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Effect of Substituting Concentrate with Dwarf Napier Grass (*Pennisetum purpureum*) on Intake, Growth and Carcass Composition of Rabbits

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Abstract

Dwarf Napier grass (*Pennisetumpurpureum*) is considered to be more suitable as forage for ruminants due to its high yield and nutritive value, but there is limited research on rabbits. Thus, the aim of this study was to investigate the effect of replacing concentrate with dwarf Napier grass on intake, growth performance and carcass composition of growing rabbits. Twelve growing rabbits were randomly distributed into three dietary groups in a completely randomized design: (i) concentrate feed *ad libitum* as control diet (T1), (ii) half of the control diet plus dwarf Napier grass *ad libitum*(T2), and (iii) quarter of the control diet plus dwarf Napier grass *ad libitum* (T3). The results showed that diets had a significant ($p<0.05$) effect on intake, growth performance and some non-carcass components. Rabbits fed T3 diet showed significantly ($p<0.05$) lower total DM intake than those fed T1 and T2 diets. Similarly, rabbits fed T3 diet showed significantly ($p<0.05$) lower total weight gain and daily weight gain than those fed T1 diet, but the respective values of those fed T2 diet were non-significantly different from those fed T1 and T3 diets. There was significant effect on weights of meat with bone, fat, pelt, head and kidney by the diets, whereas weights of most of the non-carcass components were similar among the groups. In conclusion, diet consisting of half of the concentrate and dwarf Napier grass *ad libitum* is recommended to be used as it may reduce the feed cost compared to diet consisting of the concentrate alone.

Keywords: Carcass composition, dwarf Napier grass, growth performance, intake, rabbit.

INTRODUCTION

Nowadays, rabbit farming has become increasingly popularvin smallholder farmers as an alternative source of animal protein (Owoleke *et al*. 2016). Smallholder farmers get faster benefits from it compared to other farming systems (e.g., cattle farming), because rabbits require

low investment, show short generation interval and they are able to consume forage grasses. For a profitable rabbit production, feed is considered as one of the most important inputs. When rabbit received feeds containing required amount of energy and protein, better quality meat was obtained as healthy diet for human consumption. Production of high quality meat at lower price is achievable when locally available forage plants are used in rabbit's diet.

Many forages can be used in rabbit's ration formulation by replacing the costly protein sources (Iyeghe-Erakpotobor *et al*. 2006; Iyeghe-Erakpotobor 2007; Safwat *et al*. 2014). It depends on the forages' chemical composition, viability, palatability and anti-nutritional factors. Rabbits fed leaves of browse plants and concentrate showed better performance than rabbits fed tropical grass with concentrate as reported by Amata and Okorodudu (2016).

Napier grass (*Pennisetum purpureum*) is presently the most attractive fodder grass in ruminant animal production system, and has a number of positive characters; including high yield, drought tolerance and regrowth ability (Fukagawa and Ishii 2018). There are two cultivars, namely tall and dwarf, which differ in yield and nutritive quality. Dwarf variety exhibits higher nutritive values than the normal variety; e.g., crude protein 11.5-12.1% vs. 9.8-10.6% respectively (Halim *et al*. 2013; Rahman *et al*. 2019). Furthermore, yield of dwarf Napier grass is comparable toother tropical grasses as reported by Halim *et al*. (2013).

However, there is little information about the effect of dwarf Napier grass on rabbit performance; thus, it is important to know the feeding effect of dwarf Napier grass with concentrate supplementation that can support the maintenance and growth of rabbit. Therefore, this study was conducted to assess the feeding effect of replacement of concentrate with dwarf Napier grass on intake, growth and carcass composition of rabbits.

MATERIALS AND METHODS

Experimental Site and Napier Grass Production

This study was carried out in rabbit house located at Agro Techno Park, Universiti Malaysia Kelantan (UMK). All animal handling and procedures during feeding experiment was approved by the UMK Animal Care and Use Ethics Committee (UMK/FIAT/ACUE/UG1/2018). The average daily temperature and monthly rainfall were 22℃ and 90.3 mm during the experimental period (April – July 2018).Dwarf Napier grass was established at the Experimental field of Agro Techno Park, UMK by applying standard level of fertilizer. Plants grown in plot was divided into four sub-plots so that plants maturity was controlled by cutting at different times in order to obtain similar quality.

Experimental Design and Feeding Trial

On arrival, twelveunsexed mixed breed rabbits (about 2 months old) with an average initial body weight (BW) of 769.0 g were given concentrate (commercial pelleted compound feed) *ad libitum* and this process was continued for 10 days as adjustment period. Each rabbit was housed in a cage (45 cm × 40 cm ×50 cm) with free access of water. The weight of daily consumed concentrate was recorded to know the average daily concentrate intake for each rabbit. After the adjustment period, all rabbits were randomly distributed into three dietary groups in a completely randmised design: (i) concentrate feed *ad libitum* as control diet (T1), (ii) half of the control diet plus dwarf Napier grass *ad libitum* (T2), and (iii) quarter of the control diet plus dwarf Napier grass *ad libitum* (T3).

Fresh Napier grass was harvested daily at 45-60 days of plant maturity and given to the rabbits of T2 and T3 groups on *ad libitum* basis. Grass and concentrate were fed separately and given inside the cage twice a day (9:00 am and 4:00 pm). Amount of concentrate supply was increased for T2 and T3 groups with the increasing rate of T1 group's feed intake. After the adjustment period, the experiment was lasted for 84 days. Equipment inclduing cage, feeder and waterer were cleaned daily. The rabbits and concentrate were purchased from local supplier, while Napier grass was grown at the Experimental field of Agro Techno Park, UMK. Daily feed offered and refusals were recorded to estimate feed intake. Samples of feed offered and refusals were taken once a week for determination of dry weight. Rabbits were weighed at beginning of the experiment, at 1-week interval and at the end of the experiment; the weights were always measured before being fed in the morning.

At the end, rabbits from each treatment were fasted overnight, weighed and slaughtered for carcass evaluation.

Chemical Analysis

Representative samples of concentrate and Napier grass were dried in an oven at 70°C for 48 h and ground to pass a 1.0 mm sieve for evaluation of chemical composition. Ground samples were analyzed for dry matter (DM), nitrogen (N), ether extract (EE), crude fiber (CF) and ash contents according to AOAC method (2005). Organic matter (OM) was estimated by subtracting the ash content from 100. Crude protein (CP) content was calculated as N×6.25.

Statistical Analysis

Data on feed intake and BW gain were analyzed using one-way ANOVA with SPSS software (version 12.0, SPSS Inc., Chicago, IL, USA) as a completely randomized design with repeated measures. Tukey test was used to test the significant differences among treatment means when $p<0.05$.

RESULTS AND DISCUSSION

The proximate composition of concentrate and Napier grass are shown in Table 1. The concentrate showed higher values of dry matter (DM), organic matter (OM), crude protein (CP) and ether extract (EE) than the respective values of Napier grass, whereas Napier grass showed higher values of CF and ash than concentrate. The CP value of dwarf Napier grass in this study is within the range of reported values (Halim *et al*. 2013; Rahman *et al*. 2019).

Table 1.Chemical composition (%) of the feed ingredients

Nutrients	Concentrate	Napier grass
DM	87.0	22.8
OM	96.5	89.8
CP	16.0	11.0
EE	2.0	1.5
CF	18.0	25.62
Ash	3.5	10.2

DM, dry matter; OM, organic matter; CP, crude proteiun; EE, ether extract; CF, crude fibre.

The decrease ininclusion levels of the concentrate significantly ($p<0.05$) influenced on the DM intakes of grass, concentrate and total (grass and concentrate) (Table 2). Rabbits fed T3 diet showed significantly ($p<0.05$) higher grass intake than those fed T2 diet; whereas, no change was detected for those fed T1 diet consisting solely of concentrate. Due to varied amount of concentrate among the treatments, rabbits fed T1 diet showed significantly ($p<0.05$) higher concentrate intake followed by those fed T2 and T3 diets. Total intake was similar for the T1 and T2 diets, but significantly ($p<0.05$) lower for T3 diet.

Actually, dwarf Napier grass is not as palatable as concentrate; hence, those fed T3 diet had the lowest total intake. This indicates that rabbits has difficulty in adequately adjusting to intake with very low level of concentrate, i.e. T3 diet. Whereas, similar total intake was observed for rabbits fed T1 and T2 diets; like those fed T1 diet, rabbits may surprisingly have the the ability to gain adequate nutrient from T2 diet despite consisting of only 50% concentrate. The presence of soluble oxalate in dwarf Napier grass may one possible factor, which could be contributing to this result for T3 diet. Dwarf Napier grass can accumulate soulble oxalate, which can cause health problems to rabbits such as urolithiasis or hypocalcaemia (Rahman *et al*. 2013). The anti-nutrinets in the diet can also reduce palatability and/or reduce digestibility of the feed (Kaitho *et al*. 1998). This result indicated that due to oxalate, dwarf Napier grass cannot be used with very low concentrate supplementation. This is also in agreement with the findings of Mmereole *et al*. (2011) who suggested that rabbits showed good performance when fed concentrate mixed with grass.

The average feed intake (55.1-70.1 g) observed in this study was higher than those reported by Ikyume *et al*. (2019), which could be attributed due to the higher palatability of dwarf Napier grass in this study compared to the palability of grass or legume used in the previous study of Ikyume *et al*. (2019). In contrast, average daily intake of rabbits in this study was much lower than the findings of Amata and Okorodudu (2016) who reported that average daily intake of rabbits fed Napier grass was significantly ($p<0.05$) higher (222.3 g) followed by those fed *Panicummaximum* (167.1 g), *Myrianthus arboreus*(110.3 g) and *Gmelina arborea* (89.1 g); when concentrate and forage were fed in a ratio of 1:2. This result may be attributed due to the use of different breed in their experiment. In another study, Iyeghe-Erakpotobor and Muhammad (2008) observed that intakes of Napier grass was higher than those of *Sorghum almum*, *Pennisetum pedicellatum* and *Brachiaria decumbens*, when rabbits were fed grass with 50 g concentrate.

Table 2.Average daily feed intake and weight gain of rabbits fed the experimental diets

Parameter	**Levels of concentrate supplement, % DM (mean value ± standard deviation)**		
	100 (T1)	**50 (T2)**	**25 (T3)**
Intake, g/d			
Grass	-	36.5^{a}±19.5	38.3^{b}±13.7
Concentrate	67.1^{a}±18.4	33.6^{b}±3.4	16.8^{c}±1.7
Total	67.1^{a}±18.4	70.1^{a}±18.4	55.1^{b}±13.1
Weight, g			
Initial	875.7±225.5	727.3±63.3	703.7±86.0
Final	1552.0^{a}±127.1	1267.3^{b}±71.7	1028.0^{c}±52.1
Total gain	676.3^{a}±107.5	540.0^{ab}±132.6	324.3^{b}±34.8
Daily gain	8.0^{a}±1.3	6.4^{ab}±1.6	3.8^{b}±0.4

^{a,b,c}Means with different superscripts within the same row differ significantly ($p<0.05$).

Weekly BW of rabbits fed diets containing different levels of concentrate supplementis shown in Figure 1. Final weight, total weight gain and average daily weight gain differed significantly ($p<0.05$) among the dietary groups. Rabbits fed T1 diet showed significantly ($p<0.05$) higher final BW followed by those fed T2 and T3 diets. Rabbits fed T1 diet showed significantly ($p<0.05$) higher total BW gain and daily BW gain than those fed T3 diet, whereas no difference ($p>0.05$) was observed between those fed T2 and T3 diets. Daily weight gain followed a similar pattern as total weight gain. Weight gain showed a linear decrease with decrease in concentrate levels (Table 2). The average daily weight gain (6.4 g) of rabbits fed T2 diet is similar to the findings of Ogunsipe *et al*. (2014) who reproted that Rabbits fed Napier grass with 30 g concentrate showed 7.1 g daily weight gain. However, weight gains of 3.8-8.0 g obtained in this study are lower than those (8.53-17.22 g) reported by Onyimonyi and Ene (2003) with *Panicum maximum* and concentrate. This could probably be attributed to the different forage species as opposed to dwarf Napier grass used in this study. Daily weight gains of 3.8-6.4 g obtained for the T2 and T3 diets are also lower than 8.86 g obtained by Iyeghe-Erakpotobor *et al*. (2003) for growing rabbits fed rabbit meal and chloris hay. This indicates that type and quality of forage fed to rabbits have an effect on their growth rate. Amata and Okorodudu (2016) observed that rabbits fed with Napier grass gained the highest weight compared to rabbits fed with either *Panicum maximum*, *Myrianthus arboreus* or *Gmelina arborea.*

Table 3. Carcass composition of rabbits fed the experimental diets

Weight (g)	**Levels of concentrate supplement, % DM**			**SEM**	**P-value**
	100 (T1)	**50 (T2)**	**25 (T3)**		
Pre-slaughter					
Fasting live	1581.7^{a}	1254.3^{b}	1022.3^{c}	24.9	0.000
Post-slaughter					
Meat with bone	891.7^{a}	708.3^{b}	556.7^{c}	17.3	0.000
Fat	64.6^{a}	23.9^{ab}	0.3^{b}	8.2	0.048
Pelt	146.7^{a}	118.3^{a}	85.0^{b}	4.4	0.003
Head	132.8^{a}	117.3^{ab}	108.3^{b}	3.1	0.045
Kidney	8.0^{a}	7.5^{a}	6.1^{b}	0.2	0.012
Feet	35.8	32.7	32.0	0.6	0.097
Spleen	0.5	0.9	0.5	0.1	0.256
Lungs	5.7	5.1	3.9	0.3	0.132
Heart	3.7	3.2	2.9	0.1	0.128
Liver	34.2	32.8	26.2	1.3	0.095
Stomach	53.4	44.4	51.4	1.6	0.129
Intestine	128.3	144.9	117.4	6.6	0.303

^{abc}Means with different superscripts in a row differ significantly ($p<0.05$).

Weights of carcass and non-carcass components of rabbits are shown in Table 3. Rabbits fed T1 diet showed higher ($p<0.05$) weight of meat with bone followed by those fed T2 and T3 diets. The fat weight was higher ($p<0.05$) in rabbits fed T1 diet than the value of those fed T3 diet, but no difference ($p>0.05$) was observed between those fed T1 and T2 diets, or between T2 and T3 diets. Non-carcass component weights did not differ ($p>0.05$) among the diets, except for weights of pelt and kidney which were higher for rabbits fed T1 and T2 diets than those fed T3 diet. This result is similar to the findings of Ogunsipe *et al*. (2014) who observed non-significant weights of lungs, kidney, heart and pancreas in rabbits fed sorghum offal-based diets. The head

weight was also higher ($p<0.05$) in rabbits fed T1 diet than those fed T3 diet, whereas no difference ($p>0.05$) was observed between those fed T2 and T3 diets, or between those fed T1 and T2 diets.

The above findings could be attributed as a result of the differences of final BW, total BW gain and daily BW gain by the dietary groups. However, the reason behind non-significant effect on most of the weights of non-carcass components (e.g., feet, spleen, lungs, heart, liver, stomach and intestine) may be explained that the physiological and anatomical functions of these organs were not affected by the experimental treatments.The fact that the kidney weights of rabbits on T3 is significantly ($p<0.05$) lower than rabbits fed T1 and T2 diet, which implies the unsafety of the dwarf Napier grass with low concentrate to the health of the rabbits. Weights of the liver, lungs, kidneys and heart in this study are in line with the findings of Oloruntola et al. (2015) who observed that rabbits fed Napier grass showed 37.4 g heart, 6.3 g lungs, 7.6 g kidneys and 3.5 g heart. Similar to current study, significant difference of kidneys weight was observed by Oloruntola *et al*. (2015).

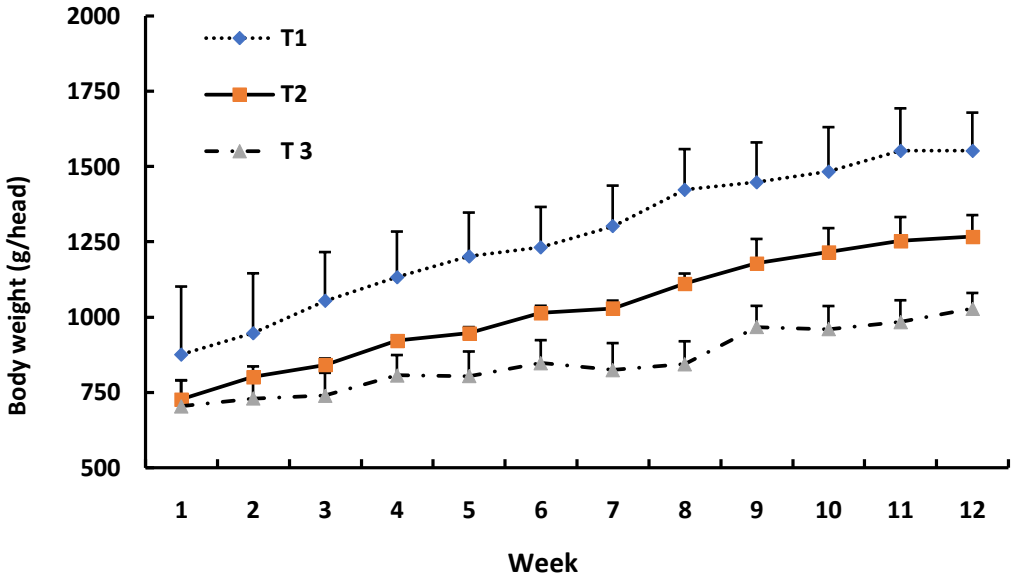

Figure 1. Weekly body weight of experimental rabbits fed diets containing different levels of concentrate supplement. Error bars indicate standard deviation.

CONCLUSION

T1 (solely concentrate) and T2 diets (half of the concentrate + dwarf Napier grass *ad libitum*) showed almost similar results which led to better rabbit performance. It is recommended for diet like T2 diet to be used as it may reduce the feed cost compared to solely concentrate diet. Even though rabbits are good forage eaters, rabbits fed dwarf Napier grass *ad libitum* with low concentrate level like T3 diet (25% concentrate + dwarf Napier grass *ad libitum*) exhibits lower intake and growth performance than those fed solely concentrate. Not to mention that diet containing dwarf Napier grass *ad libitum* with 25% concentrate instead of with 50% concentrate can also be an alternative, but it is less suggested because lower rate of intake and BW gain may occur.

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REFERENCES

Amata, I.A. andE.O. Okorodudu. 2016. Comparative evaluation of the growth performance and feed intake of weaned rabbits fed tropical grasses and selected forage leaves. IJRSAS. 2(2): 14–18.

AOAC (Association of Official Analytical Chemists). 2005. Official methods of analysis. 18th Edn. AOAC International, Arlington, VA, USA.

Fukagawa, S. andY. Ishii. 2018. Grassland establishment of dwarf napiergrass (*Pennisetum purpureum* schumach) by planting of cuttings in the winter season. Agronomy 8(12): 1–10.

Halim, R.A.,S. Shampazuraini,and A. B. Idris. 2013. Yield and nutritive quality of nine Napier grass varieties in Malaysia. Mal. J. Anim. Sci. 16(2):37−44.

Ikyume, T.T., I. E. Ogu,I. A. Okwori, andD. T. Shaahu.2019. Growth performance and apparent nutrient digestibility of grower rabbits fed combinations of concentrate with grass and/or legume forage. J. Multidis. Res. Rev. 1(1): 41–45.

Iyeghe-Erakpotobor, G.T., R. Aliyu,andJ. Uguru.2003. Combinations of concentrate, grass and other forage mixtures for feeding grower rabbits. IN: Nigerian livestock: A goldmine for economic growth and food security. Eds: AA Taiwo, AM Raji, JU Ogbonna, EA Adebowale. Proc. 28th Ann. Conf. NSAP. Institute of Agricultural Research and Training, Obafemi Awolowo University, Ibadan, Nigeria. 16-20 March 2003. Pp. 363–366.

Iyeghe-Erakpotobor,G.T., C. U. Osuhor, and T. S. Olugbemi. 2006. Performance and digestibility of weaner rabbits fed graded levels of soybean cheese waste/maize offal diet and brachiaria grass hay. Afr. J. Biotechnol.5(17): 1579–1583.

Iyeghe-Erakpotobor,G. T. 2007. Effect of concentrate and forage type on performance and digestibility of growing rabbits under sub-humid tropical conditions. Asian J. Anim. Vet. Adv. 2(3): 125–132.

Iyeghe-Erakpotobor, G.T. and I. R. Muhammad. 2008. Intake of tropical grass, legume and legume-grass mixtures by rabbits. Trop. Grasslands 42: 112–119.

Kaitho, R.J., N. N. Umunna, I. V. Nsahlai, S. Tamminga, and J. Van Bruchen. 1998. Utilization of browse supplements with varying tannin levels by Ethiopian Menz sheep. 1. Intake, digestibility and live weight changes. Agroforest. Syst. 39: 145–159.

Mmereole, F.U.C., J. O. Egoh, and J. I. Obinne. 2011. Growth performance and cost analysis of weaner rabbits fed varying dietary levels of crude protein supplements with Tridax procumbens. Pak. J. Nutr. 10(2): 120–123.

Ogunsipe, M.H., J. O. Agbede, and O. A. Adedeji. 2014. Performance response, carcass evaluation and economic benefit of rabbits fed sorghum offal-based diets. AJFAND. 14: 8585–8601.

Oloruntola, O.D., O. T. Daramola, and S. O. Omoniyi. 2015. Effect of forages on performance, carcass cuts and haematological profile of weaner rabbits. Arch. Zootec. 64 (245): 87–92.

Onyimonyi, A.E. and J. C. Ene.2003. Performance of growing rabbits fed Panicum maximum with graded levels of a concentrate diet. In: Sustainable livestock productivity and national development the holistic approach.Eds. EA Olatunji, BA. Ayanwale, EL Shiawoya, A Aremu Proc. 8th Ann. Conf., Anim. Sci. Ass. of Nig. (ASAN), Sept. 1518, 2003, Federal Univ. of Technology, Minna, Nigeria. pp. 73–75.

Owoleke, O.E., B. K. Tanimomo, T. Z. Adama, H. O. Akanya, I. C. Alemede, M. Abdulrahaman, and V. O. Kolawole. 2016. Feed evaluation and growth performance of rabbits fed diets containing different forages. Vom J. Vet. Sci. 11(1):101–111.

Rahman, M.M., R. B. Abdullah, andW. E. Wan Khadijah. 2013. A review of oxalate poisoning in domestic animals: Tolerance and performance aspects. J. Anim. Physiol. Anim. Nutr.97: 605–614.

Rahman, M.M., N. E. Syafieqa, N. A. B. M. Diah, T. Gondo, R. I. A. B. R. Khalif, and R. Akashi. 2019. Growth characteristics, biomass yield and mineral concentrations in seven varieties of Napier grass (*Cenchrus purpureus*) at establishment in Kelantan, Malaysia. Tropical Grasslands-Forrajes Tropicales 7(5):538–543.

Safwat, A.M., L. Sarmiento-Franco, R. H. Santos-Ricalde, and D. Nieves. 2014. Determination of tropical forage preferences using two offering methods in rabbits. Asian-Australasian J. Anim. Sci.27(4): 524–529.