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Performance and Histological Responses of Abino Rats Fed *Moringa oleifera* Seed Meal

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Abstract
This study investigated the performance and histological responses of *Moringa oleifera* seed meal. Sixty weanling albino rats (42.35±0.83 g) randomly allotted to four diets containing 10.0% casein (T1), 10.0% raw MSM (T2), 10.0% 3-hour water-soaked MSM (WMSM, T3) and a protein-free diet (T4) fed for 21 days. Daily weight gain (DWG, g/rat), Feed Intake (FI, g/rat), and feed conversion ratio (FCR) were measured. Kidney and liver were harvested for histological assay using standard procedures. The rats fed protein-free diet had the least DWG (-11.30±0.11), while rats on casein diet had the highest (24.10±0.15). The FI was least in the protein-free diet (39.85±0.86) and highest in casein diet (50.46±7.86). The FCR ranged from 2.14±0.32 (casein diet) to 7.74±0.26 (raw MOS). There was mild congestion of the glomeruli and distension of the capillary vessels with numerous thrombin rats fed raw MOS (T2) and protein-free diets (T4) while rats fed casein diet (T1) and water-soaked MOS (T3) observed no vision lesion in their kidneys. However, the liver of rats fed water-soaked MOS (T3) and rats on casein diet (T1) shared mild multiple foci of coagulative necrosis, while rats fed with protein-free diet (T4),and raw MOS (T2) observed moderate congestion of the sinusoids and centrolobular veins, with slight coagulative necrosis of the hepatocytes. Rats fed on three hours water-soaked moringa seed had better feed utilisation hence no organ damages were observed.

Keywords: *Moringa oleifera,* albino rats, liver, kidney

Introduction
As a result of increasing population growth in Africa in the past ten years, coupled with increasing demands for animal protein, the price of the animal product has greatly increased to the extent that it has become difficult for low-income earners to consume enough animal protein per day. The high cost of animal production in terms of feeding, housing, drugs and vaccine has greatly reduced the number of farmers going into large-scale livestock production. Consequently, man has to look for a cheaper source of animal protein, this obviously calls for more research into other non-competitive feed resources. *Moringa oleifera* seed could be an alternative choice of raw material as a protein source for animal nutrition.

Moringa oleifera is in high demand for their medicinal value. It was reported to be a good source of vitamins and amino acids (Olugbemi *et al*., 2010). *Moringa oleifera* seed was claimed to boost the immune systems of broiler chickens (Lilibeth *et al*., 2010; Olugbemi *et al*., 2010; Akangbe 2017). The leaves and green fresh pods of *Moringa oleifera* are rich in carotene and ascorbic acid (Vitamin C) (Makkar and Becker, 1999) and also, its inclusion into layers diets induced double yolks, (Akangbe and Abu 2012, Aremu *et al*., 2012, Abu and Akangbe 2017). *Moringa oleifera* seeds extract was reported to have antibacterial properties and the conclusion was made to investigate it as a phytotherapeutic agent to combat infectious agent (Ewuola, 2009, Patel, 2011). Most parts of the plant have been used in folk medicine in Africa and South Asia (Fahey, 2005). The medicinal effects of the plant were ascribed to their possession of anti-oxidants, which are known to suppress formation of reactive oxygen species (ROS) and free radicals (Aja *et al*., 2014).

Materials and Methods
The experiment was carried out at the Rat House of the Department of Animal Science, University of Ibadan, Ibadan, Nigeria. *Moringa oleifera* seed was harvested at Oluwo village, Egbeda, Ibadan, while other feed ingredients were purchased from Blessed Feeds (Nig.) Enterprises, Orogun, Ibadan. Sixty weanling albino rats were weighed and randomly assigned to four dietary treatments of 15 rats each in a completely randomized design experiment. The rats had access to one of the four experimental diets. The control T_1 received a standard diet of casein, T_2 received 10% of raw *moringa* seed meal,T_3 received 10% water -soaked moringa seed meal and T_4 received a protein-free diet. The trial consisted of a 5-day acclimatisation period followed by a 21-day collection period. Water and diet were offered *ad-libitum*. Performance: feed intake, body weight changes, feed conversion ratio and feed efficiency. Histological assay of the liver and kidney was conducted.

Table 1: Gross composition of experimental diets fed to albino rats

Ingredient (%)	T_1	T_2	T_3	T_4
Corn starch	55.00	40.00	40.00	60.50
Ground nut oil	8.00	7.00	7.00	10.50
Sucrose	12.25	10.00	10.53	13.00
Casein	10.00	-	-	-
Raw MOSM	-	28.25	-	-
Water -soaked MOSM	-	-	27.72	-
Protein free diet	-	-	-	-
Non nutritive cellulose	5.00	5.00	5.00	5.00
Glucose	6.00	6.00	6.00	6.00
Oyster shell	1.00	1.00	1.00	1.00
Di calcium phosphate	2.00	2.00	2.0	2.00
Salt	0.25	0.25	0.25	0.25
Vit. Premix	0.50	0.50	0.50	0.50
Total	100	100	100	100

Results and Discussion

The total feed intakes of rats were, 52.46, 40.26, 41.75 and 39.85g for dietary treatments 1, 2, 3 and 4 respectively. However, feed intake was significantly different ($p>0.05$) among treatments. Treatment 1 which is the control diet (casein) obtained the highest value, followed by treatment 3 which is water-soaked MOSM while treatment 4, the protein-free diet had the least value than others. The results on weight gain indicate that rats fed the control ratio (casein) obtained the highest body weight gain of 24.10g, followed by rats fed diets 3 and 2 with the values of 9.20 and 5.20g respectively. While rats fed the protein-free diet had the least value of -11.30g. The differences in weight gain were significant ($p>0.05$) for all the dietary treatments. The feed conversion ratio for the dietary treatments were significantly different ($p<0.05$) from the rats on control diet (casein) of the value of 2.14, while the dietary treatments had 4.54, 7.74 and -3.53 for diets 3, 2 and 4 respectively.

Table 2: Performance of Albino Rats Fed *Moringa oleifera* Seed

Parameters	T1	T2	T3	T4	SEM
Initial Body weight(g)	42.80	41.40	41.70	44.20	1.35
Final Body weight (g)	66.90^{a}	45.40^{b}	50.90^{b}	32.38^{c}	3.71
Body Weight Gain (g)	24.10^{a}	5.20^{c}	9.20^{b}	-11.30^{d}	1.02
Feed Intake (g)	51.46^{a}	40.26^{b}	41.75^{b}	39.86^{b}	5.41
Feed Conversion Ratio	2.14^{c}	7.74^{a}	4.54^{b}	-3.53^{d}	0.49

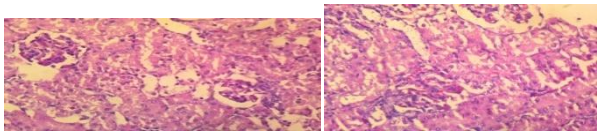
^{abcd}Means along the same row with different superscripts are significantly different ($p<0.05$)

The results of histology of rats fed *Moringa oleifera* seed meal revealed that there were significant differences ($p<0.05$) on both the kidneys and livers of the rats. There were mild congestion of the glomeruli and distension of the capillary vessels with numerous thromb in rats fed raw MOS (T2) and protein-free diets (T4) while rats fed casein diet (T1) and water-soaked MOS (T3) observed no vision lesion in their kidneys. The livers of rats fed with water-soaked MOS (T3) and rats on protein-free diet (T4), obtained mild multiple foci of coagulative necrosis, while rats fed with casein diet (T1) had no vision in the lesions and raw MOS (T2) observed moderate congestion of the sinusoids in the centrolobular veins, with slight coagulative necrosis of the hepatocytes.

Table 3: Histological assay

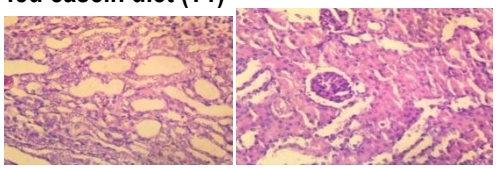
Parameters	T_1	T_2	T_3	T_4
Kidney: (Necrosis//Mild/Moderate/Severe)	NVL	Mild	NVL	Mild
Liver :Necrosis/mild/moderate/severe)	NVL	Moderate	Mild	Mild

NVL: No vision lesion.



A: Histology of albino rat kidney fed casein diet (T1)

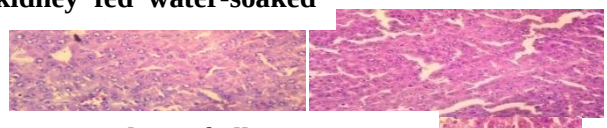
B: Histology of albino ratkidney fed raw MOSM (T2)



C: Histology of albino rat kidney fed water-soaked

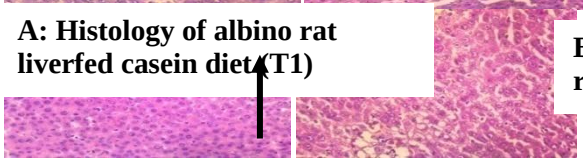
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D: Histology of albino rat kidney fed protein free diet (T4)



A: Histology of albino rat liverfed casein diet (T1)

B: Histology of albino rat liverfed raw MOS (T2)



C: Histology of albino rat liverfed water-soaked MOS

of Albino Rat Li

D: Histology of albino rat liver fed protein free diet (T4)

Discussion

The total feed intake and weight gain on the control diet (T_1) as the sole protein source were significantly better than those on the tested diets. Casein is a pure protein with thewell-balanced amino acid profile. The higher feed intake and weight gain for rats on casein diet indicated that the diet was more palatable to the rats. The low feed intake in the tested diets could be due to poor palatability. The more palatable a diet is, the more it is acceptable and consumed and vice versa. Feed intake is associated with nitrogen source, palatability, flavor and amino acid (Makkar and Becker, 1999). The low intake of the dietary treatments could be attributed to the low solubilisation of some anti-nutritional factors that are still present in both the raw and water-soaked *Moringa oleifera* seed meal.

Histology evaluation of the livers and kidneys of rats fed casein diet (T) and water-soaked MOS (T3) showed normal liver/kidney architectures, there were no distortions or inflammatory cells observed, this could be due to the effect of the processed *Moringa* seeds. This study is in line with the studies of Ewuola (2009) and Aja *et al*. (2014) who established that there were no inflammatory cells observed in treated Moringa seed and lima bean respectively. The mild liver and kidneys dysfunction observed in other treatments could be due to the toxic effects in the diets of the animals.

Conclusion

From the rat study, it was observed that *Moringa* seeds soaked in water for three hours were able to meet up with the growth performance and health status of the animals.

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