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Research Article

Intake and Palatability of Forages Fed to Rabbits in the Coastal Savannah Ecological Zone of Ghana

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Abstract

Brassica oleracea outer leaves, *Stylosanthes guianensis, Megathyrsus maximus* and *Musa paradisiaca* leaves were offered to mixed-strain rabbits in three trials. Thirty two weaner kits were used in each trial. In the first trial, the time of first bite and intake duration of the four forages offered together for 15 minutes were recorded. Weaners were randomly allocated to four groups, and kits in each group were offered one of the forage species separately with concentrate for three and seven days adaptation and testing periods respectively. Finally kits were offered the forages together. *Brassica oleracea* was bitten first (0.20 min) and had the highest intake duration (2.07 min). *Brassica oleracea* had the highest daily and relative intakes and was the most consumed when the forages were offered separately and together. Intake of the forages was followed by *Stylosanthes guianensis*, while *Musa paradisiaca* and *Megathyrsus maximus* were the least preferred forages in terms of quantities consumed. The study suggests that the first method, time of the first bite and intake duration of the forages, had a comparative advantage over the other methods in determining the preference of forages by rabbits in view of the shorter period required for the trial.

Keywords: Palatability; Preference Ranking; Acceptability; Relative Intake

Introduction

Forages constitute a major source of feed for rabbits in Ghana since they are readily available during most parts of the year and usually obtained free of charge by farmers. Rabbits are efficient converters of feed to meat and can utilize up to 30% crude fibre as against 10% by most poultry species [10] and being pseudoruminants, they have the ability to utilise forages for growth and reproduction. Though optimum rabbit production may not be sustained on tropical forages fed as a sole diet, it is possible to reduce the cost of concentrates in their diets by utilising forages that are nutritious and palatable to achieve a compromise between level of production and cost that is acceptable to rabbit keepers [8].

Preference, palatability and species differences play a role in determining the order of voluntary intake of forages. Preference is modified by previous experience, while palatability is affected by fibre content [17] taste and water content. Livestock prefer green material over dry material, and leaves over stems, and they will select feed that have the most pleasing texture to the mouth [4].

Twenty two (22) forages from trees, forbs, shrubs and grasses were identified as feed fed to rabbits as sole diet, in combination with other forages or as supplement to concentrate diets in the Coastal Savannah ecological zone of Ghana in a survey [13]. How-

ever, for rabbits to perform well on forages as sole diets or supplement to concentrate diets, the forages have to be of acceptable nutritive quality and consumed in adequate quantities. To achieve this the forages offered should be palatable enough to entice the rabbits to optimize intake. Despite the major role played by forages in the nutrition of rabbits in the tropics, particularly on small and medium-scale rabbit farms, there is paucity of information concerning the preference by rabbits of tropical forages [11,12,14,15]. There is a need therefore to evaluate the preference of the commonly used forage species in the Savannah ecological zone of Ghana as a guide to their suitability as sole feed or supplement to concentrate diets for feeding rabbits in the zone.

The techniques that have been adopted in the evaluation of preferences of tropical forages include voluntary intake of forages when offered separately and together [8,12] and the preferences assessed as relative intake and ranking (I), dry matter (DM) intake, relative palatability index and ranking [12] and co-efficient of preference [9]. In the present study, three different methods, first bite of a forage and intake duration, voluntary intake of forages when offered separately and together, were used to evaluate rabbit preference of four commonly used forages, *Brassica oleracea, Stylosanthes guianensis, Musa paradisiaca* and *Megathyrsus maximus* in the Coastal Savannah ecological zone of Ghana.

Materials and Methods

Experimental site and climate

The studies were conducted at the Rabbitry of the Council for Scientific and Industrial Research (CSIR) - Animal Research Institute (ARI) Frafraha Station, situated on latitude 50 43′ 48″ North and longitude 00 9′ 0″ East in the Coastal Savannah ecological zone of Ghana. The average annual rainfall in the zone is about 730 mm with two rainy seasons (i.e. May to mid-July and mid-August to October). There is very little variation in temperature throughout the year. The mean monthly temperatures range from 24.7°C in August (the coolest) to 33°C in March (the hottest) with an annual average of 26.8 °C (Dickson and Benneh, as cited in 11). As the area is close to the equator, the daylight hours are practically uniform throughout the year. The relative humidity is generally high with values ranging from 65% (mid-afternoon) to 95% (nighttime).

Experimental animals and housing

A total of 96 unsexed and mixed-strain population of local, California, New Zealand White, Dutch and Chinchilla rabbits, aged eight weeks old and weighing 815 to 875g that had been prevented from having access to forages, were used for the study. The rabbits were housed two to a cage of wire mesh floor and sides with wooden frame, 40 x 40 x 50 cm, fitted with a feeder and a water trough. Each animal was used only once.

Forage plants

Four forages, one each from a plant life-form, comprising *Brassica oleracea* (forb), *Stylosanthes guianensis* (shrub), *Musa paradisiaca* (tree) and *Megathyrsus maximus* (grass) were selected for preference trials. Choice of forages was based on their availability and commonly fed to rabbits in the Coastal Savannah ecological zone [13]. Outer leaves of *Brassica oleracea* were collected from a vegetable garden, leaves of *Musa paradisiaca* were harvested from a backyard farm, and tender stems and leaves of *Stylosanthes guianensis* and *Megathyrsus maximus* were harvested at the full vegetative stage of physiological maturity early in the morning daily from localities within the research station, rinsed with water to avoid contamination and offered fresh to the rabbits.

Determination of dry matter, crude protein and crude fibre contents of forages

Samples of fresh forages were taken to the laboratory immediately after harvest (a maximum delay of 60 min) and triplicates of 300g of each sample were put into crucibles and dried at 60°C for 48 hours to attain constant weights in a Precision laboratory oven at ARI-CSIR Microbiology Laboratory, Frafraha Accra. After drying, each sample was weighed and the DM percentage calculated. The crude protein (CP) and crude fibre (CF) contents were determined by the methods of Association of Official Analytical Chemists [1] at the Animal Science Laboratory, University of Cape Coast, Cape Coast, Ghana.

Experimental design

In the first study 32 kits were used to determine the time of first bite and intake duration of a forage. A weaner was put in a cage with suspended bands of approximately 30g of fresh chopped forages of *Brassica oleracea*, *Stylosanthes guianensis*, *Musa paradisiaca* and *Megathyrsus maximus* presented together for 15 min. The time of the first bite and intake duration of the forages were recorded. A set of new forages were hanged in the cage and their locations changed after each observation prior to putting in a new animal. Each rabbit was offered water and concentrate *ad libitum* after the trial.

In the second study-32 kits were grouped into four treatments comprising eight animals per treatment in a completely randomized block, balanced for sex and weight, for forage preference trial that lasted for 3 and 7 days adaptation and testing periods respectively. The treatments were concentrate diet with chopped forages

of *Brassica oleracea, Stylosanthes guianensis, Musa paradisiaca* and *Megathyrsus maximus* as supplements. Two rabbits were allocated to a cage and offered 80g concentrate diet (40g per rabbit) at 8.00 hours as digestible maintenance requirement to force the animals to consume as much of the forage offered. At 10.00 hours they were offered 800g (400g per rabbit) of one of the four forage species in the fresh form, chopped and suspended inside the cage at 9.00 hours daily during the adaptation period. Based on the quantity of the forages consumed, rabbits in each cage were offered daily allowance of 80g (40g per rabbit) concentrate diet and 700g (350g per rabbit) forage during the testing period. Water was provided *ad libitum*. Residual forage was weighed before the next feeding and the rabbits were weighed at the beginning and end of the study period.

The third trial comprised 3 days adaptation and 7 days testing periods with 32 kits. The rabbits were randomly allocated two to a cage, balanced for sex and weight, and restricted to 80g (40g per rabbit) of concentrate diet daily during the adaptation period. Rabbits in each cage were offered 800g (400g per rabbit) of each of the four selected forages in the fresh form, chopped and presented together as suspended bands at 9.00 am daily. Based on the quantity of the forages consumed in the adaptation period, rabbits in a cage were offered 300g (150g per rabbit) of each forage at the same time in addition to 80g (40g per rabbit) concentrate diet during the testing period. The locations of the forages were randomized daily and water was provided *ad libitum*. Residual forages were weighed before the next feeding and the rabbits were weighed at the beginning and end of the study period.

Data analysis

Daily forage intake was calculated as forage offered minus residual forage. Relative intake of forages was calculated as percentage of forage consumed of the forage offered, (forage consumed/forage offered x 100), and classified into three groups according to the criteria described by Iyeghe-Erakpotobor and Muhammad (2008) as high (70-100%), moderate (50-69%) and low (0-49%). Relative palatability index was calculated for each forage as percentage of forage consumed by the highest forage consumed (forage consumed/highest forage consumed value x 100). Preference ranking of the forages were from 1- highest to 4 - lowest (Osakwe and Ekwe, 2007). Dry matter content of the forages were used to calculate the DM intakes. The data collected were subjected to Analysis of Variance as outlined by the Generalized Linear Model of the GenStat Discovery Edition [7] in a completely randomized design according to the model below

$$Y_{ij} = \mu + T_i + E_{ij}$$

Yij is the response variable such as DM, first bite, intake duration, daily intake, relative intake, intake ranking, relative palatability index and palatability ranking. μ is the overall mean; Ti is the different diets (Forages and Concentrate); Eij is the residual error. Least Significant Difference (LSD) Test was used to separate the significance of differences between the means. The level of significance used in all results was 5% ($P < 0.05$), and the results were expressed as means ± Standard Error (SE).

Results

Dry matter, crude protein and crude fibre contents of forages

Table 1 presents the DM, CP and CF contents of the forages offered to the rabbits. DM and CF contents differed significantly ($p < 0.05$) amongst the forages with *Musa paradisiaca* and *Stylosanthes guianensis* having the highest, while CF content was significantly ($p < 0.05$) highest and lowest in *Stylosanthes guianensis* and *Brassica oleracea* respectively. CP content was significantly ($p < 0.05$) lowest in *Stylosanthes guianensis*.

Parameter	*B. Oleracea*	*M. maximus*	*M. Paradisiaca*	*S. guianensis*	*P-* value
DM	90.81 ± 0.16^{c}	91.53 ± 0.16^{b}	92.31 ± 0.16^{a}	90.02 ± 0.16^{d}	0.001
CP (%DM)	20.16 ± 0.18^{a}	20.74 ± 0.18^{a}	20.36 ± 0.18^{a}	18.98 ± 0.18^{b}	0.001
CF (%DM)	10.83 ± 0.29^{d}	20.03 ± 0.29^{b}	18.98 ± 0.29^{c}	24.77 ± 0.29^{a}	0.001

Table 1: Dry matter, crude protein and crude fibre contents of forages fed to rabbits.

Means in row with a common superscript are not significantly different ($P < 0.05$).

First bite and intake duration of a forage

Table 2 presents the time of first bite and intake duration of forages when the four selected forages were offered together to rabbits for a period of 15 min. The rabbits spent an average of 6.76 min, comprising 45.07% of the observation period, consuming forages. They used the rest of the period, 8.24 min, resting or moving from one forage to another without taking any bites. *Brassica oleracea* was bitten earlier (0.20 min) by the rabbits, and the time spent on the intake of the forage (2.07 min) comprised 30.62% of the total time spent by the rabbits on the intake of all the forages.

Treatment	Time, minutes	
	First bite	Intake duration
B. oleracea.	0.20 ± 0.10	2.07 ± 0.53
M. maximus	0.43 ± 0.06	1.52 ± 0.37
M. paradisiaca	0.34 ± 0.06	1.24 ± 0.33
S. guianensis	0.33 ± 0.06	1.93 ± 0.33
P value	0.306	0.389

Table 2: First bite of a forage and intake duration.

Intake of forages when offered separately

Daily intake of fresh forages by rabbits offered separately can be found in Table 3. Intakes of *Megathyrsus maximus* increased progressively from 126.50 ± 3.86g on the third to 128.67 ±3.86g on the sixth day, while those of *Musa paradisiaca* and *Stylosanthes guianensis* increased from 107.67 ± 3.86g the first to 127.67 ± 3.86g on the fifth and from 170.33 ± 3.86g on the third to 172.00 ± 3.86g on the sixth day respectively. *Brassica oleracea* intake did not follow any particular trend. The mean intake of *Brassica oleracea* by rabbits, 287.48 ± 3.4g, was significantly higher (P < 0.05), followed in descending order of magnitude by *Stylosanthes guianensis* (169.33 ± 3.4g), *Megathyrsus maximus* (125.88 ± 3.4g) and *Stylosanthes guianensis* (169.33 ± 3.4g). The increase in *Musa paradisiaca* intake (18.5g) over the entire testing period was higher than those of *Stylosanthes guianensis*, *Megathyrsus maximus* and *Brassica oleracea* which were 6.0, 8.5 and 6.67g respectively.

Forage	Daily intake (g)							Mean intake (g)
	1	2	3	4	5	6	7	
B. oleracea	285.50 ± 3.86^{a}	285.33 ± 3.86^{a}	288.17 ± 3.86^{a}	285.50 ± 3.86^{a}	290.00 ± 3.86^{a}	285.67 ± 3.86^{a}	292.17 ± 3.86^{a}	287.48 ± 3.4^{a}
M. maximus	117.67 ± 3.86^{c}	125.67 ± 3.86^{c}	123.50 ± 3.86^{c}	126.50 ± 3.86^{c}	127.67 ± 3.86^{c}	128.67 ± 3.86^{c}	126.17 ± 3.86^{c}	125.88 ± 3.4^{c}
M. paradisiaca	107.67 ± 3.86^{d}	122.83 ± 3.86^{c}	123.50 ± 3.86^{c}	126.50 ± 3.86^{c}	127.67 ± 3.86^{c}	126.17 ± 3.86^{c}	126.17 ± 3.86^{c}	122.55 ± 3.4^{c}
S. guianensis	166.00 ± 3.86^{b}	163.17 ± 3.86^{b}	170.33 ± 3.86^{b}	171.33 ± 3.86^{b}	171.33 ± 3.86^{b}	171.67 ± 3.86^{b}	172.00 ± 3.86^{b}	169.33 ± 3.4^{b}
p value	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001

Table 3: Intake of fresh forages by rabbits when offered separately.

Means within columns with different superscripts are significantly different (P < 0.05).

Intake of forages when offered together

Table 4 presents the daily intake of fresh forages by rabbits when offered together. The daily intake of forages offered together shows a gradual increase in the intake of *Brassica oleracea* during the first five days of the trial, and the intake of *Megathyrsus maximus* increased gradually from 40.58g at the fifth to 41.29g at the end of the study. There was gradual increase in the intake of *Musa paradisiaca* from 42.25 ± 1.3g on the second day to 44.25 ± 0.9g at the end of the study, while *Stylosanthes guianensis* had gradual increase from 84.69 ± 1.3g the fourth day to 88.46 ± 0.9g at the end of the study. The mean intake of *Brassica oleracea* 98.88 ± 0.9g was significantly (p < 0.05) highest, followed by *Stylosanthes guianensis* 88.46 ± 0.9g, *Musa paradisiaca* 44.25 ± 0.9g and *Megathyrsus maximus* 88.46 ± 0.9g. The mean intake of *Megathyrsus maximus* by the rabbits amounted to 40.2% of the intake of *Brassica oleracea*.

Relative intake, palatability index and rankings

The relative intake and ranking, and relative palatability index and ranking of forages separately are presented by table 5. The trends of relative intake and palatability index of the forages were similar. In both cases, *Brassica oleracea* and *Musa paradisiaca* had the highest and lowest values respectively.

Table 6 shows forage preference by rabbits when offered together with concentrate diet presented as relative intake, palatability index and rankings. The relative intakes and palatability indices tended to be higher for *Brassica oleracea* and *Stylosanthes guianensis*, and lower for *Megathyrsus maximus* and *Musa paradisiaca,* with *Brassica oleracea* being ranked highest in forage preference.

Forage	Daily intake (g)							Mean intake (g)
	1	2	3	4	5	6	7	
B. oleracea	98.08 ± 1.7^{a}	98.58 ± 1.3^{a}	98.67 ± 1.2^{a}	99.08 ± 1.3^{a}	99.25 ± 0.9^{a}	99.12 ± 0.9^{a}	99.37 ± 0.9^{a}	98.88 ± 0.9^{a}
M. maximus	40.37 ± 1.7^{c}	37.58 ± 1.3^{d}	37.12 ± 1.2^{d}	40.62 ± 1.3^{c}	40.58 ± 0.9^{c}	40.71 ± 0.9^{d}	41.29 ± 0.9^{d}	39.76 ± 0.9^{d}
M. paradisiaca	43.33 ± 1.7^{c}	42.25 ± 1.3^{c}	42.87 ± 1.2^{c}	43.46 ± 1.3^{c}	43.67 ± 0.9^{c}	43.83 ± 0.9^{c}	44.25 ± 0.9^{c}	44.25 ± 0.9^{c}
S. guianensis	83.58 ± 1.7^{b}	89.29 ± 1.3^{b}	88.83 ± 1.2^{b}	84.69 ± 1.3^{b}	85.67 ± 0.9^{b}	86.25 ± 0.9^{b}	88.46 ± 0.9^{b}	88.46 ± 0.9^{b}
p value	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Table 4: Intake of fresh forages by rabbits when offered together.

Means within columns with different superscripts are significantly different (P < 0.05).

Forage	Relative intake (g)	Intake Ranking	Relative palatability index	Palatability ranking
B. Oleracea	82.14	High	100	1
S. guianensis	35.97	Low	43.79	3
M. paradisiaca	35.01	Low	42.63	4
M. maximus	48.38	Low	58.90	2

Table 5: Relative intake, palatability index and preference ranking of fresh forages offered separately.

Forage	Relative intake (g)	Relative intake Ranking	Relative palatability index	Preference ranking
B. oleracea	66.59	Moderate	100	1
S. guianensis	59.97	Moderate	80.05	2
M. paradisiaca	29.50	Low	44.30	3
M. maximus	26.51	Low	39.81	4

Table 6: Relative intake, palatability index and preference ranking of fresh forages offered together.

Dry matter intakes of the forages when offered separately and together

The DM intakes of the forages when offered separately and together (Table 7) were significantly ($p < 0.05$) highest for *Stylosanthes guianensis,* followed by *Brassica oleracea, Musa paradisiaca*, and *Megathyrsus maximus* in descending order of magnitude. The total DM intakes of the four forages when offered together (56.96g) was close to that for *Stylosanthes guianensis* (54.52g) when offered separately, while those of *Brassica oleracea*, *Megathyrsus maximus and Musa paradisiaca* amounted to 14.91, 12.48 and 21.01% respectively of the total DM intake of the forages.

Discussion

The higher preference by rabbits for fresh *Brassica oleracea* and *Stylosanthes guianensis* when the four forages were offered separately and together, in terms of relative intake and palatability, was in agreement with the results obtained by [14] where two forages, *Brassica alicastrum* and *Leuceana leucocephala,* were the most preferred among four forages offered to rabbits in similar trials. Furthermore, the two forages were bitten earlier by rabbits when offered together. However, the different palatability rankings of *Megathyrsus maximus* and *Musa paradisiaca* when offered separately and together during the trials confirmed the findings in a previous trial [2] that care must be taken in drawing conclusions from a single forage preference experiment, especially where feed is offered to rabbits for only a short period as the intakes could increase further when forages are offered to them for longer periods.

The total DM intake of the four forages when offered together, amounting to 56.96g, was close to the highest forage intake of 54.52g for *Stylosanthes guianensis*, when the forages were offered separately. Similarly, the highest DM intake of a forage when five forages were offered separately to rabbits was close to the total DM intake when the forages were offered together since the capacity of the stomach is constant [14,15].

The greatest disadvantage of forages used as feed is the low DM content resulting in low DM intake [2,17]. However, that is not al-

ways the situation as shown in the present study where the DM intake of *Brassica oleracea* was higher than that of *Megathyrsus maximus* by 1.96 and 1.38g when offered separately and together respectively in view of the higher preference of the former despite its significantly lower DM content in comparison with that *Megathyrsus maximus* (8.5 vs. 27.04%). The DM intakes of *Brassica oleracea, Megathyrsus maximus* and *Musa paradisiaca* were 51.17, 58.77 and 39.20% respectively of that of *Stylosanthes guianensis* when offered separately. The significantly higher DM intake of *Stylosanthes guianensis* in the two trials compared with those of the other forages might have been influenced by its higher crude CF content (24.77%) since dietary CF content influences DM intake [5]. The DM intake of forages can also be improved by wilting before feeding [2,17] as was in the present study thereby increasing nutrient intake to meet the requirements of rabbits.

Conclusion

The higher intake of fresh *Brassica oleracea* outer leaves in comparison with the intakes of the other forages when fed separately and together, despite having the lowest DM content renders the forage highly acceptable by rabbits, and also suitable for feeding rabbits, particularly as supplement to concentrate.

The relatively high DM intakes of fresh *Musa paradisiaca* and *Stylosanthes guianensis* leaves when offered separately, despite their relatively low intakes and palatability in comparison with *Brassica oleracea*, also suggests their suitability as supplements to concentrate diets for feeding rabbits. However, the earlier bite of *Brassica oleracea* and its higher intake duration within the 15-min observation period confirms the higher preference of the forage over *Megathyrsus maximus*, *Musa paradisiaca* and *Stylosanthes guianensis* leaves for feeding rabbits.

Since the outcome of the three trials, in particular the higher intake of *Brassica oleracea* compared to that of the other forages with the exception of DM intake were quite similar, the time of first bite and intake duration of forages method, a novel technique, has a comparative advantage over the other two methods in determining the preference of forages by rabbits in view of the shorter period required for the trial.

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Conflict of Interest

The authors declare no conflict of interest.

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Bibliography

1. AOAC. "Official Methods of Analysis, 18th Edition, Current through Revision 2, 2007 (On-Line)". *Association of Official Analytical Chemists, Rockville, MD, USA* (2007).

2. Arias L., *et al*. "A Note on the Chemical Composition and *in Vitro* Digestibility of Common Vegetables Utilised in Urban Dairy Systems of the East of Mexico City". *Livestock Research for Rural Development* 15.2 (2003).

3. Ball DM., *et al*. "Understanding Forage Quality". *American Farm* (2001).

4. Fraser DA. "Factors Influencing Livestock Behaviour and Performance, Forest Practice Branch, British Columbia Ministry of Forests, Victoria, B.C. Rangeland Health Brochure 8 (2004).

5. Ghahri H., *et al*. "Effect of Dietary Crude Protein Level on Performance and Lysine Requirements of Male Broiler Chickens". *African Journal of Agricultural Research* 5.11 (2010).

6. Ghana Statistical Service. "District Analytical Report: Accra Metropolitan". *Ghana Statistical Service* (2014).

7. International VSN. *GenStat for Windows (12th Edition.) VSN International, Hemel Hempstead* (2010).

8. Iyeghe-Erakpotobor GT and IR Muhammad. "Intake of Tropical Grass, Legume and Legume-Grass Mixtures by Rabbits". *Tropical Grasslands* 42.2 (2008).

9. Karbo N., *et al*. "An Evaluation of Browse Forage Preferences by Sheep and Goats in the Northern Guinea Savannah Zone, Ghana. . In: J. Ndikumana and P. de Leuw (eds.) Proceedings of the 2nd African Feed Resources Network, Harare, Zimbabwe (1993): 107-110.

10. Makinde O., *et al*. "Response of Growing Rabbits to Concentrate Diet Supplemented with Leucaena (Leucaena Leucocephala) or Siratro (Macroptilium Atropurpureum) Leaves". *Journal of Biology, Agriculture and Healthcare* 5 (2015): 17-25.

11. Ojebiyi OO., *et al*. "Performance Evaluation of Male Weaner Rabbits Fed Diets Containing Graded Levels of Blood-Wild Sunflower Leaf Meal Mixture". *World Journal of Agricultural Sciences* 3.2 (2007).

12. Osakwe II and OO Ekwe. "Variation in Relative Palatability of Different Forages Fed to Rabbits". *Animal Research International* 4.1 (2008).

13. Osei DY., *et al*. "Feeds and Forages Fed to Rabbits in the Coastal Savannah Ecological Zone of Ghana". *Ghanaian Journal of Animal Science* 10.1 (2020): 75081.

14. Safwat AM., *et al*. "Determination of Tropical Forage Preferences Using Two Offering Methods in Rabbits". *Asian-Australasian Journal of Animal Sciences* 27.4 (2014).

15. Safwat AM., *et al*. "Rabbit Production Using Local Resources as Feedstuffs in the Tropics". *Tropical and Subtropical Agroecosystems* 17.2 (2014).

16. Sarkwa FO., *et al*. "Seasonal Changes in Chemical Composition, Preference and In Sacco Degradation of Eight Different Fodder Tree Leaves". *West African Journal of Applied Ecology* 29.2 (2021).

17. Sarkwa FO., *et al*. "The Effects of Season and Drying on Chemical Composition and Condensed Tannins Levels of Four Browse Species". *Bulletin of Animal Health and Production in Africa* 68.2 (2020): 133-143.