Journal of Sustainable Veterinary & Allied Sciences
P-ISSN-2695-2661 e-ISSN: 2811-1346
JoSVAS 2024 Sept. Vol 6 Issue 3: 12-173-178

Original Research

Productive efficiency of feeding weaner rabbits with yellow maize hydroponic fodder

[a]Adedokun, O. O., [b]Onabanjo, R. S., [a]Chikwendu, P. E & [a]Akubue, V. K.

[a]Department of Animal Production and Livestock Management, [b]Department of Animal Nutrition and Forage Science, College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike, Abia State

**Correspondence:* olubukolaadedokun@gmail.com *+234 8063129194*

ABSTRACT
Ever-increasing trends in the human population warrant having nutritional security, economic sustainability and food adequacy. Thus, this study aimed at determining the herbage yield of Hydroponic Yellow Maize Fodder (HYMF) as well as its impact on growth performance, carcass characteristic and organ proportion of weaner rabbit. Maize seeds procured from Ubani market were cleaned, sterilized using hydrogen peroxide and soaked in clean water for 4hrs before planting in a nutrient solution. A total number of eighteen weaned rabbits were distributed into 3 treatments of 6 animals per treatment and replicated three times with 2 animals per replicate in a Completely Randomized Design (CRD). The animals were placed on three different diets (T1: 100% concentrate, T2: 50% concentrate and 50% HYMF and T3: 100% HYMF). The experiment lasted for 42 days. The result of the study showed that the herbage yield of HYMF was 306%. The final and total body weight gain of rabbits in T1 was significantly (P<0.05) higher than rabbits in T3. Rabbits on T1 had significantly (P<0.05) higher values in all the parameters with exception of backcut and % dressed weight in comparison to other treatments in both the carcass characteristics and organ proportions. It was concluded that Hydroponic Yellow Maize Fodder in high (100%) inclusion levels is not favourable in weaner rabbit, but have a very high herbage yield.

Keywords: herbage yield, hydroponics fodder, productivity, weaner rabbit

INTRODUCTION
Hydroponic farming is a type of agriculture that involves growing plants without soil, using nutrient-rich water solutions instead. The practice has gained popularity in recent years due to its potential for higher crop yields, more efficient use of resources, and year-round crop production. The controlled use of water makes hydroponics an ideal solution not only for arid regions but also for reducing water consumption generally, presenting a cultivation method that responds to the concern for effectively securing water resources. Hence, livestock farmers are exploring unconventional methods such as hydroponically grown fodders for livestock nutrition (Jemimah *et al.,* 2015). A plant's growth rate in hydroponic cultivation is 30–50% faster than in soil cultivation, for example, the growth rate of lettuce via hydroponics is 11 times higher than via conventional cultivation (Kide *et al*., 2015). Food production via hydroponic methods is a well-known technique and its application is increasing worldwide (Hickman, 2021) ensuring higher quantities in a shorter crop cycle and high-quality, high-nutritional-value products. This phenomenon has resulted from ever-increasing production, which has allowed the development of crop diversification and higher profits for producers (Borges *et al*., 2022). This fact is important because it represents economic efficiency, which is the central goal of livestock farmers (Zhang *et al*., 2013).

There is need to harness these good qualities of hydroponics fodder in animal agriculture with the aim of producing cost efficient animal protein. The ever increasing growth rate in the human population in under-developed countries leading to increasing demand of animal protein especially meat, calls for urgent attention to produce more meat. Rabbit meat is a meat that readily comes to mind because it has many production advantages, such as high prolificacy, rapid growth rate and a short generational interval, conversion of low-cost fibre-rich forages and organic wastes in to energy and useful nutrients and with less competition for feed with human and monogastric animals (Evans *et al*. 2023).

The aim of this experiment was to evaluate the herbage yield of hydroponic yellow maize fodder and the effects on growth

http://doi.org/10.54328/covm.josvas.2024.171

performance, carcass yield and organ proportion on weaner rabbits.

MATERIALS AND METHODS

EXPERIMENTAL SITE

The study was carried out at the Rabbitry unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The area falls within the Tropical rain forest zone, it is located at latitude 05º 21' N and longitude 07º 33' E, its elevation is about 112 m above sea level. It has an average Rainfall of about 1777 – 2000 mm/annum, Relative Humidity of about 50-90% and a monthly temperature range of 17-36℃. (NRCRI, 2023).

Hydroponics Yellow Maize Fodder Production

Maize seeds were purchased in an open market in Umuahia, Abia State. They were thoroughly examined before purchase, cleaned from debris and other foreign materials thereafter germination test was carried out to check for viability. Clean seeds were then washed, sterilized in hydrogen peroxide solution and soaked in water for 4 hours and it was incubated for two days before distribution in trays. The seed trays were laid in a well-ventilated room suspended from the ground. The seeds were grown in a nutrient solution (Di-grow grains) which was conducted under natural illumination in a growth chamber. The growing stage last for 7 days. Seeds of the grain were placed in the planting trays with seeding rate of 1.5kg of the grains /tray. Trays were irrigated manually with organic hydroponic nutrient solution twice a day (7:30 am and 5:30 pm) at a fixed rate of 250 ml/tray/day using a spray gun for about 30 seconds. Drained water were collected in plastic containers which were placed under planting trays and measured. The trays were kept in a cool and well illuminated environment for 7 days. The harvested maize hydroponic fodder was wilted over night before feeding it to the rabbits.

EXPERIMENTAL ANIMALS

The experimental animals were sourced from Rabbit farmers within Umuahia, Abia State, Nigeria. The eight weeks old mixed breed rabbits were moved into cages which were raised to about 20 cm above the ground. A total of eighteen animals were allotted into three treatment groups of 6 animals per treatment and replicated thrice with 2 animals per replicate. The cages were provided with wire mesh floor which permit faeces and urine to drop. The animals were allowed one week acclimatization period. The animals were provided with a feeder and drinker in each cage compartment. Each drinker was attached to the wire mesh to prevent wastage and wetting of the feed. The rabbits were weighed to know the initial weight at the onset and the end of the feeding trial which lasted for six (6) weeks.

EXPERIMENTAL DIET

Table 1 shows the composition of concentrate diet. Rabbits in T1 was fed with the concentrate only, T2 rabbit had 50% concentrate and 50% HYMF while T3 rabbits were fed 100% HYMF.

DATA COLLECTION

Herbage yield of hydroponics maize fodder

The weight of the seeds and the soaking weight (incubation) were recorded. The sprout weight was taken at the second day. The sprout yield was also measured before wilting to feed the animals.

GROWTH PERFORMANCE PARAMETERS

Initial weights of the rabbits were taken before they were assigned into different treatments using a digital sensitive scale of about 10 kg capacity. The weights of the animals were recorded weekly until the end of the experiment as follows;

Table I: Composition of concentrate diet

Ingredients	Quantity (%)
Maize	36.70
SBM	11.00
PKC	3.30
Wheat Offal	41.25
Bone Meal	7.00
Salt	0.50
*Vitamin/Mineral Premix	0.25
Total	**100.00**
Calculated Analysis	
M.E (Kcal/kg)	2500.00
Crude Protein	15.00

**Vitamin/Mineral premix (2.5kg) contains: Vit. A (12,500,000 I.U), Vit. D3 (2,500,000 I.U), Vit. E (40,000 mg), Vit. K3 (2,000 mg), Vit. B1 (3,000 mg), Vit. B2 (5,500 mg), Niacin (55,000 mg), Calcium Pantothenate (11,500 mg), Vit. B6 (5,000 mg), Vit. B12 (25 mg), Choline Chloride (500,000 mg), Folic Acid (1,000 mg), Biotin (80 mg), Manganese (120,000 mg), Iron (100,000), Zinc (80,000 mg), Copper (8,500 mg), Iodine (1,500 mg), Cobalt (300 mg), Selenium (120 mg), Anti-Oxidant (120,000 mg).*

MHF – Maize Hydroponics Fodder, SBM – Soya Bean Meal, PKC – Palm Kernel Meal

- Weight gain = final weight – initial weight
- Average daily weight gain = $\frac{weight\ gain}{no.of\ animals \times no.of\ days}$

- Feed intake =quantity of feed given – quantity left over
- Average daily feed intake = $\frac{feed\ intake}{no.of\ animals \times no.of\ days}$
- Feed Conversion Ratio (FCR) = $\frac{feed\ intake}{weight\ gain}$
- Final body weight gain was recorded at the end of the experiment.
- Percentage mortality was recorded as number of dead animals divided by total number of animals stocked multiplied by 100.

CARCASS CHARACTERISTICS AND ORGAN PROPORTION

At the end of the feeding trial, final live weight of the rabbits were taken. Three rabbits per treatment (one per replicate) were fasted for 16 hours but offered water prior to slaughtering. The rabbit was rendered unconscious by a quick blow on the skull behind the ears before using knife to cut the head off. The rabbits per treatment weighing close to the treatment group average were selected for carcass characteristics and organ weight evaluation. Evisceration was done by first cutting the head between the zygomatic arches and the atlas. A cut was made down the breast plate through the abdomen to the pelvis. The anus was cut round and retracted together with the trachea and esophagus. The esophagus was cut round at the distal end to separate it from the diaphragm. The lungs and the trachea were removed intact and weighed while the gastro intestinal tract (GIT) was removed and weighed. Thereafter, the organs (liver, kidney, spleen, heart and the lungs) and cut parts were separated, weighed and expressed as a percentage of the live weight according to procedure enunciated by Ojewola and Longe (1999).

STATISTICAL ANALYSIS

The data collected were analyzed using one-way Analysis of Variance (ANOVA) by Steel and Torrie (1980). The mean separation for significant effect (p<0.05) was done using Duncan's Multiple Range Test Separation (Duncan, 1955).

The statistical model is as follows;

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

Where;

Y_{ij} = Single Observation

μ = Overall Mean

T_i = Effect of Treatments

E_{ij} = Random Error, ~ iind (0, δ2)

RESULTS

In Table II, the herbage yield of yellow maize hydroponic fodders showed that there was about 306% increase from the weight of seeds. The seed weight was 800g while the sprout yield was 2450g as shown in table II. The percentage yield is 2450 divided by 800 multiplied by 100 will give 306%.

Table II: Herbage yield of Hydroponics Yellow Maize Fodder

Parameters	Seed weight (g)	Weight of Incubated seed (g)	Sprout weight (g)	Sprout yield (g)
HYMF	800	1600	2000	2450

HYMF = Hydroponics Yellow Maize Fodder.

The proximate composition of experimental diets are shown in Table III. There were no significant (P<0.05) differences in all the proximate parameters considered across the diets. The crude protein decreased with the inclusion of the hydroponic fodder but the protein requirement was still met. This trend was observed in all the parameters except crude fibre which increased with inclusion of 50% and 100% HYMF.

The proximate composition contents in table III showed that the nutrient composition was rich enough to take care of the nutritional requirements of rabbits.

The growth performance of weaner rabbits fed diets containing Hydroponics Yellow Maize fodder is revealed in Table IV. The final weight and body weight gain of rabbits from T1 to T3 had the same trend, as the level of HYMF inclusion increased their values deceased significantly (P<0.05). The same trend was equally observed for total feed intake and average daily feed intake of rabbits fed the treatment diets, with rabbits on treatments T2 being significantly different from rabbits on T3 but both were similar to rabbits on treatment T1. The rabbits on T1 (8.17)

Table III: Proximate composition of experimental diet

Parameters	T1 (0% HYMF)	T2 (50% HYMF)	T3 (100% HYMF)
Dry Matter (%)	92.43	85.71	78.48
Crude Protein (%)	12.36	11.45	10.57
Crude Fibre (%)	4.68	6.28	7.82
Ether Extract (%)	1.21	1.06	0.82
Ash (%)	15.64	9.21	3.12
Nitrogen Free Extract (%)	58.54	57.71	56.15
Metabolizable Energy (Kcal/kg)	2434.41	2416.60	2370.24

MHF = Maize Hydroponics Fodder

Table IV: Growth performance of Weaner Rabbit fed diets containing Hydroponics Yellow Maize Fodder

Parameters	T1 (0% HYMF)	T2 (50% HYMF)	T3 (100% HYMF)	SEM
Initial weight(g)	450.00	450.00	450.00	0.00
Final weight(g)	1200.00^{a}	891.67^{b}	600.00^{c}	91.71
Total Body weight gain(g)	750.00^{a}	441.67^{b}	150.00^{c}	91.71
Average daily weight gain(g)	46.33	48.35	33.87	3.43
Total feed intake(g)	3300.00^{ab}	3650.00^{a}	2230.00^{b}	0.29
Average daily feed intake(g)	39.30^{ab}	43.45^{a}	26.02^{b}	3.49
FCR	8.17^{c}	9.70^{b}	15.70^{a}	1.06
%Mortality	50.00^{b}	16.67^{c}	83.33^{a}	11.79

^{abc}means within a row having different superscripts are significantly different (P<0.05); MHF = Maize Hydroponics Fodder; FCR =Feed Conversion Ratio; SEM = Standard Error of Mean

Table V: Carcass Characteristics of Rabbit fed diets containing Hydroponics Yellow Maize Fodder

PARAMETERS	T1 (0% HYMF)	T2 (50% HYMF)	T3 (100% HYMF)	SEM
Final weight (g)	1200.00^{a}	1000.00^{a}	600^{b}	94.66
Fur weight(g)	116.67^{a}	116.67^{a}	35.33^{b}	15.17
Defured weight(g)	966.67^{a}	816.67^{a}	400.00^{b}	91.00
Dressed weight(g)	500.00^{a}	466.67^{a}	200.00^{b}	49.91
Thigh (%)	8.20^{b}	8.67^{a}	6.33^{c}	0.36
Loin (%)	2.81	3.30	3.33	0.28
Shoulder (%)	3.67	3.60	2.67	0.33
Forearm (%)	2.89	2.93	2.67	0.29
Rack (%)	6.53	6.10	4.67	0.40
Backcut (%)	12.61^{b}	14.80^{a}	13.00^{ab}	0.44
% Dressed weight	41.67^{b}	46.67^{a}	33.33^{c}	1.97

^{abc} means within a row having different superscripts are significantly different (P<0.05); MHF = Maize Hydroponics Fodder; SEM= Standard Error of Mean

had the best feed conversion ratio and the worst was from rabbits on treatment T3 (15.7). More deaths occurred from rabbits on T3 followed by those on T1 and least deaths occurred from rabbits on T2. There was no particular order.

The carcass characteristics is as shown in Table V. There were significant differences in (P<0.05) some the parameters measured. The Final weight, Fur and Defured weights and Dressed weight of rabbits in both T1and T2 were similar, but statistically different (P<0.05) from rabbits in T3.

The thigh and the % dressed weight of rabbits differed (P<0.05) significantly across the treatments. Rabbits on treatment T2 had the highest values of thigh and the % dressed weight (8.67 and 46.67) while rabbits on followed T1 with the values (8.20 and 41.67) respectively. There were significant (P<0.05) differences in the backcut of rabbits fed the treatment diets. The rabbits on treatment T1 had 14.80% of the live weight while treatment T2 had 12.61% and rabbits on treatment T3 were similar to both of rabbits on treatments T1 and T2. Loins, shoulder, Forearm and rack of rabbits fed the treatment diets had no significant (P>0.05) differences across the treatments.

Table VI shows the Organ proportion of Rabbit fed Yellow Maize Hydroponic fodder. Significant differences (P<0.05) were observed in the liver of rabbits fed T1 (41.67) and that of T3 (19.00) but similar to T2 (32.33), T2 and T3 were equally similar.

Significant differences (P<0.05) were also observed in small intestine, large intestine and head of the rabbits where rabbits on T1 (191.00, 150.67 and 108.33 respectively) were higher than other treatment with T3 (120.00, 92.00 and 76.00) being the lowest among the three treatments.

DISCUSSION

This showed that hydroponics has the ability to sustain livestock production due to its fast growth as it also require less space and time for development. Naik *et al*. (2013) and Adekeye *et al*. (2020) had reported fresh fodder weight of 3.94-4.66kg/tray when 2kg of maize and wheat seeds were used. It was observed that there was increase in leaf development as compared to less root development as this would discourage mould growth as reported by Naik *et al*. (2013).

The findings of this work is in consonance with the result of Chakravarthi *et al.* (2020) who reported that the final body weight and weight gain decreased as the level of hydroponics fed increased. Mohsen *et al.* (2015) reported that inclusion of hydroponics barley at 30% in rabbit diet had no adverse effect on final live body weight and total and daily weight gain, this disagreed with the findings of this study. In a study by Kamran *et al*. (2016), they reported that supplementation of forage base diets with low level of concentrate (50 %

Table VI: Organ proportion of Rabbit fed diets containing Hydroponics Yellow Maize Fodder

Parameters	T1 (0% MHF)	T2 (50% MHF)	T3 (100% MHF)	SEM
LUNGS (%)	11.00	10.33	7.00	0.84
KIDNEY (%)	7.33	7.00	7.00	0.11
LIVER (%)	41.67[a]	32.33[ab]	19.00[b]	3.92
HEART (%)	2.33	2.67	2.00	0.17
SPLEEN (%)	1.00	1.00	1.00	0.00
SMALL INTESTINE (g)	191.00[a]	154.33[ab]	120.00[b]	14.13
LARGE INTESTINE (g)	150.67[a]	120.00[b]	92.00[c]	9.10
HEAD (g)	108.33[a]	105.00[a]	76.00[b]	5.41

[abc] means within a row having different superscripts are significantly different (P<0.05); MHF = Maize Hydroponics Fodder; SEM= Standard Error of Mean

forage and 50 % concentrate) increased body weight gain and improved feed conversion efficiency. Another study stated that the highest live body weight, weight increase, and feed conversion ratio were achieved by rabbits fed fresh hydroponic barley fodder (Abouelezz and Hussein, 2017). The observations of all these researchers are not in agreement with the results of this experiment. This could be because the lower feed conversion efficiency and growth rate in rabbits due to the consumption of sole forage diet in the absence of concentrate could be related to the depressant effect on the hind gut fermentation due to the poor amino acid profile.

This implies that 100% Hydroponics Maize Fodder have adverse effect on the carcass weight of rabbits. The findings in this study disagrees with Mohsen *et al*. (2015) who reported that there were insignificant difference in the slaughter, carcass weight and dressing percentages when hydroponically grown sprouted barley grains was fed to weaner rabbits. Morales *et al* (2009) also concluded that feeding barley hydroponic to growing rabbits impaired their growth hence the carcass quality. Carcass characteristics were used to determine carcass yield. This is in consonance with the result of this experiment. This could be the reason why rabbits on T3 100% HYMF died more than any other treatment.

The result of this study indicates that the inclusion of Hydroponic Yellow Maize Fodder negatively affected the organ proportion, most especially the liver, small intestine, large intestine and the head. The result of this study did not agree with the findings of Mohsen *et al*. (2015), who reported that the weights and percentages of organs and offals were insignificantly affected by sprouted barley grains.

CONCLUSION

From the findings of this study, it could be concluded that feeding concentrate is still beneficial than a mixture or sole hydroponic fodder because the final body weight gain, final weight and the feed conversion ratio of rabbits on 100% concentrate was the best. Since the rabbits fed 100% concentrate had the best performance, rabbits can be raised solely on concentrate without hydroponic fodder and is therefore recommended.

CONFLICT OF INTEREST

There is no conflict of interest from any of the authors.

REFERENCES

Abouelezz, F.M.K. & Hussein, A.M.A. (2017). Evaluation of baker's yeast (*Saccharomyces cerevisiae*) supplementation on the feeding value of hydroponic barley sprouts for growing rabbits. *Egypt. Poultry Science*, 37, 833-854.

Adekeye, Adetayo, Onifade, Olufemi, Amole Tunde, Aderinboye, Ronke & Alaba, Jolaoso. (2020). Water use efficiency and fodder yield of maize (*Zea mays*) and wheat (*Triticum aestivum*) under hydroponic condition as affected by sources of water and days to harvest. *African Journal of Agricultural Research,* 16 (6):909-915.

Borges, R.; Cardoso, T, & Sotto, D. (2022). Analise Economico-Financeira de um Sistema de Cultivo Hidroponico. http://www.custoseagronegocioonline.com.br/numero3v12/ok%2012%20hidroponica.pdf

Chakravarti, M.K., Venkata Pavan, T., Sreekar, V., Krishnamurthy, A., Anil Kumar C., Sudheer, K. & Moise, S. (2020). Effect of dietary incorporation of hydroponic maize fodder on the growth performance of New Zealand White Rabbits. *Forage Research*, 46 (3):30-32.

Duncan, D.B. (1955) Multiple Range and Multiple F-Test. Biometrics, 11, 1-5.

Evans, F.I., Usoro, O.O. & Essien, C.A. (2023). Growth Performance And Apparent Nutrient Digestibility Coefficient of Weaned Rabbit Fed Sundried Cassava Peel Meal as Replacement for Maize. *Nigerian Journal of Animal Science*, 25(1): 84-93

Hickman, G.W. (2021). International Greenhouse Vegetable Production – Statistics a Review of Currently Avaliable Data on the International Production of Vegetable in Greenhouses. Cuesta Roble (Oak Hill) Consulting: Mariposa, CA, USA. http://cuestaroble.com/statistics.htm.

Jemimah, R., Gnanaraj, P.T., Muthuramalingam, T & Devi, T (2015). Hydroponic Green Fodder Production. Tanuvas Experience. Tamil Nadu Veterinary and Animal Science University, Chenani, India.

Kide, W., Desai, B. & Kumar, S. (2015). Nutritional improvement and economic value of hydroponically Sprouted maize fodder. *Life Science International Research Journal*, 2: 76-79.

Kamran M, Ahad A, Aqil M, Imam SS, Sultana Y & Ali A. Design, formulation and optimization of novel soft nano-carriers for transdermal olmesartanmedoxomil delivery: In vitro characterization and in vivo pharmacokinetic assessment. *International Journal of Pharmacy*, 2016 May 30;505(1-2):147-58. doi: 10.1016/j.ijpharm.2016.03.030. Epub 2016 Mar 19. PMID: 27005906.

Mohsen, M.K., Abdel-Raof, E.M., Gaafar, M.M.A & Yousif, A.M. (2015). Nutritional Evaluation of Sprouted Barly Grains on Agricultural By-Products on Performance of Growing New Zealand White Rabbits. *World Rural Observer*, 7:96-107.

Morales, M.A., Martinz, B.F., Juarez, M & Avila E. (2009). Short communication: Effect of substituting hydroponic green barley forage for a commercial feed on performance of growing rabbits. *World Rabbit Science*, 17 (1): 35-38.

Naik, P.K., Gaikwad, S.P., Gupta, M.J., Dhuri, R.B., Dhumal, G.M. & Singh, N.P. 2013. Low cost devices for hydroponics fodder production. *Indian Dairyman*, 65: 68-72.

NRCRI, (2023). Agro-meteorological Unit, National Root Crop Research Institute, Umudike, Umuahia, Nigeria.

Ojewola, G. S. & Longe, O. G. (1999). Comparative response and carcass composition of broiler chickens fed varying protein concentration. *Proceedings of 4th Annual Conference of Animal Science Association of Nigeria*, 69 – 72.

Steel, R.G.D. & Torrie, J.H. (1980) Principles and procedures of statistics. A biometrical approach, 2nd Edition, McGraw-Hill Book Company, New York.

Zhang ChengCheng; Zhang ShiRui; He Xi; Li Min; Wen Hui; Shen Jun; Zhu LiAng & Cui ZhiJie, 2013. Amino acid standardized ileal digestibility of cottonseed meals from different areas of China for swine. *Chinese Journal of Animal Nutrition*, 25 (12): 2844-2853.