

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

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ABSTRACT

The study evaluated carcass characteristics, internal organ weights and abdominal fat of growing rabbits fed diets supplemented with mashed lime fruit juice (MLFJ) as an alternative to antibiotics. The experiment was conducted with thirty apparently healthy mixed breed growing male rabbits. 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 MLFJ 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 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 ($P<0.05$) differences between treatment means were separated using Duncan's Multiple Range Test of the same SAS. Result showed that rabbits fed Oxyt diet had the highest slaughter weights which were similar to those fed 500 and 1000 ml of MLFJ. Dressed weight was significantly ($P<0.05$) lower at 1500 ml but was similar to 1000, 2000 ml and Oxyt while others were similar. Dressing percentage of rabbits fed 0 and 500 ml were significantly ($P<0.05$) higher while the rest were similar. Abdominal fat was significantly higher at 0 ml and Oxyt but reduced in all the MLFJ treated groups. It was concluded that rabbits could tolerate dietary MLFJ up to 1500 ml/100kg without adversely affecting carcass yield and abdominal fat was significantly reduced in all the MLFJ treated groups. Therefore, MLFJ could be used at 1000ml/100kg in rabbit diet to trim fat for the production of leaner meat.

Keywords: Alternative to Antibiotics, Rabbit, Mashed Lime fruit Juice, Carcass Characteristics

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). 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 mashed 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 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 pieces with a sharp knife and mashed (ground) using a grinding machine. 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 breeds 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 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 formulated to contain ME 2515.93 kcal/kg and CP 16.00% to which was added 0, 500, 1000, 1500 and 2000 ml of MLFJ 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.

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. 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 Multiple Range Test of the same SAS software package.

RESULTS AND DISCUSSION

Table 1 shows the effect of diets supplemented with MLFJ on carcass characteristics, internal organs weights and abdominal fat of growing rabbits. There were significant ($P<0.05$) differences in slaughter weight, dressed weight, dressing percentage and all the retail cuts except the hind limb. Similarly, all the internal organs weights were significantly ($P<0.05$) affected by dietary levels of MLFJ. Rabbits fed Oxyt diet had the highest slaughter weights which were similar to those fed 500 and 1000 ml of MLFJ. Rabbits fed 2000 ml of MLFJ were similar ($P>0.05$) to those fed 0, 500 and 1000 ml while those fed 1500 ml recorded the least value which was similar to those fed 0 ml. Dressed weight was significantly ($P<0.05$) lower at 1500 ml but was similar to 1000, 2000 ml and Oxyt while others were similar. Dressing percentage of rabbits fed 0 and 500 ml were significantly ($P<0.05$) higher while the rest were similar. Fore limb weight was significantly ($P<0.05$) higher at 1000 ml and was similar to 0, 2000 ml and Oxyt diet. Fore limb weight was significantly ($P<0.05$) lower at 500 ml which was similar to 1500 ml. The 1500 ml was also similar to 0, 2000 ml and Oxyt diet. The loin weight was significantly ($P<0.05$) higher at rabbits fed 1000 ml and Oxyt diet. However, it was significantly ($P<0.05$) lower at 500 ml which was similar to 1500 ml and 1500 ml was also similar to 0.0 and 2000 ml. The rack weights were significantly ($P<0.05$) higher at rabbits fed 1500 and 2000 ml and were similar to 0, 1000 ml and Oxyt.

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

Parameters	0	Levels of Mashed Lime Fruit Juice (ml)				Oxyt (55g/100kg)	SEM
		500	1000	1500	2000		
SW (g)	2466.67 ^{cd}	2566.67 ^{abc}	2716.67 ^{ab}	2300.00 ^d	2533.33 ^{bc}	2733.33 ^a	93.17
DW (g)	1533.33 ^a	1616.67 ^a	1466.67 ^{ab}	1343.33 ^b	1490.00 ^{ab}	1516.67 ^{ab}	89.21
Dressing (%)	61.65 ^a	61.07 ^a	52.65 ^b	54.84 ^b	55.11 ^b	53.52 ^b	2.54
Retail cuts (g)							
Fore limb	17.68 ^{ab}	15.63 ^c	18.28 ^a	16.62 ^{bc}	17.70 ^{ab}	17.40 ^{ab}	0.75
Hind limb	28.03	27.93	27.96	30.65	30.04	28.31	1.37
Loin	26.02 ^{abc}	23.32 ^c	28.78 ^a	25.27 ^{bc}	26.31 ^{ab}	28.21 ^a	1.40
Rack	21.60 ^{ab}	19.30 ^b	20.92 ^{ab}	21.92 ^a	23.27 ^a	21.60 ^{ab}	1.28
Organ weights (%)							
Heart	0.21 ^b	0.23 ^{ab}	0.25 ^a	0.24 ^a	0.24 ^a	0.23 ^{ab}	0.01
Kidney	0.48 ^{ab}	0.48 ^{ab}	0.48 ^{ab}	0.51 ^a	0.44 ^{bc}	0.41 ^c	0.02
Liver	2.17 ^b	2.51 ^a	2.38 ^a	2.25 ^b	2.29 ^a	2.03 ^b	0.12
Lungs	0.57 ^{ab}	0.54 ^b	0.69 ^a	0.57 ^{ab}	0.57 ^{ab}	0.58 ^{ab}	0.07
Spleen	0.04 ^c	0.07 ^{ab}	0.04 ^c	0.08 ^a	0.05 ^{bc}	0.04 ^c	0.01
AF	5.08 ^a	2.63 ^{cd}	3.53 ^{bc}	2.35 ^d	3.89 ^b	5.33 ^a	0.51

^{abcd} 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.

The lowest value of rack was obtained at 500 ml which was similar to 0, 1000 ml and Oxyt. The heart weight was significantly (P<0.05) heavier at 1000, 1500 and 2000 ml but were similar to 500 ml and Oxyt while the lowest value was at 0 ml which was similar (P>0.05) to 500 ml and Oxyt. The kidney weight was significantly (P<0.05) higher at 1500 ml and was similar to 0, 500 and 1500 ml. The lowest kidney value was recorded at Oxyt but was similar to 2000 ml, and 2000 ml was also similar to 0, 500, and 1000 ml. Liver weight was significantly (P<0.05) higher at 500, 1000 and 2000 ml while the rest were similar. Lungs weights were significantly (P<0.05) higher at 1000 ml and was similar to 0, 1500, 2000 ml and Oxyt while the lowest value was recorded at 500 ml which was similar to 0, 1500, 2000 ml and Oxyt. Spleen weight was significantly (P<0.05) higher at 1500 ml which was similar to 500 ml. Lower spleen values were recorded at 0, 1000 ml and Oxyt which were similar to 2000 ml. Abdominal fat was significantly (P<0.05) higher 0 ml and Oxyt while the lowest value was obtained at 1500 ml which was similar to 500 ml and 500 ml was also similar to 1000 ml. Rabbits fed 1000 and 2000 ml had similar values.

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). It was observed that the addition of MLFJ did not affect total meat yield (dressed weight) negatively in this study. Similarly, the juice showed no negative impact on the retail cuts. This implied that the MLFJ was not deleterious on the carcass yields and could be used as feed additive in rabbit production. Internal organs weights in all the MLFJ treated groups were comparable to those of the controls; however, they did not follow any pattern therefore could not be attributed to dietary effect. This was in line with Khan *et al.* (2016) that significant differences in internal organs weights following no any regular pattern did not reveal any particular dietary influence on these organs. 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. The reduction in abdominal fats according to Ndelekwute *et al.* (2018) could have been made possible by the content of MLFJ which included essential oils, carotenoids, flavonoids, fatty acids, citric and ascorbic acids. Report by Kabra *et al.* (2011) also indicated that *C. aurantifolia* peels contain essential oils which played an important role in weight loss and could be useful in treatment of drug-induced obesity and related diseases.

CONCLUSION AND RECOMMENDATION

It was concluded that rabbits could tolerate dietary MLFJ up to 1500 ml/100kg without adversely affecting carcass yield and abdominal fat was significantly reduced in all the MLFJ treated groups. Therefore, MLFJ could be used at 1000ml/100kg in rabbit diet to trim fat for the production of leaner meat.

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