Phenotypic Characterization of Angus Grade - Black Cattle from Sragen District

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ABSTRACT

Angus Grade - Black Cattle is one result of the artificial insemination (AI) program that is able to grow and adapt to tropical conditions, particularly in Sragen district. The aim of this study was to identify the relationship among body measurements in Angus Grade - Black Cattle. We analyzed the phenotype of Angus Grade - Black Cattle which as a result of a crossing between possibly consists of some Indonesian local cattle and Abeerden Angus Cattle. A total of 100 cows were used. The parameters recorded were: body length (BL), withers height (WH), rump height (RH), rump length (RL), rump width (RW), heart girth (HG), shoulder width (SW), chest depth (CD), hips width (HW), face length (FL), face width (FW), ear length (EL), ear width (EW) and tail length (TL). The results showed that the mean body weight (BW) was 407,742 kg while the body measurements were 129,213 cm (BL), 125,131 cm (WH), 133,940 cm (RH), 34,235 cm (RL), 13,854 cm (RW), 170,287 cm (HG), 41,228 cm (SW), 68,382 cm (CD), 47,377 cm (HW), 46,624 cm (FL), 21,676 cm (FW), 24,473 cm (EL), 15,744 cm (EW), 120,207 (TL) respectively. The highest correlation was obtained between HG-BW while the correlation between WH-BW was observed to be the least. There were six models of equation for predicting live body weight, the components were extracted explaining for the total variation of each model were 88,6 %, 1,7 %, 0,9 %, 0,8 %, 0,7 %, 0,6 % respectively of the variability in live body weight when all the body measurements were used in the equation. The body measurements could be used as selection criteria for improving body weight of Angus Grade - Black Cattle. Angus Grade - Black Cattle can be used for the breeding program as beef cattle.
Keywords: phenotypic characterization, body measurements, Angus Grade - Black Cattle

INTRODUCTION

Angus Grade - Black Cattle that grows in Sragen regency was a result of the crossing between possibly consists of some Indonesian local cattle and Aberdeen Angus cattle. Angus cattle used are frozen straws which are used in the introduction of artificial insemination since 1970. The development of Angus Grade - Black Cattle was very good and favored by the breeder because of the ability to digest poor quality feed. Angus Grade - Black Cattle has good adaptability and reproductive ability. The phenotypic appearance of an Angus Grade - Black Cattle is very distinctive and has a special character that is not owned by other cattle breed.

Phenotypic characterization is used to identify and document diversity within and between distinct breeds, based on their observable attributes (FAO 2012). It is important to have knowledge of the variation of morphometric traits in local genetic resources as such measurements have been discovered to be very useful in comparing body size and by implication, the shape of animals. Body dimensions have been used to indicate breed, origin, and relationship or shape and size of an individual, height at withers as a prime indicator of their type. Morphology expresses a strong relationship with productive potential since it contains the structure which supports the biological functionality of the animal (Alpak et al. 2009).

It is important to have knowledge of the variation of morphometric traits in local genetic resources as such measurements have been discovered to be very useful in comparing body size and by implication, shape of animals (Latshaw and Bishop, 2001). It is the diversity in genetic characteristics that enable different animal races to survive in different climatic zones of the world (Yunusa et al. 2013). Angus Grade - Black Cattle has an excellence in the tropical environment. Body measurements are one of the important criteria in the selection of elite animals. The body conformation and relationships among different body measurements to define which of these measures best represent body conformation and to formulate suitable breeding policy for improvement of Angus Grade - Black Cattle productivity. Analysis of variance and correlations are used to obtain relationships among different body measurements. Principal component analysis, a multivariate procedure could be a leeway to solving problems associated with univariate analysis of growth and related traits. This is due to its ability to reduce related variables into lesser number of uncorrelated variables called principal components. the components will be arranged in such a way that the first few components will retain most of the variations existing in the original variables (Udeh and Ogbu, 2011). Therefore phenotypic and morphometric traits need to be studied to provide technical information about Angus Grade - Black Cattle.

MATERIAL AND METHODS

Collecting data of Morphostructural Traits

The experiment made use of a random sample of 62 Angus Grade - Black Cattle of female sexes. The animals were more than four years old as determined by dentition. They were reared through the extensive management system and originated from different herds sampled in Sragen District in Central Java, Indonesia. Efforts were made to restrict sampling to phenotypically pure Angus Grade - Black Cattle respectively by measuring only those that conformed to the classification descriptors of the breed.

Body weight (BW) of individual cattle was measured using a digitally weigh scale of 1.000 kg with a precision of 500 g. Fourteen morpho metric traits were measured on each animal. The parts measured were, body length (BL), measured from distance from the point of the shoulder joint to the point of the pin bone; withers height (WH), distance from the highest point of wither to the ground; rump height (RH), the distance from the highest point of rump to the ground; rump length (RL), measured from hips (*Tuber coxae)* to pins (*Tuber ischia)*; rump width (RW), measured as the distance from left pins (*Tuber ischia)* to right pins (*Tuber ischia)*; heart girth (HG), measured as body circumference just behind the forelegs; shoulder width (SW), measured as the distance from left to right upper arm (pars cranial of the tuberculum majors humeri); chest depth (CD), the distance from the highest point of whether to the chest bone just behind the forelegs; hips width (HW), measured as the distance from left hips (*Tuber coxae)* to right hips (*Tuber coxae)*; face length (FL), distance from between the horn site to the lower lip; face width (FW), the Distance between front of both the eyes; ear length (EL), distance from the point of attachment to the tip of the ear; ear width (EW), the Circumference of ear at the mid ear. tail length (TL), measured from the tail drop to the tip of the tail including hair of tail; The height measurement (cm) was done using a graduated measuring stick. To achieve this, animals were placed on a flat ground and held by two field assistants. The length and circumference measurements (cm) were effected using a tape rule while the width measurements (cm) were taken using a calibrated wooden caliper. All measurements were car ried out by the same person in order to avoid between individual variations.

Data Analysis

The morphological traits were subjected to analysis of means, standard errors and coefficient of variation of body weight and body measurements of the cattle. Pearson correlation coefficients among the body measurements were calculated and the stepwise multiple regression procedures were used to obtain models for predicting body weight from body measurements (a) and from factor scores (b).

BW = $a + B_1X_1 + \ldots + B_kX_k$ (a)

BW = $a + B_1FS_1 + \ldots + B_kFS_k$ (b)

Where, BW is the body weight, a is the regression intercept, B_1 is the ith partial regression coefficient of the ith linear body measurement (X_1) or the ith factor scores (FS). The analysis was obtained using IBM SPSS Statistic 20.

RESULTS DISCUSSION

Phenotype base on the Morphostructural Traits

Table 1 shows the descriptive statistics for body weight and body measurement traits of Angus Grade - Black Cattle. The skeletal dimensions of BW, WH, RL, RW, CW, HW, FL, EL, TL, were more variable (coefficient of variation ranged from 10,3 to 18,8 %) compared to BL, RH, HG, CD, FW, EW, (coefficient of variation ranged from 4,2 to 9,3%).

Table 1. Mean standard deviation (SD) and coefficient of variation (CV %) for live body weight and body measurements of Angus Grade - Black Cattle

No	Parameter	Mean	SD	CV
1.	BW (kg)	407,742	76,802	0,188
2.	BL (cm)	129,213	9,182	0,071
3.	WH (cm)	125,131	17,139	0,137
4.	RH (cm)	133,940	5,644	0,042
5.	RL (cm)	34,235	3,767	0,110
6.	RW (cm)	13,854	2,019	0,146
7.	HG (cm)	170,287	10,308	0,061
8.	SW (cm)	41,228	4,896	0,119
9.	CD (cm)	68,382	5,994	0,088
10.	HW (cm)	47,377	5,316	0,112
11.	FL (cm)	46,624	4,792	0,103
12.	FW (cm)	21,676	1,648	0,076
13.	EL (cm)	24,473	2,858	0,117
14.	EW (cm)	15,744	1,460	0,093
15	TL (cm)	120,207	19,758	0,164

Patterns of development are useful in the assessment of conformation (Salako 2006). The estimates for body length, height at withers and heart girth were in close agreement with the reports of Pundir et al. (2007a; 2007b), Singh et al. (2008). Facial and head differences are very important from an ethnological point of view in breed identification, the ethnological differences, are the basic concepts on the foundation of a breed (Sierra Alfranca 2001). Withers height is useful for visual appraisal and determining show classes for beef cattle (Alderson, 1999). Morphometric traits are used to characterize the different breeds of livestock as they give an idea of body conformation (Pundir et al. 2011).

Morphostructure provides information susceptible to be used for ethnological characterization of an animal population and allows a judgment of the productive potential based on the implicit mechanical relationships within the morphologic structure (Yakubu et al. 2010). If the relationship is not considered, it would imply that appropriate productive life adaptation models would not be right (Alpak et al. 2009). The body measurements related to meat value (rump length, chest width, heart girth), these morph structural changes are related to changes in the productive performance of the animal format; therefore, in the sustained selection process, not only changes in ethnological traits are involved, but also productive traits (Yakubu 2010, Yakubu et al. 2010a; 2010b). Performance, especially with regards to meat production, can be assessed from body measurements that are less closely associated with bone growth.

Table 2. Correlation coefficients between live body weight and body measurements of Angus Grade - Black Cattle

	BW	BL	WH	RH	RL	RW	HG	SW	CD	HW	FL	FW	EL	EW	TL
BW	1														
BL	0,583**	1													
WH	0,001	0,093	1												
RH	0,576**	0,701**	0,184	1											
RL	0,720**	0,657**	-0,061	0,587**	1										
RW	0,382**	0,215	0,040	0,335**	0,474**	1									
HG	0,941**	0,506**	-0,024	0,531**	0,661**	0,455**	1								
SW	0,668**	0,473**	0,187	0,404**	0,550**	0,534**	0,660**	1							
CD	0,454**	0,342**	0,024	0,298*	0,324*	0,358**	0,461**	0,486**	1						
HW	0,371**	0,346**	0,088	0,430**	0,447**	0,274*	0,359**	0,242	0,201	1					
FL	0,304*	0,103	0,087	0,290*	0,127	0,001	0,296*	-0,025	-0,015	0,235	1				
FW	0,594**	0,598**	-0,044	0,544**	0,508**	0,328**	0,521**	0,457**	0,364**	0,187	0,145	1			
EL	0,066	0,081	-0,136	0,153	0,152	0,058	0,149	-0,128	0,090	0,299*	0,297*	0,057	1		
EW	0,350**	0,504**	-0,041	0,440**	0,442**	0,480**	0,365**	0,342**	0,267*	0,340**	0,142	0,562**	0,424**	1	
TL	0,085	0,182	0,019	0,306*	0,010	0,232	0,029	0,214	0,167	0,062	0,061	0,137	0,024	0,111	1

**. Correlation is significant at the 0.01 level.
*. Correlation is significant at the 0.05 level.

The coefficient of correlation between body weight and body measurements of Angus Grade - Black Cattle is presented in Table 2. The correlation ranged from r = -0,136 to r = 0,941. The relationships between body weight and all the body measurements majority was positive, there are only eight were negative (-0,015 (FL-HW), -0,024 (HG-WH), -0,025 (FL-HG), -0,041 (EW-WH), -0,044 (FW-WH), -0,061 (RL-WH), -0,128 (EL-HG), -0,136 (EL-WH)). There are 10 relationships which were highly significant (P<0.01), 48 relationships which were significant (P<0.05) and 39 relationships which were no significant. The highest correlation was obtained between HG-BW while the correlation between WH-BW was observed to be the least.

Significant differences in different body measurement traits due to age and sex reported by Pundir et al. (2007a; 2007b; 2007c; 2008), Singh et al. (2008) and Yakubu et al. (2009). Such comparison could be used as the basis for selection and improvement programmers. Growth is controlled by both genetic and non-genetic factors (Kor et al. 2006). Morphological descriptions are useful for distinguishing animal breeds and strains (Gatesy and Arctander, 2000) and in evaluation of breeding goals (Zechner et al., 2001). Comparative measurements of morphometric traits can also provide evidence of breed relationships and size (Mwacharo et al., 2006) and in some cases can be used to predict an animals' weight (Goe, Alldredge and Light, 2001; Mwacharo et al., 2006).

Live body weight base on the original body measurements

Body weight related highly with most of the original body measurements of Angus Grade - Black Cattle. This is suggestive of their possible usage (i. e. the body measurements) in the prediction of body weight in Angus Grade - Black Cattle. This is because an increase in any of the body measurement will invariably lead to a corresponding increase in the body weight of Angus Grade - Black Cattle. The strong relationship existing between body weight and most of the original body measurements may be useful as a selection criterion. This is because correlated traits are more likely to be governed by the same gene action.

Table 3. Multiple regressions (stepwise) of live body weight (kg) on original body measurements of Angus Grade - Black Cattle

Step	Predictor	Intercept	Regression coefficient	SE	R^2
Original body measurements as independent variables					
1	HG	-786,399	7,013	26,169	0,886
2	HG	-761,999	6,160	24,368	0,017
	RL		3,527		
3	HG	-805,149	5,890	23,506	0,009
	RL		2,871		
	FW		5,146		
4	HG	-808,528	6,081	22,506	0,008
	RL		3,516		
	FW		5,449		
	RW		-4,164		
5	HG	-766,023	6,151	21,695	0,007
	RL		3,723		
	FW		5,249		
	RW		-4,271		
	EL		-2,278		
6	HG	-793,549	6,206	21,021	0,006
	RL		3,978		
	FW		4,630		
	RW		-5,151		
	EL		-2,354		
	TL		0,307		

SE: standard error of estimate; R^2 = coefficient of determination

The results of regression analysis for predicting live body weight from the fifteen interdependent body measurements of Angus Grade - Black Cattle showed that The components were extracted explaining the total variation of each models of equation were 88,6 % (model 1), 1,7 % (model 2), 0,9 % (model 3), 0,8 % (model 4), 0,7 % (model 5), 0,6 % (model 6) respectively of the variability in live body weight when all the body measurements (BL, WH, RH, RL, RW, HG, SW, CD, HW, FL, FW, EL, EW, TL) were used in the equation. Weighing is not always feasible and therefore live weight is often estimated from easily accessible morphometric data (Mutua et al. 2011). For genetic improvement, principal components simultaneously consider a group of attributes which may be used for selection purpose. In genetic terms, every ecological niche (i.e. ecological zone or environment) is governed by its own peculiar variability.

CONCLUSION

This study revealed the interdependency of the fourteen original body measurement characters on each other. The analysis was discovered to be a more appropriate means of predicting live body weight in Angus Grade - Black Cattle showed than the use of the original interrelated traits measured. The body measurement of heart girth, rump length, face width, rump width, ear length, and tail length could be used as selection criteria for improving body weight of Angus Grade - Black Cattle showed. The body measurements could be used as selection criteria for improving body weight of Angus Grade - Black Cattle. Angus Grade - Black Cattle can be used for the breeding program as beef cattle.

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