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Amino Acids on Bali Cattle and Wagyu Beef Based on Different Function of Muscle

(ASAM-ASAM AMINO SAPI BALI DAN DAGING SAPI WAGYU BERDASARKAN FUNGSI OTOT YANG BERBEDA)

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ABSTRACT

Beef is an essential source of protein and several functional compounds that are very important for human. The quality of beef depends on both genetic and environmental factors like feed, age, sex, and others. This research aimed to determine the composition of amino acids both Bali and Wagyu beef on the different activity of muscle, i.e. active and passive. As many as 5 g of each sample was used in this study. The active beef samples were presented by Biceps *femoris,* and passive beef samples were presented by *Longissimus dorsi.* High-Performance Liquid Chromatography (HPLC) method was used in order to an identification of amino acids according to the standard procedure. Results of the study showed that the essential amino acids content both bali cattle and wagyu were higher than non-essential, and amino acids content originated from active muscle was higher than passive muscle. Methionine, phenylalanine, and serine on bali beef cattle were lower than wagyu beef. Overall, the content of amino acids essential was lower than non-essential. In conclusion, there is no significant difference of amino acids content both bali cattle and wagyu beef, but the function of muscle (active or passive) were known contribute to the difference of amino acids content.

Keywords: amino acids; Bali cattle; wagyu beef; *Biceps femoris; Longissimus dorsi*.

ABSTRAK

Daging sapi merupakan sumber protein dan beberapa senyawa fungsional yang sangat penting bagi manusia. Kualitas daging sapi tergantung pada faktor genetik dan lingkungan seperti pakan, umur, jenis kelamin, dan lain-lain. Tujuan dari penelitian ini adalah untuk mengetahui komposisi asam amino pada sapi bali dan wagyu, dengan aktivitas otot yang bergerak aktif dan pasif. Sampel sebanyak 5 g digunakan dalam penelitian ini, diambil dari otot *Biceps femoris (*aktif*)*, dan otot *Longissimus dorsi* (pasif). Metode *High Performance Liquid Chromatography* (HPLC) digunakan untuk identifikasi asam amino sesuai prosedur standar. Hasil penelitian menunjukkan kandungan asam amino esensial baik sapi bali dan wagyu lebih tinggi dibandingkan dengan asam amino non esensial dan kandungan asam amino yang berasal dari otot aktif lebih tinggi dari pada otot pasif. Asam amino methionine, phenylanine, leucin dan serine pada daging sapi bali lebih rendah, dari pada daging sapi wagyu. Secara keseluruhan, kandungan asam amino esensial lebih rendah dari

asam amino non esensial. Dapat disimpulkan tidak ada perbedaan yang signifikan kandungan asam amino sapi bali maupun daging sapi wagyu, namun fungsi otot (aktif atau pasive) diketahui berkontribusi terhadap perbedaan kadar asam amino.

Kata-kata kunci: asam amino; daging sapi bali; wagyu; otot *Biceps femoris; Longissimus dorsi*.

INTRODUCTION

Bali cattle (*Bos sondaicus / javanicus*) are genetic resources of Indonesia, and they are known as one of the most important local beef cattle breeds that contributing to the development of livestock and devote meat production in Indonesia (Martojo, 2012). Bali cattle are producing the highest weight carcass among local breeds in Indonesia, but the beef quality is lower than wagyu beef (Suwiti *et al.*, 2015). Wagyu beef remains the first of choice by tourists who come to Bali.

Quality of meat is mostly determined by the intrinsic factors such as color, flavor, tenderness, texture, juiciness, and, as well as its nutritional properties, depend on animal genetics (Sakuma *et al*., 2017). Other factors that contributing to the quality of meat including feed, livestock practices and post mortem process that take place during the conversion of muscle into meat (Di Luca *et al.*, 2013).

Wagyu beef contain intensely marbled with softer fat. It has a higher percentage of monounsaturated fats, omega-3, and omega-6 fatty acids and also lowers cholesterol. The combinations of these fats deliver a distinctive rich and tender flavor that is different from others (Matsuhashi *et al*., 2014). The tenderness of wagyu beef is due to the presence of intramuscular fat in muscle tissue, which can be observed by histologic examination (Suwiti *et al*., 2015). Intramuscular fat content directly effects the quality of beef; therefore it is known as one of the most economically important traits in beef cattle breeding (Iida *et al.*, 2015).

In addition to the above factors, meat quality is also determined by chemical content such as amino acid Sengor *et al.*, 2008). Amino acids also influence meat palatability and flavor (Genchev *et al.*, 2008). The composition and content of amino acid play an important role in meat quality by providing nutritive value and flavor (Cai *et al.,* 2010).

Quality traits of beef, as well as its amino acids levels, depend on animal genetics, feeding, livestock practices, and post mortem procedures. Other factors including species, ages, sex, feed, location, and its function also contributed to the quality of beef (Iida *et al*., 2015). Some researcher conducted several studies. Nicastro *et al.* (2000) analyzed the influenced of diet on amino acids profile of Longissimus thoracis and semimembranous muscle in Chianina beef. Hollo *et al*. (2001) found some factors like breed, slaughter weight, and gender had an important role in the chemical composition of beef. On the contrary, there are few studies focused on the comparison of amino acid, especially among bali cattle and wagyu beef. Based on the facts above, the study which title "The Properties of Amino acids In Bali Cattle and Wagyu Beef-Based on Different Function of Muscle" were interested to publish.

RESEARCH METHODS

Sample Preparation

Two different beef namely bali and wagyu beef collected from active and passive muscle were used in this study. A total of 30 samples were collected from the supermarket in Denpasar city. The samples transported to the laboratory by portable coolers and stored at -20^{o}C before analysis. Two grams of beef samples were grounded to be a fine powder, defatted with distilled petroleum ether in Soxhlet extractors and stored in screw-capped plastic tubes at -20°C until required. Preparation of each sample was carried out in duplicate.

HPLC Analysis of amino acids

Analysis of amino acids was performed by the method of Samicho *et al.* (2013). The Waters AccQTag amino acid analysis method requires a fluorescence detector. The excitation wavelength was 285 nm, the emission wavelength was 354 nm, filter and gain sets were 1.5 second and 10, respectively. Eluent A and Eluent B were AccQTag concentrate and 60% acetonitrile: water, respectively. The column temperature was set at 37°C. The Column (Waters AccQ•Tag) was first conditioned with Eluent B at 1 L/min flow rate for five minutes. This was followed by equilibrating the column in 100% AccQTag Eluent A for nine minutes at

the same flow rate. Consistent period of the equilibration was kept for all the analysis. A blank was carried out before each analysis to determine baseline performance. The total time between injections to the end of the analysis was 50 minutes (Samicho *et al*., 2013)

Statistical Analysis

All data were expressed as mean ± standard deviation. Data were analyzed by one way Anova. Duncan's multiple-range test was used to determine the difference between means. A significant difference was considered at the level of $p < 0.05$.

RESULTS AND DISCUSSION

The result of the study showed the content of amino acids in beef both bali cattle and wagyu was different according to their function that was presented in Table 1, 2 and 3.

Data in Table 1 and 2 showed the content of amino acids was independent of the breed (p=0.125) and the difference was known dependent on the function of muscles (p=0.000) both active and passive function. This result is in accordance with the results of other previous studies. For other cows, for example, Hongarian Simmental and Holstein Friesian, there were no statistical differences in amino acid (Hollo *et al.,* 2001). The results showed that the content of amino acid was statistically higher in active muscle than passive muscle (p=0.000), as well as higher in essential amino acid than non-essential amino acids (p=0.000).

There are nine types of essential amino acids that are identified from bali beef and wagyu beef namely: Histidine, Threonine, Arginine, Methionine, Valine, Phenylalanine, Isoleucine, Leucine and Lysine. While non-essential amino acids, namely: Aspartic acid, Glutamic acid, Serine, Glycine, Alanine and Tyrosine. The content of histidine dan phenylalanine was higher in bali beef than wagyu beef on active muscle, but amino acid valine was the lowest on bali beef with passive muscle function. Moreover, serin as a non-essential amino acid was found as the highest amino acid on wagyu beef with active muscle, but glisine is the lowest. The results in Table 1 and 2 showed that the active muscle has an amino acid (histidine, phenylalanine, serine) higher than passive muscle. In general, the muscles contain various type of proteins; therefore, their amino acid profile may also differ (Hollo *et al.,* 2001). Meat muscle composition is approximately 19% proteins, being 11.5% structural proteins (myofibrillar), 5.5% soluble sarcoplasmic proteins, and 2% connective tissue (collagen and elastin), and 2.5% fat dispersed among protein fibers (Oka *et al.,* 2007). The key factors causing such variations are probably due to differences of feed (Iwamoto *et al.,* 2010), ages of slaughter (Genchev *et al*., 2008). Furthermore, Cai *et al.* (2003) clarified the quality and ratio of essential amino acids determine the nutritional value of protein. Those variables can cause changes on the micronutrients of the meat, particularly on some amino acids content as the constituents of meat proteins Samicho *et al*., 2013).

Amino acids are one of the chemical compounds of meat (Cuvelier *et al*., 2006). Glutamic acid and phenylalanine are the major amino acids in fresh meat, while in dry-cured products glutamic acid, arginine, and lysine have shown the highest levels (Lopesa *et al*., 2015). Beef also contains high amounts of glutamic acid/glutamine (16.5%), arginine, alanine, and aspartic acid (Florek *et al*., 2017[a]).

The data in Table 1 and 2 also showed that the total of amino acids between active and passive were significantly different. Total amino acids content collected from active muscle Bisep femoralis were significant higher (Pe"0.05) than passive muscle Rib. The average content of amino acids in the bali beef and wagyu beef collected from active and passive muscle presented in Table 3.

The active muscle has many muscle fibers, which play a role in the hydrolysis process (Wilkinson *et al.,* 2014). In the process of hydrolysis, active muscle causes higher the amino acid content on beef including essential and non-essential amino acids. (Wheeler *et al.*, 2000; Iwamoto *et al*., 2010) stated the muscle with the different function will have different sarcomas and also fiber properties. Furthermore, Vance *et al.* (1971) also stated that the protein content of the passive muscle was lower or different than that active muscle. The content of connective tissue and the amount of cross-linking of collagen fibers differs among the muscles derived from the same carcass. These differences occur because of changes in structural, functional and metabolic characteristics between muscles (Florek *et al*., 2017[b]). Large muscles that move actively generally produce meat with the tenderness that

Table 1. The content of essential amino acid from Bali and wagyu beef according to muscle function.

No	Type of essential amino acids	Concentration of amino acids (%)			
		Wagyu beef (active)	Bali beef (active)	Wagyu beef (passive)	Bali beef (passive)
1	Histidine	4.665	4.681	3.483	3.776
2	Threonine	1.567	1.572	1.903	1.661
3	Arginine	2.673	2.567	2.683	2.461
4	Methionine	3.672	0.762	1.588	1.913
5	Valine	1.219	1.094	0.770	0.574
6	Phenylalanine	4.153	2.717	2.688	2.168
7	Isoleucine	2.916	2.879	1.710	1.406
8	Leucine	3.664	1.544	1.695	1.421
9	Lysine	3.906	3.533	4.343	1.519
	Total	28.435	21.349	20.863	16.899

Table 2. The content of non-essential amino acid from Bali and wagyu beef according to muscle function.

No	Type of non-essential amino acids	Concentration of amino acids (%)			
		Wagyu beef (active)	Bali beef (active)	Wagyu beef (pasive)	Bali beef (passive)
1	Aspartic asid	4.738	4.009	3.791	3.550
2	Glutamic acid	5.837	5.701	7.105	6.326
3	Serine	11.157	9.905	4.272	4.729
4	Glycine	0.807	0.728	1.021	0.819
5	Alanine	1.501	1.409	2.063	1.786
6	Tyrosine	2.020	3.421	1.343	1.191
	Total	26.06	25.173	19.595	18.401

Tabel.3. The mean of amino acids content of bali beef and wagyu beef derived from active and passive muscle.

Beef origin	Amino acids content (pg/mL)	
	Active muscle	Passive muscle
Bali cattle	3.101±46.522[a]	2.267±31.750[b]
Wagyu cattle	3.633±54.495[a]	2.274±29.562[b]

Note: The same letter in the direction of the column shows no significant difference (P>0.05), and different letters towards the rows indicate significant difference (P <0.05).

is different from the meat originated from passive muscles (Osawa *et al*., 2008). The location of muscle also affected amino acids content (Wilkinson et *al.,* 2014).

Based on the results above, the total amino acid contents of bali beef were no differences compare with Wagyu beef, although any of amino acids concentration were found differ like methionine, phenylalanine, leucine and serine which showed higher concentration on Wagyu beef (P <0,05) than Bali beef. Our finding indicated that the genetic has slight correlations on the amino acids' contents. This slightly different from the content of amino acids in Japanese Black cattle (Inoue *et al.,* 2008; Nogi *et al.*, 2011). Hollo *et al.* (2001) stated that breeds were not significant influence on the content of amino acids.

CONCLUSION

The amino acid content of Bali beef is the same as Wagyu beef. On the other hand, muscle function (active and passive) becomes a significant factor that affects amino acid levels. The non-essential amino acid content in bali and wagyu beef is higher than essential amino acids.

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