FEEDING RABBITS ON LOCALLY AVAILABLE FEEDS IN PAPUA NEW GUINEA

Martin Lobao[1] and Alan Quartermain[2]

ABSTRACT

Domesticated rabbits (Oryctolagus cuniculus) were introduced into Papua New Guinea (PNG) in 1993 to improve family nutrition, income generation, self-employment opportunities for subsistence farmers and supply a by-product in the form of manure for improving soil fertility. The introduction was successful and rabbits are now kept by households in most mainland provinces. Since most rabbit farmers are located in rural areas where; access to goods and services is difficult and purchase of commercial feed is not an option due to its high cost, farmers have to resort to feeding their animals on readily available local feedstuffs. Studies conducted by the PNG University of Technology and later by the National Agricultural Research Institute (NARI) assessed available feedstuffs and low cost feeding options for farmers. Based on these studies, NARI released the recommendation that either sweet potato tubers or coconut, fed together with a suitable palatable fresh green leaf material, can be used to give satisfactory growth of weaner rabbits when fed free choice and to appetite. These diets can be entirely made up from locally available resources.

Key words: *Weaner rabbits, low cost feed options, locally available feedstuffs, sweet potato, coconut, pelleted feed, palatable green leaf.*

INTRODUCTION

The farming of domesticated rabbits *Oryctolagus cuniculus* has been a success since the introduction of the animal into Papua New Guinea (PNG) in 1993. The objectives were improvement in family nutrition, self-employment opportunities and hence income generation for subsistence farmers, and supply of a by-product in the form of manure for improving soil fertility. This initiative was suggested by the reported success of village rabbit keeping in the highlands of West Papua. The assumption was that community development can only take place if people have access to good nutrition, and that the rabbit, because of its size and feeding habits, seemed well suited to supply the high quality proteins necessary for balanced human diets. The strictly controlled importation was of 15 specific-pathogen-free rabbits, 10 Canberra Half Lop and five New Zealand White breed. Controlled distribution to 30 selected and trained breeders began in early 1994 and restrictions were eventually lifted to allow anyone to acquire and breed rabbits.

Rabbits do not get too much mention in textbooks on animal nutrition or general animal husbandry. They have the ability to utilize different types of garden crops, legumes and forages grown in or around gardens, on roadsides and in garden areas left to fallow. They have the capacity to utilize fibrous material of plant origin but cannot produce well on plant leaf material alone. They have a unique way of dealing with the problem associated with the digestion of fibre in foods. The caecum of the large intestine is capable of sustaining a significant microbial population and food components not yet digested and absorbed are subjected to fermentation. However, although microbial digestion in the caecum is similar to that in the rumen of animals such as cattle, sheep and goats, it is less effective because digesta are not held for sufficient time and many of the products of digestion, particularly amino acids and vitamins, are not absorbed. The rate of passage through the system is only 30 hours as against 120 hours for a ruminant. The rabbit has partially overcome this problem by coprophagy; the consumption of faeces. It produces two types of faeces, the normal hard pellets which are not eaten and the soft faeces or caecotrophes which contain well fermented material and are consumed for further digestion. However, coprophagy is not too helpful in improving fibre digestion because the soft faeces have much less fibre than the hard faeces. While young forages may have a digestibility of over 70 percent, mature forage digestibility may be only 45-50 percent. In spite of this, fibre is essential in the diet to aid the passage of food through the system and prevent di-

[1]National Agricultural Research Institute, High Altitude Highlands Programme, P.O. Box 120 Mt Hagen, Western Highlands Province, Papua New Guinea
[2]The PNG University of Natural Resources and Environment, Private Mail Bag, Rabaul, East New Britain Province, Papua New Guinea

gestive disorders. Feeds that are too succulent, however, may give rise to diarrhoea. A good diagram of the digestive tract is given in Fielding (1991) who also gives the comparative composition of the two types of faeces.

Nevertheless, studies and farmer practice in many tropical countries have shown that rabbits will perform well when fed tropical forages as a major component of the diet. In PNG the earlier work on rabbit feeding was done at the PNG University of Technology and has been summarized by Grant et al. (1996, 2005). The work involved feeding of weaner rabbits on a range of feeds, solely or in combination. These included sweet potato tubers and vines, cowpea or pigeon pea forage, lucerne meal, leucaena leaf meal, copra meal and poultry feed (broiler finisher pellets). The results, as summarized in Table 1, show that growth of rabbits is poor when they are fed on green leaf material alone, but when concentrated energy feeds such as sweet potato tubers, broiler chicken pellets or copra expeller meal are added to the diet then satisfactory growth performance of 16 or more grams per day can be achieved.

It is clear from this work and international experiences that rabbits can be fed on many different types of tropical forages such as legume tree forages (leucaena and erythrina), leaves of legume shrubs and beans, tuber crop leaves and vegetables provided they are supplemented with energy feeds. Although a number of forages can be fed to rabbits, some are not recommended to be fed in large quantities because of anti-nutritional factors (e.g. leucaena) and some are not palatable (e.g. gliricidia). In PNG, crops that have high energy content such as cassava, banana, sweet potato, sugarcane and coconut can be major sources of energy for rabbits where they are available in abundance and are accessible at low cost.

Further work involved the use of the milling by-products such as; wheat millrun, copra meal and soyabean meal, plus added amino acids, lysine and methionine (Bangita 2000). The upshot of all this effort was the development of a commercial pellet containing millrun, copra meal, limestone, salt and a pig feed pre-mix for additional vitamins and minerals as a complete feed for rabbits and this was produced commercially by Lae Feed Mills. However, due to escalating costs, demand for the pellet declined and production ceased. While there are alternatives to rabbit pellets in the form of commercial pellets made for feeding broiler chickens, pigs or horses, cost remains a prohibiting factor and, since most farmers interested in keeping rabbits are located in rural areas, access to goods and services is difficult and purchase of commercial feeds is not an option. Hence farmers have to resort to feeding their animals on readily available local feedstuff.

Table 1. Average growth rates of rabbits fed different diets (Grant *et al* 1996)

Treatment	Growth g/day
Sweet potato vines fresh + Broiler finisher pellets (40 g/h/d)	22
Broiler finisher mash (100 %) + Cowpea forage	20
Broiler finisher mash (75 %) + Copra expeller meal (25 %) *ad libitum*	20
Broiler finisher mash (*ad libitum*)	18
Broiler finisher mash (50 %) + Copra expeller meal (50 %) *ad libitum*	18
Copra expeller meal (100 %) + Cowpea forage (*ad libitum*)	18
Broiler finisher mash (25 %) + Copra expeller meal (75 %) *ad libitum*	16
Copra expeller meal (100 %)	16
Sweet potato vines fresh + Sweet potato tubers (120 g fresh/h/d)	12
Sweet potato vines fresh (*ad libitum*)	8
Sweet potato vines fresh + Pigeon pea leaves (100 g fresh/h/d)	6
Cowpea forage fresh (*ad libitum*)	5
Sweet potato vines oven dried (*ad libitum*)	4
Lucerne meal (*ad libitum*)	2
Lucerne meal (75 %) + Leucaena leaf meal (25 %)	-7
Lucerne meal (50 %) + Leucaena leaf meal (50 %)	-14
Lucerne meal (25 %) + Leucaena leaf meal (75 %)	-18

Rational for On-going Research

Considering the increasing cost and the limited availability of commercial feeds for use by most subsistence farmers, the Livestock Research Programme of the PNG National Agricultural Research Institute (NARI) instituted a series of trials in 2002, following on from the University of Technology work, with emphasis on assessing available feedstuffs and developing low cost feeding options for farmers. Since many rabbit farmers in most areas of PNG feed sweet potato and its leaves to rabbits in large quantities, this crop needed to be further assessed. In lowland areas, fresh coconut can be available in quantity and it may be more beneficial to feed it to animals than to make copra. Hence one major purpose of the NARI work was to confirm, through replicated trials, the utility of these two feed sources for growing rabbits. Velvet bean leaves were used for the green leaf component of the diets but other work and experience in PNG have indicated that other leaf materials such as cowpea, sweet potato and kangkong (*Ipomoea aquatica*), and kikuyu grass and white clover in the high altitude highlands are equally as useful.

NARI Experimental Results

Results from three relevant experiments as originally reported in the NARI 2003-2004 Biennial Report (National Agricultural Research Institute 2005) are given here. Control diets were either commercial rabbit pellets or horse pellets which were shown by other work to be equivalent in feeding value. The intake figures are for the feed as fed and for the non-leaf component of the diet only. All feeds were given to appetite with rabbits free to select their preferred diet from the feedstuffs presented.

In the first experiment, male and female weaner rabbits were grown for eight weeks on one or other diet of rabbit pellets (RP), fresh sweet potato (SP) plus velvet bean leaf (VB) or sun-dried cassava tuber (CT) plus velvet bean. The results are summarized in Table 2.

In the second experiment, female weaner rabbits were fed for seven weeks on one or other diet of horse pellets (HP), sweet potato plus velvet bean leaves or the sweet potato / velvet bean diet supplemented with either 10 or 20 grams per day of horse pellet. The rationale was that the addition of small, measured quantities of pellet could boost production from local material diets. The results are summarized in Table 3.

Table 2. Summary of means for sex of rabbit and diet experiment 1.

Effect	Level	Wt 0 (g)	Wt 8 (g)	Gain (g)	ADG (g)	Feed Intake (g)	FCR
Sex	Female	1274 *a*	2096 *a*	820 *a*	14.7 *a*	4001 *a*	6.8 *a*
	Male	1229 *a*	1823 *b*	596 *b*	10.7 *b*	3871 *b*	9.2 *a*
Std Error		34.2	68	76.6	1.37	320.3	1.98
Diet							
1	RP	1282 *a*	2244 *a*	960 *a*	17.2 *a*	3962 *a*	7.6 *a*
2	SP + VB	1245 *a*	1992 *a*	747 *a*	13.3 *a*	3309 *b*	4.6 *a*
3	CT + VB	1229 *a*	1643 *b*	414 *b*	7.4 *b*	4537 *c*	11.7 *a*
Std Error		102.6	204.1	229.7	4.1	311.8	6.0

Means with the same subscript are not significantly different (P > 0.05)

Table 3. Summary of means for diet experiment 2.

Effects	Level	Wt 0 (g)	Wt 7	Gain	ADG	Feed Intake	FCR
Diet 1	HP	1647 *a*	2434 *b*	788 *a*	18.75 *a*	9109 *a*	11.9 *a*
Diet 2	SP+VB+10g HP	1371 *a*	1950 *ab*	579 *b*	13.79 *b*	4163 *b*	7.2 *b*
Diet 3	SP+VB+20g HP	1569 *a*	2060 *ab*	491 *b*	11.69 *b*	4255 *b*	9.0 *ab*
Diet 4	SP+VB	1390 *a*	1799 *a*	409 *b*	9.73 *b*	6605 *c*	16.6 *c*
Std Error		263.6	254.6	100	2.4	668	2

Means with the same subscript are not significantly different (P > 0.05).
Wt=Weight, ADG= Average Daily Gain

In the third experiment, male and female weaner rabbits were grown for eight weeks on one or other diet of horse pellet, sweet potato plus velvet bean leaves or fresh coconut (C) plus velvet bean leaves. The results are summarized in Table 4.

The analysis of weekly live weights showed significant diet effects from week three to week 10 in favour of animals fed the MULHP diet. The effects of sex of animal and diet by sex interaction were not significant. For the diets, the mean live weights (Figure 1) were similar in weeks one and two, but from week three onwards rabbits fed the MULHP diet had significantly higher live weights

Table 4. Summary of means for diet experiment 3.

Effects	Levels	Wt 0 (g)	Wt 8(g)	Gain(g)	ADG(g)	Feed	FCR
Sex	M	1212 a	2058 a	746 a	12.1 a	11232 a	14.6 a
	F	1054 a	1943 b	890 a	12.7 a	10535 a	12.7 a
Std Error		102.2	66.2	225.6	1.8	813.1	1.4
Diet 1	HP	1216 a	2345 a	1128 a	16.1 a	10372 a	10.4 a
Diet 2	SP + VB	1056 a	1778 b	722 b	10.3 b	12685 a	17.6 b
Diet 3	C + VB	1126 a	1879 b	754 c	10.8 b	9594 b	12.9 ab
Std Error		125.2	249.9	276.3	2.2	995.9	1.7

Means with the same subscript are not significantly different (P > 0.05)
Wt = Weight, ADG = Average Daily Gain

A summary of all the relevant experimental results is given in Table 5.

Table 5. Average growth rates of grower rabbits fed on different diets

Treatment diets	Growth rates g/day
Horse Pellet (100%)	18
Rabbit Pellet (100%)	17
Sweet potato + Velvet bean leaves fresh + 10g Horse Pellet	14
Sweet potato + Velvet bean leaves fresh + 20g Horse Pellet	12
Sweet potato vines fresh + Sweet potato tubers (120 g fresh/h/d) **	12
Sweet potato + Velvet bean leaves fresh	11
Coconut + Velvet bean leaves fresh	11
Cassava tuber + Velvet bean leaves fresh	7

**Comparison of growth rates from previous study by Grant at el. 1996.

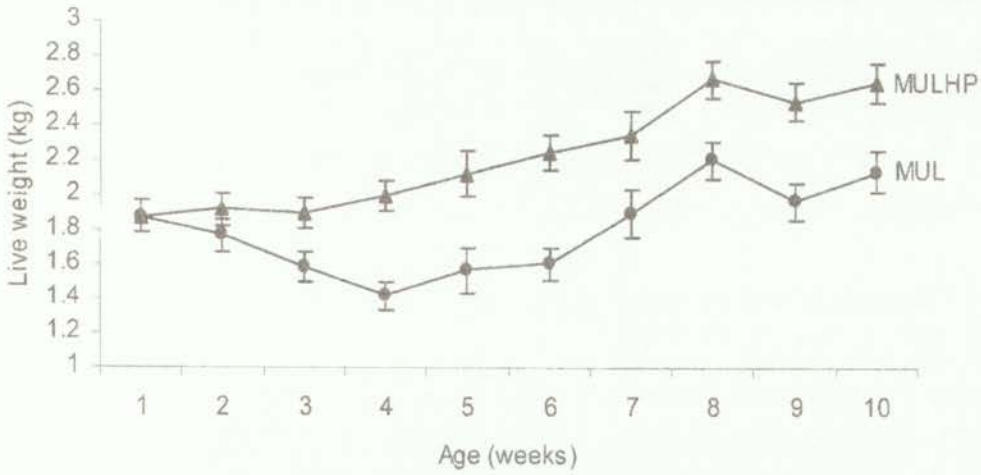
Use of Mulberry (*Morus alba*) and Kangkong (*Ipomoea aquatica*) Leaves

A fourth NARI trial (Kohun and Thomas 2006) tested the use of mulberry leaves in rabbit feeding. Eight male and eight female weaner rabbits (1.88 kg mean live weight) were allocated in same sex pairs to diets of mulberry leaves only (MUL) or mulberry leaves plus horse pellets (MULHP). Each animal on the MUL diet received 1 kg of mulberry leaves fed twice daily, while each animal on the MULHP diet received 1 kg of mulberry leaves fed twice daily plus 50g of horse pellets fed once a day. The animals were given a week to adjust to the diets before the trial commenced.

(P<0.05) than those fed the MUL diet, the latter group having lost weight from weeks two to six due to a decline in intake which is a recognized phenomena for rabbits on all-forage diets. Live weight gains during the trial were 260 and 770g for the MUL and MULHP diets, or 3.7 and 11.0g per day.10 in favour of animals fed the MULHP diet, the latter group having lost weight from weeks two to six due to a decline in intake which is a recognized phenomena for rabbits on all-forage diets.

A further trial (Moliola and Ayalew 2007) tested mulberry leaf diets with either coconut or horse pellets in a completely randomized design with 12 weaner rabbits. Rabbits achieved average

Figure 1. Growth of rabbits fed mulberry leaves with or without supplement



daily gains over a six week period of 15.3g on the coconut diet and 13.3g on the horse pellet diet, compared to 16.4g on a diet of horse pellets alone. The authors concluded that a mix of coconut and mulberry leaf can replace horse pellets without adverse effects on rabbit growth.

Finally, Ignatius (2003) compared the growth over four weeks of six weaner rabbits fed a sole diet of commercial rabbit pellets with a comparable six rabbits fed pellets plus 1 kg each per day of fresh kangkong leaves. Growth rates were high in this trial at 31.6 and 31.1g respectively due to the short feeding period during the stage of maximum growth. Total intake of pellets over the period was reduced from 105g per rabbit-day to 95g by the use of the leaves, a saving of close to 10 percent.

CONCLUSIONS

While the growth rates on pellet diets were lower in the NARI studies compared to the University studies, the University used broiler chicken feeds with high energy content and consequently greater cost. Rabbit growth on sweet potato plus leaf is similar in the two sets of data. Rabbit feeding studies are notoriously difficult due to high variation in intakes between rabbits and therefore high variation in growth rates. Rabbits are also very sensitive to environmental conditions. However, the conclusions are that diets of sweet potato or coconut fed together with a palatable green leaf material, including mulberry and kangkong, give satisfactory growth in weaner rabbits up to live weights of around two kilograms but reaching this weight will take an additional three weeks. These results and other field experience enabled NARI to make a technology release endorsing these conclusions. More work needs to be done to determine the value of cassava tuber. The results did not demonstrate any advantages in supplementing these diets with additional measured quantities of pellets.

ACKNOWLEDGEMENTS

Dr Ian Grant and David Askin initiated and facilitated the original rabbit importation. Martin Lobao carried out the first three NARI experiments reported here. Dr Alan Quartermain initiated the NARI work and wrote the 2003-2004 Biennial Report entry upon which much of this paper is based. Dr Pikah Kohun and Mr. Andrew Thomas provided support and technical assistance. Bob Mayer of the Queensland Department of Primary Industries and Fisheries provided biometrical support.

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