INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 20, No. 6, p. 91-100, 2022
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Egg production and egg quality of Japanese quails (*Coturnix coturnix japonica*) fed with commercial ration substituted with varying levels of madre de agua (*Tricanthera gigantea*) leaf meal

Niña Mae R. Villar*[1], Ricardo G. Villar[2], Maria Luz L. Soriano[1], Myrna G. Ballentes[1]

[1]*College of Agriculture, Department of Animal Science, Central Mindanao University, Musuan Town, Maramag Bukidnon, Philippines*

[2]*College of Forestry and Environmental Science, Department of Forest Resource Management, Central Mindanao University, Musuan Town, Maramag Bukidnon, Philippines*

Article published on June 20, 2022

Key words: Quail, Production, Yolk pigmentation, Egg quality, Substituted

Abstract

The study was conducted to determine the egg production and egg quality of Japanese Quails fed with commercial ration substituted with varying levels of Madre de Agua leaf meal. A total of 48 ready to lay Japanese quails were used in the study. These were weighed and separated to their respective components which are the egg shell, egg yolk, and albumin. Yolk pigmentation was graded based on the yolk color fan. Non- significant differences were observed among treatment rations with varying levels of Madre de Agua leaf meal in percent egg production, total feed consumption, feed conversion efficiency, total egg weight and average initial weight. The average egg albumin and average egg shell were slightly heavier in layer 10% Madre de Agua but these are not significantly different which implies that Madre de Agua leaf meal have better egg production, feed efficiency, weight of egg albumin, egg weight an egg shell which indicated that providing 10% Madre de Agua leaf meal in the quail's diet resulted to better performance in above parameters. Results on average egg weight however were significant ($P<0.05$) with those in treatment 3 (10% Madre de Agua leaf meal) significantly heavier compared to other treatments. Average egg yolk weight, average final weight and egg yolk pigmentation showed highly significant differences ($P<0.01$) among the treatment means. Egg yolks were highly and significantly heavier and the final weights were heaviest in quail layers fed with 10% Madre de Agua leaf meal substitution.

***Corresponding Author:** Niña Mae R. Villar ✉ f.ninamae.villar@cmu.edu.ph

Introduction

Quail rising is the country's promising industry this can be started at lower capital investment. Moreover, raising quail is a profitable venture as the birds are easy to nurture and have quick of investment. Quails can stand well with chicken as source of organic meat and eggs.

In the Philippines, the high cost of protein and energy feeds altogether accounts for the high cost of producing pork, poultry meat and eggs which consequently raising the product's price. As a result, most of protein feeds for livestock and poultry are imported. Nowadays, our country s economic crisis and industry s significant dependence on feed importation cause a major problem. Aside from an inadequate supply of basic raw materials, prices of imported feeds and feed additives are unreasonably high. The high cost of conventional protein in livestock production has forced animal nutritionist to consider alternative protein source. Hence, we must investigate further the nutritional value of some alternative protein sources. The use of plant leaves, as a probable source of protein appears to be one of the possible solutions.

Madre de Agua, (*Tricanthera gigantea*), a locally fodder tree of Acanthracea family, is a potential source of protein for quail, particularly egg production and because of its high protein content, is a considerable potential for animal feeding in tropical countries like the Philippines, where protein in the feed is most limiting. Rosales (1997) reported that chemical composition, in vitro and in sacco ferment ability indicates that Madre de Agua leaf meal is a good potential as feed for livestock. Since, there was no study conducted to determine the effect of Madre de Agua on the egg production and egg quality on quails, thus this study.

Materials and methods

Place of Study

The study was conducted at the CMU Animal Science Poultry Project. The site accommodated the set-up considering that quails only require smaller spaces.

Poultry Facilities and Equipment

Poultry cages, waterers, feeding troughs, electric bulbs, egg trays, yolk fan, sacks, weighing scale and commercial layer feeds were used in this study.

Care and Management of Experimental Animals

The cage, waterers, feeding troughs and other necessary equipment was thoroughly cleaned and disinfected before the start of the study to eliminate any infectious microorganisms which cause disease in the birds. The quails were provided the electric bulbs for a continuous source of light during the night to maintain the light requirement for laying.

The forty-eight (48) experimental birds were fed with their respective experimental rations in a restricted feeding with twenty-five (25) grams feed per bird allocated per day (PCARRD, 1986). The experimental birds were given free access to clean drinking water throughout the study.

Egg Production and Egg Quality (*Coturnix coturnix japonica*) Layers Fed Commercial Rations Substituted with Varying Levels of Madre de Agua (*Tricanthera gigantea*) Leaf Meal. Using the above – mentioned experimental rations and the specified number of quail layers, the following relevant data were collected.

Percent Egg Production

Eggs from quail's layers were collected twice a day (once in the morning and another in the afternoon). The number (pieces) of eggs produced during the experimental period (2 months) was recorded per replication in each of the treatment. Similarly, the collected eggs were also weighed and recorded to be able to generate the total egg weight produced.

Layer Quails Weight

Initial weights of the ready-to-lay quails were obtained upon their arrival at the study site. At the end of the three-months feeding period, these layers were weighed again for their final weights. The average final weight per treatment was used in computing the live weight sale of the culled layers.

Total Feed Consumption

In egg production, layers (whether chicken or quails) are constantly fed on a restricted feeding to prevent the layers from becoming fat. In general, fat layers lay egg in a lower number because they used up their nutrients for fattening than for egg production.

As recommended by PCARRD (1986), 25 grams /layer /day is the feed allowance, and this was strictly followed in this study. Layer quails however, were observed to vary in their feed consumption. Some consumed more than the others or maybe less thus, daily leftovers were also collected and subtracted from the feed allowance per day to be recorded as feed consumed.

Data Gathered

For this study, the total number (pieces) of eggs produced, its total and individual egg weight, daily feed given and leftover were recorded. From these obtained data, derivation of the following parameters was done:

Average percent egg production =

$$\frac{\text{Total number of eggs produced}}{\text{No. of birds at laying x no. of days}} \text{ x } 100$$

Total Egg weight = Total number of eggs x Average egg weight

Total feed consumption = Sum of all daily feed consumed

$$\text{Feed efficiency} = \frac{\text{Total Feed Consumption}}{\text{Total egg weight}}$$

Egg Quality of Layer Quails Fed Commercial Rations Substituted with Varying Levels of Madre de Agua *(Tricanthera gigantea*) Leaf Meal

Sampling of Eggs

For the whole two months of conduct, sampling of eggs was made in a ten days interval with five (5) eggs per replication in a treatment.

These five eggs were weighed individually and recorded before separating their respective components (egg shell, egg yolk and albumin).

Separation of Egg Components

Small aluminum foil trays prepared before the breaking of eggs shell and separation of albumin, yolk and shell followed wherein each component was placed in the individual aluminum foil trays for weighing. The weight was recorded correspondingly.

Yolk Pigmentation Grading

The yolk still in the aluminum trays were arranged accordingly and replication in a table for grading purposes using the yolk fan (PCARRD, 2000).

Increasing numerical rating scale corresponds to the different shades of yellow to orange pigmentation of the yolk in the yolk fan. The numerical ratings were recorded as data for this parameter.

Data Gathered

Individual egg weights and the weights of their corresponding components were obtained thru the triple beam weighing scale. Computations for the percentages foe each component (eggshell, albumin, yolk) were then done.

Statistical Analysis

All gathered data were subjected to the Analysis of Variance (ANOVA) of a Completely Randomized Design (CRD). Observed significant differences among treatment means were further tested using the Duncan's Multiple Range Test.

Results and discussion

Egg Production of Quail *(Coturnix coturnix japonic*a) Layers Fed Commercial Rations Substituted with Varying Levels of Madre de Agua

Egg Production

Egg production (%) is related to the number of eggs produced at a given time for a given number of hens in the house for such period. A lower egg production was observed with increasing levels of Madre de Agua leaf meal infused in the commercial layer mash. Differences in this trend, however, is not significant which imply that any level of Madre de Agua leaf meal in commercial layer mash (Treatment 1) has however

slightly higher egg production (80.97%), resulting similarly to that of pure commercial layer mash in terms of eggs produced. This is followed by Treatment 3 (90% commercial layer mash + 10% Madre de Agua leaf meal) with 76.09%, while those in Treatments 2 and 4 (95% commercial layer mash + 5% Madre de Agua leaf meal and 85% commercial layer mash + 15% Madre de Agua leaf meal) have almost similar egg production of 73.99% (Treatment2) and &3.89% (Treatment).

USNRC (1984), as cited in PCARRD (2000) stipulated that the nutrient requirements for quails are as follows: starting and growing -3000kcal/kg ME, 24% CP, 1% calcium, 0.5% available phosphorous, 1.5% lysine and 0.75% methionine + cystine while for breeding -3000kcal/kg ME, 20% CP, 2.75% calcium, 0.50% P, 1.15% Lysine and 0.76% methionine +cystine. These levels of nutrients would result to best laying performance when provided to laying quails.

Comparison of the PCARRD (2000) nutritional requirement in the composition and calculated analysis of the experimental ration Table 1 shows that the experimental rations especially in Treatment 2,3 and 4 did not satisfy the nutrient the requirement of Japanese quail layers, although worth nothing was the higher levels of crude protein in those ration with Madre de Agua leaf meal. The increased level of crude fiber in the experimental rations, especially with Madre de Agua leaf meal inclusion may have led to lowered feed consumption which in turn may also affect egg production.

In this study however, total feed consumption of layer quails was almost similar as shown in Table 1 which implies, that the varying levels of Madre de Agua (*Tricanthera gigantea*) leaf meals do not contribute much to the bulkiness of feed; thus, the similar feed consumption of all quails in the different treatments. This observation is also supported by Rosales (1996) when he mentioned that there is low neutral detergent fiber (NDF) in Madre de Agua leaves and high starch. NDF mainly consisted of plant walls (not readily digested by quails) which contributes much to the bulkiness in the feed. On the other hand, starch is already digested carbohydrates in all animals. According to Nesheim *et al.* (1979), the amino acid deficiency would result to slow egg production, of which they recommend that amount of methionine and cystine had to be considered in the diet of the layer.

Table 1. Egg production (%), total egg production (pc), total egg weight (grams), average initial weight (grams), average final weight (grams), total feed consumption and feed efficiency of Japanese quails (*Coturnix coturnix japonica*) fed with commercial ration substituted with varying levels of Madre de Agua (*Tricanthera giagantea)* leaf meal.

Parameters	Treatment				CV	
	1	2	3	4		
Egg Production (%)	80.97	73.99	76.09	73.89	11.10%	Not Significant
Total Egg Production (pc)	195	178	183	178	11.10%	Not Significant
Total Egg Weight (Grams)	1,995.98	1,923.61	1,986.41	1,878.24	11.36%	Not Significant
Average Initial Weight (Grams)	146.73	146.25	149.83	144.20	4.30%	Not Significant
Average Final Weight (Grams)	159.76b	160.25b	161.16c	145.58a	2.2%	**= highly significant
Total Feed Consumption	5,320.50	5,446.93	5,744.36	5,440.07	3.1%	Not Significant
Feed Efficiency	2.67	2.89	2.91	2.90	10.2%	Not Significant

Average Initial Weight

The average initial weight of the experiment birds is shown in Table 1. Where Treatment 3 layer quails were slightly heavier at the start of the study with 149.83 grams followed by those in Treatment 1 with 146.73 grams. Treatment 2 layer quails reflected 146.25 grams while those in Treatment 4 had 144.20 grams average initial weights. Though observed differences were seen but these did not reach statistical significance.These layer quails however, are within the standard average weight of 115 grams by the time they start laying (Coturnix, accessed 2006)

Average Final Weight

The average final weight of the birds is shown in Table 1 where highly significance difference (P<.01)

among the treatment means were observed. Quail layers in treatment 3 have the heaviest final weight of 161.16 grams which are significantly different from those in Treatments 2 and 1 (160.25, 159.76 grams) while those in Treatment 4 with 15% Madre de Agua leaf meal inclusion have significantly the lightest final weight of 145.58 grams. The decrease in the final body weight of quail layers with the addition Madre de Agua leaf meal at 15% could be attributed to the presence of the saponin and steroid even at very low levels in Madre de Agua. Saponin usually retards the growth rate. This result showed on average final weight similarity on the study of Jaya (2006) which stated that Madre de Agua leaf meal at 15% decreases body weight on pigs due primarily to reductions in feed intake caused by its bitter taste making the feed unpalatable. In the study of (Cheeke and Shull, 1985) no significant differences were observed among treatment means as well as no effect on the final weight of experimental pigs.

Layers in general are not expected to gain weight at a fast rate because their nutrient intake is normally used to produce eggs and not weight gains. In addition, fat layers are also known to produce lesser eggs.

Total Feed Consumption

PCARRD (1986) recommended that layers should be fed on restricted methods with 20 grams provided as its daily feed allocations per head. This recommendation was followed in the initial phase of the study buy it was observed that the 20 grams feed allocation was not enough for the birds as indicated during late afternoon when all the feeds were already consumed. It was then decided that the daily feed allocation be increased to 25 grams/bird.

Non-significant differences however, were observed among treatment means in the total feed consumption of Japanese quail as presented in Table 1. Birds on Treatment 3 were observed to have slightly heavier total feed consumption of 5,744.37 grams followed by Treatment 2 with 5,446.93 grams, Treatment 4 with 5,440.70 grams and Treatment 1 with 5,320 grams respectively. These results imply that Madre de Agua leaf meal inclusion levels in the diet do not affect this parameter.

This results conforms with the study by Rodriguez (2004) and Jaya (2006), that 10% Madre de Agua leaf meal inclusion had higher amount feed consumed on broiler chickens and the pigs given 10% Madre de Agua leaf meal had also higher intake than pigs given 0 and 15% Madre de Agua leaf meal but no significant differences was observed.

The decrease of feed intake in 15% level if inclusion in Madre de Agua leaf meal could be due to the bitter taste of saponin present in Madre de Agua at a very low level.

Feed Efficiency

Feed efficiency is a measure of how efficient an animal its feed into products like weight or eggs and is presented in Table 1 for this study. Although non-significant differences were observed among treatment means but those layer quails which received pure commercial layer mash needed only 2.67kg of feed to produce a number of eggs. Those in Treatments 2,4 and 3 followed, needing 2.89, 2.90 and 2.91kg feeds, respectively to produce a kg of quails' egg.

The above results showed slight similarity with the study of Rodriguez, (2004) that as the level of Madre de Agua leaf meal was increased up to 5-15% inclusion on the broiler chickens, the average feed conversion efficiency value also increased. Jaya (2006) mentioned that an increase in Madre de Agua leaf meal up to 10% did not decrease the efficiency of the pigs in converting feed to flesh. Those results however, showed non-significant differences among treatment means in broiler chickens and pigs. Egg Quality of Layer Quails (*Coturnix coturnix japonica*) Fed with Commercial Rations Substituted with Varying Levels of Madre de Agua (*Tricanthera gigantea*) Leaf Meal.

Average Egg Weight

The poultry egg consists of eggshell, white albumin and yolk, each component contributing to the distinct

weight and shape of the egg. For quails' egg average weight is about 10 grams which is almost 8% of quails' hens body weight (reported to be 115 grams). All quail's eggs in this study were heavier Table 2 than the documented average egg weight. Significant differences (P<.05) among treatment means particularly that of the Madre de Agua leaf meal substituted diets were observed as compared to pure commercial layer mash feeding. Eggs from layers fed with commercial layer mash with 10% Madre de Agua leaf meal inclusion (Treatment 3) appeared to be heavier (10.86 gram) compared to that Treatment 1 (Pure commercial layer mash) with only 10.27 grams. Treatments 2 (95% commercial layer mash + 5% Madre de Agua leaf meal) and 4 (85% commercial layer mash + 15% Madre de Agua leaf meal) have 10.82 and 10.61 grams respectively, which are statistically similar to that of Treatment 3.

Although genetics plays a significant role in egg weight, nutrition also has an equal responsibility in this parameter. The different components of an egg are primarily sourced out from its diet therefore, one could observe that those with Madre de Agua leaf meal inclusion had a better level of nutrition with this "add-on" nutrients to the commercial layer mash.

Crude protein is highly needed in albumin synthesis and of which is found to increase at increasing Madre de Agua leaf meal substitution. Calcium which composes about 98-99% of the egg shell also increases in the diet with increased Madre de Agua leaf meal inclusion.

Highly significant differences (P<.01) were observed on the average weight of Japanese quails egg yolk among treatments Table 2. Layer quail in Treatment 3 had highly and significantly heavier average egg yolk weight of 5.08 grams followed by 4.83 grams in Treatments 2 which is statistically similar to those in Treatment 4 with 4.68 grams. Treatment 1 layer quails egg had the lightest egg yolk with only 3.81 grams.

Table 2. Average egg yolk, average egg yolk weight (grams), average egg albumin (grams), Average eggshell weight (grams) and Yolk pigmentation of egg of the of Japanese quails (*Coturnix coturnix japonica*) fed with commercial ration substituted with varying levels of Madre de Agua (*Tricanthera giagantea*) leaf meal.

Parameters	Treatment				CV	
	1	2	3	4		
Average Egg Weight	10.27a	10.82b	10.86b	10.61b	2.10%	*= significant
Average Egg Yolk Weight (grams)	3.81a	4.88b	5.08c	4.68b	5.6%	**= highly significant
Average Egg Albumin (grams)	5.74	5.55	6.58	5.76	8.5%	not significant
Average Egg Shell Weight (grams)	1.57	1.65	1.67	1.63	5.3%	Not significant
Yolk Pigmentation of Egg	5.33a	8.33b	10.67c	12.00d	7.8%	**= Highly significant

Average Egg Yolk Weight

Egg yolk are primarily consists of aft lipid substances like cholesterol and pigments like carotenoids and xanthophyll Basically, these substances are end products of larger molecule nutrients like fat/lipids which were then transported to animal products like eggs thru absorption and transport in the blood.

Madre de Agua as shown in Table 2 contains 31.2g/kg of ether extract which represents the lipid content of the plant. Pigments such as Carotenoids and xanthophyll are also dissolved in organic solvents like ether. Expectedly, the ether extract value therefore contains not only lipids but pigments as well. With increased Madre de Agua leaf meal inclusion higher levels of ether extract (lipids, carotenoids, and xanthophyll is expected to be in the egg yolk thus the result.

Average Egg Albumin Weight

Non-significant differences were observed among treatment means in the average albumin weight of egg from Japanese quail layers in the study as shown in Table 2. Weight trend however, shows values of 6.58 grams, 5.7 grams, 5.74 grams and 5.55 grams for Treatments 3,4,1 and 2 respectively. The different levels of Madre de Agua leaf meal in the experimental rations did not affect the albumin weight of experimental birds,

although an increasing crude protein value was observed in the calculated analysis table (Table) of the experimental rations but this may not have sufficed the translated heavier albumin weights.

Average Egg Shell Weight

The average eggshell weight of the experimental birds is presented in Table were non-significant differences were observed among treatment means. Birds in Treatment 3 however, had a heavier average egg shell of 1.67 grams followed by Treatments 2,3 and 4 with 1.65 grams, 1.63 and 1.56 grams respectively. These observed values implied that the levels of Madre de Agua leaf meal inclusions in the diet did not affect this parameter.

The eggshell is about 98% to 99% calcium carbonate while Madre de Agua Is also containing high levels of calcium. Surprisingly however, shell weights were still statistically the same. It could be that the level of Madre de Agua leaf meal inclusion is lower thus calcium increase in the egg shell weight was not felt.

Yolk Pigmentation

Pigmentation rating of egg yolk from quail layers given commercial laying mash with varying levels of Madre de Agua (*Tricanthera gigantea*) leaf meal are shown in Table 2 where results showed highly significant differences ($P<0.01$) among treatment means indicating the effect of the experimental rations.

Highest numerical rating corresponding to best pigmentation (12) was in Treatment 4 (15% Madre de Agua leaf meal inclusion), followed by Treatment 3 with 10.67, Treatment 2 with 8.33 and those in Treatment 1 with the palest yolk. As indicated in the yolk fan, numerical rating for pigmentation becomes more intense from yellow to orange.

Madre de Agua is a plant and as Limcangco-Lopez (1973) conclude that shrubs, trees, leaves, algae and other water plants are rich in xanthophyll with values ranging from 500 to 600 ppm while Rosales (1996) also confirms reporting ether extract value of 31.2g/kg for Madre de Agua.

Xanthophylls, like other pigment are soluble in ether and may have contributed to the volume of ether extract as reported by Rosales (1996).

Results showed that an optimum level of Madre de Agua leaf meal added to the ration would affect the yolk color. The madre de Agua leaf meal contains pigment that when added to the ration improved yolk pigmentation. These are results supported by Limcangco-Lopez (1973), where she stated that Madre de Agua leaf meal contains xanthophyll from 500-600 ppm. Xanthophyll is a yellow oxygen containing pigment with chlorophyll in the plant's tissue. Thi Hmg Nhan and Van hon (1999) describe and reported that Madre de Agua leaf meal inclusion in the diet resulted to better yolk color.

According to Jaya (2006) higher levels of Madre de Agua leaf meal 155 inclusion in the ration affects the color of raw pork. This resulted to significant differences based on the ratings given with the corresponding description on the color of raw pork.

Conclusion

It is concluded that 10% Madre de Agua meal inclusion in the layer quails diet resulted to better egg production yolk weight, egg albumin weight, and eggshell weight. Yolk pigmentation was also more intense yellow with higher level of Madre de Agua leaf meal in the layer quails diet. Weight gains among Japanese layer quails also increased with 10% Madre de Agua leaf meal inclusion. These results showed that this diet met the nutrient requirement of layer quails with 10% Madre de Agua leaf meal thus the better result.

Recommendation

Results and conclusion led to the following recommendations:

1. The use of Madre de Agua leaf meal at a maximum of 10% inclusion for egg production. The above-mentioned level of inclusion could also be used to finish male Japanese quails for meat purposes.
2. The use of a cellulose enzyme to enhance digestion efficiency of Madre de Agua leaf meal in the diet may be attempted to asses and probably harness its good potential for yolk pigmentation.

Acknowledgement

The author would like to thank and acknowledge the people behind in this research. To the Department of Animal Science faculty, specially my adviser and panel members for the knowledge, suggestions, and comments they imparted. Grateful acknowledgment is also due to Dr. Ricardo G. Villar as my statistician for this research study. Profound thanks to Central Mindanao University and CMU Poultry Project for allowing the author to conduct her study.

References

Acero LE. 1985. Arboles de la Zona Cafetera Columbiana Bogota, Ediciones Fondo Bogota, Ediciones Fondo Cultural Cafetero.Volumen **16,** 132 pp.

Ameenudin S, Bird HR, Pringle DJ, Sundem L. 1983. Source in Poultry. Nutrition. Poultry Source. **60,** 505-511.

Angel JE. 1988. Avances en la Evaluacion de Recursos Nutricionales Tropicales en Columbia. In: Reporte Investigacion **1(1)** CIPAV, Cali, Columbia pp.26.

Arango JF. 1990. Evaluacion de tres niveles de nacedero *Tricanthera gigantea* en ceba de Conejos Nueva Zelanda. Tesis de Grado. Universidad Nacional de Columbia, Palmira. CIPAV 1996 Arboles Utilizado en la Alimentacion Animal como Fuente proteic. Centro para la Investegacion en Sistemas Sostenibles de Produccion Agroprecauria. Cali, Columbia 123pp.

Castemiller J. 1998. West Carotenoids in Human. Journal Nutrition **18,** 19-38.

Cheeke PR, Shull LR. 1985. Natural Toxicants in Feeds and Livestock. AVI Publishing Inc. West Port, Connecticut.

Devia A. 1998. Carcass Vivas y Barreras Contavientos. Revista Esso Agricila No **2**, November 1998

Gerpacio FM. 1986. Animal Production Technology **2(1),** 9.

Gomez KA, Gomez AA. 1984. Single Factor Experiments. Statistical Procedeures for Agricultural Research, 2nd Edition pp 7-20.

Gomez ME, Muequeitio E. 1991. Efecto de la corte sobre la Production De Biomasa De Nacedero (Tricanthera gigantea). Livestock Research for Rural Development **3(3),** 14-23.

Gonda JH. 1990. Evaluacion of de dos Especies Arboreas Agroforestales del Valle del Cauca en la Parte Central de Columbia Erthrina Poeppigiana Y Tricanthea gigantean. Sveriges Lantbruksuniversitet. Informe 126. IDRC Uppsala 17 pp.

Jaramillo CJ, Corredor G. 1989. Plantas Farrajera Proteina Barata Para el Ganado. Revista Federacion Nacional de Cafeteris de Columbia.

Jaramillo PH, Rivera PE. 1991. Efecto del Tipo de Estaca y La Densidad de Siembra Sobre El Establecimiento Y Produccion Inicial de Naceddero Tricanthera gigantean Humboldt and bonpland. Tesis de Grado. Zootecnia. Universidad Nacional de Columbia, Palmira.

Jaya A. 2006. Utilization of Madre de Agua (Tricanthera gigantean) leaf meal as feed for growing finishing pigs. An unpublished dissertation Central Mindanao University, Musuan Bukidnon.

Keir B, Dinh Van Bien, Preston IR, Orslevov ER. 1997. Nutritive Value of Leaves from Tropical Trees and Shrubs: 2. Intake, Growth and Digestibility Studies with Goats. Livestock Research for Rural Development **9(4),** 31-35.

Leonard E. 1951. The Acanthaceae of Columbia. I. Contribution from the National Herbarium Washington. United States National Museum **31,** 1-51.

Mc Grow H. 2004. Carotenoids Pigments pp. 132.

Mcdade LA. 1983. Pollination Intensity and Seed Set in Tricanthera gigantean (ACANTHACEAE). Biotropica **15(2),** 122-124.

Mjiea CE, Vargas JE. 1993. Analisis de Selectividad de Ovejas Africanas con Cuatro Tipos de Farrajes. Livestock Research for Rural Development **5(3),** 37-41.

Mohmond, Coleman. 1967. Quail Egg Composition. Poultry Journal pp **2,** 10-11.

Nguyen Ngoc Ha, Phen Thi Phen. 1995. Vegetative Propagation capacities and Effect of Fertilization on Biomass Production of Tricanthera gigantean. Livestock Research for Rural Development **8(2),** 93.

Nguyen Thi Hong Nhan, Preston TR, Dolberg F. 1996. Effectv of Shade in Biomass production and the Compostion of the Forage Tree Tricanthera gigantean . Sveriges Lantbruksuniversitit. Informe 126. IDRC Uppsala 17 pp.

PCAARD. 1989. Production and Utilization of Non-conventional Feedstuff for Livestock. Philippine Agriculture And Resources foundation.

PCAARD. 1988. The Philippine Recommends for Broiler Productions.

PCAARD. 2000. The Philippine Recommends for Livestock Feed Formulation.

Perez-Arbelaez E. 1990 Plantas Utiles de Columbia. Editorial Victor Hugo, Medellin. 14th edition. 832 pp.

PHILSAN. 1996. Feed References Standards 3rd Edition. Philippine Society of Animal Nutritionist 441.pp

Preston TR. 1995. Tropical Animal Feeding. A Manual for Research Workers. FAO Animal Production and Health Paper no. 126. P305.

Preston TR. 1992. The Role of Multipurpose Trees in Integrated Farming Systems for the Wet Tropics. In: Legume Trees and Other Fodder Trees Protein Source for Livestock. FAO Animal Production and Health Paper. No. 102. Edited by A. Speedy and P. Pugliese pp 193-209.

Records SJ, Hess RW. 1972. Timber of the New World. Use and Abuse of Americas Natural Resources. Arno Press, New York 642pp.

Rodriguez M. 2004. Growth Performance of Broiler Chicken fed with Different Levels of Madre de Agua Leaf Meal. An Unpublished MS Thesis. Central Mindanao University, Musuan, Bukidnon 86pp.

Rosales M, Galindo W. 1987. Aportes al Desarollo de un Sistema de Alimentacion para cabras en el Tropico. Tesis de Grado. Universidad Nacional de Columbia. Facultad de Ciencias Agropecuarias: Palmira.

Rosales M, Preston TR, Vargas JE. 1982. Advances in the Characterization of Non-Conventional Resourcs with Potential Use in Animal Production. British Society of Animal Production. Animal Production. In Developing Countries. Occasional Publication No. 16.pp 228-229.

Rosales M. 1996. In Vitro Assessment of the Nutritive Value of Mixtures of Leaves from Tropical Fodder Trees. D. Phil. Thesis. Department of Plant Science Oxford University, Oxford, U.K pp 214.

Sarria O. 1994. Efecto del Nacedero (Tricanthera gigantea) Como Reemplazo Parcial de la Soya en Cerda en Gestacion y Lactancia Recibiendo un Dieta Basica de Jugo de Cana. Livestock Research for Rural Development **6(1),** 62-73.

Solarte JA. 1994. Experiences from Two Ethnic Groups of Farmers Participating in Livestock Research in Different Ecological Zones of the Cauca Valley of Columbia. Msci. Thesis. Swedish University of Agricultural Sciences. Uppsala 80pp.

Theodorou MK, Williams BA, Dhanoa MS, Mcallan AB, France J. 1994. A Simple Gas Production Method Using a Pressure Transducer to Determine the Fermentation Kinetics of Ruminant Food. Animal Food Science and Technology **48,** 187-197.

USNRC. 1984. Nutrient Recommendation of Poultry.

Vasquezm L. 1987. Plantas y Frutas Medicinales de Columbia y America. Editorial CLIMET. Cali.

Vibul Chai A. 1984. Xanthophylls Pigmentation in Leaf Meal, Chapter **17,** 117-121.