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Wild Mango (Irvingia Wombolu) Kernel: Proximate Composition, Mineral Content and Haematological Profile of Wistar Albino Rat

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Abstract:
Irvingia wombolu kernel (±testa) was initially analysed for proximate and mineral composition. Thereafter, the powder and oil extract were separately mixed with a commercial animal feed to study the haematological profile of wistar. albino rats fed for three weeks at dosage of 67mg/kg body weight. Blood samples were collected in heparinized bottles for examination. Results indicated that the presence of testa influenced significantly (P≥0.05) the crude fat and mineral contents. There was preponderance of phosphorus (283-310ppm), potassium (252-261ppm) and magnesium (105-123ppm). Furthermore, virtually all the treated animal groups exhibited higher packed cell volume (PCV) and platelet count, with concomitant lower mean corpuscular haemoglobin concentration (MCHC) when compared with the control group. These parameters showed positive correlation with the erythrocyte sedimentation rate (ESR) values for the oil treated groups and the control. No significant difference (P≤ 0.05) was observed in the white blood cells (WBC) of all sample groups including the control, while their respective normocyte, lymphocyte and eosinophil concentrations followed similar ratios. Furthermore, there was no detectable basophil. Testa had no significant effect on the haematological parameters examined. It was concluded that regular consumption of I. wombolu by man for dietary reason could have concomitant clinical and beneficial effects.

Keywords: *Irvingia wombolu, testa, haematological, phytochemical, erythropoiesis, thrombocytosis*

1. Introduction

Irvingia is a non- timber forest tree comprising the stem, leaves, roots and fruits[1]. Commonly referred to as wild bush mango and African bush mango, the tree is named after a Royal Navy surgeon and botanist, George Irving[2]. It is of the order Malpighiales, family Irvingianceae and comprises seven species of which Irvingia gabonensis and Irvingia wombolu are well known. Irvingia is native to Central and West African Countries. Specifically, the species wombolu and gabonensis span through the humid forest zones of West and Central Africa.

The flesh and the kernel of I. gabonensis var. gabonensis are edible while only the kernel of var. wombolu is edible. The former is for this reason called sweet bush mango and the latter bitter bush mango. Some local names for the kernels of African bush mango include dikanut among the Camerounians and in Nigeria, ogbono among the Ibos and oro–egili and oro-aikpele among the Igala people of Kogi State, Nigeria.

Indigenous African tribes have used the fruits in various ways including the application of the kernel as a thickening agent for traditional soups. When squeezed, the oil from the fruit can also be used for cooking.

Irvingia fruit including its kernel has been reported to cause reduction in weight, waist circumference and systolic blood pressure. In addition, the presence of appreciable fibre content makes it a very viable option in reduction of blood sugar and hence management of diabetes mellitus[3].

Although literature reports abound on the role of Irvingia plant on weight and glucose control, they are rather scanty on haematological changes that occur following administration of kernel fractions, especially the oil extract. Arogba[4] had reported on the effect of testa on the physico-chemical properties of wild mango kernel. However, the in-vivo effect of testa on some haematological parameters has not been studied. Hence, the current study was aimed at providing improved knowledge on the nutritional implication of the fruit kernel.

The study was undertaken, therefore, to determine the effect of undefatted I. gabonensis (var. wombolu) kernel powder and its oil extract on the hematological profile of wistar albino rat.

The objectives of the study included proximate and mineral analyses of the kernel variety. For haematological profiling, the effects of testa of undefatted kernel powder and extracted oil fractions on packed cell volume (PCV), mean

corpuscular haemoglobin concentration (MCHC), platelets, erythrocyte sedimentation rate (ESR) and white blood cells (WBC) of wistar albino rats were studied after twenty-one days of administration.

2. Materials and Methods

2.1. Collection and Treatment of Kernel Samples

Mature I.wombolu fruits were plucked from the tree in Aloko, Bassa Local Govt., Kogi State, Nigeria in December, 2013. The fruits were then split open with a stainless steel knife. The kernels were removed from the shell and divided into two equal portions. The kernels were dried at ambient temperature (30 ± 2)^{o}C until constant weight was achieved. The testa of one of the portions was left intact (Iwkt) while the other was removed (Iwk).
Oil was extracted from parts of Iwkt and Iwk by Soxhlet extraction[5] and labeled Iwot and Iwo respectively.

2.2. Purchase of Reference Commercial Feed

The commercial feed for the study was pelletized growers mash procured from a commercial sales outlet at Anyigba, Kogi State.

2.3. Experimental Animals

Twenty-five wistar albino rats with weight range of 120 – 180g were purchased from the Animal House of Kogi State University, Anyigba and transferred to the standard aluminum cubicles at the Animal House of Biochemistry Department. Each cubicle labeled A, B, C, D, or E contained five rats.

2.4. Treatment Protocol

Kernel powder and the oil extract (±testa) respectively, were mixed with commercial animal feed (50:50) and fed to four groups of animals, while the fifth group (E), serving as control was fed with only the commercial feed. Animals in groups A and B were fed with the powder at a concentration of 67mg/kg body weight while those in groups C and D were fed with the equivalent 4ml of the oil extract. All groups were allowed unrestricted access to potable water.

The treatment lasted for a total of twenty-one days. On the twenty-second day, three animals from each group were sacrificed using a sharp surgical blade. Blood samples were collected in EDTA bottles in readiness for analysis.

Sample Types	Animal Group (5/group)
(Iwkt) Irvingia kernel powder (+testa)	A
(Iwk) Irvingia kernel powder (-testa)	B
(Iwot) Irvingia kernel powder (+testa)	C
(Iwo) Irvingia kernel oil (- testa)	D
Control – Commercial animal feed	E

Table 1: Protocol for Animal Treatment

2.5. Proximate and Mineral Content Analyses

Moisture, crude fat, protein, fibre, and ash contents were determined using methods described by Pearson[5]. Carbohydrate was calculated as percentage difference of the components mentioned.
The minerals (iron, calcium, sodium, phosphorus, and magnesium) were solubilized by wet ashing and determined by atomic absorption spectrophotometry as described in A.O.A.C.[6]. Appropriate serial dilutions of Standards were prepared for Absorbance reading. Regression curves were plotted, and concentrations extrapolated there-of.

2.6. Determination of Hematological Indices

The packed cell volume (PCV), the erythrocyte sedimentation rate (ESR), the platelets, the white blood cells (WBC), the mean corpuscular hemoglobin concentration (MCHC) were all determined a described by Baker and Silverton[7], using automated haematology analyzer (Sysmex kox1: Sysmex corporation, Kobe, Japan, Xp 300 Series, Code No AC580857)

2.7. Statistical Analysis

Analysis of Variance (ANOVA) was conducted using Bonferroni Correction Adjustment Software for multiple comparisons. Treatment means were tested for significance at P=0.05 using Duncan's New Multiple Range Test, and identified by different alphabets.

3. Results

Two sample types (A and B) were dried to similar level of dry matter. Similar relative concentrations of ash and fibre were obtained. The fat and protein contents of sample A were about 6% and 2% w/w respectively higher than those of sample B. These observations account for the differences in their carbohydrate content.

Composition (%)	Iwkt (A)	Iwk (B)
Dry matter	98.1 ± 0.07	95.9 ± 0.12
Fibre	4.2±0.02	1.5±0.02
Ash	2.2 ±0.14	2.0±0.12
Fat	41.1 ± 0.31	35.6 ± 0.27
Protein	13.5 ± 0.30	11.8 ± 0.02
Carbohydrate (by difference)	37.1±0.20	45.0±0.36

Table 2: Proximate Composition of I.g var.wombolu kernel (±testa)
Results Are Expressed as Mean ± Standard Error of Mean for N = 3
Iwkt (A) = Irvingia Kernel Powder (+ Testa)
Iwk (B) = Irvingia Kernel Powder (- Testa)

There were no significant differences ($p \leq 0.05$) between Iwkt and Iwk for sodium, calcium, and iron except potassium, magnesium and phosphorus.

Phosphorus had the highest concentration followed by potassium and magnesium. The least available was calcium.

Composition (mg/kg)	Iwkt (A)	Iwk (B)	SEM
Sodium	27.0±0.12^{a}	36.3±0.41^{a}	22.12
Potassium	261.3±0.90^{b}	252.0±3.51^{a}	2.58
Magnesium	123.0±0.90^{b}	104.7±0.70^{a}	16.32
Calcium	12.1±0.13^{a}	9.0±0.04^{a}	23.03
Iron	60.5±0.91^{a}	49.2±0.60^{a}	11.22
Phosphorus	310.0±4.99^{b}	283.0±2.20^{a}	4.99

Table 3: Composition of Some Mineral Elements of Irvingia Gabonensis Var.Wombolu Kernel (± Testa)
Results are expressed as mean ± standard error of mean for n=3
Iwkt (A) =Irvingia Kernel Powder (+Testa)
Iwk (B) =Irvingia Kernel Powder (-Testa)
Values with Similar Alphabet in A Row Show No Significant Difference at P = 0.05

Sample Type	(%)
Crude protein	15.0
Fat	7.0
Crude fibre	10.0
Calcium	1.0
Available Phosphorus	0.35
Metabolisable energy	2550(kcal/kg)

Table 4 Composition of Commercial Feed

Parameter	A Powder (+t)	B Powder (-t)	C Oil (+t)	D Oil (-t)	E Control	LSD
PCV (% v/v)	44.50±0.50^{b}	45.33±0.90^{b}	42.33±2.90^{a}	44.00±1.20^{b}	38.70±0.70^{a}	4.34
MCHC (g/dl)	29.40±0.70^{a}	28.53±0.24^{a}	33.50±0.30^{b}	33.83±0.60^{b}	33.63±0.34^{b}	1.26
WBC(10^3/µl)	7.40±0.20^{a}	7.23±1.00^{a}	6.20±0.10^{a}	6.90 ± 1.20^{a}	6.20±0.03^{a}	2.04
Normocyte (%)	61.00±0.60^{b}	52.00±3.51^{a}	62.70±3.2^{b}	61.70±0.70^{b}	61.00±0.60^{b}	6.10
Lymphocyte (%)	30.33±0.33^{a}	36.70±4.7^{b}	30.70±0.33^{a}	29.70±0.3^{a}	30.70±0.33^{a}	5.93
Monocyte (%)	5.33±0.33^{b}	4.70±0.70^{a}	2.70±1.70^{a}	6.00±0.00^{b}	5.70±0.33^{b}	2.34
Eosinophil (%)	3.00±0.60^{a}	2.70±0.33^{a}	2.70±1.33^{a}	2.33±0.33^{a}	2.00±0.60^{a}	2.05
Basophil (%)	0.00	0.00	0.00	0.00	0.00	0.00
Platelet(10^3/µl)	300.33±6.70^{d}	233.00±34.20^{b}	260.00±1.0^{cd}	275.00±23.0^{cd}	178.00±12.22^{a}	54.72
ESR (mm/h)	20.33±4.90^{b}	11.00±2.10^{a}	31.70±3.70^{c}	33.33±1.80^{c}	39.00±0.33^{c}	8.50

Table 5: Haematological Profile of Wistar Albino Rats Fed with Irvingia Gabonensis Var. Wombolu Kernel Powder and Oil (±Testa) on 22nd Day
Results Are Expressed As Mean ± Standard Error of Mean for N = 3

- A - D refers to animals treated with I.wkt, I.wk, I.wot and I.wo respectively and E is the control
- Values with similar alphabet in a row show no significant difference at p = 0.05
- PVC = packed cell volume

- MCHC = mean corpuscular haemoglobin concentration
- WBC = white blood cells
- ESR = erythrocyte sedimentation rate

4. Discussion

4.1. Proximate and Mineral Composition

Proximate analysis of both sample types confirmed the oil nature of Irvingia kernel seed, with the testa accounting for 5%. Arogba[4] had reported a range of 4-5%. The values of oil for Iwk and Iwkt in this study were lower than 70% obtained by Womeni et al[8] and 66.6% by Umoh et al[1]. The differences could be due to geographical location. Irrespective of effect of testa, the Irvingia gabonensis var. wombolu had comparable levels of crude fat and carbohydrate. The study showed comparable fibre composition of both sample types with values of 1.9% obtained by Womeni et al[8]. and 1.8 % by Umoh et al[1].

The study demonstrated the presence of sodium, potassium, magnesium, calcium, iron and phosphorus in appreciable concentrations. The testa accounted for 4% potassium, 15% magnesium, 25% calcium, 19% iron and 5% phosphorus respectively. The sodium content of both sample types was relatively higher than the value of 20mg/kg obtained by Oluwaseun et al[9]. The concentrations of potassium and phosphorus in both Iwkt and Iwk were higher than the potassium value of 86.30 mg/kg and phosphorus value of 206.18 mg/kg obtained by Ekundayo et al.[10]. However, the concentrations of magnesium and calcium in both Iwkt and Iwk were lower than the corresponding values of 212.29 mg/kg and 107.63 mg/kg reported by Ekundayo et al[10]. These observations indicate that literature is replete with wide variations of data for the mineral composition of Irvingia kernel. Nevertheless, the present study observed preponderance of phosphorus, followed by potassium, and magnesium in both kernel types.

The presence of these vital elements in I. wombolu kernel as shown in this study makes its consumption highly recommendable especially to the lower class of the society where affordability of a balanced diet is a big issue.

4.2. Haematological Profile

There were significant differences in the PCV values ($P \geq 0.05$) between the control group (E) and the treated groups except group C which was treated with the oil extract containing testa. Its PCV value was the least among the treated samples. It implied that other components of nutritional significance in the kernel powder had conferring and positive influence on PCV, thereby improving erythropoiesis. Consequently, regular consumption of Irvingia Wombolu kernel as practised in Nigerian traditional soup- making with the intact testa, is to be encouraged to obviate the need for repeated blood transfusions in malnourished and sickle cell patients and other clinical conditions requiring repeated blood transfusion. The result confirmed the works of Omonkhua and Onoagbe[11]; and Ojo et al[12] who had earlier demonstrated improved erythropoiesis in normal rabbit treated with aqueous stem bark extract of Irvingia gabonensis. Their results are comparably similar to this within similar time frame. The results in this work also showed that treatment given to the kernel samples had virtually no significant effect on PCV though the phenolic antioxidants of Irvingia plant reported by Omonkhua and Onoagbe[11] , Hubert et al.[13] and Uhegbu et al [14] could protect.

The values of MCHC were generally lower in comparison with those obtained for PCV. Furthermore, it was observed that irrespective of testa, animals fed on the kernel powder (A and B) had significantly lower MCHC than others ($P \geq 0.05$). Given the inverse relationship (MCHC= Haemogblobin concentration X 100/PCV)[15], lower MCHC was attributed to increase in platelet concentration and soluble protein in PCV.

There was no significant difference ($P \leq 0.05$) in the overall WBC of all samples, including the control. Similar trend was discerned with the eosinophil component. Basophil was not detected in any of the samples. However, the group B animals treated with kernel powder where testa was detached peculiarly differed from others in respect of normocyte, lymphocyte and monocyte concentrations ($P \geq 0.05$). Of the three components, the lymphocyte content of the group B animals was relatively higher on the basis of treatment given or in comparison with the control.

Platelets are the components of total blood that are responsible for clotting. They are smaller than both the RBCs and the WBCs. The normal platelet count is 150,000 – 450,000 platelets per µl of circulating blood[16] which is similar to the results obtained in this study. Compared with the control group (E), there was significant increase by 31-69% in all the treated samples, which averaged to 50% in treatment given with either the kernel powder or the oil samples irrespective of the presence or absence of testa. The result indicated that Irvingia wombolu kernel elicited thrombocytosis. Therefore, its regular consumption would provide immense health benefits in bleeding disorders where thrombocytopenia is a cause.

It was observed that the control and animals treated with oil extract showed relatively higher ESR than those treated with the kernel powder sample ($P \geq 0.05$). The observation correlated with results of MCHC and platelet count but contrasted with those of PCV. The reversed and negative correlation between ESR and PCV has been similarly reported by Ibrahim et.al[17], and Kanfer and Nicol[18]. It could, therefore, be further discerned that lower soluble protein content of the plasma of animals treated with oil extract enhanced the ESR values obtained.

5. Conclusion

The study has shown that I.wombolu kernel contains an appreciable protein (13%), crude fat (36 - 41%) and mineral contents particularly phosphorus (283-310 ppm), potassium (252-261 ppm) and magnesium (105-123ppm). The ranges

observed were influenced by the presence of testa. However, it had no significant effect ($P \leq 0.05$) on the haematological parameters studied, Rather, I.wombolu kernel without testa elicited erythropoiesis and thrombocytosis.

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