EFFECTS OF SUBSTITUTING GROUNDNUT CAKE WITH WATER SPINACH (*Ipomoea aquatica*) LEAF MEAL ON PERFORMANCE, CARCASS YIELD AND BLOOD PROFILE OF WEANER RABBIT

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Abstract: A study was conducted to evaluate the effects of water spinach leaf meal (WSLM) on growth performance, carcass yield and blood profile of weaner rabbits. Six diets were compounded using WSLM to substitute groundnut cake at 0.00, 2.50, 5.50, 7.50, 10.00 and 12.50% which were designated as treatments 1, 2, 3, 4, 5 and 6, respectively. Thirty six (36) weanerrabbits were allotted to the six dietary treatments of six rabbits per treatment and replicated three times with 2 rabbits per replicate in a Completely Randomized Design (CRD). Results showedthat all the growth parameters measured weresignificant (P<0.05) across the dietary treatments. Average daily Feed intake (ADFI) ranged from 39.10g to 67.10 g while the total weight gain (ADWG) ranged from 10.26 g in T1 to 23.73 g in T5. Better feed conversion ratio was observed in T2 (2.40) while inferior feed conversion ratio (FCR) was observed in T1 (3.81). There was significant difference (P<0.05) in liveweight, carcass weight and dressing percent. The results of internal organs were not significantly affected (P>0.05) across the treatmentsexcept for the heart and caecum which was significantly (P<0.05) influenced by dietary treatments. White blood cell (WBC), MCV and hemoglobin concentration were significantly affected while all the serum biochemical parameters (cholesterol, total protein, albumin, globulin, urea and glucose) measured were not affected by the dietarytreatments. It can be concluded that WSLM can substitute groundnut cake to 12.50 % without adverse effecton the performance and blood profile of weanerrabbits.

Keyword: Blood profile, growth performance, groundnut cake, rabbits, blood profile.

Introduction

In most developing countries including Nigeria, the supply of qualitative animal protein in sufficient quantity and at affordable price has been the major challenge to the livestock industries (Ahemen *et al.,* 2013). This has affected the per capita consumption of animal protein over the last decades. According to FAO (2006) report, Nigeria is one of the countries where average protein intake of the people is ranked among the lowest in the world. It is estimated that on the average, Nigerians consume only about 7 g of animal proteins on a daily basis as against the minimum requirement of 28 g/head/day recommended by Food and Agriculture. Pragmatic approach such as the use of mini-livestock (rabbit) for meat production and adaption of feeding strategy that maximizes the use of under-utilized feed resources and waste will address these challenges. Rabbit, a mini-livestock has the ability to bridge this gap. This is because is socially acceptance on the combine basis of space requirement, climatic condition, absence of taboos, high fecundity, short generation interval as well as its distinctive digestive physiology which allows the use of Agro by- products and forage (Odeyinka *et al.*, 2008; Ahemen*et al.,* 2013).

Despite all these advantages associated with rabbit production, it has not been fully explored as animalprotein source in Nigeria. Acute shortage and high cost of conventional feedstuffs especially theconventional protein and energy sources like soybean cake, groundnut cake and maize has been attributed to this challenge (Fasuyi, 2005; Yakubu*et al.*, 2013). The nutrition of rabbit in Nigeria is also primarily based on *Tridax procumbens* and or *Centrosemapubescens* whose growth and availability in the dry season cannot sustain all-year rabbit production (Odeyinka *et al*., 2008).

Water spinach is the most common plant species grown in wetlands in terms of aquatic vegetable production. This production requires relatively easy growing techniques with lower labour costs compared to other cultivated plants (Saroeun, 2010). In Yola, besides growing on inland waterways, the plant is commonly cultivated all year round in the surrounding wetlands around Gireoand Dobeli lakes. It is a primary source of nutrients (Khov*et al*., 2007) because it has high potential to convert efficiently the nitrogen in the effluent into edible biomass with high protein content (Kean and Preston, 2001).

Water spinach is a good source of protein and can be used as feed for all kinds of animal and for humans. The foliage contains protein in the range of 23.6 to 36.30% (Nguyen NhuyXuan Dung 1996; Nguyen *et al.*, 2006), and is also a good source of trace minerals (mg/kg): Zn, 5.03; Mn, 22.2; Cu, 1.37 and Fe, 75.3 (NIAH, 1995) and it is also rich in vitamin A and C. The nutrients concentrate mainly in the leaves. Umar *et al.* (2007) reported that the mineral element contents in the leaves were high, in particular the concentration of K and Fe. Also the leaves contain moderate concentrations of Na, Ca, Mg and P, with low Cu, Mn and Zn contents.

In rural regions, water spinach is commonly used by smallholders to feed their scavenging poultry, as a supplement mixed with rice bran. Using water spinach for local chickens indicates that it is also the preferred foliage to provide protein and vitamins for growing chickens (Saroeun, 2010).

Even though water spinach leaf has a lot of nutritional advantages, there is little information on the effects of substituting groundnut cake withwater spinach leaf meal on growth performance, carcass yields and blood profile of weanerrabbits. The objective of this study therefore is todetermine the effects of quantitative substitution of groundnut cake with waterspinachleaf meal on the performance, carcass and internal organs weight and blood profile of weaner rabbits.

Materials and Methods

Study area

The study was carried out at Concordia College farm located at Ngurore in Yola south Local Government Area, Adamawa State. Ngurore lies between latitude 9° 16' 59" North and longitude 12° 13' 59" East. Temperature is high in February, March and April because of high radiation, which is evenly distributed throughout the year. Maximum temperature reaches about 40°C particularly in April, while minimum temperature can be as low as 18°C betweenDecember and January (Adebayo and Tukur, 1999).

Processing of water spinach leaves

Waterspinach leaves were harvested from the bank of river Benue in Yola, Adamawa State.The leaves were removed from the stems and later dried in a well ventilated room under room temperature (25°C) until they were crispy to touch, later milled using a hammer miller to obtain thewater spinachleaf meal (WSLM).

Experimental animals and their management

Thirty six (36) weaner rabbits aged between 6-7 weeks old with an average weight of650g were used for the study. The rabbits wereobtained from small-scale producers in Ngurore.They were randomly divided into six groups of six animals per treatment with two rabbits per replicate in a Completely Randomized Design.Metallic Feeders and plastic drinkers were provided in each of the cages. Six experimental diets were compoundedusing WSLM at 0.00, 2.50, 5.50, 7.50, 10.00 and 12.50% which were designated as dietT1, T2, T3, T4, T5 and T6, respectively (Table 1). Diet1 served as the control and devoid of WSLM. The experiment lasted for fifty-six (56) days.

Table 1: Composition of experimental diets

Ingredients	Dietary treatments					
	T1	T2	T3	T4	T5	T6
Maize	57.00	57.00	57.00	57.00	57.00	57.00
GNC	12.50	10.00	7.50	5.00	2.50	0.00
WSLM	0.00	2.50	5.00	7.50	10.00	12.50
Maize Offal	25.00	25.00	25.00	25.00	25.00	25.00
Fishmeal	2.50	2.50	2.50	2.50	2.50	2.50
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Premix|*	0.50	0.50	0.50	0.50	0.50	0.50
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Determined analysis(%DM)						
Crude protein	15.22	15.40	16.05	16.11	16.15	16.21
Crude fibre	9.11	10.20	10.23	10.26	10.30	10.31
Ether extracts	3.20	3.15	3.10	3.08	3.99	2.78
Ash	7.21	7.11	6.99	6.82	6.67	6.62
NFE	65.26	64.14	63.63	63.73	62.89	64.08

*0.25 kg of Mineral/Vitamin Premix contained the following: Vitamin A 1,800IU, Vitamin D 250IU, Vitamin E 8,000IU, Vitamin K 750 mg, B1 750 mg, B_2 1000 mg, B_6 800 mg, B_{12} 25mg Folic 300 mg, Niacin 5000 mg, Pantothenate 3000 mg, Biotin 25 mg, Choline 160 g, Thyroxine 300 mg, Copper 0.4 g, Iron 4 g, Manganese 5.5 g, Iodine 0.2 g, Zinc 5 g, Cobalt 0.15 g, Selenium 0.15 g.

Data collection

Growth performance evaluation

The experimental diets were offered *ad libitum* every morning at about 08.00am. The quantity of feed offered daily and leftover were weighed to determine the daily feed intake while FCR was determined by dividing the total feed intake throughout by the total weight gain. Water was provided *ad libitum* in plastic containers.

At the beginning of the experiment, all the rabbits were weighed to determine their initial weight before allotting them to their treatments. The rabbits were weighed weekly to determine the weight gain.

Haematological and serum biochemical analysis

At the end of the experiment (56 days), one rabbit from each replicate was randomly selected for blood samples were collected. 2.0 mls each of blood samples were collected from the external ear vein into specimen bottles containing an anticoagulant, Ethylene –Diamine-Tetra-Acetic acid (EDTA) and without anticoagulant using sterile hypodermic syringe for haematological parameters and serological studies. All the parameters (packed cell volume (PVC), haemoglobin concentration (Hb) and white blood cell (WBC). Means corpuscular volume (MCV), Mean corpuscular haemoglobin concentration (MCHC) and Mean corpuscular hemoglobin (MCH), glucose, total protein, globulin, albumin, urea and cholesterol) determined were according to the procedures described by Sirios (1995).

Carcass yield and internal organs measurement

One rabbit from each replicate was randomly selectedand sacrifice. Thereafter, it was evisceratedand all the internal organs were removed to obtain thecarcass weight. Dressing percent was calculated bydividing the carcass weight by the live weight andmultiplying it by 100. All the internal organs weightswere measured on a digital scale (Model Ek-120i) while the length wasmeasured using measuring tape.

Chemical analysis

The proximate composition of the water spinachleaf meal and experimental diets were determined in the Department of Animal Science and Fisheries Laboratory, Modibbo Adamawa University of Technology, Yolausing the procedures described by AOAC (2010).

Statistical analysis

Data obtained in this study were subjected to analysisof variance (Steel and Torrie, 1980) using SPPSVersion19. Duncan Multiple Range Test was used to separate means (Duncan, 1955).

Results and Discussion

Proximate composition of water spinach leaf meal

The result of the proximate composition of water spinach leaf (WSLM) is shownin Table 2. WSLM had crude protein (CP) content of 30.02% whilethe crude fibre (CF) was 23.67%. The ether extract (EE) and ash contents were 6.20 and 9.20%, respectively.

Table 2 Proximate Composition of WSLM (%DM)

Constituents	Percentage composition
Dry matter	91.80
Crude protein	30.00
Crude Fibre	23.67
Ether extracts	6.20
Ash	9.20

The CP content of WSLM recorded in this study was higher than the values reported by Nguyen NhuyXuan Dung 1996 and Saroeun, 2010) but lower than the value (Nguyen *et al.*, 2006). The EE and ash content were lower than the values reported by Saroeun, (2010). Variations in the nutrient composition could be as a result of environmental factors such as season, geographical location stage of maturity and processing methods.

Performance of weaner rabbits fed water spinach leaf meal

The performance of weaner rabbits fed diets containing water spinach leaf meal is presented in Table 3. Significant differences (P<0.05) were observed in all the parameters measured for growth performance except initial weight. The final body weight was significantly (P<0.05) higher in treatment 5 and there was progressive increase from 1225.10 g in T1 to 1979.90 g in T5. The final body weight however declined to 1851.10 in T6. Average Daily feed intake (ADFI) increased significantly (P<0.05) from 39.10 g in T1 to 67.10 g T6. The total daily weight gain (ADWG) also increased from 10.26 g in T1 to 23.73 g in T5 and thereafter it declined to 21.41 g in T6. Superior feed conversion ratio (FCR) was (2.40) in T2 while inferior was observed in T1 (3.81).

The daily feed intake was significantly (P<0.05) influenced by inclusion level of WSLM. It shows progressive increase in feed intake as the level of WSLM increases in the diet. Yakubu *et al*. (2013) also observed a significant (P<0.05) difference infeed intake when they conducted a 20-week trial. Aduku (1988), Yakubu *et al.* (2013), Yakubu and Wafar (2014) in their separate studies reported higher feed intake with increasing levels ofcrude fibre in the diets of rabbits. Increased in feed intake recorded in this study can be explained by the fact that leaf mealscontain relatively high crude fibre which tends to increasethe total fibre content of the diets and result in dilution and absorption of other nutrients.

There was significant (P<0.05) difference in average dailyweight gain. The results showed a progressive increase in ADWG as the level of WSLM increased in the diet. The high performance of weaner rabbits on WSLM diets could confirms the reports ofFasuyi *et al.* (2005) and Yakubu and Wafar (2014) that leafy meals serve as a source of protein, vitamins and minerals which essential components diets in improving growth performance of rabbits.

Table 3.Performance of weaner rabbits fed WSLM

Parameters	Dietary treatments						
	T1	T2	T3	T4	T5	T6	SEM
Initial weight (g)	650.00	651.00	650.00	652.00	651.00	652.00	34.80^{ns}
Final weight (g)	1225.10^{c}	1611.22^{b}	1761.12^{ab}	1897.30^{a}	1979.90^{a}	1851.10^{a}	87.33^{*}
ADFI(g)	39.10^{c}	41.21^{b}	54.35^{b}	63.25^{a}	65.23^{a}	67.10^{a}	2.10^{*}
TWG (g)	575.10^{b}	960.22^{b}	1111.12^{a}	1245.30^{a}	1328.9^{a}	1199.10^{a}	12.91^{*}
ADWG	10.26^{b}	17.14^{ab}	19.84^{a}	22.23^{a}	23.73^{a}	21.41^{a}	1.34^{*}
FCR	3.81^{a}	2.40^{b}	2.73^{b}	2.84^{b}	2.74^{b}	3.13^{a}	0.25^{*}

Means on the same row with different superscript are significantly different * = Significant different P<0.05 ns = notsignificant different (P>0.05)TWG = Total weight gain,ADWG = Average Daily weight gain , ADFI = Average daily feed intake, FCR = Feed conversion ratio, SEM = Standard error of mean

Table 4: Effect of WSLM on carcass yield and internal organ characteristics of weaner rabbits

Parameters	Dietary treatments						
	T1	T2	T3	T4	T5	T6	SEM
live weight (g)	1925.20^{c}	2311.22^{b}	2511.32^{ab}	2611.30^{a}	2722.12^{a}	2678.10^{a}	87.33^{*}
Carcass weight(g)	980.22^{e}	1200.11^{d}	1320.00^{cd}	$1421,00^{bc}$	1690.00^{a}	1571.00^{ab}	68.20^{*}
Dressing %	50.91^{b}	51.92^{b}	52.56^{b}	54.41^{b}	62.08^{a}	58.66^{ab}	2.33^{*}
Pelt weight (g)	55.00	60.10	65.22	66.12	70.22	67.21	0.49^{ns}
Lion (g)	115.10^{b}	130.52^{a}	129.20^{a}	135.21^{a}	138.11^{a}	129.21^{a}	12.6^{*}
Racks/ribs %	52.13^{c}	57.01^{bc}	60.55^{abc}	63.22^{abc}	70.05^{a}	69.00^{ab}	3.74^{*}
Internal organ (% live weight)							
Heart	5.41^{b}	4.25^{c}	4.01^{c}	6.05^{a}	6.10^{a}	5.32^{b}	0.13^{*}
Caecum	2.01^{c}	2.42^{abc}	2.41^{abc}	2.11^{bc}	2.60^{a}	2.50^{ab}	0.14^{*}
Kidney	4.01	4.63	5.01	4.59	4.99	5.00	0.40^{ns}
Lungs	9.21	10.20	10.11	9.00	10.12	9.45	0.39^{ns}
Liver	24.11	23.99	24.22	25.11	23.00	24.00	2.78^{ns}
Spleen	0.69	0.70	0.41	0.31	0.42	0.45	0.34^{ns}

Means on the same row with different superscript are significantly different * = Significant different P<0.05 ns = notsignificant different (P>0.05) SEM = Standard error of mean

Carcass yield and internal organs weight

Table 4 shows the results of carcass yield and internalorgans of weaner rabbits fed quantitative substitution of WSLM. All carcass yield parameters measured weresignificantly (P<0.05) influenced by dietary level of WSLM except pelt weight. However, rabbits fed T5 diet hadhigher carcass weight (1690.00 g) than those on the other diets. Similarly, the dressing percent was higher (62.08%) in rabbits on T5 diet and lowest in diet T1 (50.91%). Racks/ribs values of rabbits on diets T3, T4, T5 and T6 were 60.55 g, 63.22 g, 70.05g and 69.00 g, respectively werehigher than the values observed on those fed diets T1 (52.13 g) and T2 (57.01 g). The weight of the loin wasalso higher in rabbits fed diet T5 (138.11 g) and those on WSLM diets were statistical similar. The weight of the pelt was not influenced (P>0.05) by dietary levels of WSLM.

The parameters measured for the internal organs werenot affected by the dietary levels of WSLM, except the weight of the heart, caecum which was significantly (P<0.05) influenced. The carcass weight and dressing percentagewere significantly (P<0.05) influenced by the substitution levels of WSLM in the diets. Although there isvariations in thedressing percent recorded in this study when compared to other studies, the values are within the range of 50 to 57% reportedbyAduku and Olukosi (1990) for rabbits fed under tropical condition.

The weight of the caecum whichwas significantly (P<0.05) affected by dietary levels of WSLM could be as a result ofrelatively higher crude fibre content of WSLM. Ahamefule *et al.* (2006) reportedthat the weights of some organs like kidney and liverof animals may be used in animal feedingexperiments as evidence of toxicity. WSLM substitution in the diets did not affect the size ofthe liver and kidney which are involved in detoxification. It is an indication that WSLM is a safe ingredient for rabbit consumption.

Haematological parameters

Table 5 present the result of haematological profile of rabbits fed varying levels of WSLM as substitute for groundnut cake. The PCV, MCH and MCHC were not significantly (P>0.05) affected by the diets. Other parameters studied showed significant difference (P<0.05) among the dietary treatments. The WBC values ranged from 9.11 in d T5 to 12 in T1 and PCV values ranged from 31.22 to 39.22. The MCHC, MCV and MCH were 31.55 to 36.22, 60.32 to 63.11 and 31.32 to 34.23, respectively.

Table 5 Effect of WSLM on hematology and biochemistry ofweaner rabbits

Parameters	Dietary treatments						
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**SEM**
PCV (m/%)	34.21	32.11	36.00	39.22	31.22	33.24	2.44^{ns}
Haemoglobin (g/dl)	15.11^{b}	15.21^{b}	15.99^{ab}	16.11^{ab}	18.11^{a}	17.22^{ab}	0.86^{*}
MCV(fl)	61.22^{ab}	60.32^{b}	62.11^{ab}	63.11^{a}	61.55^{ab}	62.10^{ab}	1.78^{*}
MCH (Pq)	33.11	32.00	31.32	33.45	34.23	33.15	1.75^{ns}
MCHC (%)	36.22	33.11	35.22	31.55	32.50	35.00	1.80^{ns}
WBC ($\times10^6$/mm^3)	12.10^{a}	9.11^{c}	9.13^{c}	10.11^{a}	9.23^{c}	11.51^{a}	0.51^{*}
			Biochemical indices				
Cholesterol (mg/dl)	48.21	47.21	45.16	49.21	46.11	47.99	2.4^{ns}
Total protein (g/dl)	7.20	7.40	7.50	7.30	7.00	7.50	0.18^{ns}
Albumin (g/dl)	40.32	41.22	40.11	42.11	40.99	42.22	2.9^{ns}
Globulin (g/dl)	19.20	18.22	19.33	20.11	19.18	18.53	2.2^{ns}
Urea (mg/dl)	6.61	6.32	6.22	6.56	6.00	6.17	0.17^{ns}
Glucose (mg/dl)	63.33	60.99	61.22	64.22	63.22	60.22	1.22^{ns}

Means on the same row with different superscript are significantly different; * = Significant different P<0.05; ns = notsignificant different (P>0.05) SEM = Standard error of mean; PCV= Packed cell volume, RBC =Red blood cells; MCH= Mean corpuscular haemoglobin; WBC= While blood cell; MCHC= Mean corpuscular haemoglobin concentration

Haematological and biochemical profile of animals suggest their physiological disposition to nutrition (Madubuike and Ekenyen, 2006). Though there were variations in the values of the parameters recorded in this study, they are still within the normal physiological ranges for rabbits as reported by Jenkins (1993). WSLM did not affect the biochemical indices of rabbits. All the parameters measured for serum biochemistry (cholesterol, total protein, albumin, globulin, urea and glucose) were within the normal physiological range for rabbits as reported by Jenkins (1993). This also suggests that the WSLM is safe for weaner rabbit consumption.

Conclusion

It can be concluded that WSLM possess a dietary quality and can substitute groundnut cake up to 12.5% without any detrimental effect on growth performance, carcass and internal organs characteristics and blood profile.Therefore, rabbit farmers are encouraged to use water spinach leaf meal in the diets of growing rabbits.

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