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The Relative Superiority of Crossbred Using Friesian Holstein Hybrid Cement Bull to Local Ongole Hybrid Cattle

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ABSTRACT

The purpose of this study was to analyze the relative superiority of crossbred to local Ongole hybrid (PO) cattle. This research was carried out for 18 months in the Konawe Selatan, and Kolaka Timur Regency, Southeast Sulawesi Province. The number of cows used was 48 cows, and the cement used was Friesian Holstein Hybrid (PFH) Cement and Ongole hybrid (PO) Cows from BBIB Lembang. Data were analyzed by the general linear model (General Liner Model) with the source of diversity was genotype and sex of calf. Based on the results of the study concluded that the crossbred calf has a relatively high relative advantage over local Ongole hybrid cattle with an average value of 7.76-11.28%. The crossing of Friesian Holstein Hybrid (PFH) cows with Ongole hybrid (PO) parents resulted in offspring with PFPO genotype with an average relative superiority value (for all parameters) of 11.28%, higher than the PFS genotype of 7.65% and PFL of 9.60%. The Result of this crossing increases meat production, and it is recommended to crossbreed PFH cows with PO mothers; however, they still consider their suitability to the local environment and the purity of local PO cows.
Keywords: Crosses, Relative Advantages, Body Weight, Body Dimension

I. INTRODUCTION

Ongole hybrid (PO) cattle are a breed of cattle from Sumba Ongole cows with local Javanese cows. This cow has been used as one of the domestic animals in Indonesia (Subiharta and Sudrajad, 2013). Some of the advantages of local livestock that are quite prominent are having high levels of reproduction and adaptability to poor environmental conditions, for example, high temperatures and humidity, being able to utilize low-quality fiber feed, resistant to disease and can be used as work animals and fertilizer producers for the community. Desinawati and Isnaini 2010; Nuryadi and Wahjuningsih 2011; Siswanto et al. 2013; Yulyanto et al. 2014).

Konawe Selatan and Kolaka Timur Regencies are PO cattle development areas in Southeast Sulawesi, especially in transmigration settlement locations. The transmigration community in this area is accustomed to raising PO cows intensively and semi-intensively. Generally, they only maintain the female cows, and the marriage of PO cows is done through artificial insemination (AI). According to Susilawati (2013), AI has been shown to have a positive impact on increasing population and improving the genetic quality of livestock.

In the last few years, the Southeast Sulawesi Regional Government, particularly the Animal Husbandry and Animal Health Service of

Konawe Selatan and Kolaka Timur Regencies, have used semen from exotic males for the implementation of AI in PO cattle. The aim is to increase the productivity of PO cows by improving genetic quality. Subiharta and Sudrajad (2013) and Rachmawati et al. (2018) states that the cross between local cattle and exotic cattle (Simmental and Limousine) aims to obtain the high birth weight of children and is followed by high selling prices. However, crossing with exotic cows is thought to cause a decrease in adaptability to the tropical environment and, if not controlled, can interfere with the purity of PO cows. The implementation of AI has produced several new genotypes, namely Peranakan Simental Ongole (PSO) and Peranakan limousine Ongole (PLO).

Lately, AI officials in the local area used semen from the Friesh Holland Hybrid (PFH) semen to inseminate the cows resulting from the crosses. It is hoped that this crossbreeding program can cover the deficiencies of each crossed livestock nation (Handley et al., 2015). This study aims to analyze the relative superiority of the results of crossing against local PO cattle.

II. MATERIALS AND METHOD

The research was carried out for 18 months in the Konawe Selatan, and Kolaka Timur Regency, Southeast Sulawesi Province. Cows used were 48 females that gave birth to healthy calves, consisting of 28 PO females, 10 PS females, and 10 PL females with a bodyweight range of 250-500 kg and age 4-8 years. The cement used was PFH cow cement and PO cement obtained from the Lembang Center for Artificial Insemination (BBIB). Of the 28 females, 18 of them were in AI with semen from PO, and two were 10 in AI with FH males. Calf from each parent observed body weight and dimensions of body dimensions from birth to 6 months of age.

The tools used in the AI process are Guns, plastic sheets, gloves, scissors, pin cages, and buckets. While the device used to measure production performance is the iconic fx series digital scales with a capacity of 1000 kg with a level of accuracy of 0.5 kg, tape meters, and rope to tie the calf to be weighed. During the study, cows were kept semi-intensively by breeders. The feed given is fresh forage that includes field grass, elephant grass, agricultural waste, and dry forage in the form of rice straw. Before the AI, all the parent brooders were synchronized using the hormone prostaglandin (PGF2α) gradually, and observations of lust were carried out by farmers and researchers. Mains of appetite are inseminated using Friesh Holland (FH) male semen, and PO and lustrous cows return after 21 days the first AI will be re-used with sperm from the same male until pregnancy.

The observed variables are:

1. Birth weights are weighed within 24 hours after birth.
2. Weaning weights (6 months old), which are considered every month until cattle are six months old.
3. Body dimensions (gumba height, body length, and chest circumference).
4. Heterosis, calculated according to (Spangler, 2007; Greiner, 2009; Wakchaure et al., 2015), namely: The average crossbred minus the average of the two elders at the same age divided by the percentage of the two elders, then multiplied by 100%, as follows:

$$\% \, Heterosis = [\frac{(Crossbred\ Average - The\ Parents\ Average)}{The\ Parent\ Average}] \, x \, 100\%.$$

This study did not maintain PFH bulls, so they could not calculate the average of the two elders, so the heterosis calculation was modified to a relative advantage with the following equation:

$$.\ a\ Relative\ Superiority\ (\%) = [\frac{(Crossbred\ Average - PO\ Average)}{PO\ Average}] \, x \, 100\%.$$

The data obtained were analyzed with a general linear model (General Liner Model) with the source of diversity of the parent nation (genotype) inseminated with male semen PFH and calf sex.

III. RESULTS AND DISCUSSION

Number of Observation Units

A total of 48 female cows with different breeds or genotypes each produce one calf, so there are 48 crossbred calves as the observation unit. A complete description of the calf data resulting from crossing can be seen in Table 1.

Table 1. Number of Calves Observed by Genotype and Gender

Male	Female Genotype	Calf Genotype	Calf Sex		
			Male	Female	Total
PO	PO	PO	8	10	18
	PO	PFPO	6	4	10
PFH	PS	PFS	4	6	10
	PL	PFL	5	5	10
		Total	**23**	**25**	**48**

Note: PO = Ongole Hybrid, PS = Simental Hybrid, PL = Limousin Hybrid

PFPO = FH and PO crosses, PFS = FH and Simental crosses, PFL = FH and Limousin crosses

Based on Table 1, it can be seen that male calves total 23, whereas females have 25. Meanwhile, based on genotype, calves consist of 18 local PO cows, 10 PFPO cows, 10 PFS cows, and 10 PFL cows.

Sources of Diversity

The causes of diversity in this study are the nation or genotype and gender. The significance of the influence of each source of diversity on body weight and body dimensions can be seen in Table 2.

Table 2. Effect of genotype and sex and their interactions on body weight and body dimensions

Parameter	age	Genotype Effect	Sex Effect	Interaction
Birth Weight	Born	*	*	ns
	Weaning	*	ns	ns
Chest circumference	Born	ns	ns	ns
	Weaning	*	ns	ns
Body Length	Born	ns	ns	ns
	Weaning	*	ns	*
Heigh of Gumba	Born	ns	ns	ns
	Weaning	ns	ns	ns

Note : * = Significant, ns = None significant

Table 2 explains that livestock genotypes have a significant effect on body weight (at birth and age 6 months), chest circumference at 6 months, body length at 6 months and gumba height at birth. Gender is only significant for calf birth weights. Meanwhile the interaction between genotype and sex was only significant to the length of the body at 6 months.

Relative Excellence

The relative superiority of the crossbred calf over local PO cattle based on body weight parameters and body dimensions are presented in Table 3.

Table 3. Relative Crossbred Advantages to local PO cattle based on body weight parameters and body dimensions.

Variable	**Age**	**Genotype**				Advantages of Relative Crosses Against Cows PO **(%)**		
		PO	**PFPO**	**PFS**	**PFL**	**PFPO**	**PFS**	**PFL**
Birth Weight	Born	27.37[a]	35.90[b]	35.90[b]	35.40[b]	31.17	31.17	29.34
	6 months	128.14[a]	163.00[c]	150.10[b]	164.10[c]	27.20	17.14	28.06
Chest circumference	Born	61.89	70.00	68.40	68.10	13.10	10.52	10.03
	6 months	109.13[a]	127.60[c]	120.50[bc]	124.80[bc]	16.92	10.42	14.36
Body Length	Born	60.00	64.60	61.30	62.60	7.67	2.17	4.33
	6 months	94.00[a]	109.40[c]	106.40[ab]	107.10[bc]	16.38	13.19	13.94
Heigh of Gumba	Born	70.00[a]	72.20[b]	71.40[b]	71.30[b]	3.14	2.00	1.86
	6 months	98.00	110.10	109.20	109.80	12.35	11.43	12.04
Average						**15.99**	**12.25**	**14.25**

In general, PO cow genotypes produce significantly inferior performance (P <0.05) on crossbred calves, both PFPO and PFL, and PFS, generally for bodyweight parameters and body dimension dimensions at six months. The crossbred genotype that produced the highest performance was PFPO (PO parent-offspring inseminated with FH male semen). The production of PFPO calves was significantly higher (P <0.05) than local PO calves and PFS (offspring from PO brooders who were IBed with FH male semen). This indicates that crossbred calves provide positive benefits for farmers. The level of crossbred benefits for farmers can be measured from the value of heterosis, which is the difference in the performance of the results of the trial (crossbred) to the average parent.

Considering that data on male elders (FH cattle) are not available, the level of crossbred benefits in this study was measured from the value of their relative superiority to local PO cows. The average relative superiority for all genotypes ranges from 11.43 - 15.99%. The PFPO crossbred calf has the highest average comparative advantage for all parameters, namely 15.99%, following the PFL 14.25%, and the lowest in the PFS calf 12.25%. When viewed per setting, the highest relative superiority occurred in PFL and PFPO calves for birth weights, respectively 31.17% and 31.17%.

DISCUSSION

Effect of Genotype

The results of this study indicate that the parent nation inseminated with male semen PFH is having a significant impact (P <0.05) on calf growth, both based on body weight parameters and body dimensions, such as gumba height, body length, and chest circumference. These results support previous research, as reported by Susanti et al. (2015), who observed the influence of the male nation on calf growth. Crossbreeding with artificial insemination between Balinese cows and Simmental, Limousine, Ongole, and Brahman breeds tend to produce calves with better performance as indicated by body dimensions such as height of the slave, body length, chest circumference, weight, and weight gain (Dominanto et al., 2016).

The differences in the parent nation in this cross produce differences in the appearance of body weight phenotypes and body dimensions. Rodrigues et al. (2014) reported that diversity of breeds and crosses in calf production systems results in differences in body weight, growth, and milk production due to heterosis effects. These differences can produce economic benefits, such as weaning weight (Rodrigues et al., 2014; Walmsley et al., 2016). However, crossbred cattle require better handling and thus increase production costs (Mendonca et al., 2019).

The crossing program in this study can produce better child performance compared to local (pure) PO cows. Improvements in body weight and body dimensions can be used as an indication of increased beef production in beef cattle. Thus, it can contribute to increase in beef production. Taylor and Field (2004) state that many meat producers use crossbreeding programs to benefit from heterosis concerning genetic improvement. Crossbreeding is an effective method to increase production efficiency in commercial cattle. However, it is necessary to understand the crossing system that will be applied and consider the advantages and disadvantages before deciding the form and level of crosses that are most suitable for the environment and available production facilities. Although it is essential to use crosses, it is even more important that the crosses are compatible with the conditions of the production environment and feed availability (Greiner, 2009). Several factors are considered in selecting breeds for use in the crossing system, including: (1) breeding objectives, (2) environmental conditions, (3) quantity and quality of feed, (4) cost and availability of superior seed stock, (5) how different breeds complement each other in crossbreeding programs, and (6) specific breed combinations that meet market demand.

Relative Excellence

Heterosis is the difference in phenotype between the average yield of crosses and their pure parents (Notter et al., 2013) and is the superiority of the results of the crosses over the average of their parents (Greiner, 2009). The calculation of heterosis requires the existence of a pure elder leader data that is kept together with the crossing offspring. This study did not maintain PFH male elders but only brought sperm to be used in the dissemination of PO, PS, and PL cows. In connection with this, the calculation of heterosis is adjusted to the existing conditions, by only calculating the superiority of crossbred over local (pure) PO cattle. The results showed the superiority of crossbred children from PO cows of the same age. Based on the accumulation of body weight parameters and body dimensions produced relative advantages of 7.76-11.28%. The highest relative superiority occurred in crossbreeding FH (PFH) males with PO parents, which resulted in crossbred children with PFPO genotype with an average comparative advantage for all parameters of 15.99%. In contrast, the PFS and PFL genotypes were only 12.25% and 14.25%.

The high superiority of crossbred with PFPO genotype is associated with high kinship distance between the two parents. FH cows come from Bos taurus, and PO cows come from Bos indicus. Meanwhile, the two elders from the PFS and PFL genotypes are both from Bos taurus. The genetic distance between the offspring of elders is very likely to affect heterosis. Increasing genetic distance between breeds will increase heterosis in crossing

(Bunning et al., 2019). This can be explained by assuming heterosis as the opposite of inbreeding pressures whose rigidity tends to below. The farther the relationship between the elders, the smaller the size of the deep cross depression, thus increasing the effect of heterosis. Blein-Nicolas et al. (2015) found that interspecies crossing (crossing with more genetically diverse parents) tended to show higher heterosis (78.8%) than intraspecies bridge (crossing with closer parents) (42.6 to 52.3%). The value of relative superiority in this crossing produces diversity in the observed parameters, both body weight, and body dimension measurements. The highest relative advantage was found in birth weight ranging from 29.34 - 31.17%, higher than the weight of 6 months of age, which was only 17.14 - 28.06%. In general, the relative superiority in body weight parameters is higher than the body dimensions. Bunning et al. (2019) reported that the type of traits and the combination of the types of crosses both had a significant effect on heterotic expression. Heterosis is found to be beneficial for a variety of properties that are economically important, including those related to stiffness such as fertility, and longevity

The relative advantages gained in this study include the height category for growth traits (body weight and body dimensions). Environmental conditions that do not support optimum growth, such as forage availability, low feed quality, high temperature, and humidity that are not suitable for exotic animals (FH, Limousine, and Simental cattle) are contributing to the high value of relative excellence. Generally, more extreme climates encourage more extreme effects of heterosis (Penasa et al., 2010), due to the increasing rigidity in the environment. Also, the high value of relative excellence in research does not fully reflect the effects of heterosis, because it is only compared to the local PO (pure breed) cattle. If you include exotic breeds, for example, the average birth weight of FH cattle (male and female) according to Aprily et al. (2016) and Sulistyowati et al. (2009) is 38.16 kg, then the average birth weight of pure elders is 32.77 kg ((FH + PO) / 2 = (38.16 kg + 27.37 kg) / 2) = 32.77 kg), then the actual birthweight heterosis value is 9.55% for the PFPO genotype, 9.55% for PFS and 8.03% for the PFL genotype. The heterosis value is in the moderate category. These results are following Banning et al. (2019) that the nature of growth has a moderate heterosis value of 12.02 ± 4.10%.

IV.CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the study and discussion, it was concluded that the crossbred calf has a relatively high relative advantage over local PO cattle with an average value for all parameters 12.25 - 15.99%. Crossbreeding of PFH cows with PO parents produces offspring with PFPO genotype, with an average relative advantage value (for all parameters) 15.99%, higher than PFS genotype 12.25% and PFL 14.25%. To increase meat production, it is recommended to develop crossbreeding of PFH cows with PO parents, but still, maintain their compatibility with the local environment and the purity of local PO cows.

V. IMPORTANT STATEMENT

This research has never been done, and its novelty lies in how to calculate the relative superiority of crossbred over local (pure) PO cattle.

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