

CARCASS CHARACTERISTICS, INTERNAL ORGAN WEIGHTS AND ABDOMINAL FAT OF GROWING RABBITS FED DIETS SUPPLEMENTED WITH SQUEEZED LIME FRUIT JUICE AS AN ALTERNATIVE TO ANTIBIOTICS

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ABSTRACT

High level of production, least cost feed and efficient feed conversion are the needs of the modern rabbit production and this to a certain extent could be achieved by the use of specific feed additives. Therefore, this study evaluated carcass characteristics and internal organ weights of growing rabbits fed diets Supplemented with squeezed lime fruit juice (SLFJ) as an alternative to antibiotics. The experiment was conducted with thirty apparently healthy mixed breed growing male rabbits with an average age of 11 weeks old. The rabbits were assigned to 6 dietary treatments (T1, T2, T3, T4, T5 and T6) in a completely randomised design. A basal diet was formulated to contain ME 2515.93 kcal/kg and CP 16.00% to which were added 0, 500, 1000, 1500 and 2000 ml of SLFJ per 100kg representing treatments T1 – T5 respectively while 55 g/100kg Oxytetracycline (Oxyt) was added to the basal diet as recommended by the manufacturer to form T6. The treatments 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. The rabbits were housed individually in galvanized wire cages of 60 x 60 x 40 cm in a well-ventilated building. The rabbits were treated for parasites before the commencement of the trial. Data generated in the study were subjected to analysis of variance using General Linear Model procedure of the SAS software package. Significant differences between treatment means were separated using Duncan's Multiple Range Test of the same SAS. Dressed weight was significantly ($P<0.05$) lower at 2000 ml while all others were similar. Dressing percentage was significantly ($P<0.05$) higher at 0.0 and 1000 ml while others were similar. Abdominal fat was significantly higher at 0.0 ml and Oxyt while others were similar. It was concluded that rabbits could tolerate dietary SLFJ up to 1500 ml/100kg without adversely affecting carcass yield. The study therefore recommended that 1000 ml/100kg SLFJ could be used in diets for growing rabbits to produce leaner carcass.

Keywords: organic acids, lime, antibiotics, rabbits, lean carcass

INTRODUCTION

High level of production, least cost feed and efficient feed conversion are the needs of the modern rabbit production and this to a certain extent could be achieved by the use of specific feed additives (Tsavkar *et al.*, 2021). Antibiotic growth promoters (AGPs) such as Zinc bacitracin among others was the most used AGP in rabbit feed (Falcão *et al.*, 2007). They stabilised the intestinal microflora and prevented some specific intestinal pathogens leading to better gain and feed conversion. However, despite these good qualities, it has been observed that antibiotics have their negative impact because of their residual effect in both animals and humans leading to public health concern. This had 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 may not have access to them, hence the need to explore and exploit natural sources which can compare favourably with AGPs. Fruits are major sources of organic acids especially *Citrus spp* (lime, lemon, and grape) which contain citric and ascorbic acids and could serve these purposes. Tsavkar *et al.* (2021) reported that lime fruit juice contained 0.6% ascorbic and 8.02% citric acids. However, there is dearth of information on their uses as dietary source of organic acids and other bioactive compounds in rabbits feeding. Hence this study evaluated carcass characteristics and internal organ weights of growing rabbits fed diets supplemented with squeezed lime fruit juice as an alternative to antibiotics.

MATERIALS AND METHODS

Study Location

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 dry season

begins in the middle of October, with dry cold weather that ends in February. This is followed by relatively hot dry weather from March to May, when the rain begins. The mean minimum and maximum daily temperature are from 14 to 24°C during the cool season and from about 19 to 38.3°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. The wet periods are between May and October with annual rainfall ranges from 700 to 1400 mm, (IARMS, 2019).

Processing of lime juice

Green lime fruits were harvested from a farm in Gboko Local Government Area of Benue State and some were purchased from Samaru market, Sabon Gari Local Government Area, Kaduna State. The lime fruits were mixed, washed and cut into two transverse sections with a sharp knife. The juice was expelled manually by squeezing with the hand. The juice containing the seeds and some particles was filtered with cheesecloth in order to have a clear juice. The juice was stored in a refrigerator at temperature of 4 degrees Celsius to reduce oxidation of bioactive compounds in the juice.

Experimental design and management of growing rabbits

The experiment was conducted with thirty apparently 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. The rabbits were treated for internal and external parasites by injecting *Ivermectin Super*[®] at 0.2 ml/kg live weight and oral administration of coccidiostat (Amprolium[®] at 1 g to 1 L of drinking water) before the commencement of the trial and housed individually in galvanised wire cages of 60 x 60 x 40 cm in a well-ventilated building. The rabbits were fed weighed quantities of the dietary treatments daily in flat bottom earthen feeders at 09:00 hours. Feed leftover and/or wastage was collected, the fur removed, weighed and recorded daily before feeding. Routine management practices were carried out daily. The trial lasted for 56 days.

Experimental diets

A basal diet was formulated to contain ME 2515.93 kcal/kg and CP 16.00% to which was added 0, 500, 1000, 1500 and 2000 ml of SLFJ per 100 kg feed was added to the basal diet to form treatments T1 – T5 respectively while T6 was formed by the addition of 55 g/100kg Oxytetracycline to the basal diet as recommended by the manufacturer. Ten kilogrammes of the feeds were compounded for each treatment every 10 days.

Carcass evaluation

At the end of the feeding trial, three rabbits from each treatment with live weight approximately or equal the treatment average were selected and processed for carcass evaluation. The selected rabbits were fasted for 24 hours (with access to water) and weighed. The rabbits were bled by severing each jugular vein, carotid artery, trachea and the oesophagus in the neck region with a sharp knife below the jaw-line, skinned and eviscerated by opening along the median line of the abdomen and removing gastro-intestinal tract. The internal organs (heart, kidney, liver, lungs and spleen) and abdominal fat were carefully removed and weighed using a sensitive digital scale and expressed as percentage of the live weight. The retail cuts (fore limb, hind limb, loin and rack) were weighed using sensitive digital scale and expressed as a percentage of the dressed weight.

Statistical Analysis

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 Duncan's Multiple Range Test of the same SAS software package.

RESULTS AND DISCUSSION

Table 1 shows the effect of diets supplemented with SLFJ on carcass characteristics, internal organs weights and abdominal fat of growing rabbits. All parameters measured were significantly ($P<0.05$) affect by dietary levels of SLFJ except forelimb, rack and spleen. Slaughter weight was significantly ($P<0.05$) higher with Oxyt and similar to rabbits fed 1000 and 1500ml. Rabbits fed 2000 ml recorded the least slaughter weight which was similar to those fed 0 ml. Rabbits fed 0, 500, 1000 and 1500 ml also recorded similar slaughter weights. Dressed weight was significantly ($P<0.05$) lower at 2000 ml while all others were similar. Dressing percentage (Dressing %) was significantly ($P<0.05$) higher at 0 and 1000 ml while others were similar. Hind limb was significantly ($P<0.05$) higher at 1000 and 2000 ml while others were similar. The loin was significantly ($P<0.05$) higher at Oxyt and was similar to 0, 1000 and 1500 ml while the lowest values were obtained at 500 and 2000 ml and were similar to 0, 1000 and 1500 ml. Heart weight for 500 was significantly ($P<0.05$) highest and was similar to 1000, 1500 and 2000 ml while lowest heart value was recorded at 0 ml but was similar to Oxyt which was similar to 1000, 1500 and 2000 ml. The kidney weights were highest at 0, 500 and 1000 ml. The lowest weight

was with Oxyt which was similar to the 1000 ml. The weights for 1500 and 2000 ml were similar. Liver weight was significantly ($P<0.05$) higher at 500 ml and was similar to 0, 1500 and 2000 ml while the lowest values were obtained at 1000 ml and Oxyt but were similar to 1500 and 2000 ml. Lungs weights were significantly ($P<0.05$) higher at 0 and Oxyt and were similar to 500 and 2000 ml while the lowest values were obtained at 1000 and 1500 ml and were similar to 500 and 2000 ml. Abdominal fat was significantly higher at 0 ml and Oxyt while others were similar.

Table 1 Effect of Diets Containing Graded Levels of Squeezed Lime Fruit Juice on Carcass Characteristics, Internal Organs Weights and Abdominal Fat of Growing Rabbits

Parameters	0	Levels of Squeezed Lime Fruit Juice (ml)				Oxyt (55g/100kg)	SEM
		500	1000	1500	2000		
SW (g)	2466.67 ^{bc}	2533.33 ^b	2616.67 ^{ab}	2583.33 ^{ab}	2333.33 ^c	2733.33 ^a	88.73
DW (g)	1533.33 ^a	1616.67 ^a	1583.33 ^a	1483.33 ^a	1300.00 ^b	1516.67 ^a	74.10
Dressing %	61.65 ^a	54.76 ^b	58.64 ^a	54.25 ^b	53.91 ^b	53.52 ^b	2.04
Retail cuts (g)							
Fore limb	17.68	17.44	17.27	18.30	18.59	17.40	0.73
Hind limb	28.03 ^b	30.00 ^b	31.03 ^a	29.66 ^b	33.34 ^a	28.31 ^b	1.43
Loin	26.02 ^{ab}	24.24 ^b	26.13 ^{ab}	25.79 ^{ab}	24.51 ^b	28.21 ^a	1.38
Rack	21.60	22.68	22.08	22.43	21.76	21.60	1.14
Organ weights (%)							
Heart	0.21 ^c	0.26 ^a	0.24 ^{ab}	0.25 ^{ab}	0.24 ^{ab}	0.23 ^{bc}	0.01
Kidney	0.48 ^a	0.47 ^a	0.47 ^a	0.42 ^{bc}	0.44 ^b	0.41 ^c	0.01
Liver	2.17 ^{ab}	2.25 ^a	1.93 ^b	2.14 ^{ab}	2.19 ^{ab}	2.03 ^b	0.10
Lungs	0.57 ^a	0.49 ^{ab}	0.44 ^b	0.46 ^b	0.48 ^{ab}	0.58 ^a	0.05
Spleen	0.04	0.04	0.05	0.04	0.05	0.04	0.01
AF	5.08 ^a	2.96 ^b	2.57 ^b	2.76 ^b	3.34 ^b	5.33 ^a	0.63

^{abc} Means with different superscript along rows are significantly different at ($P<0.05$); SW = Slaughter weight; DW = Dressed weight; AF = Abdominal fat; Oxyt = Oxytetracycline; SEM = Standard error of means.

Dressed weight is an important index of carcass characteristics because the higher the dressed value, the greater the proportion of lean meat and economic value (Adeyemo *et al.*, 2014). Carcass traits are influenced by the final body weight and maturity of rabbits at slaughter (Dalle Zotte 2002). In this study, it could be established that addition of SLFJ did not affect total meat yield (dressed weight) negatively. Dressing percentage at 1000 ml of the SLFJ treated groups was comparable to the negative control. This implied that the SLFJ was not deleterious on the carcass yields and could be used as feed additive in rabbit production. The juice showed no negative impact on the retail cuts. This is in agreement with the report of Ndelekwute *et al.* (2018) who reported similar result in retail cuts with broiler chickens. Result of the internal organs showed that SLFJ compared favourably with the controls. This indicated that the SLFJ was not detrimental to these important organs. This could have been the reason why carcass yield was not negatively altered. This was in line with Ndelekwute *et al.* (2018) who also recorded similar result in broiler chickens. Kidney, liver and lungs weights in all the SLFJ treated groups were similar to that of negative control. This was in accordance with Solomon *et al.* (2015) who reported that administration of *C. limon* juice to rabbits had a positive effect on the kidney. Abdominal fat was significantly reduced in all the SLFJ treated groups. The reduction in abdominal fat by the juice could be that it gave a platform for efficient energy utilisation giving no room for excess energy to be converted to fat and deposited in the abdomen. This agreed with Ndelekwute *et al.* (2015) who reported that at 20 and 25 ml/kg of dietary SLFJ, abdominal fat in broiler chickens was reduced significantly. Liu *et al.* (2012) also reported that lime juice reduced body fat and was used to trim weight in humans.

CONCLUSION AND RECOMMENDATION

It was concluded that rabbits could tolerate dietary SLFJ up to 1500 ml/100kg without adversely affecting carcass yield and abdominal fat was significantly reduced in all the SLFJ treated groups. The study therefore recommended that 1000 ml/100kg SLFJ could be used in diets for growing rabbits to produce leaner carcass.

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