Effect of forages on performance, carcass cuts and haematological profile of weaner rabbits

Oloruntola, O.D.@; Daramola, O.T. and Omoniyi, S.O.

Department of Agricultural Technology. The Federal Polytechnic. PMB 5351. Ado Ekiti. Ekiti State. Nigeria.

Additional keywords

Legumes and non legumes.
Proximate composition.

SUMMARY

Twenty weaned rabbits with initial weight range of 667.49-678.80 g were randomly allotted to five treatments (diets A, B, C, D and E) in a completely randomized design with four replications (one rabbit per replicate). Diet A served as control (concentrate), diets B and C were fresh elephant grass and fresh tridax respectively, while diet D was a mixture of tridax:pueraria (60:40) and E a mixture of elephant grass:pueraria (60:40). The crude fibre values recorded for tridax (12.42 %), elephant grass (33.59 %) and pueraria (39.75 %) were higher than that of concentrate (5.89 %). Ether extract of the concentrate (4.13 %) is comparable to than of the tridax (6.14 %) and elephant grass (2.35 %), although lower than 11.10 % reported for Pueuraria. The ash content of the concentrate (6.12 %) is comparable to those of the forages except for tridax (2.02 %). The average initial weights of the rabbits were similar. The total weight gain in the control is comparable to treatment D but higher significantly than that of treatments B, C and E. This trend also continues with weekly and daily weight gain. The dry matter intake of the control is similar to that of group D but higher significantly than the values reported in other treatments. The values for feed conversion rate in treatments B (4.55) and C (4.61) were significantly higher than 3.66, 3.73 and 3.62 recorded in treatment A, D and E respectively. The liver, lung, heart and bile weight is similar in the entire group. The kidney weight of the control is similar to all other treatments. The hind leg, breast and rib weights in the control (diet A) is similar to that of diet D but significantly higher than that of other groups. Foreleg, loin and abdominal wall weight in the control is significantly 39.75 % higher than that of the other treatments. In all blood parameters considered, the values are similar in all groups, except for PCV where the control value is higher than other treatments, except treatment D. It was concluded that rabbits fed with a mixture of non leguminous and legume forages supplemented with 30 g concentrate have similar performance that those fed solely with concentrate.

Palabras clave adicionales

Leguminosas y no leguminosas.
Composición nutritiva.

Efecto del forraje sobre el rendimiento piezas de la canal y perfil hematológico de conejos destetados

RESUMEN

Veinte conejos destetados, de peso inicial entre 667,49 y 678,80 g, fueron aleatoriamente asignados a cinco tratamientos (A, B, C, D, y E) en un diseño completamente al azar con cuatro repeticiones de un conejo. La dieta A (concentrado) sirvió como dieta control. Las dietas B y C se compusieron de forraje fresco de pasto elefante y de *Tridax* respectivamente; la dieta D fue una mezcla de forraje *Tridax:Pueraria* (60:40) y la E una mezcla de pasto elefante:*Pueraria* (60:40). El nivel de fibra bruta en *Tridax* (12,42 %), pasto elefante (33,59 %) y *Pueraria* (39,75 %) fue mayor que el del concentrado (5,89 %). El extracto etéreo en el concentrado (4,13 %) es comparable al de *Tridax* (6,14 %) y pasto elefante (2,35 %)e inferior al de *Pueraria* (11,10 %). El contenido de cenizas en el concentrado (6,12 %) es comparable al de los forrajes excepto *Tridax* (2,02 %). La ingestión de la dieta A es comparable a la de la D pero significativamente mayor que la de las otras dietas, tendencia que continúa semanalmente en lo relativo a la ganancia diaria y total de peso. La ingestión de materia seca de la dieta A es similar a la de la dieta D pero significativamente menor que en los restantes tratamientos. Los índices de conversión de las dietas A (3,66), D (3,73) y E (3,62) son significativamente menores ($p<0,05$) que los de las dietas B (4,55) y C (4,61). El peso de hígado, pulmones, corazón y bilis fue similar en todos los grupos. El peso del riñón en la dieta control es similar al resto de tratamientos pero hay diferencias de los tratamientos B y C con los tratamientos D y E. El peso de la pata trasera, y el pecho en la dieta control son similares al de la dieta D pero menores que en el resto de los grupos. El peso de lomos y pared abdominal es menor en la dieta A. Los parámetros hematológicos fueron similares en todos los grupos. El volumen celular es significativamente mayor en la dieta A que en las restantes salvo la D. En conclusión los conejos alimentados con una combinación de forraje suplementada con concentrados puede proporcionar un buen rendimiento, comparable al de concejos alimentados solo con concentrados.

Información

Cronología del artículo.
Recibido/Received: 13.7.2014
Aceptado/Accepted: 12.1.2015
On-line: 16.3.2015
Correspondencia a los autores/Contact e-mail:
oloruntoladavid@gmail.com

INTRODUCTION

One of the solutions to the problem of protein shortage in the diet of most Nigerian is the rearing of rabbits at both subsistence and commercial level. Rabbits possess a number of features that is of advantages such as high growth rate, high efficiency in converting forage to meat, short gestation period, and high prolificacy, relatively low cost of production and high nutritional quality of rabbit meat (Biobaku and Oguntona, 1997). However the high cost of conventional feed for production of livestock in which rabbits are inclusive makes rabbits to be expensive for the consumers (Akinmutimi and Ezea, 2006). This calls for the use of underutilized or unutilized feed resources like various forages.

The use of forages in the feeding of rabbits had been recommended for the rabbit producer by Iyeghe-Erakpotobor and Mohammad (2008). According to them, these forages can be provided as supplement to the basic concentrate diet to meet the fiber and some of the vitamin requirements. Linga and Lukefahr (2000) advocated that the rabbits can be raised on basic forages diets. It is of interest that forages are available in abundance in the tropics and that rabbits being a pseudo ruminant can successfully handle forages for growth. Optimum production has not been sustained when rabbits are raised solely on forages or concentrate (Iyeghe-Erakpotobor, 2007; Iyeghe-Erakpotobor and Mohammad, 2008). Cases of positive effects of raising rabbits on forages has been reported by Phimmasan *et al*. (2004) although negative effect in terms of weight loss was reported by Bamikole and Ezenwa (1999).

Forages such as *Panicum maximum* (guinea grass), *Pennisetum purpureum* (elephant grass), *Tridax procumbens are* acceptable by rabbits *(*Abu *et al.,* 2008). Aduku *et al.* (1986) also reported that some forages such as *Tridax procumbens, Pennisetum purpureum, Desmodium scripiums, Luffa egyptiaca, Macroptillium atropurpureum, Leucaena leucocephala remains* green throughout the year and are well accepted by rabbits as feed. Raharjo *et al.* (1988); Ukpe *et al*. (2009) and Nwagu *et al.* (2010) had carried out feeding trials on rabbit using legumes such as Stylosanthes, groundnut haulms, *Calopogonium mucunoides*. Various researchers has reported high nutritive value of some other legumes such as *Leucaena leucocephala* (Oduozo and Adegbola, 1992); *Gliricidia sepium* (Gohl, 1981); *Centrosema pubescens* (Raharjor *et al*., 1988); *Pueraria phaseoloides* (Yono *et al*., 1986; Raharjo *et al*., 1988); *Cajanus cajan* (Oduozo and Adegbola, 1992).

Relatively few studies have been made on the comparative study of the nutritional value of forages in rabbits compare to concentrate feeds. Hence, this study was undertaken to evaluate the nutritive values of three forages on weaner rabbit's production.

MATERIAL AND METHODS

Husbandry and experimentatal design

The right to conduct the experiment was given by the Research Committee of the Agricultural Technology Department of The Federal Polytechnic, Ado Ekiti, Ekiti State, Nigeria. The experiment was carried out at the rabbitary of the department of Agricultural Technology of The Federal Polytechnic, Ado-Ekiti, Ekiti-State, Nigeria according to the guidelines for applied nutrition experiments in rabbits (Fernández-Carmona *et al*., 2005). The study area is located between latitudes 7° 37´ N and 7° 12´ N and longitudes 5° 11´ E and 5° 31´ E. The mean annual rainfall is 1247 mm with relative humidity from between 70 to 85 %. The location is situated at about 437 mm above sea level with a mean annual temperature of 26.2 °C.

Twenty (20) weaned rabbits comprising crossed breed of both sexes were used for this experiment. The rabbits were given a two weeks adjustment period during which they were injected with oxytetracyclin and ivomectin intramuscularly and subcutaneously respectively to treat or prevent the common bacteria and parasitic diseases affecting rabbits. The rabbits were weighed with weight balanced such that initial average weight range between 667.49-678.8 g. Four rabbits were randomly allotted to five treatments in a completely randomized design. The experimental animals were housed one per hutch, and maintained in cages with wire screen floors raised to a height of 90 cm from the concrete. Row cages of size 76 cm x 62 cm x 42 cm each were used. Water was provided *ad libitum*. The drinking and feeding trough were made of removable steeliness container tied with binding wire to inner side of the cage. The temperature was not artificially controlled and varied 25 and 27 ºC. There was minimum natural light supply of 12 hour light per 24 hour.

Five treatment groups labeled A, B, C, D and E was used in this experiment. The treatment groups were made up of the following:

A= Concentrate (control).

B= Elephant grass supplemented with 30 g concentrate.

C= *Tridax* supplemented with 30 g concentrate.

D= Mixture of *Tridax* and *Pueraria* (60:40) with 30 g concentrate.

E= Mixture of elephant grass and *Pueraria* (60:40) with 30 g concentrate.

Each diet was replicated four times with one rabbit per replicate. 100 g concentrate **(table I)** was offered to the rabbits in the control group while 160 g of fresh chopped forages was offered as described by Omokanye *et al.* (2001) to the other groups. Where grasses were offered in combination with legumes, the forages were mixed together to reduce the opportunity of selection of the individual forages by the rabbits. Forages were offered between 07:00 and 13:00 h. After this period, all the rabbits under the various treatments were offered 30 g of concentrate. Water was provided *ad libitum*.

Source of forages and concentrates

The forages (elephant grass (*Pennisetum purpureum*), *Tridax* (*Tridax procumbens),* pueraria (*Pueraria phaseoloides*) used in the cause of this experiment was obtain in the nearness bush around the rabbitary where the experiment was carried out. Concentrates were purcha-

sed from the commercial livestock feed concentrates sellers in Ado Ekiti. Ekiti State. Nigeria.

Determination of proximate composition

The proximate composition of the diets was determined by the procedure described by AOAC (1995).

Measurement of rabbit performance characteristics

Rabbits were singly weighed at the beginning of the trial and thereafter weekly before serving fresh feed and water in the morning to determine their live body weight. Feed intake was taken as the difference between the feed supplied and left over for each replicate per day. The rabbits were weighed on weekly basis and

Table I. Ingredient composition (kg) of concentrate (Ingredientes (kg) del concentrado).

Ingredient	Composition
Maize	39.2
Wheat offals	35
Groundnut cake	22.30
Bone meal	3
Premix*	0.25
Salt	0.25
Calculated values	
Crude protein (%)	19.65
Crude fibre (%)	4.87
Gross energy (kcal/kg)	2 390

*Supply per kg feed: Vit. A= 1 500 IU; Vit. E= 11 mg; Riboflavin= 9 mg; Biotin= 0.025 mg; Panthothenic acid= 11 mg; Vit. K= 3 mg; Vit B_{12}= 8 mg; Fe= 5 mg; Mn= 10 mg; Nicotinic acid= 8 mg; Zn= 4.5 mg; Co= 0.2 mg; Se= 0.01 mg.

weight gain for each animal per week was calculated as the difference between the present weight and the weight for the previous week. The daily weight gain was obtained by dividing the total weight gain by the number of days. Feed conversion ratio was determined by dividing the quantity of feed consumed by the weight gained.

Haematology

Blood samples for haematological studies were collected from the prominent ear veins of the rabbits in each of the treatments. Samples were collected into bottle containing anticoagulant (EDTA). Packed cell volume (PCV) was determined with Wintrobe's microhaematocrit method while Red blood cell (RBC) and White blood cell (WBC) were determined with improved Neubauer haemocytometer. The haemoglobin concentration (Hb) was determined using cyano-methaemoglobin method. The erythrocytic indices, mean cell volume (MCV), mean cell haemoglobin (MCH), and mean cell haemoglobin concentration (MCHC) were computed as described by Jain (1986).

Determination of carcass yield and internal organ characteristics

At the end of the field trial, the three rabbits per treatment were fasted overnight from solid food and slaughtered by cutting the jugular vein and carotid arteries after stunning (Deltoro and Lopez, 1985). After the head and limbs were removed, each carcass was skinned, the abdomen opened, gut and internal organs removed the weights of the skin with head and limbs, heart, liver, kidneys, bile and lungs were determined and recorded. The carcass were cut into prime parts including fore legs, breast and rib cage, loin and abdominal wall, and hind legs, weighed and recorded.

Statistical analysis

The data obtained were subjected to analysis of variance using Completely Randomized Design (CRD) as described by Steel and Torrie (1980). The significant difference between the dietary treatments were determined at 5 % Confidence level while Duncan's Multiple Range Test (Duncan, 1995) was used to separate Significant differences among the means. All analysis was done using statistical package for social sciences (SPSS, 2004).

RESULTS AND DISCUSSION

The analyzed proximate composition of the concentrate and forages are presented in **table II**. The dry matter of the concentrate (90.13 %) is higher than those of the forages. The crude protein of the concentrate (18.12 %) is comparable with that of the forages except for *Tridax* which has a higher value of (34.57 %). The crude fibre values of 12.42 %; 33.59 % and 39.75 % recorded for *Tridax*, elephant grass and *Pueraria* respectively is higher than that of the concentrate (5.89 %). Ether extract of the concentrate (4.13 %) is comparable to than of the *Tridax* (6.14 %) and elephant grass (2.35 %), although lower than 11.10 % reported for pueraria. The ash content of the concentrate (6.12 %) is comparable to those of the forages except for *Tridax* where relatively lower value (2.02 %) was reported.

The 34.57 % crude protein and 12.42 % crude fibre values of *Tridax* in this study is different from 26 % CP and 17 % CF reported by Satish and Tushar (2012). The proximate composition (15.73 % CP; 39.75 % CF; 11.10 % EE and 5.67 % Ash) of pueraria obtained in this study is similar to 15.63 % CP; 39.90 % CF and 10.70 % EE reported by Yono *et al.* (1986), and 5.80 % Ash reported by Raharjo *et al.* (1988). The CP, CF, and Ash (13.15; 33.59 and 7.33 %) of elephant grass in this study is similar to 11.95 % CP reported by Raharjo *et al*. (1998) and 39.70 % CF reported by Yono *et al.* (1986) who also reported 12.50 % for Ash. *Tridax* appears to have higher nutritive value compare to the pueraria

Table II. Proximate composition of concentrate and forages (*Tridax*, *Pueraria,* elephant grass) (Composición nutritiva del concentrado y los forrajes (*Tridax*, *Pueraria* y pasto elefante).

Parameters (%)	Concentrate	*Tridax*	Elephant grass	*Pueraria*
Dry matter	90.13	15.67	26.79	19.65
Crude protein	18.12	34.57	13.15	15.73
Crude fibre	5.89	12.42	33.59	39.75
Ether extract	4.13	6.14	2.35	11.10
Ash	6.12	2.02	7.33	5.67

Table III. Effects of forages on performance of weaner rabbits (Efecto de las dietas sobre el rendimiento de conejos destetados).

Parameters	A	B	C	D	E	SEM
Average initial weight	669.95^{ab}	667.49^{ab}	678.80^{a}	674.40^{ab}	673.55^{ab}	0.72
Total weight gain	673.73^{a}	405.26^{c}	412.20^{c}	665.57^{ab}	648.58^{b}	2.5
Weekly weight gain	84.22^{a}	50.66^{c}	51.52^{c}	83.20^{ab}	81.07^{b}	0.31
Daily weight gain	12.03^{a}	7.14^{c}	7.34^{c}	11.89^{ab}	11.58^{b}	0.06
Dry matter intake (g/day)	44.05^{a}	32.39^{d}	33.78^{c}	44.40^{a}	41.87^{b}	0.14
Feed conversion ratio	3.66^{b}	4.55^{a}	4.61^{a}	3.73^{b}	3.62^{b}	0.04

$^{a, b, c}$= Mean values within rows with different superscripts letters are significantly different ($p<0.05$).

and elephant grass in this study due to its high CP value except for its relatively low dry matter and crude fibre values, although according to FAO/WHO/UNO (1991) and Chaney (2006), *Tridax* can serve as a good source of protein, with a 100 g dry sample being able to meet the daily requirement of 23-56 g.

Table III shows the performance characteristics of weaner rabbits. The total weight gain in the control (diet A) is comparable to treatment D but higher significantly ($p<0.05$) than that of diet B, C and E. This trend also continues with weekly weight gain, daily weight gain and dry matter intake. The closeness in value of the average final weight gain of rabbits in diets A, D and E indicates the similarities in the nutritive values of the three diets. This may be due to the fact that diets D and E being the combination of a legume and non leguminous forages provide similar nutrients like the concentrate (diet A) that meets the nutrient requirements of the rabbits. Furthermore, it should be noted that diet D and E has higher fibre content when compare to Diet A, therefore the similarity in the weight gain between these three may not be a surprise because the higher fibre value has been found to have favorable effect, *ballast effect* (Collins *et al.,* 1976) which promotes the growth of rabbits (Osakwe and Nwose, 2008). Ukpe *et al.* (2009) had earlier recommended the combination of leguminous forages with non leguminous forages for better performance in rabbits after he recorded higher growth in rabbit fed the combination of *Panicum maximum* (grass) and *Calopogonium mucunoides* (legume) than those fed *Tridax procumbens* only. The average daily weight gain in this study is similar to 12 g per day reported for rabbits on broiler mash by Ekpenyong (1984) but higher than 2.27 g reported for growing rabbits fed solely with mulberry leaves by Bamkole *et al.* (2005). The similarities in the dry matter intake between diets A and D may be because the palatability and acceptability of the combination of *Tridax* and pueraria is similar to that of the concentrate (treatment A). High acceptability of *Tridax procumbens* by rabbits has been reported by Aduku *et al.* (1986). The high overall characteristic performance of the rabbits fed the combination of forages (diet D and E) further support the earlier report by El-Ayouty *et al.* (2000) that up to 100 % of maize silage (whole plant) or berseem silage (*Trifolium alexandrinum)* can be fed to growing rabbits without affecting the body weight (growth). Similar report was made by Aderibigbe *et al.* (1992) that rye grass can be fed to growing rabbits up to the level of 50 % without compromising the biological performance of the rabbits. Harris *et al.* (1981) also reported successful combination of sun-flower leaves with lucerne at the ratio 40:60 without any adverse effect on the growth performance of rabbits.

There is significant ($p<0.05$) difference in the feed conversion ratio of the treatments. With treatment A, D and E having FCR of 3.66; 3.73 and 3.62 respectively which are significantly ($p<0.05$) lower than 4.55 and 4.61 of B and C respectively. However, treatment A, D and E had the best FCR.

The mean value of the carcass characteristics of the weaner rabbits are presented in **table IV**. The slaughter weight of rabbits in treatment D is similar to that of diet A and E. This value is similar to the value described by Akinnusi and Alade (2011). Weights of the liver, lung, heart and bile show no significant ($p<0.05$) difference across the groups. Similarly, the kidney weight of the control (diet A) is not significantly ($p>0.05$) different other diets. The non significant ($p>0.05$) difference observed in the liver weight, lung weight, heart weight and bile weight indicates that the physiological and anatomical functions of these organs were not affected by the various treatments, this further indicate that the forages may not have anti-nutritive factors or toxins at the levels that tampers with the normal physiological and anatomical functions of these organs in weaner rabbits. The fact that the kidney weights of rabbits on diets A is not significantly ($p<0.05$) higher than rabbits on other diets further implies the safety of the combination of the leguminous and non leguminous forages to the health of the rabbits. This result is similar to report of Ogunsipe *et al.* (2014) who observed non significant lung, kidney, heart and pancreas weights in rabbits fed sorghum offal-based diets. The skin with head and limb weight of the control (group A) is not significantly ($p>0.05$) different from group D and E but significantly ($p<0.05$) higher than group B and C. The hind leg weight, and breast and rib weight of the control (diet A) is similar to that of diet D but significantly ($p<0.05$) higher than that of other groups. Foreleg weight and Loin and abdominal wall weight in the control is significantly ($p<0.05$) higher than that of the other treatments. Results from this study signifies that forages, particularly when *Tridax* and pueraria are combined in the feeding of the rabbits.

Table V shows the haematological indices of rabbits fed forages and concentrate. In all the parameters considered, the values obtained from each of the groups are not significantly ($p>0.05$) different except in for PCV where the control value is similar to D but significantly ($p<0.05$) higher than B, C and E. However, the

Table IV. Carcass characteristics of rabbits fed different diets (Características de la canal de los conejos alimentados con diferentes dietas).

Parameters (g)	A	B	C	D	E	SEM
Slaughter weight	1 343.70[a]	1 072.70[c]	1 091[c]	1 340[ab]	1 322.10[b]	2.75
Skin with head and limb weight	336.9[a]	285.00[b]	274.2[b]	331.81[a]	328.85[a]	1.20
Liver weight	38.25	37.40	36.85	39.05	38.86	0.34
Lung weight	6.50	6.30	5.89	6.32	6.35	0.14
Kidney weight	8.20[ab]	7.62[b]	7.78[b]	8.46[a]	8.50[a]	0.07
Heart weight	3.75	3.50	3.74	3.61	3.35	0.07
Bile weight	0.68	0.63	0.74	0.75	0.74	0.02
Hind leg weight	223.90[a]	172.08[c]	174.38[c]	219.45[a]	206.50[b]	0.50
Fore leg weight	107.30[a]	81.47[d]	84.15[d]	104.45[b]	99.60[c]	0.33
Breast and rib weight	149.30[a]	119.51[c]	127.14[b]	144.45[a]	132.65[b]	0.97
Loins and abdominal wall weight	226.95[a]	173.50[e]	189.38[d]	219.20[b]	208.00[c]	0.38

[a, b, c]= Mean values within rows with different superscripts letters are significantly different ($p<0.05$).

Table V. Haematological indices of rabbits rabbits fed different diets (Índices hematológicos de conejos alimentados con diferentes dietas).

Parameters	A	B	C	D	E	SEM
PCV (%)	36.89[a]	31.57[b]	32.31[bc]	34.69[ab]	34.22[b]	0.31
RBC($x10^6/mm^3$)	5.38	4.90	5.00	5.29	5.03	0.07
WBC ($x10^6/mm^3$)	6.13	5.53	5.22	5.83	5.39	0.13
Hb Conc.(g/dl)	11.64	10.20	10.57	11.08	11.63	0.26
MCHC (g/dl)	31.53	32.32	32.75	31.90	33.98	0.71
MCH (Pg)	21.73	20.82	21.13	20.90	23.11	0.51
MCV (Fl)	68.89	64.415	64.607	65.696	68.021	1.22

[a, b, c]= Mean values within rows with different superscripts letters are significantly different ($p<0.05$).

haematological values and derived values were within the normal range reported by Mitruka and Rawnsley (1977). It appears that there is more efficient erythropoesis in rabbits on treatment A and D as this may be responsible for their higher PCV values compared to other treatment group. The RBC values fall within the 4.27-4.55 ($x10^6/mm^3$) and 3.53-5.05 ($x10^6/mm^3$) reported by Mitruka and Rawnsley (1977) and Olabaji *et al.* (2007). The fact that WBC values for all treatments in this study fall within the normal range indicates a normal antibody production which help in maintaining strong disease resistance. This is evident by the fact that no mortality was recorded during this experiment. Pharmacological potentials of forages have been reported (Satish and Tushar, 2012). The ranges of Hb values (10.57-11.64 g/dl) observed in this experiment being within the normal range for rabbits indicates the normal physiological relationship of haemoglobin with oxygen in the transport of gasses to and from the tissues of the body (Njidda *et al.*, 2006). The MCHC, MCH and MCV values in this experiment were in consonance with the normal range reported by Burke (1994). This is an indication that the rabbits on all the treatments were not anaemic.

This study showed a good performance and normal physiological and anatomical functioning of weaner rabbits fed on combination of forages that involve legume supplemented with 30 g of concentrates. It was concluded that rabbits when fed with diet composed of combination of forages supplemented with concentrates could give a good performance comparable to rabbits fed sole concentrate.

ACKNOWLEDGEMENTS

We appreciate the laboratory assistance of Mrs. Oloruntola Deborah of the Ekiti State Specialist Hospital, Ekiti State. Nigeria.

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