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EFFECT OF FEEDING VARYING LEVELS OF BLACK-BINDWEED (*Falopia convolvulus*) MEAL ON GROWTH PERFORMANCE AND ECONOMIC EFFICIENCY OF GROWING RABBITS

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ABSTRACT

A feeding trial was conducted to evaluate the effect of feeding black-bindweed (*Falopia convolvulus*) meal at varying levels in diets of growing rabbits. Four experimental diets were compounded to form a total mixed ration comprising the test materials and other feedstuffs. The feed comprised the control, 10BBW (10% black-bindweed), 20BBW (20% black-bindweed) and 30BBW (30% black-bindweed). The experimental feeds were pelleted before feeding to ensure efficient feed intake and utilization. The trial lasted for 8 weeks. A total of 20 growing New Zealand White rabbits weighing about 1 kg were used for the study. Five rabbits were randomly allotted to each of the dietary treatments in a completely randomised design, with each rabbit representing a replicate. The rabbits were weighed using a digital scale at the beginning of the study and subsequently weekly. Feed intake and feed conversion ratio (FCR) were also determined. The cost of feeds was determined using cost-benefit analysis. The data obtained were analysed using the SAS application package. The result revealed significant ($P<0.05$) effects for most of the parameters measured. The average daily weight gain, average daily feed intake and FCR values were better ($P<0.05$) in 30BBW (0.02 kg, 0.09 kg, 5.09, respectively) compared to the control. The feed cost/kg gain was lower in 30BBW (₦12,324.89) while the cost saving was higher in the same treatment with ₦3,217.83 compared to the control. It can be concluded from the study that 30% inclusion of BBW in diets of growing rabbits improved feed efficiency and promoted higher cost savings, and it is therefore recommended.

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INTRODUCTION

Rabbit production is an important agricultural activity, particularly in developing countries, as it provides a valuable source of animal protein and contributes to food security and income generation for small-scale farmers (Birolo, 2023). However, one of the major challenges facing rabbit farmers is the consumption rate of rabbits, which can account for up to 70% of the total production costs (Amber *et al.,* 2017). This financial burden can make rabbit production unsustainable for many smallholder farmers, limiting their ability to improve their livelihoods and meet the growing demand for animal-sourced foods (Alu *et al*., 2022). This challenge has prompted researchers to explore alternative, locally available feedstuffs that can serve as cost-effective sources of nutrients in rabbit diets (Amber *et al.,* 2017). One such potential feedstuff is *Falopia convolvulus*, a common weed found in many parts of the world.

Falopia convolvulus, also known as black-bindweed (BBW) or wild buckwheat, is an annual herbaceous plant that belongs to the Polygonaceae family (Costea *et al.,* 2005). Although the weed is abundantly available and cheap, it is considered a harmful weed in many agricultural systems due to its ability to compete with crops for resources and its prolific seed production (Follak and Essl, 2013). The weed can compete with crops for essential resources such as water, space, nutrients, and sunlight, leading to reduced crop yields (Blackshaw, 2008). Another issue associated with this weed is its resistance to herbicides (Uludag *et al.,* 2018). It will require heavy doses of chemicals to reduce its growth, which may affect the soil profile, leading to leeching of soil nutrients in cultivated crop lands, resulting in the greenhouse effect, the authors added. Additionally, BBW can have allelopathic effects, releasing allelochemicals that inhibit the growth of nearby plants, including crops (Cheng and Cheng, 2015; Wu *et al.,* 2016). However, despite its weedy nature, some studies have suggested that BBW may have potential as a fodder crop or alternative feedstuff for livestock due to its relatively high protein and carbohydrate content (Wilson *et al.,* 2009; Millam *et al.,* 2023) which can be consumed by both sheep and goat (Millam *et al.* 2023). Sharma *et al.* (2013) also demonstrated that the weed is palatable, increases milk production and improves the overall animal performance. Because of these advantages, instead of using heavy chemicals to control the weed, it can be harvested and fed to livestock, which is a more environmentally friendly method of controlling it, thereby reducing the cost of input and labour while driving mutual benefit from it.

Furthermore, despite its potential, there is less research on the utilization of BBW as a regular feedstuff in rabbit diets. Rabbits have unique digestive systems and specific nutritional requirements that differ from other livestock species (de Blas and Wiseman, 2010), necessitating a comprehensive investigation of the suitability and potential impacts of incorporating alternative feedstuffs such as BBW into their diets. Therefore, this study aims to address this knowledge gap and provide valuable insights into the potential of this weed as a cost-effective and locally available feedstuff for rabbit production systems.

MATERIALS AND METHODS

Location of Study Area: The study was conducted at the Rabbit unit of Adamawa State University (ADSU) Teaching and Research Farm, Mubi Local Government Area (LGA). The area lies within the northern Guinea savannah zone of Nigeria. It is geo-located between latitude 10°16.6'6.9" north of the equator and longitude 13°16'1.2" East Greenwich meridian, with 560 meters above sea level. The dry season of the area commences in November and ends in March, while the wet season begins in April and ends in late October. The mean annual rainfall is about 1050 mm. The relative humidity is extremely low (20–30%) between January and March, but reaches a peak of about 80% in August and September. The maximum temperature can reach 40°C, particularly in April, while the minimum temperature is about 12°C between December and January (Meteorological Enclosure, 2024).

Ethical Consideration: All research protocols and use of animals were approved by Adamawa State University, Institutional Animal Care and Ethics Committee, with the approval number ADSUIACEC/2024/017. It certifies that the procedures adhere to the international standards on animal use and practice.

Source of Black-bindweed and Processing: Black-bindweed (BBW) was sourced from local agricultural fields and the surrounding areas of Mubi North LGA. It was harvested along with the leaves and twigs. After which it was thoroughly cleaned, air-dried, and pulverised into a fine powder using a local roller milling machine and kept safe before it was used in compounding the experimental diet as BBW meal.

Source of Rabbits and Management: A total of 20 growing New Zealand White rabbits weighing at least 1 kg were used for the trial. They were purchased from the Rabbit unit, ADSU Teaching and Research Farm. The rabbits were allowed one week of acclimatization to the experimental pen, where they were housed for the experiment. During this period, they were closely monitored for any sign of ill-health. Feed and water were supplied *ad libitum.* Groundnut haulms served as their basal diet during the period. During the experiment, metallic cages were used for housing the rabbits. The cages (made up of wire mesh) were equipped with individual feeders and drinkers. The cages were designed to house one rabbit at a time. Feed and water were supplied using an *ad libitum* feeding regime. The pen housing the cages was well ventilated, illuminated and had a concrete floor system. The trial lasted for 8 weeks.

Treatments and Design: Four diets were compounded to form a total mixed ration comprising the test materials (BBW) and other feedstuffs as presented in Table 1. The diets consisted of the control, which had no BBW meal but cowpea husk, 10BBW (10% black-bindweed), 20BBW (20% black-bindweed) and 30BBW (30% black-bindweed). Each of the dietary treatments was palletised before it was supplied to the rabbits. This is to ensure efficient feed intake and utilization (McDonald *et al.,* 2010). The feeds were pelleted at the feed mill of the Department of Fisheries and Aquaculture, ADSU, Mubi. The diets were compounded to supply the basic nutritional requirements of the rabbits (MSD Manual, 2025). The study examined the four dietary treatments, which consisted of five rabbits randomly allocated to each of the dietary treatments in a completely randomised design. Each rabbit represents a replicate.

Table 1: Gross composition of the experimental diets

Ingredients (%)	Control	10BBW	20BBW	30BBW
Cowpea husk	30.00	-	-	-
Black-bindweed meal	-	10.00	20.00	30.00
Maize	10.32	15.79	11.25	8.54
Maize offal	25.65	36.94	29.51	22.07
Groundnut cake	12.19	14.22	14.99	15.76
Local brewers' residue	16.09	17.12	18.50	17.88
Fish meal	3.00	3.00	3.00	3.00
Bone meal	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50
Premix	0.25	0.25	0.25	0.25
Lysine	0.50	0.50	0.50	0.50
Methionine	0.50	0.50	0.50	0.50
Laboratory Analysis				
Energy (ME, kcal/kg)	3574.79	3298.79	3247.66	3262.02
Dry matter	94.02	91.00	94.02	94.37
Crude protein	14.54	17.97	21.00	22.72
Crude fibre	5.46	5.71	6.66	6.96
Ether extract	4.96	5.22	7.02	8.92
Ash	6.31	7.31	7.82	8.02
Nitrogen free extract	62.79	58.17	53.57	47.83

10BBW, 20BBW, 30BBW: level of inclusion of black-bindweed meal at 10, 20 and 30% respectively, which represents the treated groups, ME: metabolizable energy

Growth Trial: The rabbits were weighed using a digital scale (Camry®) at the beginning of the study and weekly thereafter. The feed intake was obtained by subtracting the leftover feed measured from the feed offered daily. The feed offered and left over were measured using a digital weighing scale (Scout™ Pro–SPU 202, 7124201019). Furthermore, the feed conversion ratio was computed as feed intake divided by the weight gained at the end of the trial.

Cost-benefit Analysis: A basic cost-benefit analysis was used to evaluate the potential cost-effectiveness of incorporating black-bindweed meal into the diets of rabbits. The analysis considered factors such as the cost of procuring and processing the plant material, the cost of other feed ingredients, labour, transportation, and water, among others. The estimates were made based on the prevailing market prices of feedstuff in the year 2024 (January–February). The cost/kg feed was computed as the unit cost of one kg of the feedstuff for the 100 kg formulated. The total cost of feed, also known as the cost of feeding, was obtained by multiplying the cost/kg feed by the feed intake of each rabbit. Feed cost/kg gain was calculated as the cost of feed divided by the total weight gained of each rabbit. While cost saving was realised as the feed cost/kg gain of the treated groups subtracted from that of the control diet.

Laboratory Analysis: Representative samples of the experimental diets were taken to the

Animal Nutrition Laboratory, Department of Animal Production, ADSU, Mubi, for proximate analysis. The analysis was determined using the procedures described by AOAC (2005). The metabolizable energy for the feed samples was estimated according to the formula of Pauzenga (1985) as cited in Kwari *et al.* (2014).

Statistical Analysis: All data obtained will be analysed using the Generalised Linear Models Procedure (PROC GLM) of SAS (2002). The effect of dietary treatment was tested at 95% confidence interval ($P<0.05$), and significant differences among the treatment means were established using Dunnett's test. The statistical model used was:

$$Y_{ij} = \mu + L_i + e_i$$

where:

μ = Overall mean,

L_i = Effect of the i^{th} dietary treatment,

e_I = all error terms are assumed to be random, normally distributed, and independent with expectations equal to zero

RESULTS AND DISCUSSION

Effects on Growth Performance

Table 2 shows the growth performance of growing rabbits fed diets containing black-bindweed (BBW) meal. Most of the parameters measured revealed significant ($P<0.05$) effects, except for initial weight, which was not significant ($P>0.05$). The total weight gain and average daily weight gain (ADWG) were higher ($P<0.05$) in the group of rabbits receiving 30BBW (1.21 and 0.02 kg, respectively) compared to the control diet (0.78 and 0.01 kg, respectively). The higher ADWG observed in this study was higher than that of 14.20 g recorded for 25 g/kg of sweet potato leaves fed as a replacement for pelletized concentrate feed (Abonyi *et al.*, 2012). The result might be attributed to high digestibility of protein, which may make amino acids available for protein metabolism that will promote higher weight gain (Mohammed *et al.*, 2020) or was influenced by the nutritive quality of the diet (Table 1).

Table 2: Growth performance in growing rabbits fed diets containing black-bindweed meal

Parameters	Control	10BBW	20BBW	30BBW	SEM
Initial weight (kg)	1.08	1.23	1.30	0.95	0.09^{NS}
Final weight (kg)	1.85^b	2.15^a	2.14^a	2.16^a	0.06
Total weight gain (kg)	0.78^c	0.93^b	0.84^{bc}	1.21^a	0.06
ADWG (kg/rabbit/day)	0.01^b	0.01^b	0.01^b	0.02^a	0.00
Total feed intake (kg)	4.69^b	4.92^b	4.82^b	5.61^a	0.26
ADFI (kg/rabbit/day)	0.07^c	0.08^b	0.08^b	0.09^a	0.00
Feed conversion ratio	7.44^a	6.25^{ab}	6.12^{ab}	5.09^b	0.99

^{abcd}: Means with different superscript on same row are statistically different at 95% confidence interval, 10, 20 and 30BBW: 10, 20, 30% inclusion of black-bindweed meal, ADWG: average daily weight gain, ADFI: average daily feed intake, NS: not significant, SEM: standard error of means

Regarding total feed intake and average daily feed intake (ADFI), it was observed to be higher ($P<0.05$) in the group of rabbits fed 30BBW (5.61 and 0.09 kg, respectively) compared to the control diet (4.69 and 0.07 kg, respectively). Similarly, the higher ADFI observed was higher than 44.83 g recorded for rabbits fed 25 g/kg sweet potato leaves as a replacement for pelletized concentrate feed (Abonyi *et al.*, 2012). The result might be attributed to the palatability of the diet resulted from the higher levels of soluble carbohydrates (Table 1) or due to higher digestibility of crude fibre which may trigger less retention period for the diet in the gut, consequently leading to more intake of the diet (Millam, 2023). Similarly, higher intakes in the dietary groups with the test material by the rabbits suggest that the inclusion levels of the forages did not affect the acceptability of the diets by the rabbits (Osei *et al.*, 2024). Besides, the authors added, the intake and the survivability of all the rabbits during the experiment suggest that the diets were of good nutritive quality.

Feed conversion ratio (FCR) is the most extensively used parameter to express the efficiency of converting feed to live weight gain (Osei *et al.*, 2024). The FCR value (5.09) was the least ($P<0.05$) in the group of rabbits receiving 30BBW compared to the control diet (7.44). The least FCR (5.09) observed in this study was higher than the range of values (2.41–4.95) recorded for rabbits fed sweet potato leaves as a replacement for pelletized concentrate feed (Abonyi *et al.*, 2012). The least result observed in this study might be attributed to the efficient utilization of the diets by the rabbits due to the inclusion of BBW meal.

Effects on Economic Profitability

The economic efficiency of producing growing rabbits fed diets containing varying levels of BBW meal is presented in Table 3. The cost/kg feed observed in this trial was seen to be lower in the control group (₦2,584.93), followed by the group of rabbits receiving 10BBW (₦2,644.79) compared to the other treatments.

Table 3: Economic proficiency of feeding black-bindweed meal in diets of grower rabbits

Parameters	Control	10BBW	20BBW	30BBW
Cost/kg feed (₦)	2584.93	2644.79	2645.13	2658.31
Total feed intake (kg)	4.69	4.92	4.82	5.61
Total cost of feed (₦)	12123.32	13012.36	12749.53	14913.12
Total weight gain (kg)	0.78	0.93	0.84	1.21
Feed cost/kg gain (₦)	15542.72	13991.78	15178.01	12324.89
Cost saving (₦)	-	1550.94	364.71	3217.83

10, 20 and 30BBW: 10, 20, 30% inclusion of black-bindweed meal

This lower cost in 10BBW might be attributed to the cost of conventional feed being cheaper at the time of purchase of ingredients during which the trial was conducted, or because the level of inclusion was less than the others. Although the BBW was obtained at a cheaper rate, the cost of labour and other costs accrued from transportation, among others, might have led to the test material having some high-cost value. It was also observed that the cost of feed increases as the level of inclusion of BBW increases.

The total cost of feed was observed to be lower in the control diet (₦12,123.32) followed by 20BBW (₦12,749.53) compared to the other treatments. The lower total cost of feed in 20BBW might be attributed to the lower feed consumed by the rabbits in the treatment groups. This result was divergent from the findings reported by Adamu *et al.* (2013), who documented a low cost of feed consumed in the treatment group, where less test material was added. Nevertheless, it was consistent with their findings on total feed intake, which recorded lower total feed cost as feed intake reduced.

Lower feed cost/kg gain was observed to be lower in the group of rabbits receiving 30BBW (₦12,324.89) while maintaining a higher cost saving (₦5,414.81) compared to the control diet (₦15,542.72). The observed result on feed cost/kg gain might be attributed to lower feed consumption in the same treatment. A similar observation was made by Ishaya *et al.* (2025), who documented their findings indicating that lower feed cost per kg gain has been consistent with lower cost of feed consumed. Higher cost savings might be due to lower feed cost/kg gain. It was reported previously that higher cost savings can be attained due to lower feed cost/kg gain (Osei *et al.*, 2024). Concerning the economy of gain, diet 30BBW is much better than others. Even though the control diet and 20BBW contributed economically to the cost/kg and total feed consumed, the study suggests that the best biological and economic returns related to this trial were obtained in the 30BBW group.

CONCLUSION AND RECOMMENDATION

From the results of the study, it was agreed that inclusion of 30% BBW in the diets of growing rabbits improved feed efficiency by 2.35 and promoted higher cost saving by ₦3,217.83, and it is therefore recommended.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

REFERENCE

Abonyi, F. O., Iyi, E. O. & Machebe, N. S. (2012). Effects of feeding sweet potato (Ipomoea batatas) leaves on growth performance and nutrient digestibility of rabbits. *African Journal of Biotechnology*, *11*(15), 3709–3712.

Adamu, L., Igwebuike, J. U., Kwari, I. D., & Aliyu, J. (2013). Utilization of *Prosopis africana* pulp for rabbit feeding: 1. Effects on growth and economic performance. *Global Journal of Pure and Applied Science,* *19*(2013), 1–7. https://dx.doi.org/10.4314/gipas.v19i1.1

Alu, S. E., Ari, M. M., Swomen, F. E., Abdullahi, H. R. & Ushie, F. T. (2022). Growth response, nutrient digestibility and cost benefits of rabbits fed solid waste product of sugar industry *Animal Feed Science and Technology*, *18*(1), 37–45

Amber, K. H., Yakout, H. M., & Hanafy, M. (2017). Feeding value of some unconventional feedstuffs for rabbit diets. *Egyptian Journal of Rabbit Science, 27*(1), 25–39.

AOAC (Association of Analytical Chemists). (2005). *Official method of analysis* (17th ed.). Maryland, USA: AOAC International.

Birolo, M. (2023). Feeding, nutrition and rearing systems of the rabbit. *Animals, 13*, 1305. https://doi.org/10.3390/ani13081305

Blackshaw, R. E. (2008). Competitiveness of spring wheat, oat, and yellow mustard crops against weed infestations. *Weed Science, 56*(4), 550–556.

Cheng, F., & Cheng, Z. (2015). Research progress on the use of plant allelopathy in agriculture and the physiological and ecological mechanisms of allelopathy. *Frontiers in Plant Science, 6*, 1020.

Costea, M., Andra, F., & Tardif, F. J. (2005). Taxonomy, history and genetic diversity of *Polygonum convolvulus* and *Polygonum convolvulus* var. *subalatum* (*Polygonaceae*). *Weed Research, 45*(6), 391–400.

de Blas, C., & Wiseman, J. (2010). *Nutrition of the rabbit* (2nd ed.). CABI.

Follak, S., & Essl, F. (2013). Invasion dynamics and impact of *Acalypha australis* and *Polygonum aviculare* in central Europe. *Weed Research, 53*(5), 319–327.

Ishaya, A., Millam, J. J., Abubakar, A., & Abbaya, H. Y. (2025). Economic benefits of diets containing varying levels of Moringa (*Moringa oleifera*) leaf meal fed to broiler chickens. In *Proceedings of the 50th Annual Conference of NSAP 2025, Nassarawa, Nigeria*. In press.

Kwari, I. D., Igwebuike, J. U., Shuaibu, H., Titimaand, S. I., & Raji, A. O. (2014). Growth and carcass characteristics of broiler chickens fed maize, sorghum, millet and their combinations in the semi-arid zone of Nigeria. *International Journal of Science and Nature*, *5*(2), 240–245.

McDonald, P., Edwards, R. A., Greenhalgh, J. F. D., Morgan, C. A., Sinclair, L. A., & Wilkinson, R. G. (2010). *Animal Nutrition* (7th ed.; C. A. Morgan, J. F. D. Greenhalgh, L. A. Sinclair, & R. G. Wilkinson, Eds.). Harlow, England: Prentice Hall.

Metrological Enclosure (2024). *Weather Report for Mubi Climate: Department of Geography, ADSU-Mubi.* Adamawa State University (ADSU), Mubi.

Millam, J. J. (2023). *Nutrient evaluation of urea and/or lime treated groundnut shells supplemented with xylanase and glucanase on the performance of Yankasa rams*. Doctoral dissertation, Ahmadu Bello University, Zaria.

Millam, J. J., Ahijo, C., Abbaya, H. Y. & Kosontyav, J. (2023). Nutrient and phytochemical composition of black-bindweed (*Fallopia convolvulus*) hay. In Odunsi, A. A and Oluwafemi, R. A. (Eds), *Proceedings of 28th Annual Conference of ASAN 2023, Abuja, Nigeria* (pp. 554–557). Animal Science Association of Nigeria.

Mohammed, S., Ijaiya, A. T., Ayanwale, B. A. & Kudu, Y. S. (2020). Growth performance and nutrient digestibility of weaner rabbits fed African locust bean (*Parkia biglobosa*) fruit pulp. *Nigerian Journal of Animal Production*, *47*(4), 120–131

MSD Manual (2025). *Veterinary manual: Nutrient requirement of rabbits*. Merck and Co., Inc., Rahway, NJ, USA. https://www.msdvetmanual.com/multimedia/table/nutrient-requirements-of-rabbits

Osei, D. Y., Apori, S. O., Hagan, J. K., Amedorme, D., & Ayizanga, R. (2024). Growth performance and carcass characteristics of rabbits fed concentrate diets containing graded levels of *Brassica oleracea* outer leaves and *Musa paradisiaca* leaves. *World Rabbit Science*, *32*, 21–29. https://doi.org/10.4995/wrs.2024.19616

SAS (Statistical Analysis Systems). (2002). *Statistical package for analysis* (version 9.0). North Carolina, USA. Statistical Analysis Systems Institute, Cary.

Sharma, A., Kaur, N., & Kumar, V. (2013). Potential of *Convolvulus arvensis* as an alternative livestock feed. *Animal Nutrition and Feed Technology, 13*(2), 321–330.

Uludag, A., Bodnar, S., & Yergin, R. (2018). Invasive alien plant species in Turkey. *Journal of Agricultural Faculty of Uludag University, 32*(1), 183–199.

Wu, H., Pratley, J., Lemerle, D., & Haig, T. (2016). Allelopathy in wheat (*Triticum aestivum*). *Annals of Applied Biology, 139*(1), 1–9.