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Short Communication

Feed Intake and Apparent Nutrient Digestibility of Growing Rabbits Fed *Asystasia gangetica* with Different Levels of Corn

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ABSTRACT

This study investigated the effect of different corn levels on intake and digestibility in rabbits. The rabbits were divided into four groups and given *Asystasia gangetica ad libitum* as a basal diet and supplemented with either 80 g (T1), 60 g (T2), 40 g (T3), or 0 g (T4) corn/head/day. Rabbits fed with the T4 diet demonstrated a higher intake/kg metabolic weight than the other treatments. Nevertheless, rabbits fed with T4 and T1 diets depicted the lowest and highest digestibility, respectively. In conclusion, apparent nutrient digestibility was significantly improved in growing rabbits following supplemental feeding with a diet containing 60-80 g of corn.

Keywords: *Asystasia gangetica*, corn, feed intake, nutrient digestibility

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INTRODUCTION

Asystasia gangetica is an important perennial herb and weed widely distributed in tropical Asia and Africa. It is widely grown as ground cover in Malaysian and Indonesian oil palm plantations due to its tolerance to low soil fertility and shade (Ramdani et al., 2017). Although *A. gangetica* is considered a serious environmental and agricultural weed, it has high nutritional

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value as an animal feed and contains several biologically active substances with various medicinal properties (Ali et al., 2021). For instance, the leaves of *A. gangetica* contain 19.3% crude protein (CP), which is higher than the protein requirements for ruminants and pseudo-ruminants (Khalil, 2016). Given the high protein value, *A. gangetica* is already utilised as forage for ruminants in South-East Asia either by grazing or cut and then used in stall-feeding (Ali et al., 2021).

According to Amata and Okorodudu (2016), a ratio of 50:50 mixture of *Centrocema pubescens* and maize concentrate is necessary for maximum performance. In another study, Rahman et al. (2020a) observed that a rabbit's diet, which includes half concentrate and half-dwarf Napier grass, resulted in the best growth and performance. Nonetheless, the effect of *A. gangetica* with corn supplementation on rabbits remains underreported and unclear. Therefore, this study was conducted to investigate the effects of different dietary levels of corn on intake and digestibility in rabbits fed with *A. gangetica* as a basal diet.

MATERIALS AND METHODS

Study Site and Experimental Design

The experiment was conducted at Agro Techno Park, Universiti Malaysia Kelantan (UMK), Jeli Campus, Kelantan; according to the procedures approved by the UMK Animal Care and Use Committee (UMK/FIAT/ACUE/FYP/1/2020). A total of 16 weaned rabbits with an approximate age of two months of both sexes were bought from a local supplier. The mean (± standard deviation) body weight of the rabbits was 1387.5 (± 145.5 g). The rabbits were adapted to the new environment for seven days of pre-data collection before experimenting. During the acclimatisation period, the rabbits were fed commercial rabbit pellets. The rabbits were divided into four groups and given *Asystasia gangetica ad libitum* as a basal diet and supplemented with either 80 g (T1), 60 g (T2), 40 g (T3), or 0 g (T4) corn/head/day. *A. gangetica* was offered to rbbits with a target amount of 10% refusal. The rabbits consumed about 80.0 g of corn as a sole source of feed prior to the experiment. Hence, rabbits in the control group (T1) were offered corn at 80 g/d/rabbit with the inclusion of *A. gangetica*.

A digestibility trial with rabbits was conducted for 28 days: 21 days as the preliminary period and seven days for the collection period. In the preliminary period, the same amount of test feed administered during the collection period was provided daily. *Asystasia gangetica* and corn were offered twice daily (9:00 a.m. and 5:00 p.m.) after dividing into two equal portions. The corn was bought from a local supplier, while naturally grown *A. gangetica* was collected daily at the vegetative growth stage from Agro Techno Park, UMK. The corn and *A. gangetica* were offered in separate feeders. The samples of *A. gangetica* were obtained daily to determine dry matter (DM) intakes since there would be variation in the DM daily. The rabbits were housed individually in metal stacked cages (size of the cage: 45 cm height × 40 cm wide × 50 cm length). Each cage was allocated a feed trough

and automatic water nipples. During the collection period, plastic gauze was placed under each cage for faeces collection.

Parameters Measured and Chemical Analysis

The feed offered and refusals were recorded to estimate intake, and the samples were collected daily to determine dry weight. Before the morning feed, rabbits were weighed at the beginning of the experiment, at 1-week intervals, and the end. The total weight gain of a rabbit was calculated by subtracting the initial weight from its final weight. During the collection period, offered feeds, refusals and faeces were recorded, and representative samples were stored in a freezer. Prior to chemical analysis, each rabbit's faeces samples were thawed and mixed to obtain a representative sample. After that, the representative samples of faeces and feeds were dried and analysed for dry matter (DM), ash, CP, ether extract (EE), and crude fibre (CF) following the method of the Association of Official Analytical Chemists (AOAC) (2000). All data were analysed using a one-way analysis of variance in Statistical Product and Service Solutions (SPSS) software (version 23). Mean comparisons were conducted using the Duncan Multiple Range Test (DMRT) at $p < 0.05$.

RESULTS AND DISCUSSION

Nutritive Value

The chemical composition of *A. gangetica* and corn is presented in Table 1. The DM (16.6%) and EE (4.3%) contents of *A. gangetica* in this study were higher compared to the estimates reported by Rahman et al. (2020b). These differences might be due to several factors, including botanical fractions and plant maturity (Koca & Erakul, 2016). Notably, the EE contents of both ingredients used in this study were higher than the EE requirements (2.5-4.0%) for adult rabbits, as reported by the National Research Council (NRC) (1977). In contrast, the organic matter (OM) content of *A. gangetica* is similar to the findings by Rahman et al. (2020b). The CP content is lower compared to the reports by Khalil (2016), who found that the CP content in *A. gangetica* was 23.2%.

Table 1
Chemical composition (%, DM) of Asystasia gangetica *and corn*

Nutrients	*Asystasia gangetica*	Corn
Dry matter	16.6	90.0
Organic matter	91.8	93.4
Crude protein	18.5	8.0
Ether extract	4.3	7.8
Crude fibre	21.1	0.5
Ash	8.2	6.6
Metabolisable energy (MJ/kg DM)$^{\beta}$	9.1	12.9

Note. $^{\beta}$data obtained from the secondary data (Sudin et al., 2005); MJ = Megajoule; DM = Dry matter

Cheeke (1987) reported that rabbits require 14% CF in their diet to maintain gut motility. The *A. gangetica* in this study contained 21.1% CF, which is lower than the findings of Khalil (2016). Meanwhile, the ash content is consistent with Sudin et al. (2005), who reported that *A. gangetica* contained 10.9% and 6.7% ash content in their young shoot and mature plants, respectively.

Nutrient Intake

Rabbits fed with the T4 diet demonstrated higher ($p < 0.05$) DM intake/kg metabolic weight (MW, equal to $W^{0.75}$) (63.0 g), followed by those fed with T1 (50.4 g), T3 (46.5 g), and T2 (45.9 g) diets (Table 2). The decrease in daily DM intake/kg MW was more significant when the level of CF in diets was low. Similarly, the OM intake/kg MW by rabbits fed diets T1, T2, and T3 were similar to the OM intake by these three groups, which was significantly ($p < 0.05$) lower compared to those fed the T4 diet. Meanwhile, rabbits fed with the T4 diet depicted significantly higher ($p < 0.05$) CP and CF intakes, followed by rabbits fed with T3, T2, and T1 diets. Fibre can be efficiently utilised in rabbits' diets since it is vital for preventing gut problems, diarrhoea, and mortality in animals (Ikyume et al., 2019). In contrast, rabbits fed with the T4 diet consumed 173.4 kcal metabolisable energy (ME) per day, which accounted for 89% of

Table 2
Dry matter and nutrient intakes by rabbits fed with Asystasia gangetica *with different corn levels*

Parameter	Treatment (mean ± standard deviation)				*p*-value
	T1	T2	T3	T4	
Daily intake (g)					
Asystasia gangetica	$21.7^{d} \pm 2.48$	$25.3^{c} \pm 3.29$	$42.8^{b} \pm 3.44$	$79.5^{a} \pm 3.39$	0.000
Corn	$47.7^{a} \pm 7.37$	$32.9^{b} \pm 3.01$	$20.0^{c} \pm 0.00$	$0.0^{d} \pm 0.00$	0.000
Total dry matter	$69.4^{b} \pm 6.26$	$59.1^{c} \pm 3.18$	$61.8^{c} \pm 2.23$	$79.5^{a} \pm 4.51$	0.000
Total dry matter/kg $W^{0.75}$	$50.4^{b} \pm 7.28$	$45.9^{b} \pm 3.33$	$46.5^{b} \pm 3.36$	$63.0^{a} \pm 5.50$	0.002
Total organic matter	55.1 ± 18.77	54.8 ± 2.94	56.4 ± 3.06	73.0 ± 4.14	0.062
Total organic matter/kg $W^{0.75}$	$39.0^{b} \pm 11.06$	$42.6^{b} \pm 3.06$	$42.4^{b} \pm 3.96$	$57.8^{a} \pm 5.04$	0.007
Total crude protein	$7.8^{c} \pm 0.66$	$7.4^{c} + 0.58$	$9.4^{b} \pm 0.61$	$14.7^{a} \pm 0.83$	0.000
Total crude protein/kg $W^{0.75}$	$5.7^{c} \pm 0.91$	$5.8^{c} \pm 0.62$	$7.1^{b} \pm 0.73$	$11.6^{a} \pm 1.010$	0.000
Total ether extract	4.7 ± 0.47	3.7 ± 0.21	5.4 ± 4.34	3.4 ± 0.19	0.588
Total ether extract/kg $W^{0.75}$	3.4 ± 0.47	2.9 ± 0.18	4.1 ± 3.41	2.7 ± 0.23	0.681
Total crude fibre	$4.9^{c} \pm 0.57$	$5.5^{c} \pm 0.80$	$9.1^{b} \pm 0.70$	$16.7^{a} \pm 0.95$	0.000
Total crude fibre/kg $W^{0.75}$	$3.5^{c} \pm 0.75$	$4.3^{c} \pm 0.76$	$6.9^{b} \pm 0.79$	$13.3^{a} \pm 1.16$	0.000
ME from *Asystasia gangetica* (kcal)¶	$47.2^{c} \pm 5.39$	$55.1^{c} \pm 7.16$	$93.2^{b} \pm 7.48$	$173.4^{a} \pm 7.36$	0.000
ME from corn (kcal)¶	$147.0^{a} \pm 22.73$	$101.6^{b} \pm 9.29$	$61.7^{c} \pm 0.00$	-	0.000
Total ME (kcal)¶ intake	$194.3^{a} \pm 19.97$	$156.7^{c} \pm 8.14$	$154.9^{c} \pm 7.48$	$173.4^{b} \pm 7.37$	0.000

Note. $W^{0.75}$ = Metabolic weight; Means with different superscripts in a row differ significantly ($p < 0.05$); ¶Metabolisabe energy intake was calculated using energy values for the ingredients obtained from Sudin et al. (2005)

the ME intake in the T1 group ($p < 0.05$). Approximately 76%, 65%, 40%, and 0% of the total daily ME intake for T1, T2, T3, and T4 groups was contributed by corn, whereas *A. gangetica* contributed nearly 24%, 35%, 60%, and 100%, respectively. Higher DM and nutrient intakes were observed for rabbits fed with the T4 diet than in the other treatments, which aligns with the findings of Yu and Peter (1996), who reported that feed intake increased with increasing dietary fibre levels.

Nutrient Digestibility and Growth

The DM and OM digestibility were higher ($p < 0.05$) in rabbits fed with diets T1 and T2 compared to those fed diets T3 and T4. The DM digestibility observed in this study ranged from 80.2% to 89.2%, and these values are similar to the reports of Ikyume et al. (2019) but higher than the findings of Rahman et al. (2020b). Likewise, the OM digestibility values in this study ranged from 48.4% to 74.0%, aligning with previous findings (Rahman et al., 2020b). The CP digestibility of the rabbits was not significantly ($p > 0.05$) different among the dietary groups, ranging from 47.4% to 56.9%. These results are lower than the earlier outcomes of Ikyume et al. (2019), who had fed *Leucaena leucocephala* and *Panicum maximum* forages to weaned rabbits.

The EE digestibility was significantly ($p < 0.05$) higher in rabbits fed with diets T1 and T2 than those fed diet T4, whereas those fed diets T3 and T4 were statistically similar. A decreasing trend was observed in EE digestibility with a reducing rate of corn in the diet, except for diet T1. The EE digestibility values for diets T1 and T2 are consistent with the reports by Ikyume et al. (2019), but they were lower for diets T3 and T4. The CF digestibility was higher ($p < 0.05$) in rabbits fed with the T1 diet compared with those fed diets T3 and T4, whereas no statistical difference was observed between those fed diets T2, T3, and T4. This finding might be attributed to the difference in the physical forms of the experimental diets, thereby contributing to the variation in the degree of digestibility of the cell wall. In other words, diet T1 is significantly easier to digest, probably due to its higher corn contents, which contain less fibre (0.5%) compared to *A. gangetica* (21.1%) (Table 1).

Rabbits fed with diet T1 showed the highest value of final body weight (BW) (1617.5 g), while those fed diet T4 presented the lowest (1412.5 g). Rabbits fed with diet T1 showed significantly ($p < 0.05$) higher BW gain than those fed diet T4. Meanwhile, rabbits fed with diet T4 did not reveal any significant growth throughout the four weeks despite consuming 79.5 g of *A. gangetica* DM daily, resulting in a total protein consumption of 14.7 g and ME 173.4 kcal/day. It might be explained by the high content of structural carbohydrates such as cellulose and hemicellulose in *A. gangetica*, which reduces CF digestibility. In this study, the CF digestibility was significantly higher ($p < 0.05$) in all the diets when compared solely with the *A. ganetica* diet (Table 3). This finding suggests that if the amounts

Table 3
Apparent nutrient digestibility and growth on rabbits fed with Asystasia gangetica *with different levels of corn*

Parameter	Treatment (mean ± standard deviation)				*p*-value
	T1	T2	T3	T4	
Digestibility (%)					
Dry matter	$88.8^{a} \pm 4.14$	$89.2^{a} \pm 3.00$	$81.2^{b} \pm 9.81$	$80.2^{b} \pm 2.74$	0.023
Organic matter	$73.0^{a} \pm 8.50$	$74.0^{a} \pm 7.69$	$49.8^{b} \pm 10.69$	$48.4^{b} \pm 5.14$	0.001
Crude protein	56.6 ± 20.49	55.2 ± 10.36	47.4 ± 9.67	56.9 ± 3.77	0.681
Ether extract	$82.0^{a} \pm 14.34$	$84.1^{a} \pm 8.70$	$49.6^{ab} \pm 32.15$	$32.7^{b} \pm 7.80$	0.005
Crude fibre	$43.8^{a} \pm 17.22$	$27.5^{ab} \pm 16.20$	$13.6^{b} \pm 11.41$	$7.7^{b} \pm 6.40$	0.012
Growth					
Initial BW (g)	1387.5 ± 205.6	1325.0 ± 119.0	1425.0 ± 132.3	1412.5 ± 154.8	0.757
Final BW (g)	1617.5 ±195.5	1476.7 ± 211.3	1482.5 ± 89.9	1412.5 ± 149.3	0.389
Total BW gain (g)	230.0 ± 57.2	176.7 ± 127.0	57.5 ± 168.6	0.0 ± 70.7	0.059
Daily BW gain (g)	8.2 ± 2.0	6.3 ± 4.5	2.1 ± 6.0	0.0 ± 2.6	0.059

Note. Means with different superscripts in a row differ significantly ($p < 0.05$); BW = Body weight

of CF intake by rabbits increase more than a certain amount of fibre, its digestibility tends to decrease. Hence, rabbits fed with the T4 diet demonstrate lower performance despite consuming relatively higher CP intake. This result coincides with the report by Mohammed et al. (2016), who found that high fibre content in diet could reduce the use of net efficiency of ME.

Although *A. gangetica* is a very nutritious plant, rabbits fed with *A. gangetica* did not show higher final body weight and weight gains. However, the energy and protein intakes were adequate compared to other treatments. It might be due to several factors: (i) improved fibre digestibility when the *A. gangetica* was supplemented with corn. In other words, the lower energy content of the *A. gangetica* (9.1 MJ/kg DM) relative to corn (12.9 MJ/kg DM) was compensated by improved digestibility of the energy, and specifically the fibrous fraction, (ii) the *A. gangetica* might have been of different quality when harvested, (iii) there might be an imbalance in mineral and vitamin intakes, as these two nutrients were not added in the diets, and (iv) some anti-nutritional factors present in the *A. gangetica* might have influenced the results. Nevertheless, since the duration of this study was too short (four weeks), it is still too early to make a solid assertion.

CONCLUSION

Rabbits fed *Asystasia gangetica* only demonstrated higher intakes/kg MW than those fed *A. gangetica* with corn. In contrast, the higher ME intake resulted in significantly ($p < 0.05$) higher digestibility values in rabbits fed with the highest level of corn supplement compared to those fed only *A. gangetica*. By using *A. gangetica ad libitum* with supplementation of different

levels of corn, farmers could improve the performance and productivity of rabbit rearing. Feeding *Asystasia gangetica* as a sole feed may not supply enough energy to support growth, although the protein in the forage may be sufficient. Nonetheless, further research with mineral and vitamin supplements using a larger sample size of animals for a longer period needs to be conducted to elucidate the findings reported in this study.

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REFERENCES

Ali, A. I. M., Sandi, S., Riswandi., Rofifiq, M. N., & Suhubdy. (2021). Effect of feeding *Asystasia gangetica* weed on intake, nutrient utilization, and gain in Kacang goat. *Annals of Agricultural Sciences*, *66*(2), 137–141. https://doi.org/10.1016/j.aoas.2021.10.002

Amata, I. A., & Okorodudu, E. O. (2016). Comparative evaluation of the growth performance and feed intake of weaned rabbits fed tropical grasses and selected forage leaves. *International Journal of Research Studies in Agricultural Sciences*, *2*(2), 14-18. https://doi.org/10.20431/2455-6224.0202003

Association of Official Analytical Chemists. (2000). *Official methods of analysis* (17th ed.). AOAC International.

Cheeke, P. R. (1987). *Rabbit feeding and nutrition*. Academic Press.

Ikyume, T. T., Ogu, I. E., Okwori, I. A., & Shaahu, D. T. (2019). Growth performance and apparent nutrient digestibility of grower rabbits fed combinations of concentrate with grass and/or legume forage. *Journal of Multidisciplinary Research and Reviews*, *1*(1), 41-45.

Khalil. (2016). Crude nutrient and mineral composition of *Asystasia gangetica* (L.) as a predominant forage species for feeding of goats. *Pakistan Journal of Nutrition*, *15*(9), 867-872. https://doi.org/10.3923/PJN.2016.867.872

Koca, Y. O., & Erekul, O. (2016). Changes of dry matter, biomass and relative growth rate with different phenological stages of corn. *Agriculture and Agricultural Science Procedia*, *10*, 67-75. https://doi.org/10.1016/j.aaspro.2016.09.015

Mohammed, M., Fadlalla, B., & Abdelkreim, M. (2016). Improvement of millet (*Pennisetum glaucum*) straw as animal feed using physical and chemical treatment. *International Journal of Innovative Science, Engineering and Technology*, *3*(5), 87-93.

National Research Council. (1977). *Nutrient requirements of rabbits* (2nd ed.). The National Academics Press. https://doi.org/10.17226/35

Rahman, M. M., Mustapher, M. N. B., Mat, K. B., Utamy, R. F., & Nor, M. M. (2020a). Effect of substituting concentrate with dwarf Napier grass (*Pennisetum purpureum*) on intake, growth and carcass composition of rabbits. *Hasanuddin Journal of Animal Science*, *2*(1), 1-8.

Rahman, M. M., Ismail, S. N. B., Mat, K., Gondo, T., Nor, M. M., & Akashi, R. (2020b). Effects of diets containing *Asystasia gangetica* and *Brachiaria decumbens* on intake, digestibility and growth performance of growing rabbits. *Pertanika Journal of Tropical Agricultural Science*, *43*(4), 609-619. https://doi.org/10.47836/pjtas.43.4.14

Ramdani, D., Abdullah, L., & Kumalasari, N. R. (2017). Analysis of local forage potential under

ruminant - Palm plantation integration system in Mandau District, Bengkalis Regency of Riau Province. *Buletin Ilmu Makanan Ternak*, *104*(1), 1−8.

Sudin, M. Y, Saniman, S., & Miw, N. A. (2005). *Nutrient composition of Malaysian feed materials and guides to feeding of cattle and goats*. https://www.dvs.gov.my/dvs/resources/auto%20download%20images/560a42a080bb4.pdf

Yu, B., & Peter, W. S. (1996). Effects of crude fibre level in the diet on the intestinal morphology of growing rabbits. *Laboratory Animals*, *30*(2), 143−148. https://doi.org/10.1258/002367796780865826