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EFFECT OF SQUEEZED LIME FRUIT JUICE AS AN ALTERNATIVE TO ANTIBIOTICS ON GROWTH PERFORMANCE OF GROWING RABBITS

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Abstract

The study evaluated the effect of squeezed lime fruit juice as an alternative to antibiotics on growth performance of growing rabbits. The experiment was conducted with thirty clinically healthy mixed breed growing male rabbits with an average age of 11 weeks old. The rabbits were assigned to six dietary treatments (T1, T2, T3, T4, T5 and T6) in completely randomized design and T1 and T6 served as negative and positive controls respectively. Five growing rabbits were assigned to each dietary treatment and each rabbit served as a replicate. A basal diet formulated as shown in Table 1 was designated as 0.0; then 500, 1000, 1500 and 2000 ml of the squeezed lime fruit juice per 100kg feed was added to the basal diet to form treatments T2 - T5 respectively while T6 was formed by the addition of 55 g/100kg Oxytetracycline to the basal diet as recommended by the manufacturer.Data generated in the study were subjected to analysis of variance using General Linear Model procedure of the Statistical Analysis System software package. Significant differences between treatment means were separated using LSD. Result of squeezed lime fruit juice on growth performance showed an improvement in final body weight with the best performance (44.81%) at rabbits fed 1000 ml/100kg dietary squeezed lime fruit juice. It was concluded that rabbits could tolerate dietary squeezed lime fruit juice up 1500 ml/100kg without negatively affecting feed intake and weight gain. Therefore addition of 1000 ml/100kg squeezed lime fruit juice in diets for growing rabbits could be regarded as good practice and was advocated.

Key words: Antibiotics, Organic acids, Lime, Growth performance

Introduction

High level of production, least cost feed and efficient feed conversion are the needs of the modern rabbit production. This to a certain extent could be achieved by the use of specific feed additives. Antibiotic growth promoters (AGPs) such as Zinc bacitracin among others was the most used AGP in rabbit feed (Falcão-e-Cunha *et al.,* 2007).They stabilised the intestinal microflora and prevented some specific intestinal pathogens leading to better gain and feed conversion (Waldroup *et al.,* 2005). However, despite these good qualities, it had been observed that antibiotics have their negative impact because of their residual effect in both animals and humans leading to public health concern (Dibner, 2004). This has necessitated the search for alternatives to AGPs. As alternative to AGPs, organic acids among others have been reported to be efficacious by modifying intestinal pH, improving digestion and absorption of nutrients (Adams, 1999). However, organic acids currently in use are synthetic types which are very expensive and most farmers do not have access to them, hence the need to explore and exploit natural sources (Ndelekwute and Enyenihi, 2017). *Citrus spp* especially their fruits stand a good chance of becoming an alternative feed additive to replace

antibiotics because of their organic acids content and other bioactive compounds such as carotenoids and flavonoids. The peels and seeds contain essential oils (Gbolade *etal*., 2015). Lime, a *Citrus spp* which abounds in tropical ecosystem is a rich source of citric and ascorbic acids (Ndelekwute and Enyenihi, 2017). Therefore the study evaluated the effect of squeezed lime fruit juice as an alternative to antibiotics on growth performance of growing rabbits.

Materials and Methods

The study was conducted at the Rabbit Research Unit of Swine and Rabbit Research Programme of the National Animal Production Research Institute, Shika-Zaria, Nigeria, located in the Northern Guinea Savannah ecological zone. The area lies between latitude 10°11' N and longitude 7°8' E, and 650m above sea level. The mean minimum and maximum daily temperature is from 14 to 24^{0}C during the cool season and from about 19 to 38.3^{0}C during the hot season. The relative humidity varies between 19 and 35% in the dry season and between 63 and 85% in the wet season (IARMS 20219).

The experiment was conducted with 30 mixed breed growing male rabbits with an average age of 11 weeks old. The rabbits were assigned to six dietary treatments (T1, T2, T3, T4, T5 and T6) in completely randomized design and T1 and T6 served as negative and positive controls respectively. Five growing rabbits were assigned to each dietary treatment and each rabbit served as a replicate. A basal diet formulated as shown in Table 1 was designated as 0.0; then 500, 1000, 1500 and 2000 ml of the squeezed lime fruit juice per 100kg feed was added to the basal diet to form treatments T2 – T5 respectively while T6 was formed by the addition of 55 g/100kg Oxytetracycline (Oxyt) to the basal diet as recommended by the manufacturer. All management practices and medication were observed. The trial lasted for 56 days.

Table 1: Ingredients composition and calculated nutrients of the experimental diet fed to growing rabbits

Ingredients	**(%)**
Maize	34.85
Groundnut cake	20.00
Maize offal	22.00
Rice offal	20.00
Bone ash meal	2.00
Common salt	0.30
Vitamin/mineral premix*	0.25
Lysine	0.30
Methionine	0.30
Total	**100.00**
Calculated Nutrient Analysis	
Metabolisable energy, (kcal/kg)	2515.93
Crude protein, %	16.00
Crude fibre, %	12.74
Ether extract, %	4.43
Calcium, %	0.83
Available phosphorus,%	0.41
Lysine, %	0.71
Methionine + cystine, %	0.53
Feed cost, ₦/kg	78.59

*Biomix broiler starter premix supplies the following per kg diet: vit.A1000 IU; Vit. D3, 2000 IU; Vit. E, 5.0mg; Vit. K, 2mg; Vit. B1, 1.8mg; Vit B2, 5.5mg; Niacin, 27.5mg; Pantothenic acid, 0.5mg; Vit.B6, 0.30mg; Vit. B12, 0.015mg; Folic acid, 7.5mg; Biotin, 0.06mg; Choline Chloride, 300mg; Cobalt, 0.2mg; Copper, 3mg; Iodine, 1mg; Iron, 20mg; Manganese, 40mg; Selenium, 0.2mg; Zinc, 30mg; Antioxidant, 1.25mg.

Initial and final body weights of the rabbits were taken at the start and at the end of the feeding trial. Parameters determined were feed intake, weekly body weight gain, feed conversion ratio, feed cost per kg and mortality. Data generated in the study were subjected to analysis of variance using General Linear Model procedure of the Statistical Analysis System (SAS, 2002) software package. Significant differences between treatment means were separated using least significant difference.

Results and Discussion

Growth performance of growing rabbits fed diets containing graded levels of squeezed lime fruit juice(SLFJ) is presented in Table 2. There were no significant (P>0.05) differences in feed intake, average daily feed intake (ADFI) and feed conversion ratio (FCR). Final body weight, weight gain, average daily weight gain (ADWG) and feed cost per kg gain (FC/kg G) were significantly (P<0.05) affected by dietary squeezed lime fruit juice. The highest weight gain was observed in rabbits fed diets containing Oxyt, 1000 and 1500 ml SLFJ. The least weight gain was recorded in rabbits fed diets containing 500 and 2000 ml SLFJ but were similar to those in the control group (0.0 ml). Weight gain in the control group (0.0 ml) was similar to rabbits fed diets containing 1000 and 1500 ml SLFJ. ADWG followed similar trend as the weight gain. FC/kg G was significantly highest in rabbits fed diets containing 0.0, 500, 1500 and 2000 ml SLFJ, while the least value was obtained in those fed diets containing Oxyt and 1000 ml SLFJ. However, it was similar to FC/Kg G in rabbits fed 0.0, 500 and 1500 ml SLFJ based diets. No mortality occurred during the period of the experiment.

Table 2: Growth performance of growing rabbits fed dietary levels of mashed lime fruit juice

Parameters	T1(0.0)	T2(500)	T3(1000)	T4(1500)	T5(2000)	T6(Oxyt)	SEM
Initial weight (g)	1530.00	1500.00	1580.00	1490.00	1490.00	1480.00	199.21
Final weight (g)	2490.00^{b}	2420.00^{cd}	2700.00^{ab}	2670.00^{abc}	2375.00^{d}	2760.50^{a}	134.13
Weight gain (g)	960.00^{bc}	880.00^{c}	1220.00^{ab}	1180.00^{ab}	885^{c}	1280.50^{a}	135.59
ADWG (g)	17.14^{bc}	15.71^{c}	21.79^{a}	21.07^{ab}	15.80^{c}	22.87^{a}	2.32
Feed intake (g)	6866.00	6844.00	6784.00	6850.00	6784.00	6716.00	409.10
ADFI (g)	122.61	122.21	121.14	122.32	121.14	119.93	6.63
FCR	7.15	7.78	5.56	5.81	7.67	5.24	1.28
FC/kg G ₦	751.00^{ab}	656.94^{ab}	502.01^{b}	558.57^{ab}	782.26^{a}	430.15^{b}	109.55
Mortality (%)							

abc Means with different superscript along rows are significantly different at (P<0.05); Oxyt = Oxytetracycline; SEM = Standard error means; ADWG = Average daily weight gain; ADFI = Average daily feed intake; FCR = Feed conversion ratio; FC/kg G = Feed cost per kg gain.

Final body weight, weight gain and ADGW were improved by squeezed lime fruit juice at 1000 and 1500 ml which were superior to the negative control and were comparable to the positive control. This was a pointer that the juice was safe for rabbits and could replace antibiotics in the diets of rabbits. This result disagreed with Uddin *et al.* (2014) who recorded no significant differences in final body weight when they studied the effect of citric acid as feed additive in diets of rabbit on growth performance. The dietary squeezed lime fruit juice caused significant (P<0.05) variation in weight gain and ADWG. Weight gain and ADWG of rabbits fed 1000 and 1500

ml dietary squeezed lime fruit juice compared favourably with the positive control but were superior to the negative control. This result was contrary to Hohler and Pallauf (1993) and Uddin *et al.* (2014) who reported similarities in these parameters. Dietary squeezed lime fruit juice did not statistically affected feed intake, ADFI and FCR. This result agreed with Hohler and Pallauf (1993) who reported that feed intake and feed conversion efficiency were not significantly affected when pigs were supplemented with 1.5% citric acid. The result was also in line with the report of Uddin *et al.* (2014). Ndelekwute and Enyenihi (2017) also recorded similar result when they studied the effect of lime juice on growth performance of broilers at the finisher phase. FC/kg G was significantly affected by dietary squeezed lime fruit juice. FC/kg G of rabbits fed 1000 ml dietary squeezed lime fruit juice was similar to that of the positive control. This was in agreement with the report of Uddin *et al.* (2014) who also recorded similar result. The zero mortality recorded in this study was an indication of the safety of squeezed lime fruit juice in rabbits' diets. A similar result was also recorded by Ndelekwute *et al.* (2018) with broiler chickens.

Conclusion

Results of this study showed that rabbits could tolerate dietary squeezed lime fruit juice up 1500 ml/100kg without negatively affecting feed intake and weight gain. Therefore addition of 1000 ml/100kg squeezed lime fruit juice in diets for growing rabbits could be regarded as good practice and was advocated.

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