International Journal of Development and Sustainability
ISSN: 2186-8662 – www.isdsnet.com/ijds
Volume 5 Number 4 (2016): Pages 199-212
ISDS Article ID: IJDS15030401

ISDS JOURNALS

Performance of New Zealand White, California White and their cross under two feeding regimes

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Abstract

To evaluate the effect of breed and feeding regime on performance and cost of production of New Zealand White (NZW), California White(CAL) breeds and their cross (Z×C), 60 litters from 30 does were fed on either concentrate or forage based diet. The parameters assessed for does were conception rates, litter size at birth, number weaned per litter, total weaning weight per litter and pre-weaning mortality. The weaners from 60 litters (NZW, CAL, ZxC) were evaluated for feed intake, weight gain, time taken to reach the average market weight of 2kg and the cost of weight gain. Doe performance indicators were not significantly different ($P > 0.05$) for conception rates and pre-weaning mortality between the breeds. However, the litter weaning weight differed ($P < 0.05$) between the breeds at 5313 g, 4683 g and 4033 g for Z×C, NZW and CAL respectively. Litter size at birth was higher for NZW (10.1) compared to 8.45 for CAL. During the post-weaning period, the growers on concentrate diet reached the 2 kg weight faster (12 weeks) compared to 17 weeks on forage based diet. The total feed intake was lowest ($P < 0.05$) for the Z×C group within a feeding regime. The daily weight gain did not differ among breeds within a feeding regime for both feeding regimes and ranged between 23 to 36gd^{-1} for concentrate and 10 to 30gd^{-1} for forage based diets respectively. FCR differed ($P< 0.05$) across the breeds for concentrate based diet at 4.9, 4.3 and 3.9 for NZW, CAL and Z×C respectively but not for forage based diet ($P> 0.05$). The feed cost per unit weight gain differed ($P< 0.05$) between breeds and feeding regimes ($P< 0.01$). However, in both feeding regimes, the crossbreed performed better compared to the other two breeds. It was concluded that irrespective of the feeding regime, the crossbreed performed better for meat production when both biological and economic traits are considered.

Keywords: Rabbit Breeds, Concentrate Diet, Rhodes Grass Hay, Growth Rate, Production Cost

Cite this article as: Wanjala, F.N., Wanyoike, M.W. and Gachuiri, C.K. (2016), "Performance of New Zealand White, California White and their cross under two feeding regimes", *International Journal of Development and Sustainability*, Vol. 5 No. 4, pp. 199-212.

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1. Introduction

Due to the decrease in individual land holdings in the high agricultural potential areas, farmers are being encouraged to rear animals which require less space such as pigs, chicken, dairy goats, bees and rabbits (Kiptarus, 2005). The high cost of agricultural inputs, unemployment rate and cost of cereal grains in many developing countries has prompted resource poor farmers to venture into alternative agricultural enterprises such as rabbit production (Owen, 1981; Lukefahr and Cheeke, 1991). Lack of protein of animal origin (FAO, 2001) can be corrected through adoption of animal breeds that have high feed conversion efficiency, less space requirements, early maturity and low investments cost of which attributes the rabbit encompasses (Lukefahr, 1998; Omotoso, 2011).

New Zealand White (NZW) and California (CAL) are well known as the common breeds under intensive rabbit meat production system (USDA, 1973; FAO, 1997). In a baseline survey in Kenya, Serem (2014) reported the main rabbit breeds as NZW (29%), crossbreds (24%), CAL (12%) and Chinchilla (11.5%).

The high cost of cereal and cereal byproducts based animal feeds (Oluyemi, 1984) has necessitated the use of agro-by-products in animal rations. In Kenya 38.3% of the farmers fed their rabbits on locally available forages/weeds as the sole diet while 57.0% fed a combination of locally available forages and purchased concentrates (Serem, 2014).

Therefore, the main objective of this study was to assess the performance of the two rabbit breeds (NZW, CAL) and their cross under two feeding regimes i.e. concentrate based ration and forage based diet supplemented with different levels of the concentrate.

2. Materials and methods

2.1. Animals, experimental design and management

The experiment was carried out at the rabbit unit, Department of Animal Production, College of Agriculture and Veterinary Sciences (CAVS), University of Nairobi, Upper Kabete Campus, Nairobi, Kenya between September 2012 and September 2013. This area is characterized by low temperatures with a mean minimum and maximum of 12.6°C and 23.4°C respectively.

Ten females of each breed (NZW and CAL) were mated (ratio of 1 male to 5 females) to obtain the purebreds litters. To obtain the crossbreed (Z×C) another 10 NZW females were mated with CAL males. Each of these does were bred twice to produce two litters for the two feeding trials resulting in a total 60 litters resulting from 30 does (20 NZW and 10 CAL does). For the two feeding regimes a total of 360 kits (60 litters with a minimum number of 6 kits weaned per litter) were evaluated for growth performance.

Does were housed individually in a 70x50x45cm metallic cages where they kindled and nursed the young ones. Hay was used as bedding material for kindling, spread five days prior to parturition and was changed on weekly basis until weaning at 42 days.

The study was a complete random design (CRD) with a 3 × 2 factorial arrangement of treatments (two genetic groups plus their cross) and two feeds (Concentrate or forage based diet). The breed and feeding regime were the treatments. At weaning, the litters were randomly allocated to either of the feeding regimes and fed until they attained a 2kg live weight. To be recruited in the experiment each litter had to have a minimum of 6 weaners which were housed in twos (regardless of the sex) in a 70x50x45cm metallic cage equipped with feeders and waterers so as to have three replicates per litter per doe per feeding regime. Where a litter was more than six kits, the cage size allowed adequate space for housing of three kits together. A cage was treated as a unit.

2.2. Experimental diets and feeding

Two experimental diets were evaluated using pregnant, lactating and grower rabbits from weaning to attainment of 2kg. The concentrate ration was formulated to meet the recommended nutrient requirements of pregnant, lactating and growing rabbits by NRC (1977) and pelleted. The diet and water was offered *ad libitum* to the pregnant and lactating does. For the growers feed was offered *ad libitum* but water was restricted to two hours daily (between 9-11am) for the first three weeks post weaning corresponding to the first three weeks of the experiment to reduce digestive disorders common in weaners, then *ad libitum* to the end of the feeding trial. In addition, about 150g of kales (*Brassica oleracea acephala*) per day/per cage was offered for 3 days in a week. The kales were placed hanging from the top of the cage.

For forage based diet, Rhodes grass (*Chloris gayana*) hay obtained from the Veterinary farm (CAVS), University of Nairobi was chopped to about 1-2cm. Prior to being offered in earthen bowls, the hay was sprayed with molasses diluted with water at the ratio of 5:1 water to molasses respectively (to improve palatability) and then offered *ad libitum*. Hay offered was weighed weekly and the intake estimated as the difference between initial weight of the hay and final weight of the left over hay. The left over hay was collected, dried then sampled for analysis to determine selection by the rabbits. The rabbits were also supplemented with the formulated concentrate diet at 50% of expected *ad libitum* intake of the balanced concentrate intake (i.e. 25g/d, 35g/d, 45g/d, 55g/d for week 6-9) then fixed at 60g/d per animal from 10th week till the end of the experiment.

2.3. Data collection

To determine the effect of breed on doe performance, data on number of services per successful conception, litter size, number weaned per litter, total weaning weight per litter and mortality from birth to weaning was recorded for 30 does. To determine the effect of breed and feeding regime on performance of grower rabbits, the following data was collected: Initial body weight of weaners at 6 weeks of age, Live weight (average of the animals per cage as each cage was considered a unit) on weekly basis until the end of the trial and feeds offered and the left-over on a weekly basis for each cage and treatment to determine intake. Feed conversion efficiency was calculated as the amount of feed intake per unit of live weight gain. Mortalities were recorded as they occurred.

2.4. Chemical analysis

The chemical composition (DM, OM, Ash, CP and CF) of the feeds were assayed according to the Association of Official Analytic Chemist (AOAC) methods (1998). Dietary fiber (NDF and ADF) determination was conducted according to Van Soest et al. (1991). Digestible energy (DE) and Metabolizable energy (ME) for the concentrate was estimated according to Noblet and Perez (1993) as quoted by NRC (1998). Only DE for Rhodes grass hay was estimated as described by the same authors.

To determine selectivity behavior of the rabbits on the forage based diet, the hay left-overs per treatment was collected weekly, labeled and dried until the end of the feeding trial. Leftovers from each treatment were then mixed together and three representative samples collected for Crude protein and Crude Fiber analysis (AOAC, 1998). The results were compared to those of the hay as fed.

2.5. Statistical analyses

All data was captured using Excel 2007 spreadsheet, Windows 2007. Data collected to determine doe performance (Litter size at birth, litter size at weaning, total weaning weight and pre-weaning mortality), grower rabbits performance (live weight and weight gain) as well as feed intake were subjected to Analysis of Variance (ANOVA) procedure using the package Genstat software (Genstat, 13th edition) for windows. When analysis of variance indicated significance for treatment effects, specific differences between means were ranked using the Bonferroni Test of the same package.

2.6. Assessment of production costs and returns

Feed costs were calculated based on the current costs of ingredients at the time the feeding trial was conducted. The quantity of feed consumed for the experimental period per unit weight gain of rabbits was used to assess the cost of feed kg^{-1} weight gain. The price of rabbit meat was based on the prevailing market price (Sh.400/kg[1]) while the price of fur was also based on the prevailing market price set by the Kenya Leather Developmental Council (Sh. 50 per piece). In calculating the simulated profit margin, total feed costs were subtracted from total income (meat and skin).

3. Results and discussion

3.1. Diets

The ingredients of the concentrate diet and results of chemical analysis are presented in Table 1.

[1] The shilling to dollar exchange rate was at 85.

Table 1. Ingredient and chemical composition of the concentrate ration on Dry Matter basis

Ingredient	Percentage	Chemical composition	Percentage
Maize grain	15.3	Moisture	11.40
Wheat Bran	15.0	Crude protein	16.05
Pollard	28.8	Ether extract	4.12
Rice Bran	12.6	Crude fiber	11.29
Rhodes Hay	10.0	Total ash	8.56
Cotton seed cake	6.3	Nitrogen free extract	48.58
Soybean Meal	6.3	Calcium	1.14
Limestone	2.3	Phosphorus	0.56
Dicalcium Phosphate	0.3	DE (kcal/kg)	2910.18
Premix*	0.09	ME (kcal/kg)	2820.82
Lysine (100% CP)	0.27		
Methionine	0.27		
Molasses	1.8		
Urea	0.45		
Salt	0.27		

**2 kg of premix contains: Vit A;12,500,000.00IU: Vit D_3;2,500,000.00IU: Vit E;25,000.00IU: Vit K;2,250.00mg: Vit B_1;2,000.00mg: Vit B_2;5,000.00mg: Biotin; 60.00mg: Folic acid;1,000.00mg: Iron; 40,000.00mg: Cobalt; 800.00mg: Copper; 6,000.00mg: Manganese;80,000.00mg: Vit B_6; 5,000.00mg: Vit B_{12}; 20.00mg: Pantothenic Acid; 10,000.00mg: Niacin;25,000.00mg: Choline-Cl;300,000.00mg: Zinc;50,000.00mg: Iodine;1,500.00mg: Selenium;300.00mg: Antioxidants;qs: Carrier:qs.*

The CP at 16.1% was lower than the recommended level of 17.5% needed for growing rabbits (Cheeke, 1987). The CF content (11.29%) was less than the recommended (15-16%) for rabbit diets (Fekete and Gippert, 1985) but within range (10-14%) recommended by (FAO, 1997). The estimated energy (DE and ME) levels were well above the recommended levels of 2400kcal - 2600kcal/kg diet for DE and 2200-2500kcla/kg diet for ME (FAO, 1997).

Chemical composition of the Rhodes grass hay and that of left over for the different breeds is presented in Table 2.

Table 2. Chemical composition on DM basis of Rhodes grass hay and left overs for the different breeds

Parameter (%)	Hay offered	California White	Crossbreed	New Zealand White	SEM	Significance
CP	8.32	-	-	-	-	-
OM	86.95	-	-	-	-	-
DM	91.4	-	-	-	-	-
Ash	13.05	-	-	-	-	-
CF	34.2	-	-	-	-	-
NDF	66.25 ± 1.49^{c}	45.59 ± 1.74^{a}	52.08 ± 0.68^{b}	48.79 ± 0.53^{ab}	1.25	***
ADF	40.51 ± 0.94^{b}	26.30 ± 1.08^{a}	30.12 ± 0.93^{a}	27.79 ± 0.90^{a}	0.97	***
Lignin	8.58 ± 0.82^{b}	6.90 ± 0.67^{ab}	5.36 ± 0.29^{a}	5.58 ± 0.30^{a}	0.57	***

*a,b,c Means within same row with different superscripts are significantly different NS- Non significant (P>0.05); P<0.05) **; (P<0.01***)*

The CP and ash content of the hay was higher (8.32% and 13.1% respectively) than that reported by Abdulrazak et al. (2005) CP of 7.2% and 10.3% ash. The NDF and ADF of the Rhodes grass was higher than that reported by Adegbola and Oduozo (1992) at 38.9, 28.2 compared to 66.25 and 40.51 for this trial. However, the CF content was lower at 34% compared to 48.70% by the same authors and the 37% reported by Ouda (2009). The hay chemical composition will be affected by many factors including the stage of maturity at which the grass is harvested, agronomic practices and the conditions of curing.

3.2. Doe parameters

The doe performance parameters for the various breeds are presented in Table 3.

Table 3. Doe performance parameters for New Zealand White, California White and crossbreed

	New Zealand White	California white	Crossbreed	SEM	Sig
Conception rates (%)	94.5 ± 0.34^{a}	93.75 ± 0.50^{a}	γ*	0.405	NS
Litter size at birth(no)	10.2 ± 0.36^{b}	8.45 ± 0.34^{a}	γ*	0.361	**
Litter size at weaning (no)	9.5 ± 0.39^{b}	7.65 ± 0.41^{a}	γ*	0.398	**
	4683 ± 133.8^{b}	4033 ± 154.4^{a}	5313 ± 115.9^{c}	135.7	***

Total weight at weaning(g)					
Average Individual kit weaning weight (g)	780.5±20.7^{b}	672.3±22.8^{a}	885.5±17.4^{c}	20.9	***
Pre-weaning kit mortality (%)	6.8±1.51^{a}	9.85±2.60^{a}	γ*	1.94	NS

*^{a,b,c} Means within same row with different superscripts are significantly different NS- Non significant (P>0.05); P<0.05) **; (P<0.01***).*

γ same as for NZW does as all the mothers of the crossbreed were NZW*

The conception rates were similar at 94.5 and 93.8% for NZW and CAL respectively and were higher than 80% for NZW breed reported by Matheron and Dolet (1986) in their study in Goudaloupe. In addition to differences in rabbit strains within breeds (Lebas et al., 1997), physiological status of the doe (Theau-Clement, 2001) and physical environment especially light (Theau-Clement et al., 1990) an important factor of conception rates is nutrition. Nutritional status of does will affect the number of corpus luteum, number of implantation sites and the embryo viability (Theriez, 1984).

The litter size at birth was higher (P<0.05) for NZW does (10.2) compared to CAL (8.5). Ponce de Leon (1977) also reported a higher litter size of 8.5 for NZW and 8.0 in CAL. Omotoso (2011) recorded a litter size of 10.1 for NZW. The litter size at weaning remained higher (P<0.05) for NZW does (9.5) than for CAL (7.65). The total weaning weights differed significantly (P <0.01) between the breeds and was highest for Z×C kits (5313g), followed by NZW (4683g) and CAL (4033g).

The average individual kit weaning weight was also higher for the group whose mothers were NZW at 781.8g and 885.9g i.e. for NZW purebreds and the cross respectively compared to 670.9g for kits from CAL does. These results reflected strong maternal effects and superiority of the NZW does as dam breeds as reported by Ozimba and Lukefahr (1991), Lebas et al., 1997 and McNitt et al., 2000. Khalil and Afifi (2000) noted that this superiority can be explained by excellence in pre-natal ability (ovulation rate, fetal survival, uterine capacity and intra-uterine environment) and also post-natal abilities (milk production, maternal behavior and caring ability). The superiority in weaning weight of the ZxC over the NZW purebreds appears to reflect positive heterosis in addition to the good mothering ability of their NZW dams.

3.3. Performance of weaner rabbits

Feed intake, total weight gains and the average weekly weight gains are presented in Table 4. The average time taken to reach the target weight of 2 kg was 12 weeks for feeding regime 1 and 17 weeks for feeding regime 2.

The total feed intake on forage based diet was significantly higher (P<0.01) than those on concentrate based diet attributed to the longer time of feeding (12 weeks vs. 17 weeks for concentrate and forage based diets respectively). The total average CPI was higher (P<0.01) for the concentrate based diet (890.8 g) compared with 837.2 g for forage based diet attributed to higher levels of CP in the concentrate diet. There were no significant differences in CPI within rabbit breeds in feeding regime 1 but this differed ($P<0.05$) within feeding regime 2.

The respective estimated total DEI to 2kg target weight was 17.2, 16.2 and 14.9 MJ for NZW, CAL and the crossbreed for concentrate based diet and 16.2, 18.1 and 14.3 MJ for NZW, CAL and the Crossbreed respectively on the forage based diet. There was no significant difference in DEI between NZW and CAL in either of the feeding regimes. However, the crossbreeds recorded the lowest DEI regardless of the feeding regime. This can be explained by the fact that under both feeding regimes, the crossbred rabbits attained the target 2kg live-weight within a shorter time, of 1 and 2 weeks under the concentrate and forage based diets respectively, than the purebreds. Nutrient intake has been demonstrated to influence weight gain in rabbits (Maertens, 1999) which is proportional to nutrient intake of rabbits fed these nutrients to appetite (Xiccato and Trocino, 2010). However, this is affected by the FCR of an animal as well as the rate of intake of these nutrients (Xiccato and Trocino, 2010). This explains why although all the rabbits ingested almost similar energy and protein, the concentrate based rabbits grew faster due to higher density of these nutrients in the feed when compared with the forage based rabbits.

The crossbreed had a higher weekly feed intake for both feeding regimes but had the lowest total average feed intake as they reached the target weight of 2 kg earlier than the purebreds. These observations (higher feed intake thus higher weight gain) agree with many other authors Niedzwiadek (1979), Brun and Ouhayoun (1989), Ozimba and Lukefahr (1991) and more recently by Kabir et al. (2012). However, the crossbreed does not always perform better than pure breeds. Reyntens et al (1970) reported intermediate performance of the cross between NZW and Blanc de Termonde as did Hamilton et al. (1997) for the same crosses of CAL and Blanc de Termonde.

The lower overall growth performance of rabbits in feeding regime 2 can be attributed to the low digestibility and nutrient density of Rhodes grass *(Chloris gayana)* (Raharjo et al., 1986) compared to concentrate diet. However, Rhodes grass can be used as a source of the all important fibre in rabbit feeding (NRC, 1977). The beneficial effect of high dietary fibre could explain the fact that the post weaning mortalities for the rabbits on the forage based diet were lower (6.3%) compared to 14.6% for those on the concentrate based diet with a lower fiber content. Elmaghraby (2011) reported a mortality of 12.5% for rabbits on concentrate ration. Robinson et al. (1999) reported that as dietary NDF increases nutrients intake and by inference the performance decreases but where the NDF is too low stomach upsets may occur leading to higher mortality rates.

This requirement for high dietary fibre by rabbits may explain the results given in Table 2. The rabbits on hay based diet selected for fibre (NDF, ADF and lignin) as indicated by the lower content of these in the left over hay. This observation is in agreement with Cheeke (1987) who reported that given a choice, rabbits preferred barley to corn, either because of palatability or higher fiber content or both. Hall and Johnston (1976) also reported that corn-based diets gave poorer growth responses with rabbits than either barley or oat-based diets and in lactation diets, oats gave the best performance of the four grains suggesting factors other than energy content are involved. Other scenarios depicting the preference of fibre by rabbits are shown by the preference of fibrous alfa alfa *(Medicago sativa)* hay over oil seed cakes (Cheeke, 1986).

Table 4. Feed intake, weight gains, feed conversion efficiency and cost of weight gain of weaner rabbits fed on concentrate and roughage based diet.

	Feeding regime 1 (Concentrate based)			Feeding regime 2 (forage based)				
	New Zealand White	California White	Crossbreed	New Zealand White	California White	Crossbreed	SEM	Sig
Total feed intake (kg)	5.912±67^{by}	5.591±32^{abxy}	5.148±20^{ax}	8.635±43^{dy}	9.66±88^{ez}	7.533±3.0^{cx}	0.16	***
Concentrate supp (kg)				1.6	1.68	1.48		
Total hay intake (kg)				7.03	7.98	6.05		
Total CPI	948.5^{cx}	897.5^{bx}	826.3^{bx}	838.5^{by}	932.9^{cx}	740.3^{ay}	15.3	***
Total DEI	17.2^{by}	16.3^{by}	14.98^{ax}	16.2^{by}	18.1^{cy}	14.3^{ax}	4.2	***
Average weekly gain (g)	198.5±2.2^{cx}	200.0±7.1^{dx}	208.9±3.2^{dex}	140.5±2.9^{ax}	147.1±5.8^{abx}	156.6±3.7^{bx}	10.0	***
Total weight gain (g)	1227±22^{abx}	1319±1.9^{bxy}	1278±2.1^{abx}	1255±8.52^{abx}	1291±11^{abx}	1201±10.20^{ax}	34.6	**
FCR	4.818±0.1^{bxy}	4.23±0.03^{abxy}	3.966±0.02^{ax}	6.898±0.05^{cx}	7.393±0.11^{cx}	6.272±0.06^{cx}	0.232	***
Total feed Cost(Ksh)	183.2±2.1^{dxy}	173.3±0.99^{dxy}	159.59±0.7^{cx}	120±0.43^{abx}	131.9±0.88^{bxy}	106.4±0.30^{ax}	3.21	***
Cost/Kg weight gain(sh)	150.1	131.3	124.9	96	102.2	88.6		
Simulated profit margin	2,960,548(USD 34,830)			2,742,742(USD 32,268)				

Average post weaning mortality rate (%)	14.6±0.82[b]	6.3±0.31 [a]	0.21	***

*a,b,c,d,e Means within same row with different superscripts are significantly different between the feeding regimes. x,y,z Means within same row with different superscripts are significantly different within a feeding regime. NS- Non significant (P>0.05); P<0.05) **; (P<0.01***)*

Weekly weight gains were highly significantly different (P<0.01) between the feeding regimes but not within a feeding regime. The average daily weight gain was 28.9 g and 21.2 g for feeding regime 1 and 2 respectively. In agreement, Pinheiro et al. (2011) observed that rabbits kept under intensive system on high concentrate diets gained more weight than those kept under extensive system on forages. Lukefahr (1998) reported that in Uganda, where rabbits are mainly reared on forages, it took around 4-5 months to produce a 2 kg fryer which is comparable to the 17 weeks for rabbits on forage based diet in this study. Cheeke (1987) also concluded that it took twice the amount of time for fryers to reach a 2 kg weight under the extensive production systems (common in developing countries) compared to intensive production systems common in developed economies, which is a reflection of nutrition level.

However, in both feeding regimes, the crossbreed had the highest weight gains among the three groups and attained the target weight earliest at 12 weeks in feeding regime 1 and 15 weeks in feeding regime 2. This was probably due to positive heterosis as suggested by Ozimba and Lukefahr (1991).

The average feed conversion ratio (FCR) during the growth period for feeding regime 1 was lower (P<0.01) (4.3) compared to 6.9 for feeding regime 2. In both feeding regimes, the crossbreed had a lower total feed intake which was attributed to the shorter time to reach target weight leading to better feed efficiency ratio (Table 5). Generally, the FCR increased with age in agreement with Maertens (2009) who observed that young animals have a lower FCR than those near slaughter weight. This was attributed to differences in content of tissue accretion (fat *vs* protein and water), whereby the proportion of fat increases with age would require more energy per unit weight gain thus the poor FCR for older animals. The crossbreed regardless of the feeding regime recorded better FCR due to the fact that these reached the target weight earlier than the purebreds.

The estimated cost of production differed (P≤0.01) between and within the feeding regimes for the different breeds. Within the two feeding regimes, the crossbreed outperformed the purebreds. The crossbred reached market weight earlier and thus consumed less feed under both feeding systems which translated to cheaper cost of gain in agreement with Ozimba and Lukefahr (1991). From the results of the study, the NZW appears to perform better under the less intensive feeding system (feeding regime 1) while the CAL performed better under the intensive system (feeding regime 1).

The cost per unit weight gain was lower under feeding regime 2 and within this regime was lowest for the crossbreed at Sh.88.6 (USD 1.04) followed by NZW at Sh.96 (USD 1.13) and CAL at Sh.102.2 (USD 1.20). This is explained by the lower feed cost at an average of Ksh. 95.6 compared to 135.4/kg of feed for animals under feeding regimes 2 and 1 respectively. Ekpo et al. (2009) cited Obikaonu and Udedibe (2006) also concluded that non-conventional feeding (using cassava tuber meals) led to lower cost of production due to lower cost of the raw material. However, when production for a 100 does unit per annum was simulated, production under feeding regime 1 yielded higher returns by Ksh. 217,806 (USD 2,533). This was explained by a higher offtake rate of 4.3 vs. 3.1 litter crops per annum for feeding regime 1 and 2 respectively, calculated using the 12 and 17 weeks to the 2kg target market weight.

The interaction between breed and feeding regimes for the different parameters are shown in Table 5. Within both feeding regimes, total feed intake and total feed cost was significantly affected by breed with the crossbred consuming the least (Table 4). Also more feed was consumed in feeding regime 2 irrespective of the breed.

Table 5. The effect of Breed and Feeding regime interaction on feed intake, weight gain and the FCR of weaner rabbits

	P-Value		
Parameters	**Breed**	**Feed**	**Interaction (B×F)**
Total feed intake	<.01	<.01	<.01
Total weight change	0.039	0.454	0.054
FCR	0.007	<.001	0.078
Total feed cost	<.01	<.01	0.015

Non significant (P>0.05); Significant (P<0.05); highly significant (P<0.01).

The other variables of FCR and total weight gain were not affected. The lack of significance (P>0.05) for total weight changes could be due to the fact that for all the regimes, the target weight was 2 kg for all breeds.

4. Conclusion and recommendation

It was concluded that rabbit production under the less intensive feeding regime 2 (roughage supplemented with concentrate) resulted in lower cost of production and would be more suitable for resource poor farmers. However, intensification as with feeding system 1 would increase profitability of the enterprise and yield higher amounts of meat per annum. Additionally, the crossbreed performed better than the pure breeds for meat production when both biological and economic traits were considered in either of the feeding systems.

Acknowledgements

The following institutions are acknowledged for their input into the study; National Commission for Science, Technology and Innovations (NACOSTI) under the project 'Strategies to Promote the Rabbit Value Chain in Kenya' for funding this project and the Department of Animal Production, University of Nairobi, for providing the physical facilities and the technical support.

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