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NUTRIENTS AND DIGESTIBILITY OF RABBIT FED GRADED LEVELS OF MORNING GLORY (*Ipomea asarifolia)* LEAF MEAL

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ABSTRACT

A study was conducted to evaluate graded levels of Morning glory (*Ipomea asarifolia)* leaf meal on growing rabbits. Four experimental diets were formulated, with inclusion levels of 0, 5, 10 and 15 g/kg of *Ipomea asarifolia* leaf meal. The diets were designated as Treatment T_1, T_2, T_3 and T_4 respectively. Forty male rabbits used for the experiment were allotted in to four treatments groups (1, 2, 3, and 4) with two rabbits per replicate in a completely randomized design. The feeding trial lasted for 56 days. The following parameters were monitored (Feed intake, live weight gain, nutrient intake and its digestibility). There was no significant difference ($P>0.05$) between the control and the animals fed 5 and 10 g/kg *Ipomea asarifolia* in terms of dry matter intake, feed intake, nutrients intake and digestibility and growth decreased significantly ($P<0.05$) when the levels of *Ipeomea asarifolia* exceeded 5g/kg. It was concluded that inclusion of *Ipomea asarifolia* in the diets of growing rabbits should not exceed 5 g/kg.

Keywords: Rabbit; Nutrient intake; Nutrient digestibility; *Ipomea asarifolia*

INTRODUCTION

Morning Glory (*Ipomea asarifolia)* is used traditionally in other parts of the world as a vegetable for consumption and feed for monogastric animals. However, in Nigeria it is considered as weed, abandoned and survives throughout the year under harsh environmental condition. It has a short growth period and is resistant to common insect pests. There appears to be little information in literature on its utilization as livestock feed in Nigeria (Kean and Preston, 2001). In Nigeria, the leaf of *Ipomea asarifolia* is not generally consumed by either humans or livestock. It mostly grows as a weed and thus popularly used as compost material, ethno veterinary and human medication practice and mulch. *Ipomoea asarifolia* is a potential cheap feed ingredient for optimum and sustainable animal production. In Nigeria, the traditional names include "*Doman kada*" in Hausa and "*Gboro ababa*, in Yoruba language (Schmelerz *et al.,* 2008). Thus, with a crude protein level of 32%, metabolizable energy of 2768kcal/kg and good mineral profile, (Jegede *et al., 2009*) *Ipomea asarifolia* leaf meal, when successfully adopted as a feed has a potential to be a cheap feed ingredient for

monogastric animals and therefore has the capacity to contribute in alleviating the animal protein deficit in human diets.

Rabbits have immense potentials and good attributes, which include high growth rate, high efficiency in converting forage in to meat, short gestation period, high prolificacy, relatively low cost of production and high nutritional quality of meat which includes low fat and cholesterol levels. Rabbit meat has high protein level of about 18 % and its consumption is bereft of cultural and religious biases (Biobaku and Oguntona, 1997; Ndor *et al.*, 2009). Due to these potentials, there is need to encourage farmers to go into rabbit production using cheaper feed materials so as to supply animal protein at cheaper cost.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Livestock Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto. Sokoto State is located in the North-western part of Nigeria between longitudes 4^0 8' and 6^0 54' E and latitudes 12^0 0'N and 13^0 58'N and attain altitude of 350m above sea level (Mamman *et al.*, 2000). The state has a semi-arid climate which is characterised by low rainfall, ranging from 500-1300 mm with seasonal variations. Heat is more severe in the state in March and April, but the weather is always cool in the mornings and hot in the afternoons except during the harmattan period (SSMIYSC, 2010). A minimum temperature of 13^0 C has been recorded in January and maximum of 44^0 C in April (SSDG, 2002). Sokoto has two main seasons, the dry season; which starts from October and last up to April, in some part it may extend to May or June. The wet season begins in most part of the state in May or June and last up to either September or October (SSMIYSC, 2010).

Identification

Asarifolia leaves were collected from naturally growing plants at the campus near student's Hostel of Usmanu Danfodio University Sokoto, Nigeria. A voucher specimen registration number (UDUH \ ANS \ 0140) was deposited at the Botany Department Herbarium of Usmanu Danfodio University Sokoto where it was identified botanically.

Phyto – Chemical Analysis

Phyto-chemical analyses of Morning glory (*Ipomoea asarifolia*) were carried out as described by Prashant *et al.* (2011) and Solomon *et al.* (2013) as follows:

Detection of Alkaloids: Morning glory (*Ipomoea asarifolia*) extracts were dissolved individually in diluted Hydrochloric acid and filtered (a) Mayer's Test: Filtrates were treated with Mayer's reagent (Potassium mercui iodide). Formation of a yellow coloured precipitate indicates the presence of alkaloids. (b) Wagner's Test: Filtrates were treated with Wagner's reagent (Iodine in Potassium Iodide). Formation of brown/reddish precipitate indicates the presence of alkaloids. (c) Dragendroff's Test: Filtrates were treated with Dragendroff's reagent (solution of Potassium bismuth iodide). Formation of red precipitate indicates the presence of alkaloids. (d) Hager's Test: Filtrates were treated with Hager's reagent (saturated

picric acid solution). Presence of alkaloids confirmed by the formation of yellow coloured precipitate.

Detection of glycosides: extracts were hydrolysed with dilute HCl, and then subjected to test for glycosides. (a) Modified Borntrager's Test: Morning glory extracts were treated with Ferric chloride solution and immersed in boiling water for about 5 minutes. The mixture was allowed to cooled and extracted with equal volumes of benzene. The benzene layer was separated and treated with ammonia solution. Formation of rose-pink colour in the ammonical layer indicates the presence of anthranol glycosides.

Legal's Test: Morning glory (*Ipomoea asarifolia)* extracts were treated with sodium nitropruside in pyridine and sodium hydroxide. Formation of pink to blood red colour which indicates the presence of cardiac glycosides.

Detection of saponins (a) Froth Test: Morning glory extracts were diluted with distilled water to 20 ml and this were shaken in a graduated cylinder for 15 minutes. Formation of 1 cm layer of foam indicates the presence of saponins. (b) Foam Test: 0.5 gm of morning glory (*Ipomoea asarifolia*) extract was shaken with 2 ml of water. If foam produced persists for ten minutes it indicates the presence of saponins.

Detection of phytosterols (a) Salkowski's Test; Morning glory extracts were treated with chloroform and filtered. The filtrates were treated with few drops of conc. Sulphuric acid, shaken and allowed to stand. Appearance of golden yellow colour indicates the presence of triterpenes (b) Libermann Burchard's test: Morning glory extracts were treated with chloroform and filtered. The filtrates were treated with few drops of acetic anhydride, boiled and cooled Conc. Sulphuric acid were added. Formation of brown ring at the junction indicates the presence of phytosterols. Detection of phenols Ferric Chloride Test: Morning glory extracts were treated with 3-4 drops of ferric chloride solution. Formation of bluish black colour indicates the presence of phenols.

Detection of tannins, Gelatine Test: To the extract, 1 % gelatine solution containing sodium chloride was added. Formation of white precipitate indicates the presence of tannins.

Detection of flavonoids (a) Alkaline Reagent Tests: morning glory (*Ipomoea asarifolia*) extracts were treated with few drops of sodium hydroxide solution. Formation of intense yellow colour, which becomes colourless on addition of dilute acid, indicates the presence of flavonoids. (b) Lead acetate Test: morning glory (*Ipomoea asarifolia)* Extracts were treated with few drops of lead acetate solution. Formation of yellow colour precipitate indicates the presence of flavonoids.

Detection of proteins and amino acids (a) Xanthoproteic Test: Morning glory extracts were treated with few drops of conc. Nitric acid. Formation of yellow colour indicates the presence of proteins. (b) Ninhydrin Test: To the Morning glory extract, 0.25 % w/v ninhydrin reagent was added and boiled for few minutes. Formation of blue colour indicates the presence of amino acid.

Detection of diterpenes Copper acetate Test: Morning glory extracts was dissolved in water and treated with 3-4 drops of copper acetate solution. Formation of emerald green colour indicates the presence of diterpenes.

Proximate and Fiber Analysis

Thoroughly mixed representative sample of the experimental diet and the test ingredient were analyzed for proximate composition according to the procedures of A.O.A.C (AOAC, 2011) to determine the moisture content, crude protein (CP), crude fiber (CF), ether

extract (EE) and Ash, while fibre fractions were analysed according to Van Soest *et al.* (1991).

Management of Experimental Animals

Forty New Zealand White breed of eight weeks old rabbits weighing an average of 900 g were sourced from National Veterinary Research Institute, Vom, Nigeria. The animals were housed in cages measuring 35 × 35 × 55 cm (width × length × height). The cages were cleaned. Plastic drinkers and improvised metallic feeding troughs were provided in each cage. The drinkers were washed daily. Both feed and water were provided *ad-libitum* during the experimental period. All the experimental rabbits were identified and allowed two weeks pre-conditioning period to acclimatize. They were medicated against coccidiosis and mange. They were given prophylactic coccidiostat (ampro-vitracycline) via drinking water as recommended by the manufacturer, they were dipped with cinatic powder base on the instruction given by manufacturer.

Experimental Feed Sourcing

Maize, wheat offal, groundnut cake, groundnut haulms, fish meal, limestone, salt (NaCl) and premix were purchased from Sokoto Central Market, milled and separately bagged for diet formulation. Fresh *Ipomoea asarifolia* leaves were sourced within the Main Campus of Usmanu Danfodiyo University. The plants were dried under the shade in an open air, milled and kept in air tight containers.

Formulation of Experimental Diets

Four experimental diets were formulated and fed as complete diet (Table 1). *Ipomoea asarifolia* was included at 0, 5, 10,15g /kg inclusion levels. The diets were designated as diet1, 2, 3, and 4 respectively in the experiment, the composition of the experimental diet and calculated chemical composition are shown in Table 1.

Table 1: Composition of the experiment diets

Ingredients	TREATMENTS (supplemented level of *I. Asarifolia g/kg*)			
	T1 (0)	T2 (5)	T3 (10)	T4 (15)
Maize	34	34	34	34
Wheat offal	17	17	17	17
Groundnut cake	27	27	27	27
Groundnut Haulms	16.50	16.50	16.50	16.50
Fish meal	3	3	3	3
Limestone	2	2	2	2
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
Supplemented level of *I. Asarifolia* (g/kg)	0	5	10	15

Chemical Analysis of Experimental Diets

Samples of formulated experimental diets were analyzed for proximate components (crude protein, nitrogen free extract, crude fibre, ether extract, ash, energy and dry matter), as outlined by the Association of Official Analytical Chemists, AOAC (2005).
Neutral detergent fibre (NDF), Acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined using the procedures described by Van Soest*et al*. (1991). Hemicellulose were calculated by the difference between Neutral Detergent Fibre and Acid Detergent Fibre fractions (NDF-ADF).

Experimental Layout

Complete Randomized Design (CRD) was used with four treatments replicated five times with two animals per replicate making a total of fourty rabbits.

Nutrient retention studies

Nutrient retention studies were carried out using three animals from each treatment. They were housed in different cages for two weeks (one week for adaptation and one week for faecal sample collection). Faecal samples were collected and weighed. The samples of faeces and feeds taken to the laboratory for analysis. The nutrients retained by the animals were obtained as follows:

$$\text{Nutrient retained} = \frac{\text{Nutrient intake} - \text{Nutrient voided}}{\text{Nutrient intake}} \times 100$$

Data Analysis

The data collected from the experiment were subjected to analysis of variance (ANOVA) Significant difference among treatment means were separated by least significant difference (LSD).

RESULTS AND DISCUSSION

Proximate and fibre Components of the Experimental Diets

The Proximate composition of the experimental diet is presented in Table 2

Table 2: Proximate composition of the experimental diets

Parameter	TREATMENTS (supplemented level of *I. Asarifolia g/kg*)			
	T1 (0)	T2 (5)	T3 (10)	T4 (15)
Dry matter (%)	83.42	93.52	94.34	93.84
Crude prot. (%)	18.69	19.31	19.00	18.66
Ether extr. (%)	6.10	6.60	5.00	6.10
Crude fibr (%)	6.98	6.48	7.98	8.98
NFE (%)	60.38	50.76	59.43	58.81
ASH (%)	7.85	8.40	8.35	9.25
ME (kcal/kg)	3023.510	3049.280	2999.49	2986.45

NPE- Nitrogen Free Extra

Proximate composition of the experimental diet showed that crude fibre is higher for treatments 3 and 4. The dry matter composition of the diet ranged from 93.4 to 94.3. There was a decrease in moisture, NFE and cellulose increased (Table 2). The values for crude protein (%) and Energy (Kcals) were comparable between the treatments. The variations shown among the experimental diets except for the inclusion levels of *Ipomoea asarifolia.* Crude protein (CP) and energy in the diet were formulated to be iso-proteineous, and iso-calorigenic, so as to balance the requirements for the animals. The experimental diets were within the recommended optimal crude protein level of 18-20 % (Sheldon and Williams, 2000).The crude fibre of the treatment diets were higher than that of the control group but falls within the recommended range of 6-16 % (Sheldon and Williams, 2000). The higher fibre content obtained for treatment 4 (8.98 %) could be due to high fibre content of the *Ipomoea asarifolia,* as observed by Hassan and Umar (2006). The fibre content is within the required level for rabbits.

Phyto-Chemical Analysis of *Ipomoea asarifolia*

Qualitative phyto-chemical analysis of the test ingredient indicated high presence of flavonoids, Tannins, Phenols, Alkaloids, Saponins, Steroids and Terpens, are only slightly present in the dried and boiled samples. All other phyto-chemicals are found to be slightly present in the boiled samples. Quantitative composition of the test ingredient indicated high content of Alkaloids (%) and flavonoids (mg/ml) compared to other phyto-chemicals (Table 3).

Table 3: Phyto-Chemical analysis of *Ipomoea asarifolia*

Parameters Qualitative	Fresh	Dried	Boiled
Flavonoids	+ +	+ +	+
Tannins	+ +	+ +	+
Phenol	+ +	+ +	+
Alkaloids	+ +	+ +	+
Saponins	+ +	+ +	+
Glycoside	+ +	+ +	+
Steroid	+ +	+	+
Terpens	+ +	+	+
Saponins (%)	0.025	1.00	0.5
Alkaloid (%)	0.178	0.56	0.29
Tannins'(mg/ml)	0.0035	0.1794	0.0080
Phenolic(mg/ml)	0.0029	1.0808	0.5404
Steroid (mg/ml)	0.0016	0.2514	0.1229
Flavones (mg/ml)	0.642	0.5773	0.1527

-absent; + Slightly present; ++ moderately presents

Table 4: Nutrient intake by New-Zealand rabbits fed graded levels of *Ipomoea sarifolia.*

Parameter	TREATMENTS (supplemented level of *I. asarifolia* g/kg)				
	T1 (0)	T2 (5)	T3 (10)	T4 (15)	SEM
DMI	127.063[a]	133.381[a]	111.699[b]	80.872[c]	5.42
CPI	27.098[a]	17.382[b]	18.706[b]	12.706[b]	3.82
EEI	8.297[a]	9.413[a]	6.394[ab]	5.257[b]	0.67
CFI	9.494[a]	9.242[a]	9.448[a]	7.739[b]	0.92
ASHI	10.677[a]	11.980[a]	9.886[a]	7.972[b]	0.99
NFEI	73.175[a]	76.737[a]	64.410[a]	43.263[b]	6.103
NDFI	47.333[a]	47.636[a]	48.781[a]	38.781[b]	2.339
ADFI	18.362[a]	17.543[a]	15.866[a]	10.945[b]	0.755
HEMII	28.971	30.093	27.149	27.836	1.776
CELLI	14.145[ab]	12.696[ab]	12.432[b]	15.359[a]	0.794
HEMII	28.971	30.093	27.149	27.836	1.776

a, b, c, mean values with different superscripts denote significant ($p<0.05$) difference between mean within the same rows ADFI=Average daily feed intake: DMI-=Dry matter intake: CPI=Crude protein intake: EEI= Ether extract intake: CFI= Crude fiber intake: NFE: Nitrogen free extract: NDFI= Neutral detergent fibre intake: ADFI=Acid detergent fibre intake: CELLUI=Cellulose intake: HEMI=Hemicelluloses intake:

Nutrient Intake of Rabbit Fed Graded Levels of *Ipomoea asarifolia*

The result showed that rabbits in treatments 1 and 2 had similar dry matter intake of 127 and 133.4g/day, which were significantly higher than those of treatment 3 (111.7g/day) ($P<0.05$). The intake of crude protein however, was higher for rabbits in the control group (27.1g/d) which was significantly different from those in treatments 2 (17.4g/d), 3(18.7g/d) and 4(12.7g/d) which were similar. Intake of ether extract was higher for animals fed the control diet (8.3g/d) and those fed 5g/kg (9.4g/kg). Value obtained for those fed 15g/d was the lowest ($P<0.05$) (5.3g/d) although it did not differ significantly from the value obtained for those fed 10g/kg.

The intake of crude fibre was lower ($P<0.05$) for rabbit fed 15g/kg IALM (7.8g/d) compared to those fed 0, 5 and 10g/kg IALM which were (9.5, 9.3, 9.4g/d, respectably) ($P>0.05$). Ash intake followed the same pattern. Rabbits in the control group had 10.7g/d, those in group 2 had 11.98g/d and those in group 3 had 9.9g/kg ($P>0/05$.The lowest ash intake was obtained for rabbits fed diet 4 (7.97g/d) ($P<0.05$).The intake of Nitrogen free extracts was also similar for rabbits fed 0, 5 and 10g/kg IALM (72.2, 76.7 and 64.4g/d ,respectably) while those fed 15g/kg IALM had the lowest ($P<0. 05$) NFE intake of 43.3g/d.

Nutrient detergent fibre and Acid detergent fibre intakes were higher but similar among rabbits fed 0, 5, and 10g/kg IALM (47.3 and18.4, 47.6 and 17.5, 48.8 and 15.9g/d) while the lowest values were obtained from rabbits fed 15g/kg IALM which ware 38.8 and 10.9g/day ($P>0.05$) .The intake of hemicellulose did not show any significant difference as intake values ranged from 27.1g//d for rabbits fed 10g/kg to 30.1g/d for those fed 5g /kg IALM. However, intake of cellulose was highest for rabbits fed 15g/kg IALM which was significantly different from the value obtained from those fed 10g/kg IALM (12.4g/d) but similar to values for those fed 0 and 5g/kg. Values for rabbits fed 0, and 5g/kg was also similar to those fed 10g/kg IALM.

Higher dry matter intake in treatments 1 and 2 might be attributed to high soluble carbohydrates (NFE) content and protein quality of the diet. Beyond nutritional compassion, animals tend to consume more palatable diet. Higher values of DMI obtained for treatments

1, and 2 in the present study could be attributed to the levels of CP in the diets, and also the level of maturity of the plant when harvested for the experiment which were known to stimulate the DMI (Huston *at al.*1988). However, the DMI, values reported were lower when compared to those reported by Odoemelam *et al.* (2015). This could be due to the difference in feed ingredients used, climate and breed of the animal used. Lower levels of the test ingredient might have contributed to the higher DMI. Animals in treatments 3 and 4 had a lower DMI due to higher levels of *Ipomoea asarifolia.* However, the DMI of all the animals were higher than 65-75 g DM /day reported in previous studies in which rabbits were fed water spinach-based diet (Samkol*et al*. 2006).

Table 5: Nutrient digestibility (%) by New-Zealand white rabbits fed graded levels of *Ipomoea asarifolia*

Parameters	TREATMENTS (Supplemented levels of *I. Asarifolia* g/kg)				
	T1(0)	T2(5)	T3(10)	T4(15)	SEM
DMD	55.94^{a}	56.42^{a}	47.94^{b}	37.91^{c}	2.11
CPD	66.66^{a}	72.53^{a}	50.34^{b}	30.45^{c}	5.53
CFD	62.82^{a}	64.71^{a}	55.83^{b}	34.90^{c}	2.85
NFED	63.26^{a}	68.44^{a}	52.89^{b}	47.75^{c}	2.65
EED	73.41^{b}	81.93^{a}	75.94^{b}	65.29^{c}	1.58

a, b, c, mean values with different superscripts denote significant ($p<0.05$) difference between mean within the same rows DMD =Dry matter digestible: CPD = Crude protein digestible: CFD =Crude fibre digestible; NFED = Nitrogen free extract digestible: EED = Ether extract digestible

Nutrient Digestibility

The result of nutrient digestibility of New-Zealand white rabbits fed graded levels of *Ipomoea asarifolia* is shown in Table 5. There was significant difference between the treatments in terms of CF, DM, CP, NFE, and EE digestibility ($P<0.05$). Digestibility of all nutrient were significantly lower for animals fed diet containing higher levels of *Ipomoea asarifolia* ($P<0.05$). Digestibility of all nutrients were significantly lower for rabbits fed diets containing higher levels of *Ipomoea asarifolia* due to high content of phyto-chemicals contained in the test ingredient especially the tannins and alkaloids (Table 2). The higher content of these substances might have contributed to the suppression of microbes at hind gut that might helps increase retention time of feeds and hence degradability. Similar observation was also made by Gidenne *et al*. (2006). Even though the fibre levels of the diets increased with increase in the levels of *Ipomoea asarifolia* from diet 1 to diet 4, it has not shown any improvement in the nutrient retention of the animals, because fibre is not efficiently utilized. Gidenne *et al* (2006) stated that higher levels of fibre in diets decrease retention time and increase caecotrope production because of increasing bacterial fibrolytic activity, which in turn results in a reduction of diet digestibility. The DM digestibility values are similar to those reported by Samkol *et al.* (2006). The value of NDF digestibility is lower than those reported by Samkol *et al.* (2006). However, the CP digestibility values obtained in the present study are lower compared to the value of 59.9-70 % reported by PokSamkol *et al*. (2006). The difference might be attributed to variation in the type of feeds, and animal breed differences. These results translated to a significantly ($P<0.05$) reduced final body weight, weight gain, efficiency feed conversion and carcass characteristics for animals fed diets containing higher levels of *Ipomoea asarifolia.*

CONCLUSSION

It was concluded that inclusion level of *Ipomea asarifolia* in the diets of growing rabbits should not exceed 5g/kg.

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