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PHYSICAL CHARACTERISTICS, CHEMICAL COMPOSITION AND ORGANOLEPTICAL PROPERTIES OF BALI CATTLE AND ONGOLE CROSS BREED MEAT AS AFFECTED BY FATTENING AND REARING SYSTEM

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ABSTRACT

The experiment was conducted to study the physical characteristics, chemical composition, and organoleptical properties of Bali cattle and Ongole Cross Breed meat of two groups of cattle, either reared by farmers or by fattening system. Nine heads of cattle of each group were slaughtered at abattoir. After slaughtering, meat samples used were *Longissimus dorsi* (LD) and *Biceps femoris* (BF) muscles. The variables measured were physical characteristics (pH, tenderness, water-holding capacity and cooking loss), chemical composition (water content, total protein, soluble protein, fibrous protein, total fat, saturated and unsaturated fatty acid, ash and cholesterol content), and organoleptical properties and also microstructure test. The data were analysed by using a 2 x 2 x 2 factorial analysis of variance. The organoleptical properties were analysed non parametrically by Kruskal-Wallis method. The results showed that there were significant differences ($P<0.05$) on tenderness as affected by breed, growing system and kinds of muscles. The pH did not differ significantly among treatments. The range of pH was normal and at the standard level of market meat. The water-holding capacity was significantly different ($P<0.05$) as affected by breed and growing systems. Bali Cattle meat was significantly higher in cooking loss than Ongole Cross Breed Cattle meat. Fattened cattle had a higher cooking loss than the reared cattle by farmer. The cooking loss of BF muscle was significantly higher than that of LD muscle ($P<0.05$). Water content was not affected by breed, but it was affected by growing system and kind of muscles. The total protein content was affected by breed and growing systems, but it was not different on kinds of muscles. The fibrous protein of Bali Cattle and Onggole cross breed was different ($P<0.05$). The fibrous protein was different between the growing systems. The soluble protein was different between kinds of muscles. Fat content did not differ between meat of Bali cattle and Onggole cross breed and between LD and BF, but the growing systems had significant differences on the fat content. The fattening had higher fat content than the rearing by farmers. The percent of fatty acid was different $P<0.05$) between Bali cattle and Onggole cross breed. Saturated fatty acids of Bali cattle meat were greater than those of Ongole cross breed. The unsaturated fatty acids and special essential fatty acids of Bali Cattle meat were higher than those of Ongole cross breed. The cholesterol content did not differ between Bali Cattle and Onggole cross breed, and between fattening system and rearing system. The ash content did not differ among treatments. There were no interactions on physical characteristics and chemical composition. The meat color and texture of Bali

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cattle was better than that of Ongole cross breed meat. Flavor and juiciness were not different between the two breeds.

Key word: Breed, Fattening and rearing system, Characteristic, Chemical, Organoleptic.

INTRODUCTION

Meat represents the substance of food which of benefit to body health. Meat role as food is very important because meat contains the well-balanced and complete amino acids (Forrest et al., 1975). Besides, meat contains protein, fat, carbohydrate and organic component or minerals. Meat constitutes a main component of carcass. Meat is animal muscle livestock after its physiological function finishes (Soeparno 2005). The main component of meat consists of adipose tissue, connective tissues (collagen, elastin and reticulin), as well as blood vessels, epithelial and nerve tissues(Tien and Sugiyono 1992). Meat from livestock slaughtered in Indonesia has nor significantly contributed to the health and has a low quality. This is caused by the facts that slaughtered livestocks are mainly coming from draught livestock and fattened livestock, so that the meat yielded content either a lot of connective tissue or fat and cholesterol. Meat characteristics are determined by the nature of physical and chemical. The two characteristics determine the value or quality of meat. Meat characteristic constitutes factors determining the consumer assessment on meat quality, such as pH, tenderness, taste (flavor), texture, aroma, color, cooking loss and water-holding capacity (Crouse 1989; Soeparno, 2005).

Soluble protein content and protein fibrous are highly correlated whith tenderness as an indication of the number of sitoplasm and amino acid contents. Collagen constitutes the main structural protein of connective tissue(Forrest *et al.*, 1975). Collagen could influence the tenderness. Fatty acids and cholesterol composition of meat has been related to acceptability, and certain consumers prefer unsaturated, and another aspect of the reduction of calorie consumption from fat, especially fatty acid nutrient balance and health (Soeparno 2005). Contribution of meat cholesterol and its effect on serum cholesterol is an issue of controvertial to consumer interest and health science (Hoelscher *et al.*, 1988) Research on chemical composition, especially fatty acid and cholesterol of meat from local cattle (Bali cattle and Ongole cross breed) has not been conducted. Fattening cattle constitutes an afford to increase meat production and there are some factors influencing fattening system, such as breed, age, slaughter weight, cattle type, sex, and nutrition (Dyer and O'Mary 1977). Fattening has a side effect on the amount of fat especially the nonessential fatty acids.

MATERIALS AND METHODS

The research was conducted by individual pens fattening in Puspeta Klaten. Slaughtering of animals were done at Ngampilan abattoir and at Klaten abattoir. The meat analyses were done at the Laboratory of Meat Processing Technology of the Faculty of Animal Science and at the Faculty of Veterinary Medicine, GMU, and at the Food and Nutrition Laboratory, GMU. The research was done from July 2005 until

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January 2006, composed of fattening and rearing by farmers for 3 months, and analyses of physical and chemical characteristics and a panel test for 3 months.

The materials used were 18 Bali cattle and 18 Ongole cross breed. Each breed was divided into to groups of nine cattle either being fattened individually or being grown by farmers . The samples of meat were taken from *Longissimus dorsi* (LD) and *Biceps femoris* (BF) muscles. The samples were tested for physical characteristics, namely pH degree or acidy), tenderness (shear-force), *water-holding capacity* (WHC), and cooking loss (CL). Chemical composition included protein, soluble protein, fibrous protein, crude fat, ash (mineral), saturated and unsaturated fatty acids, and cholesterol. The microstructure (histology), and organoleptical test (color, texture, flavor, juiciness) were also determined.

The data were analysed by variance analysis from completely randomized design of factorial pattern of 2x2x2 (Bali Cattle and Ongole cross breed, fattening and rearing by farmers system, *Longissimus dorsi* and *Biceps femoris* muscles), continued by Duncan's Multiple Range test. The organoleptical test was done by using Kruskal-Wallis method.

RESULT AND DISCUSSION

The results of research indicated that the pH did not differ significantly among all treatments. The pH value of meat between Bali Cattle and Ongole Cross Breed did not differ and also between LD and BF muscles. The glycogen contents between breed and between muscles were likely to be similar. Accordingly, the pH values were not significantly different, as also explained by Romans and Ziegler (1974). The pH values obtained were generally similar to the normal pH values of meat.

The tenderness between breeds differed significantly. The Bali Cattle was more tender than the Ongole cross breed meat .The value was 5.04 ± 0.33 kg/ cm^2 and 6.05 ± 0.22 kg/cm^2, respectively. The tenderness was also different significantly ($P < 0.05$) between fattening system and rearing by farmers.The LD muscle was more tender compared with that of BF muscle.

Tables 1. Physical characteristics of Bali cattle, and Ongole cross breed by fattening and rearing system of *Longissimus dorsi* (LD) and *Biceps femoris* (BF) muscles

Physical Characteristics	Kinds of muscle	Bali cattle		Ongole cross bread	
		Fattening	Reared by farmer	Fattening	Reared by farmer
pH	LD	6.17 ± 0.22	6.18 ± 0.28	5.94 ± 0.22	6.08 ± 0.11
	BF	6.02 ± 0.25	6.15 ± 0.33	6.07 ± 0.24	6.06 ± 0.18
Tenderness	LD	4.31 ± 0.48	5.30 ± 0.43	5.76 ± 0.44	6.15 ± 0.22
(kg/cm2)	BF	4.75 ± 0.30	5.79 ± 0.33	5.28 ± 0.37	6.31 ± 0.29
Water-holding capacity	LD	34.16 ± 0.79	36.66 ± 0.75	35.32 0.53	37.47 ± 0.79
(%)	BF	35.39 ± 0.55	37.04 ± 0.76	35.93 ± 0.54	37.79 ± 0.59
Cooking loss	LD	33.36 ± 1.89	28.65 ± 2.47	30.44 ± 1.17	26.21 ± 1.07
(%)	BF	31.14 ± 1.13	31.05 ± 1.59	29.06 ± 0.83	27.59 ± 1.21

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The differences in tenderness were likely to be due to breed type, muscle structures, contraction status of myofibril and also due to the less tendon and the larger cytoplasm of LD muscle.(Lawrie 1979; Koohmaraie *et al.*, 1994, Soeparno, 2005). There were no interactions among treatments.

The water-holding capacity differed significantly between breeds ($P<0.05$). Ongole cross breed had higher water-holding capacity than Bali Cattle. Rearing by farmers had a higher-water holding capacity than fattening system. The LD had the lower water-holding capacity compared with the BF. The differences in water-holding capacity might be due to breed differences, as well as growing methods and kinds of muscles, as indicated by different in chemical components, such as water content, protein, and fat. Chemical components primarily protein had a close relationship with water-holding capacity (Lawrie 1979; Soeparno 2005). Cattle type or breed, and different growing systems could result in the difference of water-holding capacity. It was indicated that there were no significant interactions among treatments.

Cooking loss differed significantly among treatments ($P\leq0.05$). Ongole cross breed had a lower cooking loss than of Bali cattle. Fattening had a higher cooking loss than rearing by farmers. LD muscle had a higher cooking loss compared with the BF muscle. Cooking loss was closely correlated with the crude protein content, especially fibrous protein or water-holding capacity. The greater cooking loss resulted in the less water-holding capacity(Lawrie, 1979; Judge *et al.*, 1989; Soeparno, 2005). Thus, cooking loss had a close and negative relationship with water-holding capacity and closely related to the composition of protein and fatty acids.

Meat of Bali cattle and Ongole cross breed had a similar water content. Ngadiyono (1999) stated that water content of meat was affected by feed and protein content. The water content of meat from fattened cattle and from reared by farmers differed significantly ($P<0.05$) The differences in water content could be due to differences in growing system and fattening system, as also explained by Zubir (2001) that fattened cattle tended to have higher water content than the draught cattle. LD and BF muscles had similar water content. This result disagreed with Zubir (2001) that the BF muscles tended to have a higher water content than the LD muscles.

Protein. Both Bali cattle meat and Ongole Cross Breed cattle had similar protein content. This might be due to an environmental factor of tropical cattle. Ngadiyono (1995) indicated that the meat of tropical cattle tended to have similar protein content. The protein content of meat from reared cattle by farmer was higher than that of meat from fattened cattle ($P\leq0.05$). Johnson *et al.* (1988) indicated that the protein content of meat was influenced by management system, as also found in the present result. The protein content of LD muscle was similar to that of BF muscle. This result was in accordance with Judge *et al.* (1989) that the protein content of meat was not likely to be influenced by kind of muscle. There was no interaction between treatments on the protein content. The protein content did not vary significantly between breed, between management system and between muscles.

Fibrous protein. Bali cattle had a lower fibrous protein than did the Ongole cross breed cattle. Johnson *et al.* (1988) indicated that the meat fibrous protein could be affected by breed. Fattened cattle had a lower fibrous protein compared with did the reared cattle by farmer. The result agreed with Miller *et al.* (1990) that tropical cattle tended to produce a lower fibrous protein. *Biceps femoris* muscle had a higher fibrous protein than did the *Longissimus dorsi* muscle, as also indicated that an active muscle

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usually had a higher collagen content compared with the less active muscle (Miller *et al.*, 1990). The interactions among treatments were not significantly different.

Soluble protein. Bali cattle had higher soluble protein that the Ongole cross breed. This could be due to the lower fibrous protein on the meat of Bali cattle. Johnson *et al.* (1988) indicated that the soluble protein had a negative correlation with the fibrous protein. Meat from fattened cattle contained more soluble protein than the reared cattle by farmer. The fattened cattle had less activity than the reared cattle, so that the muscle cell content was lower, while the soluble protein was higher as was also in accordance with Johnson *et.al.* (1988) and Miller *et al* (1990) that soluble protein content of meat was closely correlated with the amount of muscle sarcoplasm. The LD and BF muscles had relatively a similar soluble protein. There was no interaction between treatments.

Fat content. The Bali cattle had a similar fat content than ongole cross breed cattle. This similar fat content could be due to the same environmental factor, such as the similar tropical condition. Fattening produced a higher subcutaneous fat compared with did rearing by farmer. Rusman (1997) and Zubir (2001) also indicated that Bali cattle and Ongole cross breed had a relatively similar fat in some adipose tissues. Fattening could result in a higher meat fat compared with rearing by farmer ($P \leq 0.05$).

The result agreed with Hoelscher *et al.* (1985) that fattening could produce higher rate of meat fat deposition. There was no fat difference between *Longissimus dorsi* and *Biceps femoris* muscles Jenkins, (1987) and Zubir *et al.* (2002) also stated that the fat of *Longissimus dorsi* and *Biceps femoris* muscles tended to be similar. There was no interaction between treatments on the meat fat content.

Ash. The ash content did not differ significantly, either between growing system or between muscles. No interaction among treatments was found. The non significant differences on ash content could be due to the constant ash content of the meat (Soeparno, 2005).The ash content of meat was generally similar and it was approximately one percent. Thus, the ash content of meat was not significantly different between treatments.

Cholesterol content. Bali cattle had a lower cholesterol content than the Ongole cross breed. The result agreed with Hoelscher *et al.* (1985) who stated that the local breed tended to have a similar level of cholesterol, and that the existing differences might be influenced by genetic factor. Fattened cattle had a higher cholesterol level than did the reared cattle by farmer. This was likely to relate to the higher concentrate level in the feed given to the fattened cattle. The result was in accordance with Rusman (1997), who stated that fattened cattle tended to produce a higher level of cholesterol. The LD muscle had a lower level of cholesterol compared with that of the BF muscle. The differences in cholesterol level might be due to the differences in the muscle activity. The LD was muscle less active. The more active muscle needed the more energy supply for activity which could be obtained from the fat of meat. Rusman (1997) and Zubir *et al*,. (2002) stated the higher level of cholesterol on the BF muscle than on the LD muscle. In the present research, there were no interactions among treatments.

Fatty acid. Fatty acid percentage differed significantly between breeds ($P \leq 0.05$). Bali cattle had a higher saturated fatty acid than did the Ongole cross breed cattle. The management system produced similar saturated fatty acid. The differences in fatty acid could be related to be the differences in the genetic factor.

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Tables 2. Meat chemical composition of meat of Bali cattle and Ongole cross breed as affected reared by farmer and fattening system from *Longissimus dorsi* (LD) and *Bicep femoris* (BF) muscles

Chemical Composition	Kinds of muscle	Bali cattle		Ongole cross breed	
		Fattening	Reared by farmer	Fattening	Reared by farmer
Water	LD	76.76 ± 0.57	77.95 ± 0.73	77.64 ± 1.03	78.45 ± 0.72
(%)	BF	77.09 ± 0.54	78.36 ± 0.89	77.81 ± 0.66	77.99 ± 0.54
Crude Protein	LD	19.37 ± 0.71	21.05 ± 0.89	19.81 ± 0.66	21.57 ± 0.76
(%)	BF	20.29 ± 0.51	21.45 ± 0.80	19.99 ± 0.68	25.02 ± 1.04
Protein fibrous	LD	12.97 ± 0.87	15.29 ± 1.37	14.13 ± 0.76	17.12 ± 1.19
(%)	BF	14.48 ± 0.72	16.49 ± 0.99	13.87 ± 0.881	15.90 ± 1.38
Soluble protein	LD	6.40 ± 0.63	5.81 ± 0.37	5.68 ± 0.45	4.45 ± 0.69
(%)	BF	5.81 ± 0.41	4.95 ± 0.65	6.05 ± 0.49	5.12 ± 0.60
Crude fat	LD	5.77 ± 0.47	4.89 ± 0.48	5.98 ± 0.65	4.99 ± 0.39
(%)	BF	5.96 ± 0.42	5.25 ± 0.35	5.87 ± 0.74	5.71 ± 0.50
Ash	LD	1.31 ± 0.28	1.17 ± 0.14	1.08 ± 0.12	1.10 ± 0.16
(%)	BF	1.21 ± 0.24	1.36 ± 0.24	1.15 ± 0.16	1.08 ± 0.12
Cholesterol	LD	70.8648±4.7727	57.0127±7.7138	81.3965±3.4552	73.4445±6.2001
(mg/ml)	BF	77.3952 ± 2.3984	75.6020 ± 3.2511	83.0.967 ± 2.7119	77.6264 ± 2.0091
Fatty acid	Saturated	36.89	38.09	36.37	37.67
(%)	Unsaturated	63.11	61.91	63.83	62.33

The saturated fatty acid was lower, while the unsaturated fatty acid was higher on fattened cattle compared with those on reared cattle by farmer. The lower saturated fatty acid and the higher unsaturated fatty acid were likely to related to the fattening system. A lot of concentrate feed could increase fat content of the meat, and this increased the unsaturated fatty acid and decreased the saturated fatty acids. The results were in accordance with Zubir *et al.* (2002) and Soeparno (2005) that fattened cattle could decrease saturated fat and increase unsaturated fat of the meat. The unsaturated fat of LD muscle was higher than that of BF muscle. On the contrary, the saturated fat of LD muscle was lower than that of BF muscle. These could be due the differences in fat content of the muscle, as also influenced by the muscle activity.

CONCLUSION

Bali cattle had better physical characteristics and chemical content than Ongole cross breed. Ongole cross breed on fattening system did not reduce cholesterol content and did not increase the proportion of essential fatty acid, especially arachidonic acid. Fattened cattle could produce a higher cholesterol a lower saturated fatty acid and higher unsaturated fatty acid than those of reared cattle by farmer. The LD muscle could produce a higher unsaturated fatty acid than did the BF muscle. No interaction was found among treatments.

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