Evaluation of Carcass Production of PO Cattle Based on Heart Girth Measurement, Body Condition Score and Slaughter Weight

(Evaluasi Produksi Karkas Sapi PO Berdasarkan Ukuran Lingkar Dada, *Body Condition Score*, dan Bobot Potong)

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Abstract. The objective of study was to evaluate of carcass production of PO beef cattle based on measurement of heart girth, body condition score (BCS), and slaughter weight. It was conducted in the slaughtering house at Mersi Purwokerto city. The materials for this study were 60 heads of male PO breed cattle. Simple random sampling was used for taking samples. Data was analyzed by using multiple regression equation to determine the effects of heart girth, BCS, and slaughter weight on carcass weight. The potency of carcass relative growth was assessed with Huxley allometric equation. The result showed that heart girth did not differ significantly ($P>0.05$), BCS had significant effect ($P<0.01$) on carcass weight and percentage, and slaughter weight had significant effect ($P<0.01$) on carcass weight. Relative growth of carcass weight to slaughter weight had a high potential (b=1.136), otherwise relative growth of carcass proportion to slaughter weight had a less potential (b=0.136). It could be concluded that (1) carcass weight could be predicted using BCS and slaughter weight parameters, and (2) PO beef cattle slaughtered had a good of relative growth potential for the carcass.

Key Words: PO beef cattle, heart girth, BCS, slaughter weight, carcass

Introduction

The cattle is one of main commodities to yield meat that still requires major attention from the government. Beef demand increases continually, in according with the increase of human population. However, the ability of indigenous beef production can not cope with the demand (Directorate General of Animal Farming, 2000). The existence of Ongole cross breed (PO cattle), therefore, as an indigenous breed, is greatly expected to be able to fulfill the demand of beef in this country. It is well-known, more over, that the potential of Ongole cross breed cattle as a beef producer is excellent. This case can be seen from the high frequency of daily Ongole cross breed cattle slaughter, including the productive PO cows.

Carcass production characteristics are very important, especially to determine the correct slaughter time. The PO cattle productivity indicators can be determine partly from its birth weight, daily gain, weaning weight, carcass weight and percentage, back fat thickness, etc. The growth and carcass productivity of beef cattle are influenced by breed, age, and sex (Casa and Cundiff, 2006; Choat *et al.*, 2006). Other factor that determine carcass productivity include linear measurement of body, slaughter weight, and also body condition of the cattle (Park *et al.,* 2002; Bruns *et al.,* 2004; Bergen *et al.,* 2005). Generally, cattle that are slaughtered at abattoir come from traditional farms with various body conditions (thin, moderate, fat) and slaughter weight. This case will cause various production of carcass as well, quantitatively as well as qualitatively. It is different with imported beef that comes from modern farm management, as a result, higher-quality carcass production is achieved, compared to indigenous beef, including PO cattle.

On the other hand, the facilities of type-C abattoir is not complete as indicated with the absence of animal balance, therefore, the body weight and carcass production of the cattle is only based on the assumption of the workers.

This condition will disadvantage economically to the consumers, because the selling value (price) of a cattle is based on its body weight.

Based on the conditions mentioned above, it is quite important to study correlation between cattle performances with carcass production at an abattoir. From the carcass production, it can be known if the cattle has a low, moderate, or high beef potential capacity. The evaluation of carcass production potential needs to be conducted accurately in order to predict the correct time when the cattle is ready to be slaughtered.

The purpose of this study is to know a correlation between heart girth, body condition score (BCS), and slaughter weight at one side, to carcass production at the other side, and to predict the potential of carcass of PO cattle that are slaughtered at abattoir, Mersi village. The advantage of this study is to inform the potential of carcass growth and production, and to obtain a mathematical formula that can be used to predict carcass production of PO cattle.

Research Method

Materials

The materials used in this study were 60 heads of PO cattle that were slaughtered at Mersi abattoir with the ages ranged from 1.5 to 3 years. The support implements consisted of clamp stall, 1,000 kg-capacity digital cattle balance, 50 kg and 100 kg capacities stick balance, 25 kg-capacity spiral balance, a unit of slaughter implement, bucket, writing stensil, and a calculator.

Method

Survey method was used in this study. The location of this study was at the Mersi abattoir. Samples were collected randomly by meant of simple random sampling, as many as 5 heads of cattle daily, with a total of 60 heads during the research. The number of cattle being slaughtered daily ranged from 10 to 15 heads. Before slaughter, measurements of heart girth and BCS were conducted, followed with weighing in a clamp stall to determine slaughter weight. After slaughters were finished, carcass weighing was also conducted to determine carcass weight and percentage.

Parameters evaluated were heart girth, slaughter weight, carcass percentage, and BCS at 1 – 5 scoring scale (1=very thin, 2=thin, 3=moderate,4=fat, and 5= very fat). Heart girth was measured by surrounding the thorax (chest, breast) with a meter-line, exactly behind the shoulder (magnitude in cm). Slaughter weight was measured by weighing the cattle before slaughter with a digital balance (magnitude in kg). Carcass weight was measured with a stick balance (magnitude in kg). Carcass percentage was calculated by dividing the carcass by slaughter weight, multiplied with 100 percent. British system (scale point of 1 to 5) was used to determine BCS, with the categories: BCS 1; the sense of short rib was very sharp, skeleton structure was looked very obvious, body flesh and fatness was very limited. BCS 2; the sense of short rib was rather sharp, little flesh and fatness especially at the site of tail head, hipbone, and flank. BCS 3; the sense of short rib can only be detected through strong pressure, homogenous flesh, fatness at the site of tail head. BCS 4; short rib looked leveled, can not be sensed via pressure, full of flesh especially around hind quarter, fatness was distributed among tail head, ribs, and humerus. BCS 5; skeleton structure was not obviously seen, sense and full of flesh around tail head, hip bone, ribs, and humerus.

Data Analysis

Descriptive statistic to explain the carcass physical and production characteristics of PO cattle was done using of SPSS. Calculation analysis, using multiple regression equation: $Y = a + b_1X_1 + b_2X_2 + b_3X_3$. Y = carcass weight (kg) and percentage (%), a = intersept; b = regression coefficient, X_1 = heart girth (cm); X_2 = BCS; X_3 = slaughter weight (kg). Carcass growth potential was analysed using Huxley allometric equation (Amsar et al., 1984; Keane et al., 1990) namely: $Y = a X^b$ or Log Y = Log a + b Log X. Y = carcass weight (kg) and percentage (%), a = intercept; b = growth coefficient, X = slaughter weight (kg). B value was an indicator of carcass growth potential: low (b<1), moderate (b=1), and high (b>1).

Result and Discussion

General Description

The results of heart girth, BCS, slaughter weight, carcass weight and percentage measurements of PO cattle that were slaughtered at Mersi abattoir were as follows (Table 1).

The results of this research (Table 1) showed that the average value of carcass production of PO cattle that were slaughtered at Mersi abattoir was 125.07 ± 21.47 kg or relatively 47.78 ± 2.82 percent similar compared to several previous studies, although it was lower compared to other indigenous cattle. Arianto (2002) reports that the majority of PO cattle that were slaughtered at abattoir were originated from backyard (small scale) farming with carcass weight average of 186.3 kg and carcass percentage of less than 50%. It is also reported that adult, male PO cattle (bull) were able to produce carcass as much as 45-48%, lower than carcass percentage of 56-57% of Bali cattle or carcass percentage of 48-63% from Madura cattle.

According to Murtidjo (2003), PO cattle with heart girth of 162 cm and slaughter weight of 302.6 kg, produces carcass weight and percentage of 136.2 kg and 45.3 percent, respectively. Keane et al. (1990) report that cattle with 380 ± 15 kg is able to produces 181,5 ± 8 kg of carcass. Meanwhile Apple et $al.$ (1999) suggest that cattle that were slaughtered at BCS of 2-8 (scale interval of 1-9) produces carcass percentages ranging from 47.2 ± 1.9 to 55.1 ± 1,9 percent.

Correlation among heart girth, BCS, and slaughter weight to carcass weight and percentage

Relationship between heart girth, BCS, and slaughter weight to carcass weight and followed a regression equation (1) Y= -17.51 − $0.0464X_1 + 6.516X_2 + 0.488X_3$ (R^2 = 97.3 %). The analysis of variance showed that the regression equation could be used to predict carcass weight (P<0.01). However, the analysis of regression coefficient showed that heart girth parameter did not show any significant effect (P>0.05) on carcass weight, meanwhile BCS and slaughter weight parameters showed a highly significant effect (P<0.01) on carcass weight. It meant that BCS and slaughter weight parameters in the equation (1) could be used to predict carcass weight of male PO cattle that were slaughter at Mersi abattoir.

Whereas the relationship between heart girth, BCS, and slaughter weight to carcass percentage of male PO cattle that were slaughtered at Mersi abattoir followed a regression (2) Y = 41.072 − $0.0251X_1 + 2.537X_2 + 0.00724X_3$ (R^2 = 71.3%). Analysis of variance showed that in generally, the equation (2) could be used to predict carcass percentage (P<0.01). However, analysis of regression coefficient showed that heart girth and slaughter weight did not give any significant effect (P>0.05), whereas BCS gave a highly significant effect (P<0.01) on carcass percentage. It meant that in equation (2), only BCS parameter that could be used to predict carcass percentage of male PO cattle slaughtered at Mersi abattoir.

Previous studies report the relationships between BCS and slaughter weight to the characteristics of beef cattle. Arango et $al.$ (2002) report that genetic correlation between body weight and BCS is about 86% and both parameters are effective to determine the growth of an animal. Tennant et $al.$ (2002) also report that body weight has a highly significant interaction (P<0.01) with BCS, although it is not consistent in each age periode of the cattle. The body weight of beef cattle is very effective to explain correlation to carcass weight and meat composition of cattle (Suryadi, 2003; Nephawe et $al.,$ 2004). The body weight of Angus cattle in Virginia at the ages of 2-5 years increases from 2.6 to 2.8 points, using scale 1 to 5 interval (Marlowe and Morrow, 1985). Renquist et $al.$ (2006) say that the increase of age that is followed by the increase in body weight and BCS resulted in an increase in carcass weight. According to Bergen et $al.$ (2006) slaughter age is genetically has a correlation with live weight and carcass characteristics, especially fat deposition, in steers or castrated bulls.

Table 1. Data of heart girth , BCS, slaughter weight, carcass weight, and carcass percentage of PO cattle that were slaughtered at Mersi abattoir

Measurement of	Average	Deviation standard	N
Heart girth (cm)	159.43	10.81	60
BCS (skala 1-5)	3.35	0.86	60
Slaughter weight (kg)	262.82	38.96	60
Carcass weight (kg)	125.07	21.47	60
Carcass percentage (%)	47.78	2.82	60

The calves resulted from the crossbreed between Hereford and Angus cattle have a high BCS at 2, 3, and 7 years old (Arango *et al.*, 2002), and its have BCS from 0.2 to 0.4 points higher than those of their parent pure breeds, and have a highly significant different ($P<0.01$) at 2 year of age, significantly different ($P<0.05$) at the age of 3 years, whereas for older ages (5-6 years) the differences in BCS is 0.40 point (Arango *et al.,* 2004).

Growth potential of male PO cattle carcass

The relationship between potential growth with slaughter weight of male PO cattle was illustrated by a Huxley Allometric equation: $Y = 0,0008444X^{1.136}$. The b value of greater than 1 (b>1) indicated the PO cattle slaughtered at Mersi abattoir had a high carcass growth potential relative to their live weight. The result of regression coefficient analysis showed that growth potential of carcass was highly significantly ($P<0.01$) affected by the slaughter weight of PO cattle. Quantitatively, the growth potential of carcass was high enough, because the cattle that were slaughtered at Mersi abattoir were at their growing period, or were still at their productive ages. The closeness of the relationship between carcass weight to slaughter weight was high ($R^2 = 90.9\%$). It meant that the increase in slaughter weight was followed with the increase in carcass weight of PO cattle. Meanwhile the growth potential of carcass proportionally, compared to the slaughter weight, followed a Huxley Allometric: $Y = 22.28435X^{0.136}$. The b value, 0.136, or b>1, indicated that the PO cattle that were slaughtered at Mersi abattoir had a relatively low growth potential of carcass, relative to their live weight. The results of regression coefficient showed that slaughter weight had a highly significant effect ($P<0.01$) on relative growth of carcass percentage of PO

cattle slaughtered at Mersi abattoir. However, the coefficient of determination ($R^2 = 11.1\%$) indicated that the closeness of relationship between slaughter weight to carcass percentage was weak.

Oljen (1988) reports that the change in body weight as a result of daily body weight gain had a highly significant correlation ($P<0.01$) on body composition of male cattle with a correlation coefficient value of 0.85. Growth rate of body weight of cattle at the ages of 3 to 5 years increases highly significantly ($P<0.01$). However, at the ages of 6 to 10 years, it did not show any significant difference ($P>0.05$), compared to 5 years of age. The genetic correlation between live weight to carcass weight of male cattle is 0.80 (Crews dan Kemp, 2001). Slaughter weight had a close relationship with carcass growth and its components (Rios-Utrera *et al.*, 2006). High growth rate of cattle will affect carcass characteristics, therefore, it could be benefitial economically (Kahi *et al.,* 2007). It is also reported that the value of genetic correlation between daily body weight gain, carcass weight, and carcass price are 0.14; 0.30; and 0.19, respectively.

The relative carcass growth potential at the growing period had a value greater than 1 (b>1). It meant that the ability of cattle to produce carcass was enough. Keane *et al.* (1990) reports that the increase in slaughter weight a had a significant effect on carcass growth of beef cattle. It also reported that carcass growth potential of some breeds of cattle is high enough especially due to the contribution of the growth of flank muscle tissue (b=1.13), rib muscle (b=1.20), and breast muscle (b=1.13). According to Kemspter *et al.,* (1976), the value of carcass growth coefficient (b) that is greater than 1 especially occurs at the quarter part of rear-side carcass, whereas in

the quarter part of front-side carcass, the value of b is less than 1 (b>1).

Relative carcass growth potential of other livestock also show the similar values of b. For instance in indigenous sheep (Amsar *et al.*, 1984), that has a b value of 1.3901 for rams and 1.3613 for ewes, respectively. Haryoko (2007) also reports a similar result in the fillial of New Zealand White crossbreed: relative carcass growth potential significantly correlated to slaughter weight with the values of b coefficient of 1.290 and 1.296 for male and female rabbit, respectively.

Meanwhile, if it is observed from relative growth of carcass percentage to slaughter weight, the value of b is smaller than 1 (b<1), due to similar physiological ages of PO cattle that were slaughtered at Mersi abattoir, therefore, the increase in carcass weight was not followed with the increase in carcass percentage. The change in carcass percentage was significant enough if the physiological ages of slaughtered cattle were different. Sents *et al.* (1982) report that the increase in slaughter weight can increase carcass weight of the animal, but is not always followed with the increase in carcass percentage. The results of this research was similar to those reported by Amsar *et al.* (1984) in sheep, and Haryoko (2007) in rabbit.

Conclusions

The results of this research conclude that (1) the PO bulls that are slaughtered at Mersi abattoir, Purwokerto, generally have fulfilled the standard slaughter weight, (2) the BCS can be used to predict the weight and percentage of PO cattle carcass, meanwhile slaughter weight is any properly used to determine carcass weight, and (3) carcass growth potential can be included into moderately high category.

Acknowledgements

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