Reception: **June 8, 2017** | Acceptance: **October 2, 2018**

USE OF MARALFALFA (*PENNISETUM PURPUREUM*) FLOUR IN THE FOOD OF NEW ZELAND RABBITS (*ORYCTOLAGUS CUNICULUS*) SINCE WEANING UNTIL THE BEGINNING OF THE REPRODUCTIVE LIFE

—

Hermenegildo Díaz Berrones

Pablo Rigoberto Andino Nájera

Richar Neboth Muyulema Erazo Abisa
rimuer1@gmail.com

Julio Enrique Usca Méndez

Andrés Eduardo Tapia Barba

Escuela Superior Politécnica de Chimborazo
Faculty of Animal Sciences, Riobamba, Ecuador

To quote this article:

Díaz, H., *et al*. (2019). Utilización de la harina de maralfalfa (*Pennisetum purpureum*) en la alimentación de conejos neozelandés (*Oryctolagus cuniculus*) desde el destete hasta el inicio de la vida reproductiva. *Espacio I+D, Innovación más Desarrollo. Vol. VIII* (19). Recuperado de: http://dx.doi.org/10.31644/IMASD.19.2019.a01

— Abstract—

The effect of different levels of maralfalfa flour (Pennisetum purpureum) (5, 10, 15 and 20%), in the diet of New Zealand rabbits (Oryctolagus cuniculus) from weaning to the beginning of the reproductive life, was evaluated. 4 treatments with 5 repetitions to be compared with a control treatment. A completely randomized design was applied in combinatorial arrangement of two factors, where the factor A, were the levels of maralfalfa flour and the B factor the gender of the animal. The results of the present investigation show that the use of maralfalfa flour supplied to rabbits improves the productive parameters, which is reflected in a reduction of costs and an increase in profitability, observing that when applying 20% of maralfalfa flour, better final weight (4.51kg), higher weight gain (3.63kg) with a total feed intake of 3.63 kg / MS (Dry matter) were recorded; feed conversion (4.20); carcass weight (2.61kg) and carcass yield (58.53%).

Keywords

Maralfalfa flour, feeding, New Zealand rabbits .

Rabbits, just like other animals, need a balanced diet between energy, protein, fiber, minerals and vitamins to carry out their vital functions, growth, reproduction and production. There are factors that influence the nutritional requirements of this species such as the category, reproductive status and the external environment in which they are housed. That is why the balance of nutrients should be optimal to meet daily requirements and obtain favorable responses in terms of productivity. (1. ACPA, 2005 and Templeton, 2008). A rabbit must eat 15% of its live weight daily, but if it has more appetite and eats more, it is not a problem (Grajales, 2002) .The base diet of rabbits consists of hay (straw) daily and food in pellets with high nutritional level for them and that does not cause a problem to health over the years, in addition to having water always available (Augustín, 2004). The peculiar digestive system of the rabbit has allowed feeding it with vegetable and industrial by-products of all kinds, being the maralfalfa flour (Pennisetum purpureum) one of them for its easy digestion. The marafalfa flour contains 70% fiber, between 9 and 12% of proteins, 1.5% of fats, up to 15% of water at the time of packaging, as well as different minerals such as potassium and phosphoric acid (Muscari, 2003). In addition, maralfalfa flour is an excellent protein supplement in cereal-based rations since in addition to its high protein content it contributes an important percentage of lysine that complements the lack of cereals normally used in animal feed (Cajamarca, 2006). In the present investigation, the benefits of maralfalfa flour in the feeding of rabbits were demonstrated to fill the nutritional requirements necessary in each one of the phases of its development and in this way stimulate the production of this species that is very prolific and of great importance for the quality of their meat or also to take advantage of their skin or feces as fertilizer to care for the environment.

EQUIPMENT AND METHODS

Location and duration of the experiment

This research was developed in the facilities of the minor species program, rabbit section of the Faculty of Animal Sciences of the Escuela Superior Politécnica de Chimborazo, located at kilómetro 1 ½ de la panamericana sur in the city of Riobamba, country of Ecuador, during 120 days of work.

Experimental units

For the development of the present investigation, 50 New Zealand rabbits (*Oryctolagus cuniculus*) of 45 days of age and with an average weight of 0.87 kg were used, of which 25 were males and 25 females. They were housed

in cages of 0.5 x 0.5 x 0.4 m, in a number of 1 animal per cage, in each cage was placed a feeder and drinking trough.

Treatments and experimental design

In the present investigation we worked with 4 treatments based on different levels of maralfalfa flour, (5, 10, 15 and 20%), to be compared with a control treatment. A completely random design was applied in combinatorial arrangement of two factors, where the factor A are the levels of maralfalfa flour and the factor B the animal's gender.

Experimental procedure

The food was distributed according to the established formulations of the different levels of maralfalfa flour corresponding to 5% for the T1 treatment, 10% for the T2 treatment, 15% for the T3 treatment and 20% for the T4 treatment and water to will. The weight control of the animals was carried out every 15 days, until the final weight at 120 days.

At the end of the experiment (120 days of experimentation), the animals were weighed for the last time and taken to the slaughter room where the carcass performance data were recorded.

The formula that was applied in the feeding and the analysis were calculated from the ration for the weaning phase until the start of the reproductive life of the rabbits. The cleaning and disinfection of the cages and equipment with Vanodine and Creso was carried out in a proportion of 20 ml/10 liters of water, which was carried out three times during the experimentation.

The animals were internally and externally dewormed at 14 and 81 days with a powder dewormer (Neguvón® Powder) plus healings with Eterol.

RESULTS AND DISCUSSION

Productive behavior of New Zealand rabbits based on different levels of maralfalfa flour

The initial average weight of the New Zealand rabbits at the beginning of the work was 0.85 kg for the control group; 0.86 kg for the treatment T1 (0.5%), 0.88 kg for the treatment T2 (10%), T3 (15%) and 0.89 kg in the rabbits of the treatment T4 (20%) (Table 1).

The final weight assessment of New Zealand rabbits determined highly significant differences (P <0.001) due to the inclusion of different levels of maralfalfa meal. The highest responses are appreciated in the treatment T4 (20%), with 4.51 kg and that drops to 4.01 kg in the rabbits of the treatment T3 (15%), later the answers reached in the batch of rabbits of the To and T1 treatments are registered with 4.04 and 4.03 kg respectively (Table 1). That is, the highest final weight responses are recorded with the inclusion of higher levels of maralfalfa i.e. (20%). In this regard Muscari (2003), states that maralfalfa flour contains 70% fiber, between 9 and 12% protein, 1.5% fat, up to 15% water at the time of packaging and different minerals such as potassium and acid phosphoric. The greater the amount of protein, the flour will have a greater capacity to absorb water; the term "protein" is vague, since it refers only to the known group of amino acids totaling 23 nutrients.

Table 1. New Zealand rabbits productive behavior based on different levels of maralfalfa

Variables	Maralfalfa levels, %					Gender effect	
	T0 0	T1 5	T2 10	T3 15	T4 20	Males	Females
Initial weight, kg.	0,85 b	0,86 b	0,88 c	0,88 c	0,89 a	0,87 a	0,88 a
Final weight, kg.	4,04 b	4,03 b	4,36 c	4,01 b	4,51 a	4,21 a	4,17 b
Weight gain, kg.	3,19 b	3,17 b	3,47 c	3,13 b	3,63 a	3,35 a	3,29 b
Forage intake, kg/MS.	7,10 a	7,10 a	7,11 a	7,08 a	7,00 a	13,11 a	13,10 a
Balanced consumption, kg/MS.	7,10 a	7,10 a	7,11 a	7,08 a	7,00 a	7,10 a	7,06 a
Meal consumption, kg/MS.	20,16 a	20,20 a	20,32 a	20,12 a	20,11 a	20,20 a	20,16 a
Food conversion,	5,27 a	6,37 a	4,52 c	6,36 a	4,20 b	5,42 a	5,26 a
Carcass weight, kg.	2,23 c	2,35 c	2,53 ab	2,37 c	2,61 a	2,38 b	2,45 a
Carcass yield, %	55,26 c	58,14 c	58,13 b	58,44 c	58,53 a	56,52 a	58,88 a
Cost per kilogram of weight gain, $	0,75 c	0,75 c	0,81 c	0,75 b	0,84 a	0,79 b	0,78 a

Veloz (2010) also reported values at the beginning of the reproductive life of 2,778.80 and 2,937.90 kg that correspond to the animals that received the balance with 16 and 8% of algae flour, and that are lower than the records of the present investigation. As Villacis (1999), reported that California rabbits had final weights of 2,785 kg when they received balanced feed plus the incorporation of growth stimulants. Benavides (2001) reported final weights that fluctuated between 2,939 kg and 2,975 kg when fed with balanced meal that contained 15 and 5% of quail feces.

The statistical analysis of the New Zealand rabbits' final weight, reported highly significant differences (P <0.001) by effect of the animal's gender. The final weight of the male rabbits was 4.21 kg while the weight of the females was 4.17 kg, (Table 1), that is male animals have a greater capacity to absorb nutrients from the diet, which is reflected in their greater weight at the beginning of the reproductive life. The exposed results are superior to those estimated by Veloz (2010), who according to the animal's gender recorded that the females presented a better body development than males since the average weights of the males was 2,786.75 kg while for the females it was 2,921.40 kg.

Regarding weight gain, the average values of the rabbits' weight gain reported highly significant differences (P <0.001), due to the effect of the inclusion of different levels of maralfalfa flour in the diet, establishing therefore the higher responses in the batch of rabbits of the T4 treatment (20%), with 3.63 kg, followed by the reports established in the rabbits of the T2 treatment (10%), with records of 3.47 kg. In addition, the weight gain achieved in the rabbits of the T1 treatment and the control group was 3.17 and 3.19 kg respectively, while the lowest responses were reported in the rabbits of the T3 treatment (15%), with 3.13 kg. These results show that the highest weight gain is achieved with higher levels of maralfalfa flour added to the balanced feed of rabbits from weaning to the start of the reproductive phase (Table 1).

In this aspect Hurtado and Romero (1999) state that, within the species of underutilized animals, the rabbit is having increasing importance, since it is an efficient producer of protein and has characteristics that make it suitable for small and medium-sized production scale. The production of rabbits should be considered as an alternative that allows to satisfy the current and future feeding needs of the poorest sectors of the population, both rural and urban, mainly in home production systems, where rabbits can provide reasonable amounts of meat.

Rabbit breeding represents an alternative to produce animal protein of excellent quality and at low cost, based on the high reproductive efficiency of the rabbit. Because an adult rabbit is capable of producing 25.2 young weanling rabbits per year, which when taken to slaughter is translated into 48.6 kg of live weight (pv) per rabbit per year. However, to maintain these indexes in underdeveloped countries, research should be strengthened in relation to the feeding of this species in these conditions (Hurtado, 1999).

The results of the present investigation are superior to the records of Veloz (2010), who when evaluating different levels of seaweed flour recorded weight

gains on average of 1,669.60 g and 1,712.30 g, when they received 8% and 16% of seaweed flour. In another investigation, Barrios (2010) reports that when carrying out the study with feeding rabbits, plus the addition of marine microalgae, determined an average gain of body weight that is within the physiological range of the species with respect to their age.

Forage intake, kg

The forage consumption of the rabbits was not statistically affected by the supply of maralfalfa flour (P> 0.05), establishing consumptions between 13.06 kg, which correspond to the control group rabbits, up to 13.21 kg, in the Treatment T2 rabbits' batch (10%), which are the lowest and highest consumption of the investigation. Likewise it is seen in treatments T1, T3 and T4 responses of 13.10 kg, 13.03 kg and 13.12 kg. That is, numerically the highest forage consumption is seen in rabbits to which 10% of maralfalfa flour was added in the balanced feed; corroborated by Irlbeck (2001), whom indicates that the rabbit is a strict herbivore, has a digestion system with different characteristics that differentiate it from the species commonly produced in our latitudes. This animal is classified as a posterior bowel fermenter, which due to its small size and high metabolic rate, requires high quality forages. In another investigation, Brown (2000) reported that the organism of these animals makes it difficult for them to store large amounts of fiber proportionally to their weight, as is the case with the cow and the horse; in addition, Dihigo (2005) mentions that its physiological characteristics allow it to include different varieties of foliage of trees and shrubs that have been used successfully in other species of animals.

The evaluation of forage consumption of the New Zealand rabbit did not report statistical differences due to the gender of the animal, however, the highest results in male rabbits were 13.11 kg compared to females that reported 13.10 kg of forage consumption, say, male rabbits have a greater capacity to consume and transform forage in kilograms of meat (Table 1). The values reported in the present investigation are lower than those recorded by Veloz (2010) (8), who when evaluating different levels of seaweed flour reported forage consumption in the 100 days of evaluation, between 9.60 and 9.82 kg of forage in dry matter.

The reported mean values of forage consumption of the New Zealand rabbit recorded statistical differences due to the interaction between the different levels of maralfalfa flour and the gender of the animal, establishing the highest results in the lot of female rabbits of the T2 treatment (10 % H),

with averages of 13.42 kg, meanwhile the lowest results were reported in the female rabbits of the T3 treatment (15% H), with averages of 12.70 kg.

Balanced consumption, kg

The average balance consumption of the New Zealand rabbit in the physiological stage of weaning until the beginning of the reproductive life did not report significant statistical differences between treatments. However, some superiority was observed in the responses recorded by the rabbits of the T2 treatment (10%), since they reported results of 7.11 kg. Subsequently the consumption of balance reported in the control group and treatment T1 (5%), which shared the consumption value of 7.10 kg, for the two cases under study, then the results achieved in the treatment T3 (15 %), since the averages were 7.08 kg. In addition, the lowest responses were recorded in the animals of the T4 treatment (20%), with responses of 7 kg, as illustrated in graphic 1. That is to say that numerically the highest consumption of the highest balance is achieved by including in the diet 10% of maralfalfa flour.

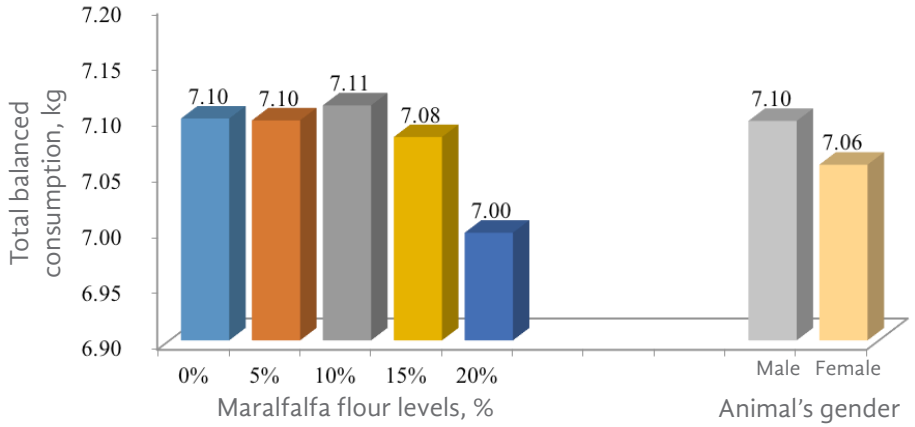
The answers of the present investigation in what has to do with the consumption of balanced are similar to the reports of Zambrano and Castillo (1992), who when evaluating the cotton flour in the balanced feed of fattening rabbits, reported the highest consumption with the application of 5%, since the answers were 10.09 kg of dry matter. Macias (2009), when using carob flour in partial replacement of corn in rabbit feed, recorded the highest consumption by adding 14% carob flour with averages of 5,591 kg, which is a low average in relation to the results reported in this investigation.

The analysis of the average balanced consumption reported by the New Zealand rabbits fed with different levels of maralfalfa flour did not report statistical differences due to the gender of the animal, however numerically the highest reports are observed in the male rabbits since the average were 7.10 kg, compared to the responses recorded in the females that indicated an average consumption of 7.06 kg, therefore it can be seen according to the results that the highest consumption is established in male animals (Table 1). The answers established in the research are superior to those reported by Veloz (2010) (8), who when evaluating different levels of seaweed flour established that due to gender, the differences found were also minimal, as the males consumed 6.50 kg of balance in dry matter and females 6.55 kg.

When evaluating the consumption of balanced, no statistical differences were reported between means, by effect of the interaction between the levels of maralfalfa flour and the gender of the animal, however of numerical

character the highest responses in the batch of female rabbits are appreciated in treatment T2 (10% H), since the means were 7.12 kg and that it drops to 7.11 kg in the male rabbits of the T1 treatment (5% M), with 7.11 kg, meanwhile that the lowest results were reported in the group of female rabbits of treatment T4 (20% H), with averages of 6.91 kg.

Graph 1. Balanced consumption of rabbits fed with different levels of maralfalfa (5, 10, 15 and 20%)



Total consumption of food, kg

The average total food consumption of New Zealand rabbits from weaning to the start of reproductive life did not report significant differences (P> 0.05) due to the effect of maralfalfa flour levels added to the diet, although these numerically varied by consumption of food (Table 1), reaching 20.32 kg, in the batch of rabbits of treatment T2 (10%), followed by the results achieved in the batch of rabbits of treatment T1 (5%), with 20.20 kg, as well as descending to 20.16 kg and 20.12 kg, registered in the rabbits of the control group and treatment T3 (15%). Meanwhile, the lowest responses were reported in the rabbits of the T4 treatment (20%), with means of 20.11 kg. That is, for rabbits to have a higher consumption of balanced, it is required that 10% of maralfalfa flour be added to the diet, since it was demonstrated that there was a greater preference on behalf of the animal. The answers mentioned above are superior to those reported by Veloz (2010), who when evaluating different levels of seaweed flour registered consumptions that were between 6.44 and 6.68 kg of dry matter, which correspond to the animals that received the food with 24 and 8 % of seaweed flour.

Brenes and Pontes (2007) mentioned that the rabbit needs a balanced ration that provides the nutrients necessary for the maintenance of its body, growth and reproduction. These nutrients are carbohydrates, fats, protein, vitamins, minerals and water. Foods rich in proteins include barley, oats, and flours, especially maralfalfa, among others, these foods also contain fats.

The mean values recorded for the consumption of balanced feed of the New Zealand rabbits, when performing the analysis of variance did not report statistical differences due to the gender of the animal, however the male rabbits consumed more in relation to the female rabbits, so the males presented a greater affinity to consume the balanced meal, it can be basically to present nutrients that favored the palatability of the same.

The average balance consumption during the research period of the New Zealand rabbits, did not report statistical differences between means, due to the interaction between the different levels of maralfalfa added to the daily formula and the gender of the animal, however, numerical character is appreciated the highest consumption in the batch of females of the T1 treatment (10% F), since the results were 20.53 kg, meanwhile the lowest responses were established in the batch of male and female rabbits of the control and treatment group T3 (0% M and 15% F), with averages of 19.97 kg and 19.78 kg.

Food conversion

The means of the food conversion reported highly significant differences ($P < 0.01$) due to the addition of different levels of maralfalfa flour incorporated in the balanced (Table 1). It was observed that when 15% of maralfalfa meal was used in the balance, a greater amount of food was required to gain 1 kg of weight; and that descends to 5.27 in the rabbits of the control group, meanwhile in the batch of rabbits of treatment T4 (20%), according to the reports, a smaller amount of food was demanded, since the conversion ratio was 4.20, which turn out to be the most efficient responses of the research, since it is demonstrated that higher levels of maralfalfa flour added to the feed rabbits present a better use of the food supplied daily.

Damero (2010), reported that the best food conversion was recorded in the control group and using 15% carob flour with 4.32 ± 0.457 and 4.72 ± 0.367 respectively; meanwhile, the lowest conversion was recorded by the diet with 10% carob flour, since the responses were 6.15 ± 1.024 and a coefficient of variation of 16.65%.

Cost per kilogram of weight gain

The reported mean values of the variable cost per kilogram of food determined highly significant differences between means (P <0.01) due to the inclusion of different levels of maralfalfa flour in the diet of New Zealand rabbits, therefore it is appreciated that the higher results were reported in the T4 treatment (20%), since the means were 0.84 to produce a kilogram of meat and that drops to 0.75 USD in the rabbits of the control group, T1 (5%) and T3 (15 %). In other words, the highest production cost of one kilogram of meat was recorded in rabbits fed with diets to which higher levels of maralfalfa were included.

According to the gender of the animal there are significant differences in what has to do with the analysis of the cost per kilogram of weight in New Zealand rabbits, verifying that the highest cost was reported in male rabbits since values of 0.79 were reported, in comparison of the weight reached by the females that was 0.78, that is to say that in the males there is a greater benefit as far as the cost per kilogram of weight gain is concerned.

The mean values reported by the variable cost per kilogram of weight gain of the rabbits showed no statistical differences (P> 0.05), due to the interaction between the different levels of maralfalfa flour and the gender of the animal (Table 2); however, the highest cost in the treatment T4M and T4F was observed when using 20% of maralfalfa flour, the responses were 0.85 USD and 0.83 USD, meanwhile the lowest results were registered by the rabbits fed with 5 and 15 % of maralfalfa flour, with 0.75 USD.

Table 2. Evaluation of the productive characteristics of New Zealand rabbits based on the different levels of maralfalfa (%), and the animal's gender

Variables	Interaction level of maralfalfa (%), by the animal's gender									
	0M T0M	0H T0H	5M T1M	5H T1H	10M T2M	10H T2H	15M T3M	15H T3H	20M T4M	20H T4H
Forage intake, kg/MS.	12,87 c	13,25 b	13,30 b	12,91 bc	13,01 b	13,42 a	13,37 b	12,70 c	12,98 bc	13,25 b
Meal consumption, kg/MS.	19,97 a	20,34 a	20,40 a	20,00 a	20,11 a	20,53 a	20,46 a	19,78 a	20,07 a	20,16 a
Food conversion	5,27 c	5,83 c	2,24 c	6,24 c	6,37 b	4,52 b	4,70 a	6,36 a	4,20 b	4,30 b
Cost per kilogram of weight gain , $.	0,76 d	0,75 d	0,75 d	0,75 d	0,82 b	0,80 c	0,75 d	0,75 d	0,85 a	0,83 ab

Carcass Weight, kg

The results of the carcass weight of the New Zealand rabbits showed highly significant differences (P <0.01) due to the inclusion of different levels of maralfalfa flour in the diet, with the greatest carcass weight being observed in the T4 treatment (20%) with 2.61 kg. Meanwhile the lowest result was reported in the rabbits of the control group with records of 2.23 kg. According to Zaldivar (2015), in the production of rabbit meat, the economic result is strongly influenced by the rate of transformation, carcass weight yield of the strains that are exploited. A low index means less amount of food to gain a kilogram of live weight. The performance implies that for a same live carcass weight reaches greater weight and therefore a higher value. These factors indicate to the grower the selective control that he must apply to his cattle to increase the profit and they guide him with respect to the commercialization as far as the convenience of selling live or in carcass, alluded previously in the supposition that the cuniculturist can choose.

In rabbits of industrial type it is essential to use a well-balanced ration to achieve a high production, which must contain the nutritional principles in each of the phases. Regarding the carcass weight of the rabbits in the weaning stage (45 days), until the beginning of the reproductive life, fed with different levels of maralfalfa flour, reported statistical differences (P <0.01) due to gender of the animal, establishing the highest responses in the batch of females with records of 2.45 kg, compared to the carcass weight of the males whose responses were 2.38 kg, that is, the females registered higher carcass weights (Table 1). These results are superior when compared to the records of Rodríguez (2012), who when evaluating the use of vegetable protein (Nupro) in the feeding of New Zealand rabbits from weaning to the beginning of reproduction, reported that male and female rabbits reached a carcass weight of 1.63 and 1.69 kg respectively.

Carcass yield, %

The best carcass yield (RC) was obtained with the rabbits that were fed with 20%, of maralfalfa flour, since the means were of 58.53%; but without statistical differences (P> 0.05) between treatments. The results in the batch of rabbits of treatment T3 are shown below, since the means were 58.44%. Subsequently, the performances reached in the treatment T1 and T2, with results of 58.14% and 58.13%, meanwhile, the lowest results were recorded by the rabbits of the control group with means of 55.26%. That is to say, the results of carcass yield numerically more efficient are established by using higher levels of maralfalfa flour added to the balanced meal. In this regard,

Roca (2015), indicates that in the rabbit, the carcass yield ranges between 50-65%, this wide variation being motivated by several factors such as the mode of expression, since there are notable variations due to the diversity of channel definitions that exist in different countries and the live weight that is considered (in the slaughterhouse or in the exploitation). At the same age, the different races and genotypes present different RC, increases with age at slaughter, within the same genotype, up to an upper limit, variable according to the races. With respect to the carcass weight, a higher CR has been found in fast-growing animals than in slow-growing animals.

The results of the carcass yield reported highly significant differences ($P < 0.01$) due to the gender of the animal. In Table 1, it is observed that in the batch of females the highest responses are recorded with averages of 58.88%, compared to the responses expressed in male rabbits which were 56.52%. The results of this research are slightly lower than those determined by Veloz (2010) (8), who when performing the evaluation of different levels of algae flour in the rabbits' feeding recorded yields to the carcass according to the gender factor of the animals of 62.16% in females and 62.27% in males.

Economic evaluation, USD

For the economic evaluation using the benefit/cost indicator, the sale of the rabbits' carcass was considered. The best benefit/cost of New Zealand rabbits was obtained by using higher levels of maralfalfa flour, i.e. 20%, (T4), since the answers are 1.38; that is to say that for each dollar invested a return of 38% is expected and that is higher than the one reported in the batch of rabbits of the treatment T2 (10%), with records of 1.33 or a gain per dollar invested of 33%.

CONCLUSIONS AND RECOMMENDATIONS

The responses reported in the present investigation show that the addition of maralfalfa flour supplied to rabbits from weaning to the beginning of the reproductive life improves the productive parameters. The above reflects a reduction in costs and an increase in profitability.

The productive parameters of the New Zealand rabbit were obtained with the application of 20% of maralfalfa, since the best final weights (4.51 kg) were recorded, with a total weight gain of 3.63 kg, a daily feed intake of 3.63 kg, dry matter, a feed conversion of 4.20; a carcass weight of 2.61 kg and a carcass yield of 58.53%.

The results displayed that male rabbits show higher final weight and feed conversion (5.42) than female rabbits.

The highest economic profitability was 1.38 for the rabbits of the T4 treatment (20%), that is to say that for every dollar invested a profit of 38% is expected, which greatly exceeds the margins reached in other activities and above all it has the advantage of providing to the market high quality meat with low fat content.

REFERENCES

acpa. (2005). Manejo y explotación del conejo. La Habana: *acpa*. p. 25 – 30

Augustín R. 2004. Determinación de la edad óptima de destete en cuyes. Investigaciones en cuyes. *VII Reunión científica anual, appa*. Lima, Perú. Edit inia-ciid. p. 5l, 89.

Barrios V. (2010). *Caracterización toxicológica de las macroalgas marinas Hypnea spp y Sargasun spp para la futura utilización en la alimentación y la salud animal como humana*. Edit Centro Nacional de Sanidad Agropecuaria censa. Departamento de Farmacología y Toxicología. La Habana p. 45-56.

Benavides W. (2001). Inclusión de diferentes niveles de coturnaza en la alimentación de conejos californianos en la etapa de crecimiento-engorde. p. 41-68.

Brenes A., Brenes P. and Pontes M. (2007). Requerimientos nutritivos del conejo.

Brown S. 2000. Rabbit GI physiology and nutrition. Midwest bird and exotic animal hospital national house rabbit and vet information. Obtenido de http://www.hrschicago.org/articleslay.html

Cajamarca D. (2006). Utilización de la harina de lombriz en la alimentación de conejos es mejorados en la etapa de crecimiento – engorde. p. 23-24

Damero C. (2010). Sustitución parcial de la soya en la alimentación de conejos por diferentes niveles de harina de algarrobo en las fases de crecimiento engorde. p. 76 -79.

Dihigo LE. (2008). Avance en los estudios de fisiología digestiva del conejo en Cuba con el uso de fuentes de alimentos no tradicionales. *Consideraciones fisiológicas*. Instituto de Ciencia Animal. San José de las Lajas, La Habana. Disponible en http://www.sian.info.ve/porcinos/publicaciones/encuentros/viii_encuentro/luise.htm

Grajales H., Guzmán J. and Castaño M. (2002). *Manual Agropecuario Biblioteca del Campo*. sn. st. Colombia. Edit. Quebecor World Bogota S.A. p. 299-301,307

Hurtado E. and Romero R. (1999). Efectos no genéticos sobre el comportamiento productivo de conejos (Oryctolagus cuniculus) durante el crecimiento post destete. *Revista Fac. Ciencias Veterinarias ucv, Maracay Venezuela* (1): 139-142.

Irlbeck, NA. (2001). How to feed the rabbit (Oryctolagus cuniculus) gastrointestinal tract. Journal Animal Science 79:343-346.

Lukefahr S. and P. Cheeke. (1991). Rabbit project development strategies insubsistence farming system. Editor S. S. Branckaert. *World Animal Review a Quarterly Journal on Animal Health, Production and Products.* fao (2): 69.

Macías E. (2009). Utilización de harina de algarrobo en sustitución parcial del maíz en la alimentación de conejos. p. 76 -79.

Muscari J. (2003). *Evaluación de gestaciones post partum y post destete en conejos*. ed. Turrialba, Peru. Edit. Limonales. p. 12-19.

Rodríguez J. (2012). Utilización de proteína vegetal (NUPRO) en la alimentación de conejos neozelandés desde el destete hasta el inicio de la reproducción. p. 55-62.

Roca T. (2015). Caracterización de la carne de conejo.

Templeton G. (2008). *Necesidades energéticas de los conejos. Cría del conejo doméstico*. Trad. José Luis de la Loma. México D.F. Continental. p. 15-19, 67, 13.

Veloz D. (2010). Utilización de diferentes niveles de harina de algas de agua dulce en sustitución de la soya en la alimentación de conejos californianos desde el destete hasta el inicio de la vida reproductiva. p. 44-59.

Villacís I. (1999). Evaluación de promotores de crecimiento y Probióticos en el crecimiento y engorde de conejos californianos y neozelandeses. p. 32-57.

Zaldivar H. (2015). Alimentación de la reposición de conejos.

Zambrano P. and Castillo G. (1992). Evaluación de la harina de algodón en el alimento balanceado de conejos de engorde.

Tajer, D. (2009 b). *Construyendo una agenda de género en las políticas públicas en salud*. En: Tajer D. Género y Salud. Las Políticas en acción. Buenos Aires: Lugar Editorial.

Unsain, A; Echegoyemberry, MN (2017). *Comunicación ambiental desde un enfoque de Derechos Humanos -en prensa- Gestión de las comunicaciones públicas*.

Viteri, C. (2000). *Visión Indígena del desarrollo en la Amazonía*. 3, 2002. Ecuador: Polis.

Wilches Chaux, G. (1989). *Desastres, Ecologismo y Formación Profesional: Herramientas para la Crisis*. Servicio Nacional de Aprendizaje, Popayán.