BIBLIOGRAPHY

LAOANA, MELVAL. APRIL 2013. Growth Performance Of Rabbits Fed With Chayote *(Sechium Edule Jacq. Swartz)* Fruits And Leaves As Basal Diet. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

This study was conducted at Benguet State University Experiment Station, to determine the performance of rabbit in terms of gain in weight and feed with efficiency and to estimate the cost of production using chayote fruits and leaves as rabbit feed.

A total of 12 rabbits was distributed into three treatments following completely randomized design. The treatments used were: T_1 = chayote fruits, T_2 = chayote leaves including petioles and tendrils, T_3 = chayote fruits and leaves.

Chayote leaves as a basal diet of rabbits resulted in faster growth rates than chayote fruits and mixture of chayote fruits and leaves. Higher net return and ROI were realized from the rabbits given chayote leaves as basal diet, followed by rabbits given chayote fruits and those given chayote fruits and leaves gave the lowest net return and ROI.

It is recommended that chayote leaves may be given to the rabbits basing on the gain in weight, feed conversion ratio and ROI.

INTRODUCTION

Contrary to popular opinion, the domestic rabbit (*Oryctolagus cuniculus*) is a substantial part of the world's meat supply. However, rabbits are now intensively raised for food only in temperate, mostly industrialized, nations in Europe and the United States. In most developing countries, on the other hand, rabbits are not well known - at least compared with other livestock. But rabbits have great promise in the tropics, and in recent years, there has been a dramatic increase in interest. For those developing countries where information is available, rabbit meat production almost doubled for instance, in several African countries. A number of Asian countries - such as the Philippines, Indonesia, India, and Vietnam - are also encouraging rabbit farming (BOSTID, 1991).

In developing countries, where commercial feeds are either not available or cost-prohibitive, Linga and Lukefahr (2000) advocated raising rabbits on a basic forage diet with an energy supplement. Forages are readily available and cheap in the tropics, and rabbits, being pseudo-ruminants, have the ability to utilize forages for growth. Though optimum rabbit production has not been sustained on forages alone using most tropical forages, it is possible to reduce the cost of concentrates in the rations by utilizing forages that are nutritious and palatable, In industrial countries, diets for rabbits are usually made from cereal grains and alfalfa prepared as pellets (Lebas *et al*., 1997). However, in developing countries such feeds are expensive and there is a need to develop alternatives which make greater use of local resources.

The rabbit has a unique digestive tract that utilizes herbage. Taking advantage of this attribute, many rabbit raisers are trying different kinds of plants as a substitute for commercial feeds to reduce feed cost. For instance, the chayote plant is abundant in the

locality. There are many chayote fruits rejected when packing up the products to be sold in the market. These “rejects” are only discarded as wastes if not consumed. The utilization of these wastes as a source of feed for livestock might be one way to reduce and solve such problems. Along with the leaves, chayote fruits unfit for human consumption can be put to better utilization as livestock feed.

The demand for human food for animal products (meat, egg, and milk) is increasing year by year and it is predicted by Leng (2002) that there will be a world shortage of cereal grain due to the competing needs of expanding human and livestock populations. Therefore, there is a need for research to develop systems of animal production based on locally available resources.

The study was conducted to determine the response of rabbits, in terms of efficiency and economy of gain, to chayote fruits and leaves as basal diet. In addition, the research attempted to estimate the cost of production using chayote fruits and leaves as rabbit feed.

This experiment was carried out at the Benguet State University Experiment Station in Balili, La Trinidad , Benguet from December 2011 to February 2012.

REVIEW OF LITERATURE

The rabbit, a non-ruminant herbivore, has a digestible tract adapted to a high in dietary fiber. Thus, this animal is suited to consume tropical feedstuffs. There are some recent reports concerning the use of tropical foliage as a supplementary or alternative source of nutrients for rabbits. However, no report on the utilization of chayote plant as rabbit feed was available to the researcher.

Use of Various Tropical Foliages

Akinfala *et al.* (2003) investigated the response to inclusion of whole cassava plant meal as replacement for maize in the diet of growing rabbits. Growth rates and feed intakes were higher on the diets with whole cassava plant meal replacing the maize, but there were no differences in feed conversion. Apparent digestibility coefficients for all proximate analysis constituents were higher on the cassava diets. The researchers concluded that whole cassava plant meal can be used to replace maize in the diet of weaner rabbits without any adverse effect on the performance and apparent nutrient digestibility.

The apparent digestibility and intake of some tree leaves by rabbits was investigated by Cawad (2004) while the growth performance of rabbit fed with different tree leaves was studied by Longbuan (2009).

Sarwatt *et al.* (2003) evaluated the potential of *Trichanthera gigantea* as a substitute for the conventional protein sources in the diets of growing rabbits. Inclusion of *Trichanthera gigantea* in the diets significantly ($P<0.05$) increased daily average DM intake from 51.4 to 73.6 g, protein intake from 11.2 to 16.7 g, growth rate from 12.8 to 18.2 g/d and hot carcass weight from 1203 to 1301 g, relative to the control. The average feed conversion ratio was not significantly ($P>0.05$) influenced by the diets. It was

concluded that levels up to 27% of *Trichanthera gigantea* could be included in the diet of growing rabbits to promote feed intake and growth performance without influencing the feed conversion efficiency.

In Vietnam, Hongthong Phimmasan *et al.* (2004) found that water spinach as the only source of feed for growing rabbits appears to support acceptable growth rates of close to 20 g/day with a DM feed conversion of 2.7. This simple feeding system may be attractive for small-holder farmers in the tropics, due to the possibility to raise rabbits with a local resource (water spinach) that is easy to grow and needs no processing.

A similar study in Cambodia was reported by Samkol *et al*. (2006) using water spinach taken from the first and second harvests of plants after 30 days of first growth (or regrowth). Increasing the offer level of water spinach from 8 to 18% of live weight (DM basis) increased the proportion of leaf consumed, the intake of crude protein and the digestibility of the DM and the crude protein. Digestibility of crude fiber decreased with increase in the proportion of leaves consumed. Live weight gain was depressed with increasing offer level apparently because of a decrease in the crude fiber content of the diet, as with increasing offer level the rabbits selected "low-fiber" leaves rather than "high-fiber" stems. It is concluded that fresh water spinach as the sole feed of rabbits can support acceptable growth rates of 14 to 20g/day with DM feed conversion between 3.83 and 5.18. The crude fiber level in water spinach appears to be too low to support maximum performance and better results may be achieved by providing supplementary feed sources that are high in fiber.

The study of Nguyen Van and Nguyen Thi (2008) aimed to evaluate the effects of fresh Sweet Potato Vine (Ipomoea batatas) and Water Spinach (Ipomoea aquatica)

associated with Mom grass (Hymenachne acutigluma) and Cuc (Wedelia spp) in the diets on feed and nutrient utilization, growth performance and economic return of crossbred rabbits. The conclusion of their study was that Water Spinach, Sweet Potato Vine, Mom grass and Cuc could be used for feeding the growing rabbits for an utilization of local available feeds. Water spinach and sweet potato vine associated Mom grass or Cuc at ratio of 1:1 would be economically used and increase economic return.

Use of Vegetable Wastes

Raksina Timkhlai *et al.* (2009) utilized vegetable wastes as feed for growing rabbits. The results showed that the rabbits fed with head lettuce residue had significantly higher final weight and average daily gain (ADG) than the rabbits fed Napier grass (2,493 ± 4.19 and 2,086 ± 150g and 17.1 ± 0.51 and 13.1 ± 1.37g, respectively) ($P<0.01$). The rabbits fed with head lettuce residue had significant lower FCR than the Cabbage residue group (3.25 ± 0.36 and 4.14 ± 0.77, respectively) ($P<0.05$). In conclusion the cabbage and head lettuce residue can be used as roughages to improve the growth performance.

Aspilan (2006) found that 20% of chayote leaves in the ration of broilers is not detrimental to the growth of the animals.

MATERIALS AND METHOD

Materials

This study made use of the following materials: 12 heads of healthy weanling rabbits (New Zealand X Chinchilla), weighing scale, drinking containers, and chayote fruits and leaves. The experimental rabbits were kept individually in elevated cages made of wire mesh.

The chayote fruits were gathered from Poblacion, Kibungan, Benguet while the chayote leaves with petioles and tendrils were sourced out from Atok, Benguet. Chayote fruits and leaves were washed and air-dried. The fruits were chopped into small pieces.

Experimental Design and Treatments

Each rabbit was assigned at random into three dietary treatments using completely randomized design (CRD). Each treatment was replicated four times. The dietary treatments were as follows:

T_1 = chayote fruits

T_2 = chayote leaves including petiole and tendrils

T_3 = chayote fruits and leaves

Feeding and Care Management

The pens/cages were cleaned and disinfected one week before the study was started. The dietary treatments were first offered to the animals after which pellets were provided as supplement. The rabbits were fed two times a day: 6:00AM and 5:00PM. Clean, fresh water was provided at all times. The rabbits were fed for seven days for an adjustment on their diet before the experiment was started. The feeding trial lasted for 42 days. The

cleaning of cages was done every day before feeding. The experimental area was cleaned every day.

Data Gathered

1. Initial weight (kg). This was obtained by weighing the animal at the start of the study.

2. Final weight (kg). This was obtained by weighing the animal at the end of the study.

3. Feed offered (kg). This refers to the diet that was consumed by the animal.

4. Feed left-over (kg). This refers to the amount of diet that was not consumed by the animal.

5. Morbidity. This refers to the animals that got sick during the study.

6. Mortality. This refers to the animal that died during the feeding trial.

7. Cost of chayote fruits, leaves, petioles and tendrils.

From the data gathered, the following were computed:

1. Total gain in weight (kg). This was computed by getting the difference between final weight and initial weight.

2. Total feed consumption (kg). This was computed by getting the sum of the amount of feed consumed by the animals from the start to the end of the study.

3. Daily feed intake (kg). This was done by using the formula

$$\text{Daily Feed Intake} = \frac{\text{Feed Intake}}{\text{No. of Days on Test}}$$

4. Dry matter intake (kg). This was determined using the formula

Feed consumed x % DM

5. Feed conversion ratio. This will be computed by using the formula

$$\text{Feed conversion ratio} = \frac{\text{Total feed intake}}{\text{Total gain in weight}}$$

6. Morbidity rate. This was taken by dividing the number of sick rabbit by the initial number per replicate then multiplied by 100.

7. Mortality rate. This was taken by getting the quotient of the number of the animals that died by the total number of replicate then multiplied by 100.

8. Total cost of production. This was taken by computing all the expenses that will be used during the duration of the experiment.

9. Net income. This was obtained by subtracting the total expenses from the gross income/sales.

10. Return on investment. This was calculated using the formula:

$$\text{ROI} = \frac{\text{Net Profit}}{\text{Total cost of Production}} \times 100\%$$

Data Analysis

All the data were subjected to two-way analysis of variance for a completely randomized design (CRD). Treatment means that differed significantly were compared using the Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Initial Weight and Final Weight

Table 1 shows the mean initial weight per rabbit in the three treatments. Statistical analysis revealed that there were no significant differences among the weight of the rabbits. This indicates that the rabbit have almost the same weight and sizes at the start of the study. The overall mean initial weight of the rabbit was 0.900 kg.

In terms of final weight, statistical analysis revealed that treatment means differ significantly (P>0.05). While the experimental rabbits started with the same initial weight, the animals finished the feeding trial at different weights. Rabbits fed with chayote leaves obtained the highest final weight of 1.751 kg, followed by rabbits receiving chayote fruits and leaves with mean final weight of 1.498 kg, rabbits fed with chayote fruits had the lowest final weight of 1.478 kg. The overall mean final weight of the rabbit was 1.576 kg.

Table 1. Mean initial weight (42 days) and final weight (81 days) of the rabbits

TREATMENT	INITIAL (kg)	FINAL (kg)
Chayote fruits	0.93[a]	1.478[b]
Chayote fruits and leaves	0.78[a]	1.498[b]
Chayote leaves	0.99[a]	1.751[a]

[a,b] Means with the same superscript are not significantly different (P>0.05) by DMRT.

Total Gain in Weight

Table 2 shows the mean total gain in weight of rabbits subjected to the three treatments. Statistical analysis revealed that differences among treatment means were highly significant.

Rabbits given chayote fruits had a total gain in weight of 0.536 kg only. Those given with chayote fruits and leaves had 0.716 kg. Lastly, the experimental rabbits that received chayote leaves had gained 0.760 kg.

Rabbits fed with chayote leaves and chayote fruits and leaves had a better growth performance in terms of gain in weight as compared to the rabbits fed with chayote fruits.

Total Feed Consumption

Table 3 shows the total fed consumption of the experimental rabbits both as fed and on dry matter (DM) basis. Chayote fruit was determined to contain 4.92% DM while chayote fruits and leaves had a DM of 7.67%. The DM content of chayote leaves was 11.90%. Results of statistical analysis revealed a highly significant difference observed in feed intake of experimental rabbits.

Table 2. Total gain in weight of experimental rabbits

TREATMENT	MEAN (kg)
Chayote fruits	0.536[c]
Chayote fruits and leaves	0.716[b]
Chayote leaves	0.760[a]

[a,b] Means with the same superscript are not significantly different (P>0.05) by DMRT.

Rabbits fed with chayote leaves had the highest total consumption of fresh and DM (8.116 kg and 1.242 kg, respectively). The rabbits given chayote fruits and leaves had higher consumption at 7.937 kg than those fed with fruits (7.927 kg). Rabbits fed with chayote fruits consumed the least amount of feed may be because of the high water content of the fruits. As stated by Aspilan (2006), 20% of chayote leaves in the ration of rabbits is not detrimental to the growth of the animal but according to this is study we can give more than 20% in the ration of rabbits.

Table 3. Mean total feed consumption of the rabbits given different chayote parts

TREATMENT	FRESH BASIS (kg)	DM BASIS (kg)
Chayote fruits	7.927[c]	0.638[c]
Chayote fruits and leaves	7.937[b]	0.883[b]
Chayote leaves	8.116[a]	1.242[a]

[a,b] Means with the same superscript are not significantly different (P>0.05) by DMRT.

Feed Conversion Ratio

Table 4 shows the feed conversion ratio (FCR) of the rabbits fed with the different parts of chayote. Statistical analysis showed that there were highly significant differences between treatment means both as fed and DM basis. The FCR of the rabbits based on fresh diet was 18.71 derived for the rabbits fed with chayote fruits, 14.02 for those fed with chayote fruits and leaves, and 13.44 derived from the rabbits fed with chayote leaves. The rabbits given chayote leaves consumed the least amount of the diet to gain the highest weight. The result implies that chayote part has significant effect on feed efficiency of rabbits.

Table 4. Feed conversion ratio

TREATMENT	FRESH BASIS	DM BASIS
Chayote fruits	18.71[a]	4.41[a]
Chayote fruits and leaves	14.02[b]	3.61[b]
Chayote leaves	13.44[c]	3.87[b]

[a,b] Means with the same superscript are not significantly different (P>0.05) by DMRT.

Cost and Return Analysis

Table 5 presents the return on investment (ROI) obtained from feeding the rabbits with different parts of chayote. While this parameter was not subjected to statistical analysis, it is revealed in the table that the ROI from rabbits given chayote leaves was the highest at 16.26%. The feeding of chayote fruits resulted in a 6.275% ROI while chayote fruits and leaves consequently produced the lowest ROI at 3.74%.

In the computation of total production cost, chayote leaves incurred the highest cost (PhP1,626.32) among the chayote parts used as rabbit feed. However, the significantly heavier final weights of rabbits given chayote leaves generated the highest net return (PhP264.49).

Table 5. Return on investment

TREATMENT	GROSS SALE (PhP)	TPC (PhP)	NET RETURN (PhP)	ROI (%)
Chayote fruits	1,596.24	1,495.708	100.532	6.275
Chayote fruits and leaves	1,617.57	1,559.238	58.332	3.74
Chayote leaves	1,890.81	1,626.32	264.49	16.26

Morbidity and Mortality Rate

There was no rabbit that got sick nor died from the beginning until the end of the experiment. This indicates that the dietary treatments had no adverse effect on the health of experimental rabbits. The finding also confirms the report of Aspilan (2006) that the inclusion of 20% of chayote leaves in the ration is not detrimental to the growth of the animals.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

The feeding trial using chayote fruits and leaves as basal diet for rabbits was conducted at the Benguet State University Experiment Station in Balili, La Trinidad, Benguet on December 2012 to January 2013. The study was conducted to determine the response of rabbits, in terms of efficiency and economy of gain, to chayote fruits and leaves as basal diet. In addition, the research attempted to estimate the cost of production using chayote fruits and leaves as rabbit feed.

A total of 12 crossbred (New Zealand X Chinchilla) rabbits was used in the experiment. There were three treatments replicated four times in a completely randomized design as follows: T_1 = chayote fruits, T_2 = chayote fruits and leaves, and T_3 = chayote leaves.

The result of the study revealed that rabbits fed with chayote leaves obtained the highest final weight, total gain in weight, and feed conversion ratio. Moreover, the significantly heavier final weights of rabbits given chayote leaves generated the highest net return and ROI. The dietary treatments had no adverse effect on the health of experimental rabbits.

Conclusion

Based on the results of the study, it is therefore concluded that giving chayote leaves to the rabbits resulted in significantly higher gain in weight, feed efficiency and return on investment than chayote fruits.

Recommendations

It is recommended to feed rabbits with chayote leaves, especially during times of feed shortage. Chayote fruits can also be utilized as rabbit feed when these are abundant and the retail price is low.

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