat fed this diet had low susceptibility to infection compared to other test diets since platelets are carriers of antibodies that help fight against foreign bodies in farm animals. The value recorded is within the range recommended by [20]. This significant ( $P < 0.05$ ) variation observed in rats fed the treatment diets with the highest value recorded in rats fed parboiled and sundried false yam concerning neutrophil shows that the anti-nutritional factor present in false yam was reduced to the barest minimum that gave a higher neutrophil value in rats fed diet 4. The value falls within the recommended range established by [21,19] and [22]. The significant variation in lymphocyte value with highest value recorded in rat fed sun-dried false yam (diet 3) is a pointer to the fact that the rats placed on this diet has higher immunity and low susceptibility to infection and diseases and higher lymphocyte is associated with the ability of animals to perform well under a very stressful condition. The value also fell within the recommended range established by [21] and [22]. Feeding the rats with the different diets did not significantly affect the pack cell volume and mean corpuscular volume values of the experimental rats when compared to the control groups and suggested that the consumption of false yam is safe and has no potential blood toxicity effect. Blood toxicity is usually accompanied with significant

changes in the values of hematological parameters including fall in values of RBC, Hb and PVC due to possible suppression of erythropoietic processes of hemolysis of the available RBC and resulting in liver necrosis and anemia with changes in blood biochemical parameters [23]. The results of these blood parameters show very low standard mean error (SEM $\pm$ ) and thus support their findings.

#### 4.2 Serum Chemistry Study of Albino Rats Fed Treatment Diets

Serum biochemistry profile of the experimental rats showed similarities ( $P > 0.05$ ) in the values of total protein and Albumin while significant variation ( $P < 0.05$ ) were observed in the value of globulin, urea and creatinine Serum total protein, albumin and globulin synthesis is related to the availability of protein and micro-nutrient [24]. The similarities observed in total protein could be due to the high level of protein present in *Icacina trichantha* (false yam) [3]. It is also known to contain some vitamins and mineral which makes it a renounced unconventional protein source in animal or mini-livestock feeding Albumin and Globulin values recorded fell within the recommended range by [11] and [20]. Serum Urea is known to be a function of the protein quality ingested by the animal, energy deficiency and decrease condition which impair protein utilization. When diet is deficient in essential amino acid, the amino acid present will be deaminated resulting in an increase in urea excretion [25]. In this present study, highest urea value was recorded in diet 4, followed by comparable urea values in diet 1, 2 and three respectively. This indicates that the diets were adequate in amino acid building blocks. [26] reported that creatinine is an indirect measure of protein utilization in poultry. The significant difference observed in the creatinine value with least creatinine value recorded in diet 4 suggest optimum protein utilization. It is of note that high level of creatinine could lead to tissue wastage while low creatinine enhances tissue build up in farm animals.

#### 5. CONCLUSION

It is concluded therefore that the inclusion of oven dried false yam meal as substitute for maize in the diet enhances the blood quality of Albino rats and this preliminary study can be extended to further feeding trail using other livestock such as Rabbits, poultry, pigs, and

ruminants so as to build data base of *Icacina trichantha* as possible feed stuff.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

As per international standard or university standard, written ethical approval has been collected and preserved by the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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