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Effect of the Inclusion of Three Levels of Chicken Manure in Diet on Productive Performance of Finishing Lambs

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Abstract: The objective of this study was to evaluate the effect of different levels of chicken manure in finishing lamb diets on productive performance without producing negative effects on health and Cu content in liver and blood. Twenty-one not castrated Katahdin male lambs (Initial BW 35±1.20 kg) were assigned to a completely randomized design. Three levels of inclusion of chicken manure were evaluated in a mixed diet: T1) 10; T2) 15 and T3) 20%. The variables evaluated were Average Daily Gain (ADG), Daily Feed Intake (DMI), Feed Conversion (FC), Carcass Yield (CY), ruminal pH, VFA production *in situ* DM degradability and Cu content in blood serum and liver. At the 86 day in trial, the final live weight was obtained (T1: 50.3, T2: 48.2 and T3: 45.7 kg) and significantly decreased ($p<0.05$) as the chicken manure level increased; the same happened for DMI (2039, 1932 and 1779 g day $lamb^{-1}$). No differences ($p>0.05$) for ADG (312, 291 and 277 g), FC (6.6, 6.6 and 6.4) and CY (54, 54 and 56%) were observed. The production of VFA increased ($p<0.05$) as the chicken manure in the diet increased too (62.1, 78.4 and 95.7 mM/L). No pathological signs were observed in the animals during the study and blood serum and liver Cu contents exceeded the normal range without producing toxicity. Concentrations of 10, 15 and 20% of chicken manure in finishing lamb diets neither affected negatively the production performance nor produced signs of toxicity in lambs.

Key words: Sheep, finishing, chicken manure, Cu, finishing lamb, chicken manure

INTRODUCTION

Due to their digestive characteristics, ruminants can use Non-protein Pitrogen sources (NNP) in their diets which can replace part of the crude protein on cereals, improve the ruminal environment and ensure the constant supply of ammonia for the synthesis of microbial protein in a slow and continuous way (Ortiz *et al*., 2007; Calderon and Elias, 2006). Chicken manure which contains more than 30% of N can be used in the partial substitution of conventional feeds in diets of ruminants (Tobia and Vargas, 2000).

Chicken manure has been used as a nutritional alternative for ruminants due to its nitrogen and protein content, low cost and wide availability. The Protein Content (PC = %N×6.25) of the chicken manure oscillates between 11-30% depending on the type of material used as bed for chickens and the period of permanence of these in the production rooms (Egana *et al*., 1989). Several studies support the economical and zootechnical advantages of chicken manure in ruminant feeding (Goyo *et al*., 2000; Arroyo *et al*., 2003). In diets for small ruminants, inclusion levels of 50 or 60% did not affect dry matter consumption (Rios *et al*., 2005). The use of chicken manure in sheep diets is a widespread practice and the importance of its use is mainly due to the high costs of conventional feeds that can be partially substituted for chicken manure. Therefore, the objective of this study was to determine the best of three concentrations of chicken manure that can be used in lamb diets without producing undesirable effects on production parameters, carcass characteristics, lamb health and Cu concentration in liver and blood as well as impact on the economic cost of each experimental diet.

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MATERIALS AND METHODS

The study was carried out in the animal production facilities of the Technological Institute of El Llano, Aguascalientes, Mexico, located at 18 km, Aguascalientes-San Luis Potosi Highway, 21°55' Ny 101° 58' O., at an altitude of 2020 masl. The climate is semi-dry with an average annual temperature of 17.4°C and 526 mm annual rainfall (Garcia, 1987). The 21 Katahdin male lambs of average initial body weight of 35±1.2 kg were used and placed in individual pens, water and feed were offered for free access at 8:00 and 16:00 h daily. The lambs were randomly assigned in a completely randomized design with three treatments and seven replicates per treatment and initial body weight was used as a covariable. Three diets were evaluated which consisted in the inclusion of three levels of chicken manure mixed with a typical diet for finishing lambs (Table 1), the T1 with 10% chicken manure; T2, 15% chicken manure and T3, 20% of chicken manure.

The experiment lasted 86 days and was divided into four periods; first period: adaptation to diets (15 days): Lambs were identified, dewormed with ivermectin (1 mL/20 kg^{-1} BW) and injected vitamins ADE (1 mL $lamb^{-1}$). Second period: record of productive parameters (44 days) in this period, data of initial and final body weight and daily feed intake were recorded and collection of ruminal fluid and blood serum samples were done. Lambs were weighed two consecutive days at day 1 and 44 and data of feed offered, orts and daily feed intake were recorded. In the last week, ruminal fluid (about 150 mL) was collected from each of the lambs, 6 h after feeding at 08:00 h by suction with a vacuum pump and a½-inch plastic probe with blunt edges and one end with holes. Then, the ruminal fluid was used in the laboratory for ruminal pH and Volatile Fatty Acids (VFA) (Erwin *et al*., 1961) analyzes. Blood samples were taken from the jugular vein and by centrifugation, blood serum was obtained and processed for Cu analyses (Fick *et al*., 1979). The components of the proximal analysis in diets were determined according to the techniques of the (Horwitz and Latimer, 2007), the neutral detergent fiber and acid detergent fiber by the technique of Van Soest *et al*. (1991) and copper concentration in chicken manure and blood samples by atomic absorption spectrophotometry technique of Fick *et al*. (1979). The *in situ* DM degradability was determined using four 450 kg Holstein cows with cannula in the rumen and diet samples were incubated for 72 h (Orskov *et al*., 1980). Third period: exclusion of diets containing chicken manure (25 days), lambs stopped eating the experimental diets and were given a diet without chicken manure.Fourth period: slaughter (2 day), the animals were slaughtered on the municipal slaughter house of San Francisco de Los Romos, Ags. The weights of hot carcasses were recorded to calculate the carcass yield. As additional data, the coloration of meat and the presence or absence of abscesses in liver were recorded and liver samples were collected for Cu analysis (Fick *et al*., 1979).

Table 1: Feed ingredients and chemical composition (g/kg^{-1} DM) of the diets used in lambs in different treatments

Feed	T1	T2	T3
Alfalfa	12.00	12.00	12.00
Chicken manure	10.00	15.00	20.00
Cotton seeds	5.00	5.000	5.000
Soy hulls	13.50	13.00	13.00
Soy bean meal	10.20	9.200	7.700
Cotton seed meal	06.30	5.800	5.800
Cane molasses	07.50	7.500	7.500
Ground corn	34.45	31.45	27.95
Sodium bicarbonate	00.75	0.750	0.750
Salt	00.30	0.300	0.300
Total	100.00	100.00	100.00
Cost/kg (Mex Pesos)	05.05	4.780	4.490
Chemical Composition (g/kg DM^{-1})			
DM	809.00	788.00	813.00
CP = %N×6.25	174.00	177.00	179.00
NDF	260.00	300.00	300.00
ADF	190.00	220.00	230.00
ME, Mcal/kg**	2.592	2.530	2.4770
Ashes	79.15	93.80	95.500
EE	36.00	36.00	35.000
NFC	450.90	393.20	390.50
TDN	669.00	638.00	636.00
Ca	6.30	7.700	9.100
P	5.70	6.400	7.100
DM degradability	695.00	687.00	668.00

*Determined in laboratory; **Calculated from ration formulation

The studied variables in the experiment were: daily Feed Intake (DMI), Average Daily Gain (ADG), Final Body Weight (FBW), Body Weight Gain (BWG), Feed Conversion (FC), Carcass Yield (CY), pH and VFA production in ruminal fluid, Cu blood serum and Cu liver content and *in situ* DM degradability of diets was also determined at 12, 24, 36, 48 and 72 h of rumen incubation (Orskov *et al*. 1980).

Data were analyzed by Analysis of Variance (ANOVA) and comparisons of means (Tukey) to determine differences among treatments, taking the initial body weight as a covariable and using GLM of the SAS Software package (SAS., 2008). The statistical model was the following:

$$Yij = m+ti+b(Xij-x.)+eij$$

Where:

Yij = Response variable
m = Overall mean
ti = Effect of the ith treatment
b = Coefficient of regression

Xij = Covariable (Initial body weight)
eij = Experimental error

RESULTS AND DISCUSSION

Average daily gain and feed intake: Although, the T1 lambs were fed a diet with a lower concentration of chicken manure, average daily gains were not different ($p>0.05$) than T2 and T3 lambs. The DMI (g/day) was lower ($p<0.05$) in lambs of T3 than T1 and no statistical differences were present between T1 and T2 (Table 2). A numerical decrease in DMI (g/day) as the chicken manure was increased in diet is the result of the differences in final body weight among treatments but when feed intake was expressed in g kg $BW^{0.75}$ no differences ($p>0.05$) among treatments were observed (Table 2). An adequate supply of nutrients is an important factor in order to obtain ADG between 200 and 300 g in growing lambs; Morales *et al*. (2003) reported average daily gains of 111 and 86 g in pelibuey female lambs fed a diet with 15 or 30% chicken manure, complemented with 70% of ground corn; the low values of body weight gain were the result of using a low protein diet (11%) and probably the breed of the lambs also influenced in body weight gain.

Martinez *et al*. (2007) evaluated four commercial diets without chicken manure in Suffolk male lambs of 25 kg and obtained ADG of 260, 216, 285 and 202 g/day which are lower than those found in our study where chicken manure was included in 10, 15 and 20% in diet and these results show that the rational use of chicken manure does not negatively affect the weight gain in lambs and can substitute higher-cost ingredients of the diet.

According to the results, DMI (g kg $BW^{0.75}$) in lambs of T1 was not different ($p>0.05$) to T2 and T3, this could be explain in part because the increasing concentration from 10-20% of chicken manure in diet was not enough to decrease feed intake among treatments. On the other hand, Lallo *et al.* (1992) reported in male lambs of 16.8 kg fed diets with 0, 300 and 500 g/kg DM of chicken manure, feed intakes of 1.10; 1.07 and 1.08 kg of DM/day and average daily gains of 181, 224 and 208 g, respectively and concluded that average daily gain is reduced when chicken manure in diet is used in 30 and 50% but economic income is improved by cost of feed.

In other study with lambs fed a native grass and supplemented with 12 or 20 g/kg BW of coffee poultry manure, average daily gains increased as the amount of poultry manure in the diet increased too, this was attributed to an improvement in grass digestibility by the nitrogen supplied by the excreta, likewise, the carcass yield was higher in the sheep supplemented with poultry manure that those of the control group (Ortiz *et al*., 2007).

Table 2: Mean values of productive parameters, carcass yield, ruminal fermentation products and Cu concentration in blood serum and liver

Variables	T11 (0% CHM)	T2 (15% CHM)	T3 (20% CHM)	SE
IBW (kg)	36.6	35.4	33.5	
FBW (kg)	50.3^{a}	48.2^{b}	45.7^{c}	1.194
BWG (kg $lamb^{-1}$)	13.7^{a}	12.8^{a}	12.2^{a}	1.194
ADG (g/day)	312^{a}	291^{a}	277^{a}	27.17
DMI (g/day)	2039^{a}	1932^{ab}	1779^{b}	177
DMI (g/kg $BW^{0.75}$)	121^{a}	118^{a}	113^{a}	8.39
FC	6.6^{a}	6.6^{a}	6.4^{a}	0.588
Carcass yield (%)	54^{a}	54^{a}	56^{a}	2.63
Ruminal pH	7.3^{a}	7.2^{a}	7.1^{a}	0.397
VFA				
VFAt (mM/L)	62.1^{c}	78.4^{b}	95.7^{a}	31.3
Acetic (%)	58^{a}	59.7^{a}	57.4^{a}	3.9
Propionic (%)	30.3^{a}	26.5^{a}	30.1^{a}	4.5
Butyric (%)	11.9^{a}	13.7^{a}	12.5^{a}	1.7
A:P ratio	2.0^{a}	2.3^{a}	1.9^{a}	0.47
Cu blood serum ppm*	3.1^{a}	3.5^{a}	3.72^{a}	0.56
Cu liver, ppm**	313^{a}	443^{a}	485^{a}	193

$^{a-c}$Means with different letter in a raw are different ($p<0.05$); SE = Standard Error; IBM = Initial Body Weight; FBW = Final Body Weight; BWG = Body Weight Gain; ADG = Average Daily Gain; DMI = Dry Matter Intake; FC = Feed Conversion; VFA = Volatile Fatty Acids; A:P = Acetic: Propionic Ratio; CHM = Chicken Manure in diet; *Normal concentration in sheep, 0.7-1.3 ppm ; **Normal concentration in sheep, 100-300 ppm

Feed conversion: No differences ($p>0.05$) among treatments in feed conversion were observed (Table 2), average values obtained are higher than the feed conversion in male lambs but it is important to mention that lambs in fattening (BW>30 kg) have a higher feed conversion because energy efficiency is lower than in animals of<30 kg (Partida and Martinez, 1992). The results obtained in this study are similar to those obtained by Cortes *et al*. (2007) who used male lambs in fattening of an average body weight of 37 kg which were fed a mixed diet and others with forage and concentrate, separately, (concentrate, once and twice a day) and they obtained feed conversions of 7.2 and 7.3 kg/kg BW gain in forage and concentrate-fed lambs while those fed the mixed diet had a feed conversion of 6 kg. In our study, the range of FC was from 6.5-6.7 kg and the lack of differences among treatments is explained in part by the similarity of ADG among the three treatments and to the close level of inclusion of chicken manure in diets.

Carcass yield: In Carcass Yield (CY), no differences among treatments ($p>0.05$) were observed (Table 2). These values are higher to those obtained by Calderon and Elias (2006) who reported average carcass yields of 43 and 45% in pelibuey male lambs fed a grass (Bothriochloa pentosa) supplemented with chicken manure and molasses, probably the low carcass yield that these researchers obtained is due in part to the breed used and also to the low slaughter weight (22-29 kg). In other study carried out by Goyo *et al*. (2000) in pelibuey sheep wethers of 22 months of age fed swine and chicken manure, a mean carcass yield of 42% was reported, this value was smaller than the ones obtained in our study due to breed, diets and age and a low slaughter weight (29 kg) of the animals. Ortiz *et al*. (2007) reported that growing sheep fed chicken manure (12 g and 20 g/kg BW) obtained higher ($p<0.05$) carcass yields (46.7 and 47.5%) than those fed diets without chicken manure (45.8%).

Rumen fermentation products: No significant differences ($p>0.05$) were observed in samples of ruminal pH of the different treatments, the values were slightly alkaline (Table 2) and were higher than the normal and optimal range of 6.2-7.0. The pH of the rumen fluid is a good indicator of the proper functioning of the rumen and the activity of their microorganisms. Aranda *et al*. (2009) carried out an experiment in cattle where they used chicken manure in 50% of the diet and obtained a ruminal pH of 7.3, this value was higher than those usually reported and it is in agreement with the values obtained in our study. Ruminal pH in chicken manure-fed animals tends to exceed neutral pH because stored chicken manure has a pH between 8.0 and 9.5 (Pareja, 2005) and animals fed this excreta may have a higher ruminal pH.

In ruminal fermentation products, no differences ($p>0.05$) among treatments were observed, neither for acetic, propionic and butyric acid concentrations nor the acetic:propionic ratio, this indicates that for 2.0, 2.3 and 1.9 units (T1-T3, respectively (Table 3) of acetate is obtained a unit of propionate; However, in fattening animals where it is desirable to lower this ratio and this is achieved when high-concentrate diets are used and according to Shimada (2005) this is presented when the concentrate is increased above 70% and the rates of VFA (acetate, propionate and butyrate) usually are reported as 45:40:15, respectively. In the present study, the average ratios obtained were 58:29:14. In studies where low and high concentrate diets have been tested it has been observed that, although, the concentration of acetate is reduced when the level of concentrate is increased, its production does not change considerably, it is possible that at the same time that the production of propionate increases the rate of absorption of all fatty acids considerably increases too (Rodriguez and Llamas, 1990).

Blood serum and liver copper concentration: The concentration of copper in blood serum and liver presented no differences ($p>0.05$) among treatments (Table 2). Copper concentrations in blood serum found in lambs were high but not toxic, based on the normal range of 0.7-1.3 ppm (Underwood, 1977). By Rubio *et al*. (2000) found levels of 6 ppm of copper in blood serum and from 192-511 ppm in liver samples of sheep with a copper toxicity reported. By Vega *et al*. (2013) quantifying the Cu content in chicken manure sold by three companies in Yucatan, Mexico found an average of 82 ppm. It has been reported that chicken manure has a high copper content and when it is used to feed farm animals, the increase of copper in blood serum and liver is given and sheep are very susceptible to this element and levels from 5 ppm in blood serum is sufficient confirmation for the diagnosis of copper toxicity (Fraser, 1993).

Table 3: Dry matter degradability (%) of diets containing chicken manure at different times of ruminal incubation

	Incubation times (h)				
Treatments	12	24	36	48	72
T1	30.9[a]	47.5[a]	56.3[a]	60.5[a]	69.5[a]
T2	28.1[a]	43.6[a]	54.2[a]	58.2[a]	68.7[a]
T3	32.6[a]	43.7[a]	55.8[a]	60.9[a]	66.8[a]

[a,b]Means with the same letter in the same column are not different ($p>0.05$); CV = 6.31%

Chicken manure contains high amounts of Cu, element contained in copper sulphate, a compound used as a promoter of growth in chickens and high amounts are toxic (Aguirre *et al.,* 2003) especially in sheep that are very susceptible to intoxication by this mineral, since, it accumulates in liver. In our study, the chicken manure used in lamb diets had a mean Cu concentration of 153 ppm, value like to the range of 23-161 ppm reported by Aguirre *et al.* (2003) in several samples of this excreta in Yucatan, Mexico. In our study, the Cu concentration in liver was high and not different ($p>0.05$) among treatments (Table 2) but the lambs never showed any symptom of toxicity in the short period of finishing in part explained by the dilution of copper in the mixed diet to a 30 ppm approximately; probably Cu in liver can accumulates if sheep are fed this excreta during all the year.

Meat coloration: The effect of chicken manure on meat quality in sheep lambs has been poorly documented but it has been commented that an obscure coloration of meat is found in sheep fed chicken manure. In our study, no changes or differences were found among the carcasses of the evaluated treatments, clear red carcasses were obtained which is a normal coloration in this species and no pathological alterations were found in liver in any of the treatments. Rios *et al.* (2005) and Taylor and Geyer (1979) mentioned that despite the absence of a direct penalty from the FDA by the use of high amounts of drugs in animal diets, these animal products should not be considered a safe feed, due to the possibility to find drug residues in the tissues and by-products of animals fed chicken manure. Some researchers have pointed out that if there are doubts about the safety of the chicken manure, artificial dehydration, piles, pellets, chemical treatments and silage are available methods to eliminate pathogenic bacteria (Caswell *et al.,*1978).

Mavimbela and Van Ryssen (2001) concluded that the inclusion of chicken manure in sheep diets in concentration of 56% did not negatively affect the sensorial characteristics of meat whereas higher levels may have a slight adverse effect on the composition of the subcutaneous fat and sensorial characteristics.

***In situ* dry matter degradability:** Dry matter degradability of diets increased linearly as the test time elapsed (Table 3), at 12 h the three treatment diets had a degradability>18% and no significant differences (p>0.05) among treatments were observed. At 24 h, the degradability rate was slower compared to the time 1. The highest fractional percentage of degradability of the diets was obtained between 24 and 36 h. Bonilla *et al.* (2006) used chicken manure in the inclusions from 37-58% in diets for beef cattle and determined the percentage of *in situ* digestibility of DM of the complete diets and obtained the same trend as in our study as the level of chicken manure decreased in diet the digestibility increased from 51.5-63.3%, this in part is due to the high content of ashes of the chicken manure (NRC., 2007).

Due to its nutritional characteristics and its low cost, chicken manure can substitute protein feeds such as soybean meal and cotton seed meal and also energy feeds such as ground corn. These feeds are quoted on the market with a high cost compared to the price of this excreta that when used in mixed diets does not affect the production parameters and can reduce the production costs from 10-20% compared to a diet without chicken manure (Table 1).

CONCLUSION

The inclusion of chicken manure at levels from 10-20% in finishing lamb diets in intensive systems does not adversely affect the productive parameters and health and meat quality are not compromised, therefore, it is recommended to use this by-product as a complement in diets for lambs in order to improve the economic income.

RECOMMENDATIONS

It is recommended to discontinue the use of chicken manure in diet at least 14 days prior to the slaughter of animals to avoid undesirable characteristics as an obscure coloration of meat. The use of chicken manure in finishing lamb diets improves the profitability of production systems by reducing feed costs and no changes in coloration of meat are produced.

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REFERENCES

Aguirre, J.A.P., J.L.R., Guercio, W.A.V. Casares, V.M.A. Vidal and A.F.C. Ruelas, 2003. [Quantification of the content of copper and other minerals in poultry produced in the state of Yucatan (In Spanish)]. Mex. J. Anim. Sci., 41: 197-207.

Aranda, E.M., G.D. Mendoza, J.A. Ramos, S. Salgado and A.C. Vitti, 2009. [Selectivity of sugarcane in cattle (In Spanish)]. Adv. Agric. Res., 13: 21-26.

Arroyo, C., A.R. Bourrillon and R. Rosales, 2003. [Urea or pollinaza as protein supplement for toretes consuming silage of pejibaye pulp (In Spanish)]. Costa Rican Agron., 27: 69-73.

Bonilla, L.N.Z., A.S. Londono and J.J. Pena, 2006. [Design and evaluation of a technological system for bovine feeding in the warm zone of the Upper Magdalena]. Rev. Med. Vet., 12: 23-34.

Calderon, A.J.O and A.I. Elias, 2006. [Contribution to ovine supplementation with fermented chicken (Vitafert) and four levels of molasses (In Spanish)]. Vet. Electron. Mag., 7: 1-7.

Caswell, L.F., J.P. Fontenot and K.E. Webb Jr., 1978. Fermentation and utilization of broiler litter ensiled at different moisture levels. J. Anim. Sci., 46: 547-561.

Cortes, E.D., M.H.A. Pedro, C.S.D. Real and L.S. Roman, 2007. [Completion of lambs with different strategy of offering the same diet]. Proceedings of the 5th Latin American Congress on Specialists in Small Ruminants and South American Camelids, May 2-4, 2007, Universidad A. Chapingo, Mendoza, Argentina, pp: 1-4 (In Detect).

Egana, J.I., E. Haardt and F. Pizarro, 1989. [Determinants of the chemical composition and nutritional value of broiler beds. I. Effect of the type of floor of the house (In Spanish)]. Arch. Med. Vet., 22: 145-149.

Erwin, E.S., G.J. Marco and E.M. Emery, 1961. Volatile fatty acids analysis of blood and rumen fluid by gas chromatography. J. Dairy Sci., 44: 1768-1770.

Fick, K., P. McDowell, N. Miles, J. Wilkinson and J. Funk *et al.*, 1979. [Methods of Mineral Analysis for Plant and Animal Tissues]. 2nd Edn., University of Florida, Gainesville, Florida, (In Spanish).

Fraser, C.M., 1993. [The Veterinary Merck Manual]. 4th Edn., Oceano Difusion Editorial, Mexico, Pages: 2092 (In Spanish).

Garcia, E., 1987. [Modifications to the Koppen Classification System (to Adapt them to the Conditions of the Mexican Republic)]. 4th Edn., National Autonomous University of Mexico, Mexico, Pages: 90 (In Spanish).

Goyo, E.C.P., A.F.C. Ruelas, J.G.C. Castillo and Y.B.M. Ordonez, 2000. [Impact of the use of high levels of animal excreta in the feeding of sheep (In Spanish)]. Livestock Res. Rural Dev., Vol. 12,

Horwitz, W. and G. Latimer, 2007. Official Methods of Analysis of AOAC International. 18th Edn., Association of Official Analytical Chemistry, Gaithersburg, ISBN: 9780935584783..

Lallo, C.H.O., F.A. Nekles and W.A. Harper, 1992. [The feeding of lambs of hair based on litter of sugar cane bagasse under intensive production conditions (In Spanish)]. Rev. Cubana Cienc. Agric., 26: 145-145.

Martinez, G.D.M., F.X.P. Perez, M.R. Mella, M.A.M. Delgadillo and H.L. Rangel *et al*., 2007. [Evaluation of whole foods for the intensive fattening of sheep (In Spanish)]. Rev. Sci., 17: 66-72.

Mavimbela, D.T. and J.B.J. Van Ryssen, 2001. Effect of dietary molasses on the site and extent of digestion of nutrients in sheep fed broiler litter. South Afr. J. Anim. Sci., 31: 33-40.

Morales, G.A., L.M. Velasquez and Y.C. Nieto, 2003. [Weight gain, feed conversion and efficiency in sheep fed with parota tree (Enterolobium cyclocarpum) fruit (seed and pod) and poultry manure (In Spanish)]. Veterinaria Mexico, 34: 39-46.

NRC., 2007. [Nutrient Requirements of Small Ruminants]. 7th Edn., National Academy Press, Washington, DC., USA., (In Spanish).

Orskov, E.R., F.D.D. Hovell and F. Mould, 1980. The use of the nylon bag technique for the evaluation of feedstuffs. Trop. Anim. Prod., 5: 195-213.

Ortiz, A., A. Elias and M. Valdivie, 2007. [Evaluation of chicken dung on coffee shells as feeding supplement in the fattening of grazing sheep (In Spanish)]. Pasture Forage., 30: 279-286.

Pareja, M.M.E., 2005. [Management and processing of chicken manure (In Spanish)]. Lasallista Mag. Invest., 2: 43-48.

Partida P.J.A. and R.L. Martinez, 1992. [Behavior of pelibuey sheep fed with two energy levels in four growth periods (In Spanish)]. Livestock Tech. Mex., 30: 1-11.

Rios de Alvarez, L., J. Combellas and R. Alvarez, 2005. [Revision use of excreta of birds in the feeding of sheep (In Spanish)]. Trop. Zootechnics, 23: 183-210.

Rodriguez, G.F. and L.G. Llamas, 1990. [Digestibility, Nutrient Balance and Ruminal Fermentation Patterns]. In: Manual of Research Techniques in Ruminology, Castellanos, R.A., L.G. Llamasy and S.A. Shimada (Eds.). Systems of Continuing Education, Mexico, pp: 95-126.

Rubio, L.J.G., R.G. Arroyo, M.P.M. Santiyan and F.S. Rodriguez, 2000. [Copper poisoning in sheep: Efficacy of the treatment and evaluation of serum copper]. Proceedings of the 25th Scientific and 4th International Conference on the Spanish Society of Ovinotecnia and Caprinotecnia, September 28-30, 2000, Spanish Society of Ovinotecnia and Caprinotecnia SEOC, Teruel, Spain, pp: 377-380 (In Spanish).

SAS., 2008. [Statistical Analysis Systems Institute User's Guide: Statistical Analysis Systems Institute User's Guide]. 9th Edn., SAS Institute Inc, Cary, North Carolina,.

Shimada, M.A., 2005. Nutricion Animal: Primera Edicion. Trillas, S.A. De C.V. Publisher, Mexico,.

Taylor, J.C. and R.E. Geyer, 1979. Regulatory considerations in the use of animal waste as feed ingredients. J. Anim. Sci., 48: 218-222.

Tobia, C. and E. Vargas, 2000. [Evaluation of chicken excreta fattening (pollinaza) in animal feed. II fractionation of nitrogen components and energy content (In Spanish)]. Costa Rican Agron., 24: 55-62.

Underwood, E.J., 1977. Trace Elements in Human and Animal Nutrition. 2nd Edn., Academic Press, New York, USA.

Van Soest, P.J., J.B. Robertson and B.A. Lewis, 1991. Methods for dietary fiber, neutral detergent fiber and nonstarch polysaccharides in relation to animal nutrition. J. Dairy Sci., 74: 3583-3597.

Vega, W.H.O., A. Pacheco and C.R. Quirino, 2013. [Evaluation of blood urea nitrogen and uterine pH in cows supplemented with poultry litter as a protein source (In Spanish)]. Redvet Rev. Electron. Vet., 14: 1-9.