EFFECT OF AGRICULTURAL BY-PRODUCT DIETS ON CARCASS CHARACTERISTICS OF FOUR TYPES OF CATTLE IN THE FEEDLOT

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Summary

Five type of formulated diet from agricultural by-products (ABP) were fed to four breedtype of cattle in feedlot. The ABP used are palm kernel cake (PKC), palm press fibre (PPF), palm oil mill effluent (POME), cocoa pod (COP), coffee pulp (COF) and pineapple waste (PAP). The formulated diets are PS (52% PKC, 15% PPF and 30% POME), PF (57% PKC, 20% PPF and 20% POME), PA (42% PKC and 55% PAP), CO (42% PKC and 55% COP) and CF (67% PKC and 30% COF) with 1% urea, 1% NaCl and 1% vitamins premix. The cattle breedtypes are Kedah-Kelantan (KK), Brahman-KK (BK), Hereford KK (HK) and Sahiwal Friesian (SF). The result showed that breedtype significantly affect all the carcass characteristic except dressing percentage. Each breedtype has it's specific carcass characteristics. HK cattle gave high marbling. BK has high % of carcass bone, KK has high % of carcass meat and low % of carcass fat (lean meat type) and SF has high % of carcass fat. Diet-type significantly affect the deposition of fat in the carcass. High moisture diets (PA and CO) produced significantly higher % carcass fat than low moisture diets (PS, PF and CF). PS diet produced the highest % carcass bone, the lowest % carcass fat and the highest % carcass meat (65.3%). PF, CF, PA and CO diets produced 63.4%, 59.9%, 55.3% and 54.1% carcass meat respectively. (**Key Words**: Carcass Characteristics, Agricultural By-Products, Feedlot, Cattle)

Introduction

Beef cattle feedlotting is said to have a potential in Malaysia because of the abundant availability of agricultural by-products (ABP) mainly from oil palm, cocoa, pineapple and other crops. These ABP can be utilized in ruminant feeding as sources of fiber or energy and also to some extent as sources of protein such as palm kernel cake (16% curde protein). Balanced and economical diets can be formulated for feedlotting enterprise from various combination of these ABP (Dahlan, 1986).

Performance of animals on various ABP diets in feedlot were reported by many researchers in Malaysia (Sukri, 1981; Babjee et al., 1984; Sukri and Dahlan, 1984; Dahlan, 1986; Sukri et al., 1987). Dahlan (1985) reported on the performance of various breeds of cattle on ABP feedlot diets. He also compared the carcass characteristics of feedlot and grazing cattle. Breed of cattle was found to have significant effect on carcass weight per day of age (CWDA). All crossbred animals showed higher CWDA than purebred Kedah-Kelantan cattle. Fat composition in the carcass of Zebu cattle (Kedah-Kelantan and Brahman) was higher than Zebu × Temperate cattle. Zebu cattle displayed increased fat levels due to improved animal adaptability. Dahlan et al. (1988) found that the carcass of buffaloes from ABP diets contained more carcass fat than grazing animals. Carcass fat is considered as an uneconomical product of animal and the presence of large quantity of fat in the carcass will lower the carcass value. Based on this condition, the effect of ABP diets on carcass characteristics of animal need to have further study in order to determine suitable diets and breedtypes that will produce the lowest carcass fat from the feedlot operation.

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Materials and Methods

The study was conducted at MARDI Research Station near Pontian, Johore. All feeding experiments were carried out in the feedlot located at the centre of agricultural activities in The Coastal area of Johore State. Most of agricultural by-products (ABP) used in this experiment were collected from this area. Six types of ABP were selected for the formulation of suitable diets for feedlot cattle. Table 1 showed the chemical composition of the ABP used. Table 2 showed the composition of the various ABP in the formulated diets. Each diet type was formulated based on calculated metabolizable energy (ME, MJ/kg dry-matter) content (medium energy level of 9-9.5 MJ/kg DM), crude protein content (more than 10% CP) and practicality of feeding management. The formulated diets vary in term of DM or moisture content. Pineapple waste (PAP) and cocoa pod (COP) were used in fresh form, while palm kernel cake (PKC), palm oil mill effluent (POME) and palm press fiber (PPF) were used in dry form. Coffee pulp (COF) was soaked in

TABLE 1. AGRICULTURAL BY-PRODUCTS (ABP) USED IN DIETS FORMULATION

ABP used[1]	DM (%)	CP (%)	CF (%)	Fat (%)	ME (MJ/kg)	Ash (%)	Ca (%)	P (%)
Palm kernel cake	88.5	16.2	18.0	3.2	10.4	4.2	0.3	0.7
Palm press fiber	94.5	4.3	36.4	21.0	7.9	9.0	0.3	0.1
Palm oil milk effluent	89.6	12.1	15.2	24.1	9.8	18.6	0.6	0.4
Cocoa pod (fresh)	18.7	7.2	31.5	1.1	8.8	16.4	0.5	0.7
Coffee pulp (soaked in water)	88.6	10.2	29.7	1.3	8.1	8.8	0.4	0.6
Pineapple press (wet)	14.8	7.1	25.5	1.2	9.5	4.5	0.3	0.2

[1] Proximate analysis value: DM-dry matter, CP-crude protein, CF-crude fiber, FAT-crude fat, ME-metabolizable energy.

TABLE 2. AGRICULTURAL BY-PRODUCTS COMPOSITION IN THE FORMULATED DIETS

Ingredients in the diets kg/100 kg dry matter	Diet type				
	PS	PF	PA	CO	CF
Palm kernel cake	52	57	42	42	67
Palm press fiber	15	20	–	–	–
Palm oil mill effluent	30	20	–		–
Pineapple press	–	–	55	–	–
Cocoa pod		–	–	55	–
Coffee pulp	–	–			30
Urea	1.0	1.0	1.5	1.5	1.0
Salt	1.0	1.0	1.0	1.0	1.0
Vitamins premix	1.0	1.0	0.5	0.5	1.0
Chemical composition					
Dry matter (%)	86.6	88.3	25.4	25.4	62.0
Moisture (%)	13.4	11.7	74.6	74.6	38.0
Crude protein (%)	12.7	12.5	10.7	10.8	13.9
Crude fiber (%)	19.5	21.1	21.6	24.9	21.0
ME (MJ/kg)	9.5	9.5	9.6	9.2	9.4
Ash (%)	9.2	7.3	4.4	8.3	7.6
Ca (%)	0.5	0.4	0.4	0.6	0.6
P (%)	0.6	0.4	0.2	0.4	0.3

water over night before feeding to the animals. Five types of diet, namely: PS (palm-sludge), PF (palm-fiber), PA (pineapple-palm), CO (cocoa-palm) and CF (coffee-palm) were fed to four breeds of intact male cattle, namely: Kedah-Kelantan (KK) cattle (n=11), Brahman-KK (BK) cattle (n=11), Hereford-KK (HK) cattle (n=5) and Sahiwal-Friesian (SF) cattle (n=12). These animals were born in MARDI Kluang Research Farm and managed on improved pastures for a period of 12 months before there were transferred and housed in feedlot stalls in MARDI Pontian Research Station. All animals were housed according to their breedtypes and respective diets in stalls measuring 8 m × 12 m. Water and mineral lick blocks was available all the time. All animals were dewormed at the beginning of the experiment. They were then introduced to the diets for a periods of 14 days by gradually decreasing the amount of grass offered. Fresh feed was mixed daily and offered *ad libitum* twice at 07:00 and 16:00 h. The animals were fed for a period of about 12 to 14 months. Feed sampling was done once in two months for proximate analysis determination.

Animals were transported and slaughtered at MARDI Serdang Research Station and carcass analysis was carried out according to Dahlan et al. (1986). This paper will discuss only the carcass characteristics of the animals. The carcass data was transformed into percentage of carcass weight and analysed by analysis of variance (SAS/GLM Proc, 1986) in order to determine the effect of diet and breed on carcass characteristics. The mean values of carcass weight, dressing percentage, % carcass fat, % cracass bone, % carcass lean and others were compared by Duncan's Multiple Range Test (SAS, 1986).

Results and Discussion

The analysis of variance of carcass data was based on the effects of breedtypes, diets and breedtypes-diets interactions. Factors affecting the slaughter weight and carcass characteristics are shown in table 3. This result (table 3) showed that all carcass characteristics were significantly ($p < 0.05$) affected by breedtype except for dressing percentage. Percent carcass bone (CB), % carcass meat (CM), % carcass fat (CF) and marbling score were found to be influenced ($p < 0.05$) by the diets. There is interaction effect ($p < 0.05$) between breedtype and diet for marbling formation in the meat. Based on this result, we found that breedtype of the animal is very important for the determination of the carcass characteristics of feedlot animal. Diet type mainly affect the fat composition and related carcass characteristics.

TABLE 3. FACTORS AFFECTING SLAUGHTER WEIGHT AND CARCASS CHARACTERISTICS OF FEEDLOT CATTLE

Variables	Factors
Slaughter weight (SW)	Breed***
Carcass weight (CW)	Breed***
Dressing percentage (DP)	All not significant
Carcass fat (%) (CF)	Breed***, Feed**
Carcass bone (%) (CB)	Breed*, Feed*
Carcass meat (%) (CM)	Breed***, Feed*
Marbling score (M)	Breed***, Feed*, Breed × Feed*
Loin eye area (LEA)	Breed***

Level of significance:
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 4 showed the comparison between mean values of carcass characteristics according to breedtype. The result showed that HK was the highest and KK was the lowest in slaughter weight and carcass weight. This is because of variation in breed size although they are in the same age group. Comparison of carcass characteristics is more meaningful in terms of percentages composition. Dressing percentage of these cattle are not significantly different, but SF showed higher dressing % than other breedtype and KK was the lowest. SF showed the highest % CF and KK was the lowest. Other breeds were intermediate. This condition may due to the dairy characteristic of SF breed and the lean characteristics of KK cattle. BK showed higher % CB than other breeds. KK was the highest in % CM. HK was the biggest in loin eye area of longissimus dorsi (LEA) and the highest in marbling score. All these special carcass characteristics produced were related to the specific breed characteristic. For expample, HK is good for marbling, BK is a big size breed and it has larger bone structure (highest % CB) and KK is famous for lean type of cattle (highest % CM and lowest

TABLE 4. COMPARISON BETWEEN CARCASS CHARACTERISTICS OF KK, BK, HK AND SF CATTLE IN FEEDLOT

Breed types[1]	KK	BK	HK	SF
No. of cattle	11	11	5	12
Slaughter WT. (kg)	206.4^{c}	338.4^{b}	418.0^{a}	289.8^{c}
Carcass WT. (kg)	145.4^{c}	190.3^{b}	238.9^{a}	169.7^{b}
Dressing (%)	55.9^{a}	56.1^{a}	57.1^{a}	58.5^{a}
Carcass fat (%)	12.5^{c}	15.3^{bc}	15.8^{b}	24.1^{a}
Carcass bone (%)	17.9^{ab}	18.6^{a}	16.6^{b}	16.5^{b}
Carcass meat (%)	66.2^{a}	63.0^{b}	62.8^{b}	56.4^{c}
Meat : Bone	3.7	3.5	3.8	3.4
Meat : Fat	5.5^{a}	4.3^{b}	4.3^{b}	2.4^{c}
Marbling (unit)	1.2^{b}	1.6^{b}	3.2^{a}	1.9^{b}
Loin eye area (cm^{2})	54.5^{c}	70.5^{ab}	80.9^{a}	63.6^{bc}
Loin eye area/100 kg	37.7	37.4	33.9	37.6
Fat in carcass (kg)	18.3^{c}	29.5^{b}	38.3^{a}	41.4^{a}
Meat in carcass (kg)	96.2^{c}	119.7^{b}	149.5^{a}	95.5^{c}

^{abc} Means with the same letter are not significantly different ($p < 0.05$).
[1] Breed types: KK: Kedah-Kelantan, BK: Brahman-KK, HK: Hereford-KK and SF: Sahiwal-Friesian.

% CF). Similar finding was reported by Dahlan et al. (1985) for grazing cattle. They reported that HK cattle produced bigger LEA than other crossbreds and KK cattle produced the highest meat to bone ratio and percent carcass meat. Carpenter et al. (1964) showed that increased grade and percent fat were associated with increased in *Bos taurus* breeding and decreased as Brahman breeding increased.

Table 5 showed the carcass characteristics from the five types of diets. Dressing percentage was not significantly different for all types of diet. PA and CO diets produced higher ($p < 0.05$) % CF and lower % CM. PF and PS diets produced lower % CF and higher % CM and meat to fat ratio. PS diet produced higher % CB. PF, PA and CO diets produced higher marbling score than PS and CF diets. Diet type did not affect the meat to bone ratio and size of LEA of these animals.

This result showed that % CF was significantly ($p < 0.05$) affected by the diet type. Moisture

TABLE 5. CARCASS CHARACTERISTICS FROM FIVE TYPE OF DIETS

Diet type	PF	PS	PA	CO	CF
No. of cattle	15	12	4	4	4
Slaughter WT. (kg)	338.3^{a}	300.2^{ab}	294.5^{b}	292.5^{b}	282.5^{b}
Carcass WT. (kg)	191.0^{a}	168.6^{ab}	176.0^{ab}	173.6^{ab}	159.5^{b}
Dressing percentage	56.2	56.2	59.8	59.4	56.4
Carcass fat (%)	14.4^{c}	14.1^{c}	26.7^{a}	26.1^{a}	19.8^{b}
Carcass bone (%)	16.9^{b}	19.2^{a}	16.1^{b}	16.0^{b}	17.5^{ab}
Carcass meat (%)	63.4^{ab}	65.3^{a}	55.3^{c}	54.1^{c}	59.9^{b}
Marbling score	2.3^{a}	1.1^{b}	2.5^{a}	2.0^{ab}	1.3^{b}
Meat : Bone ratio	3.8	3.5	3.4	3.4	3.5
Meat : Fat ratio	4.7^{a}	4.9^{a}	2.1^{b}	2.1^{b}	3.1^{b}
Loin eye area (cm^{2})	68.4	62.8	71.6	60.1	59.0
LEA/100 kg	36.3	37.6	41.1	34.7	36.8

^{abc} Means with the same letter are not significantly different ($p < 0.05$).

content (table 2) of the diets significantly ($p < 0.05$) affecting the % CF of the animals. Moist diets such as PA and CO produced significantly ($p < 0.05$) higher % fat than dry diets (PF, PS and CF). The roughage content of the diet and particle size had no significant effects on carcass characteristics. Similar finding was also reported by Holzer et al. (1976). They showed that by increasing the moisture content of the diet it significantly increased the content of depot fats and also the efficiency of conversion of metabolizable energy into carcass weight. Holzer et al. (1975) reported that total fat (carcass plus internal fat) was rather greater in animals on moist diets. This also may be attributed to the higher proportion of the propionic acid produced on moist diets. The higher the proportion of propionic acid in the digestion products, lead to higher the efficiency of body fat synthesis.

This result also showed that PS diet produced the highest ($p < 0.05$) % carcass bone. Perhaps inclusion of higher % of POME in the diet cause minerals imbalance (especially Calcium and Phosphorus) and this condition may lead to defective bone development. Correction on the minerals content and balance in the diet need to be evaluated, especially when POME is incorporated in the diets, since it's contained high % of ash (more than 18% ash).

Based on this result PS diet was one of the best formulated ABP diet for the feedlot to produce good carcass characteristics. Carcass produced had the highest % carcass meat and the lowest % carcass fat. Other ABP diets were also good for the feedlot. These data demonstrate that with practical feedlot rations and superior breedtype selected, better quality carcasses can be successfully produced. Further evaluation and verification of the diets need to be carried out in order to achieve satisfactory carcass characteristics and optimum carcass yield.

Literature Cited

Babjee, A. M., H. Husein and R. M. Lam. 1984. Palmbeef: A value added product of palm kernel cake. Proc. 8th. Malaysian Soc. of Animal Prod. conf. Malaysia. pp. 92-93.

Carpenter, J. W., A. Z. Palmer, W. G. Kirk, F. M. Peacock and M. Koger. 1964. Slaughter and carcass characteristics of Brahman and Brahman Shorthorn steers. Fla. Agr. Exp. Sta. Tech. Bull. 680.

Dahlan, I. 1985. "Carcass and meat quality of cattle in feedlot when fed with agricultural by-products". (Malay). Proc. Calf fattenning workshop. Perlis, Malaysia. pp. 130-138.

Dahlan, I. 1986. Performance of Kedah-Kelantan cattle and it's crosses on ration containing sago pith, coffee pulp and palm kernel cake, reared under smallholder's condition. Livst. Prod. and Dis. in the Tropics. Proc. 5th. Intl Conf. in Livst. Prod. and Dis. Kuala Lumpur. pp. 91-93.

Dahlan, I., M. Mahyuddin and M. A. Omar. 1985. Performance and carcass traits of Kedah-Kelantan cattle and it's F1 crosses. Efficient animal production for Asian welfare. Proc. 3rd. AAAP Animal Sc. Congr. Seoul, Korea. pp. 345-347.

Dahlan, I., M. Mahyuddin, O. Shokri and M. Ariff. 1986. Prediction of total lean meat of Kedah-Kelantan cattle and it's crosses from live body measurements. MARDI Res. Bull. 14(1) 85-91.

Dahlan, I., M. H. I. Sukri and O. Abu Hassan. 1988. Body components and carcass characteristics of swamp buffaloes fed with oil palm by products or grass diet. MARDI Res. J. 16(2):125-132.

Holzer, Z., D. Levy, H. Tagari and R. Volcani. 1975. Soaking of complete fattenning rations high in poor roughage. 1. The effect of moisture content and spontaneous fermentation on nutritional value. Anim. Prod. 21:323-335.

Holzer, Z., H. Tagari, D. Levy and R. Volcani. 1976. Soaking of complete fattenning rations high in poor roughage. 2. The effect of moisture content and of particle size of the roughage component on the performance of male cattle. Anim. Prod. 22:41-53.

SAS User's Guide. 1986. Statistical Analysis System. Edition 5. SAS Institute Inc., Box 8000 Cary. NC 27511-8000 USA.

Sukri, I. 1981. The utilization of palm press fibre and palm kernel cake for beef steers in feedlot. MARDI Res. Bull. 9(1):121-125.

Sukri, I. and I. Dahlan. 1984. Feedlot and semifeedlot systems of beef cattle for smallholders. Feeds and Feeding Systems for Livestock. Proc. 8th Malaysian Soc. Anim. Prod. Conf. Kuala Lumpur, pp. 74-78.

Sukri, I., N. Jariah and H. Rozali. 1987. Fattening of swamp buffalo in feedlot. Proc. 10th. Malaysian Soc. Anim. Prod. conf. Kuala Lumpur, pp. 272-275.