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# Relation of Growth of Crossbred Hair Sheep with some Zoometric Measures

Research Article

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## ABSTRACT

The weighing records of 18 crossbred females with average live weight of 14.7 ± 3.14 kg were analyzed to study the relationship of the growth of crossbred hair sheep with some zoometric measures. The weight was established and took the measures thoracic perimeter, cannon perimeter, body length, neck length, hip amplitude, ischial amplitude, withers height and croup height. All parameters were stated as cm. Within 60 days of the initial weighing and taken the zoometric measures, animals were weighed again and the average daily gain was estimated. The correlation coefficients of initial body weight with zoometric measures were high (r>0.7) and the highest of average daily gain were with thoracic perimeter (r=0.41) and body length (r=0.34), to the remaining variables the coefficients were below 0.3. According to Akaike information criterion the best fit model to describe the growth was, average daily gain (ADG) (g/d)= 3.3 × thoracic perimeter (PT) - 44.4 × perimeter cane (PC) + 5.4 × body length (LCO) + 5.6 × amplitude hip (AC) - 3.3 × height at the croup (ALG) (R2=0.92, Akaike information criterion (AIC)=96.8; P<0.05). The zoometric measures relate to the growth, proving to be a tool for information about the growth potential of crossbred lambs.

KEY WORDS animal morphology, body regions, regression analysis.

## INTRODUCTION

The zoometric variables have been shown as a useful tool for estimating the weight of the animals (Musa *et al.* 2012; Zhang *et al.* 2016) and to describe and characterize the races (Mernies *et al.* 2007). Rocha *et al.* (2007) used the zoometric measures to characterize the goat race Moxotó and was possible to verify the differentiation and formation of subpopulations within the race. Furthermore, relationship of zoometric measures with some production parameters has been reported (De Haas *et al.* 2007). MacNeil and Mot (2006) in Hereford cattle observed correlation between the udder shape and milk production, which has been proposed to use morphology measures in selection processes in countries where no breeding programs are carried (Haldar *et al.* 2014). Similarly, in goats, the relationship of body conformation and prolificacy was observed, noting a strong and positive relationship between litter size and various zoometric traits in black Bengal goats, as neck length, body length, height at withers, height of the croup, hip width and Ischia width, characteristics that allowed discrimination goats carrying multiple fetuses of carrying a single fetus (Haldar *et al.* 2014). In the case of sheep they have reported relationship of some zoometric measures or conformation with growth (Tatum *et al.* 1998a; Burke *et al.* 2003; López-Carlos *et al.* 2010), body weight (Tatum *et al.* 1998a; Vatankhah and Talebi, 2008; López-Carlos *et al.* 2010; Musa *et al.* 2012; König *et al.* 2017), the characteristics of the carcass (Tatum *et al.* 1998b, Souza *et al.* 2013; Bautista-Díaz *et al.* 2017; König *et al.* 2017) and salable meat (Ricardo *et al.* 2016). However, there is not information for growth in hair sheep crossbred. The aim of this study was to analyze the relationship of the growth of hair sheep crossbred with some zoometric measures.

## MATERIALS AND METHODS

### Location

This study was conducted on a commercial farm in the municipality of Ocaña, Norte de Santander, Colombia, at 1270 meters above sea level, having average temperature of 22 ˚C.

### Data collection and animal management

Weighing records of 18 crossbred sheep (Rizwana *et al.* 2016) from heterogeneous creole ewes crossed with males of Creoles, Dorper and Blackbelly were analyzed, with an average of 14.7 ± 3.14 kg initial body weight. When the weight was established, then measured thoracic perimeter (PT), as the circumference at the height of the heart; perimeter cane (PC) as the circumference at the midpoint of the rod; body length (LCO), as the length from the front of the shoulder to the back of the ischium; neck length (LCU), from the first cervical vertebra to the last; hip amplitude (AC), the distance between the outer faces of the two coxal tuberosities; Ischia amplitude (AI), distance between the outer faces of the two ischial tuberosities; height at the withers (ALC), distance from the floor to the highest point in the insertion of the shoulders and rump height (ALG), distance from the floor to the highest point of the hip. All zoometric measures were taken in centimeter, perimeters using a tape measure and other measures with a measuring stick. Within 60 days of the initial weighing and taking the measures zoometric animals were weighed again and the average daily gain (ADG) was estimated. The animals were grazed during the day and confined at night. They were supplemented with mineralized salt.

### Statistical analysis

The data were subjected to correlation analysis and multiple regression. The fit of the model was evaluated according to the Akaike information criterion (AIC). The data analysis was performed using the SAS program REG package (SAS, 2002).

## RESULTS AND DISCUSSION

Table 1 shows the means of the variables analyzed. At 60 days of fattening two animals showed no weight gain and were not taken into account in the following analysis because it is indicative of the presence of subclinical health problems (Sandoval *et al.* 2007).

The observed average daily gain was close to that reported by Carneiro *et al.* (2010) for the Colombian native breed of wool and the Colombian Red in system of extensive management, but lower than that reported for Blackbelly (BB), Dorper (D) and Santa Ines, although in the case of races D and Santa Ines managed in intensive and semi-intensive systems, respectively.

Moderate variation was observed for zoometric measures, corresponding to that observed in Uruguayan Creole sheep (Mernies *et al.* 2007), indicating that disputethe heterogeneous racial composition was homogeneous group in conformation.

Most zoometric variables showed high correlations with each other (r>0.7), the lowest correlations were presented with the AC. Correlations with ADG were also observed low (r<0.3) with exception of PT and LCO and in case of the PC, the correlation was negative. These results are shown in Table 2.

The high correlations observed between zoometric variables and PI correspond with previous results in sheep, was reported in the Shugor breed, where most relationships between body weight of the animal and the PT was observed (Musa *et al.* 2012) and those observed in Katahdin (K), D, BB and Pelibuey (P) breeds where most zoometric measures related to the initial and final live weight. However, in that work, body length (LCO) was the only measure that was not different between races and was not related to BW in the race.

Instead, they observed that the abdominal circumference (PA) was in line with the body size. In a similar way, they found that waist circumference was poorly related to the BW on race D (heavier lambs), but strongly related to BW in K, P (light lambs) and BB (lighter lambs).

Overall, they observed differences between races for the values of the correlations of measures zoometric with growth characteristics, indicating differences in growth, according to race (López-Carlos *et al.* 2010). Similar observations to those made in three types of breeds of sheep of Burkina Faso, which measures the perimeter of the nose, the length of the head, tail length, the length of the ears, body length, depth chest and height at withers showed significant differences for all races (Traoré *et al.* 2008). These differences between races contrast with the results in this study because despite the racial heterogeneity of the animals studied correlations of zoometric measures and PI were high. In Brazil, in the Santa Inés sheep breed, evaluating the rate of structural frame or as frame size index (FSI), which is calculated taking into account the height, length and weight of the animal, could see similar results in this study, since animals with higher initial FSI they had higher final weight, indicating a positive correlation between body weight and shape.

**Table 1** Summary of zoometric measures and weight of the sheep

| Variable | N | Means | SD |
|---|---|---|---|
| PT, cm | 16 | 58.544 | 4.705 |
| PC, cm | 16 | 6.069 | 0.574 |
| LCO, cm | 16 | 46.056 | 3.616 |
| AC, cm | 16 | 9.725 | 1.714 |
| AI, cm | 16 | 12 | 1.610 |
| LCU, cm | 16 | 18.163 | 2.267 |
| ALC, cm | 16 | 52.213 | 4.392 |
| ALG, cm | 16 | 51.713 | 3.881 |
| PI, kg | 16 | 15.119 | 3.225 |
| ADG, g/d | 16 | 59.479 | 25.471 |

PT: thoracic perimeter; PC: perimeter cane; LCO: body length; LCU: length neck; AC: amplitude hip; AI: amplitude of Ischia; ALC: height at the withers; ALG: height at the croup; PI: initial weight and ADG: average daily gain.
SD: standard deviation.

**Table 2** Pearson correlation coefficients for the variables analyzed

| Variable | PI | PT | PC | LCO | AC | AI | LCU | ALC | ALG | ADG |
|---|---|---|---|---|---|---|---|---|---|---|
| PI | - | - | - | - | - | - | - | - | - | - |
| PT | 0.834 | - | - | - | - | - | - | - | - | - |
| PC | 0.580 | 0.621 | - | - | - | - | - | - | - | - |
| LCO | 0.752 | 0.704 | 0.671 | - | - | - | - | - | - | - |
| AC | 0.198 | 0.173 | 0.514 | 0.241 | - | - | - | - | - | - |
| AI | 0.896 | 0.765 | 0.720 | 0.725 | 0.488 | - | - | - | - | - |
| LCU | 0.826 | 0.643 | 0.432 | 0.505 | 0.271 | 0.788 | - | - | - | - |
| ALC | 0.836 | 0.562 | 0.362 | 0.617 | 0.148 | 0.809 | 0.712 | - | - | - |
| ALG | 0.808 | 0.541 | 0.511 | 0.723 | 0.233 | 0.771 | 0.570 | 0.882 | - | - |
| ADG | 0.287 | 0.410 | -0.094 | 0.343 | 0.080 | 0.184 | 0.138 | 0.170 | 0.053 | - |

PI: initial weight; PT: thoracic perimeter; PC: perimeter cane; LCO: body length; LCU: length neck; AC: amplitude hip; AI: amplitude of Ischia; ALC: height at the withers; ALG: height at the croup and ADG: average daily gain.
SD: standard deviation.

They also obtained similar results in the carcass, where heavier carcasses observed in animals with higher FSI, but this effect was not observed it when analyzed as carcass yield (Souza *et al.* 2013). Furthermore, the weight of salable meat showed high correlation with external carcass length, rump perimeter, carcass width, thoracic depth and leg perimeter in lambs; for BW the results were similar (Ricardo *et al.* 2016).

The results of this study are also similar to those observed by Legaz *et al.* (2011) characterizing the Assaf.E sheep in Spain, where the thoracic circumference was the variable with the highest correlation coefficient in both males and females (83 and 85%, respectively) with the size of the animal, on the contrary, measures ears, which were not analyzed in this study, showed to be independent of the size of the animal.

The results of this study are in corroboration with those of Tatum *et al.* (1998a) evaluating the classification by the conformation of lambs and five diets as they observed that animals with higher conformation (CoA) had a higher body length and height at the withers, that visually classified as low conformation (CoB) and average (Com). In a similar way, high conformation animals had higher initial and final weight.

In the case of ADG, correlation coefficients of ADG with zoometric measures were middle for PT and LCO, with other variables were low and the PC a negative correlation was observed. These results are similar to those observed in lambs D, K, P and BB of 4.7 months old. K (28 kg BW) was observed positive and significant correlations for LC, PA, PMC, amplitude pectoris (AMP), the perimeter of the metatarsal (PMT), thoracic perimeter (PT), neck circumference (PCU) and carpo perimeter (PCA). And P (29 kg BW) for this age where the only variable body conformation with positive correlation with ADG and consumption was the PA. At 7.6 months of age significant positive correlations between the variables of growth and body conformation for BB (ALC, PT, PA, AMP and PCU), D (ALA, PA and PMC), K (LCO, PA were observed, PT and PCA) and PA for P (López-Carlos *et al.* 2010). The results of this study were contrary to those seen at 4.7 months of age in D (38 kg live weight) where the PC was positively correlated with growth variables (ADG, consumption and EA). The other body measurements had negative or no significant relationships.

In a similar way, BB (23 kg LW) no positive correlations were observed between body measurements and ADG (López-Carlos *et al.* 2010).

The results of this study are in the same direction of Tatum *et al.* (1998a), where the average daily gain (ADG) was observed, which was higher in animals CoA than in the CoB, except in the diet high in concentrate with high protein (80% and 14.5%, respectively) in which no differences were observed. In addition, diets low inclusion of concentrated (30%), middle inclusion concentrates with low protein (55% and 12.5%, respectively) and mean inclusion of concentrate with high protein (55% and 14.5% respectively) the CoA animals had a higher weight gain than CoM animals.

In the two diets high in concentrate (80%), regardless of the protein level (12.5 and 14.5%) the ADG was similar in animals CoA and CoM. These results were similar for animals CoM and of CoB, which had an equal ADG in most diets except for the two high concentrate diets, which highlights the relationship between growth and food. Moreover, König *et al.* (2017) in Red Maasai, Dorper breeds and their crosses observed that the live animal measures (LCO and PT) were shown to significantly predict the growth rate.

Finally, the results of this study are contrary to those seen in the Santa Ines race by Souza *et al.* (2013) which found no relationship between the FSI and ADG as the ADG was not different between the high and low FSI, despite having a difference of 40.7 g/d (304.1 g/d to 263.4 g/d).

Predictive models of initial weight with lower AIC according to the number of variables taken into account are summarized in Table 3. According to the AIC, the best-fitting model (AIC=0.18) was the model that took into account PT, LCU and ALG. These results are consistent with previous results in Shugor, where it was observed that the model with the highest coefficient of determination took into account PT and ALG, however, did not take into account LCO, but ALC; also exchange value for each centimeter increase in PT is 0.42 kg, less than that observed in the present study, otherwise to that observed for ALG where the value of 0.35 kg is similar to that observed in the present study (Musa *et al.* 2012).

ADG predictive models with the lowest AIC according to the number of variables taken into account are summarized in Table 4; the intercept was not significant (P>0.05) so the models without Intercepts were chosen. Only for informational purposes models with fewer variables are presented, although they showed AIC values greater, as they could be useful to have fewer variables despite the loss adjustment. According to the AIC, the best-fitting model (AIC=96.8) to describe the growth of the sheep was the one that took into account five predictor variables, which involved PT, PC, LCO, AC and ALG.

These results are similar to those obtained by Musa *et al.* (2012) who observed that the PT was the variable most predictive weight of the Shugor sheep. But they are contrary to those observed at 4.7 months of age in K, D, P and D, where the PT was not the variable with the highest positive correlation; and also observed in D to this age, where the PC was positively related to ADG (López-Carlos *et al.* 2010), while in the model developed in this study shows a negative relationship, but similar to for PT in K and BB to 7.6 months of age, where showed a positive correlation (López-Carlos *et al.* 2010).

Moreover, this model is also consistent with the results of Tatum *et al.* (1998a) in which animals with greater length and greater height (CoA) had better ADG. However are contrary to those observed in Santa Ines sheep where the formation did not affect ADG. Therefore, the zoometric measures provide information on the characteristics of animals, which has proven it is essential to improve productivity of sheep (Alves *et al.* 2003).

Moreover, Bautista-Diaz *et al.* (2017) observed that biometric measurements can improve the accuracy and precision of the predictions to selection programs and to assist decision support systems. In that sense, it is given the high heritability that presents the ADG (Sinha and Singh, 1997), can be selected animals with higher ADG predicted, according to its shape using the proposed model, seeking to improve productivity and profitability of the farm.

**Table 3** Predictive models of body weight (BW) according to the zoometric measures

| N. variables | Model | P | $R^2$-aj | AIC |
|---|---|---|---|---|
| 1 | BW (kg)= -6.41 + 1.7 × AI | < 0.0001 | 0.79 | 14.4 |
| 2 | BW (kg)= -26.8 + 0.36 × PT + 0.39 × ALC | < 0.0001 | 0.88 | 6.8 |
| 3 | BW (kg)= -26.8 + 0.27 × PT + 0.49 × LCU + 0.33 × ALG | < 0.0001 | 0.92 | 0.2 |

PT: thoracic perimeter; LCU: length neck; AI: amplitude of Ischia; ALC: height at the withers; ALG: height at the croup and and AIC: Akaike information criterion.

**Table 4** Predictive models of ADG according to the zoometric measures

| N. variables | Modelo | P | $R^2$-aj | AIC |
|---|---|---|---|---|
| 1 | ADG (g/d)= 1.02 × PT | < 0.0001 | 0.86 | 102.5 |
| 2 | ADG (g/d)= 3.8 × PT – 21.1 × PC | < 0.0001 | 0.89 | 99.5 |
| 3 | ADG (g/d)= 4.03 × PT – 36.6 × PC + 4.74 × AC | < 0.0001 | 0.9 | 99.6 |
| 4 | ADG (g/d)= 2.98 × PT – 32.5 × PC + 5.03 × LCO – 2.9 × ALG | < 0.0001 | 0.91 | 98.7 |
| 5 | ADG (g/d)= 3.3 × PT – 44.4 × PC + 5.4 × LCO + 5.6 × AC – 3.3 × ALG | < 0.0001 | 0.92 | 96.8 |

PT: thoracic perimeter; PC: perimeter cane; LCO: body length; AC: amplitude hip; ALG: height at the croup; ADG: average daily gain and AIC: Akaike information criterion.

Previously it has been observed that the ADG is one of the determining factors of production and productivity in fattening lambs and is the most practical approach to indirectly improve production efficiency in lambs (Snowder and Van Vleck, 2003).

## CONCLUSION

In conclusion, zoometric measures are an important tool for predicting the growth of crossbred sheep and can be used to select animals with better production characteristics that result in increased production, productivity and profitability of the farm.

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## REFERENCES

Alves K.S., Carvalho F.F.R., Verás A.S.C., Ferreira M., Costa R.G., Vieira A.M., Nunes A., Souto R.J. and Bezerra D.K. (2003). Níveis de energia em dietas para ovinos Santa Inês: Desempenho. *R. Bras. Zootec.* **32,** 1937-1944.

Bautista-Díaz E., Salazar-Cuytun R., Chay-Canul A.J., Herrera R.A.G., Piñeiro-Vázquez Á.T., Monforte J.G.M. and Tedeschi L.O. (2017). Determination of carcass traits in Pelibuey ewes using biometric measurements. *Small Rumin. Res.* **147,** 115-119.

Burke J.M., Apple J.K., Roberts W.J., Boger C.B. and Kegl ey E.B. (2003). Effect of breed-type on performance and carcass traits of intensively managed hair sheep. *Meat Sci.* **63,** 309-315.

Carneiro H., Louvandini H., Paiva S.R., Macedo F., Mernies B. and McManus C. (2010). Morphological characterization of sheep breeds in Brazil, Uruguay and Colombia. *Small Rumin. Res.* **94,** 58-65.

De Haas Y., Janss L.L.G. and Kadarmideen H.N. (2007). Genetic and phenotypic parameters for conformation and yield traits in three Swiss dairy cattle breeds. *J. Anim. Breed. Genet.* **124(1),** 12-19.

Haldar A., Prasenjit Pal M., Datta Rajesh P., Saumen K.P., Debasis Majumdar C., Biswas K. and Subhransu P. (2014). Prolificacy and its relationship with age, body weight, parity, previous litter size and body linear type traits in meat-type goats. *Asian-Australasian J. Anim. Sci.* **27(5),** 628-634.

König E.Z., Ojango J.M.K., Audho J., Mirkena T., Strandberg E., Okeyo A.M. and Philipsson J. (2017). Live weight, conformation, carcass traits and economic values of ram lambs of Red Maasai and Dorper sheep and their crosses. *Trop. Anim. Health Prod.* **49(1),** 121-129.

Legaz E., Cervantes I., Perez-Cabal M.A., de la Fuente L.F., Martinez R., Goyache F. and Gutierrez J.P. (2011). Multivariate characterisation of morphological traits in Assaf (Assaf. E) sheep. *Small Rumin. Res.* **100,** 122-130.

López-Carlos M.A., Ramírez R.G., Aguilera-Soto J.I., Aréchiga I.C.F. and Rodríguez H. (2010). Size and shape analyses in hair sheep ram lambs and its relationships with growth performance. *Livest. Sci.* **31,** 203-211.

MacNeil M.D. and Mott T.B. (2006). Genetic analysis of gain from birth to weaning, milk production and udder conformation in line 1 Hereford cattle. *J. Anim. Sci.* **84,** 1639-1645.

Mernies B., Macedo F., Filonenko Y. and Fernández G. (2007). Zoometric indices in a sample of Uruguayan creole ewes. *Arch. Zootec.* **56(1),** 473-478.

Musa A.M., Idam N.Z. and Elamin K.M. (2012). Regression analysis of linear body measurements on live weight in Sudanese Shugor sheep. *Online J. Anim. Feed Res.* **2(1),** 27-29.

Ricardo H.A., Roça R.O., Lambe N.R., Seno L.O., Fuzikawa I.S. and Fernandes A.M. (2016). Prediction of weight and percentage of salable meat from Brazilian market lambs by subjective conformation and fatness scores. *R. Bras. Zootec.* **45(10),** 639-644.

Rizwana H., Shahani F., Abro R., Naeem M., Rajput N., Memon M.I., Abro S.H., Baloch H., Kunbhar H.K., Mughal G.A. and Ali S.S. (2016). Comparative study on growth and conformation of male dumbi lambs under two management systems. *J. Basic Appl. Sci.* **12,** 275-280.

Rocha L., Venció R., Oliveira J., Ribeiro M. and Delgado J. (2007). Estimation of morphoestructural traits in Moxoto breed goats. *Arch. Zootec.* **56(1),** 483-488.

Sandoval E., Morales G., Jiménez D., Pino L. and Márquez O. (2007). Efecto de tratamientos antiparasitario y antianémico sobre la ganancia de peso e indicadores hematoquímicos en ovejas tropicales infectadas en condiciones naturales. *Zoo. Trop.* **25(4),** 285-290.

SAS Institute. (2002). SAS®/STAT Software, Release 9.2. SAS Institute, Inc., Cary, NC. USA.

Sinha N. and Singh S. (1997). Genetic and phenotypic parameters of body weights, average daily gains and first shearing wool yield in Muzaffarnagri sheep. *Small Rumin. Res.* **26,** 21-29.

Snowder G. and Van Vleck L. (2003). Estimates of genetic parame ters and selection strategies to improve the economic ef ficiency of postweaning growth in lambs. *J. Anim. Sci.* **81,** 2704-2713.

Souza E., Sousa W., Pimenta E., Gonzaga S., Cartaxo F., Cezar M., Cunha M. and Pereira J. (2013). Effect of frame size on performance and carcass traits of Santa Inês lambs finished in a feedlot. *R. Bras. Zootec*. **42(4),** 284-290.

Tatum J., DeWalt M., LeValley S., Savell J. and Williams F. (1998a). Relationship of feeder lamb frame size to feedlot gain and carcass yield and quality grades. *J. Anim. Sci.* **76,** 435-440.

Tatum J., Samber J., Gillmore B., LeValley S. and Williams F. (1998b). Relationship of visual assessments of feeder lamb muscularity to differences in carcass yield traits. *J. Anim. Sci.* **76,** 774-780.

Traoré A., Tamboura H., Kaboré A., Royo L., Fernandez I., Alvarez I., Sangaré M., Bouchel D., Poivey J., François D., Toguyeni A., Sawadogo L. and Goyache F. (2008). Multivariate characterization of morphological traits in Burkina Faso sheep. *Small Rumin. Res.* **80(1),** 62-67.

Vatankhah M. and Talebi M. (2008). Genetic parameters of body weight and fat-tail measurements in lambs. *Small Rumin. Res.* **75(1),** 1-6.

Zhang L., Wu P., Xuan C., Liu Y. and Wu J. (2016). Advances in body size measurement and conformation appraisal for sheep. *Transac. CSAE.* **32(1),** 190-197.