PROXIMATE COMPOSITION AND FATTY ACID PROFILE OF BEEF AND CARABEEF

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Proximate composition and fatty acid profile of beef and carabeef

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The Author

Abstract

A study was conducted to compare the nutritional value of beef and carabeef in terms of proximate composition and fatty acid profile. Longissimus and thigh muscle samples were collected and subjected to chemical analyses. Moisture, crude protein, and crude fat contents of beef and carabeef has somewhat differ significantly. Carabeef had significantly higher ash content in case of longissimus muscle but both muscles crude protein were higher than beef. The principal fatty acids identified in beef and carabeef were palmitic, stearic, linoleic and oleic. Carabeef had higher oleic acid content (43.68%) than beef (37.15%). The linolenic acid content (1.17%) of beef was significantly lower than that of carabeef (4.76%). The linoleic acid content of beef and carabeef has differ significantly. The saturated fatty acid content in carabeef did not differ from that of beef. The unsaturated fatty acid in carabeef was significantly higher than in beef. Results imply that beef and carabeef fatty acid profile were not entirely different. The study showed that carabeef is as good as beef in terms of proximate and fatty acid composition.

Key words: Proximate composition, beef, carabeef, protein, fatty acid profile.

Chapter 1
Introduction

Beef is the best source of animal proteins, micronutrients, and B-complex vitamins in the human diet. The chemical composition of meat is an important factor determining both its nutritional value and its suitability for processing meat products (Litwinczuk et al., 2016)**.** Meat plays an important role in humane diet. Aside from pork and chicken, beef is one of the more popular meat items in the market. The per capita consumption of beef is 2.52kg (BAS, 2005). Among the common meat in the market, carabeef closely resembles beef. It has a per capita consumption is 1.76 kg (BAS, 2005). A study has shown that sensory characteristics of carabeef did not differ significantly from that of beef (Lapitan and Arganosa, 1976). As with other types of meat, carabeef has been found to be useful in the preparation of many meat products like in fresh and emulsion type sausages and it can replace beef in corned beef manufacture.

Likewise, it can befully utilized in many different beef recipes, with no significant difference in palatability. It has also been reported that carabeef contained lower fat and cholesterol than beef, pork and skinless chicken (Pablico, 2003). Despite these facts, carabeef remains less popular among consumers.

Recently, it has also been well recognized that the carabeef tends to be popular with beef consumers as a healthy meat in developed countries, because the carabeef generally contains relatively low levels of fat and cholesterol (i.e a high proportion of lean meat) as compared with normal beef (USDA, 1997).

Therefore, carabeef is reported to be a good choice of red meat for people with heart and circulatory system diseases (Kucukkebapci, 2005). Becauseof these characteristics, there has been increased interest in meat from this species (Irurueta et al., 2008). In particular, buffalo meat seems to be extremely suitable for patients who need dietetical foods (Calabro et al., 2014). Finally, buffalo meat is considered in Turkey as an alternative healthy product because of its good nutritional.

One of the possible approaches to reduce or eliminate prejudice against carabeef is to determine its nutritional qualities and prove that it is as good as, or even better than beef. With the change in attitude of the consumers towards health preserving diets, the quality of meat products had to be improved to meet consumers expectation. Consumers tend to prefer meat with low intra-muscular fat content over those with higher fat of even better palatability. Although a lowerfat level has become obligatory, the fatty acid composition of any meat is also an important point to consider. Fatty acid profile and proximate composition of meat vary can be influenced by breed, feed, age and sex of animal. Aside from the proximate components of meat, the study focused on determining the fatty acid composition and characterizing the fatty acid in beef and carabeef.

The fatty acid composition is one of the most significant determinants of the health quality of meat (Kaczor et al., 2010). In addition, muscle lipids are an important signifier of the nutritional quality of meat (Flynn et al., 1985). At the present time, especially in developed countries, there is an increasing trend in consumers to prefer lean red meat with less fat and high quality (Mushi et al.,2008**;** Khan & Iqbal,2009**)**. The fatty acid profile of buffalo fat affects the nutritional value of the meat, different aspects of meat quality, flavor content and shelf life (Lambertz et al., 2014). On the other hand, the structure of the fatty acids plays an important role in maintaining health (Williams, 2000). Moreover, the ratio between polyunsaturated and saturated fatty acids (P:S) and the ratio between omega 6 (*n*-6) and omega 3 (*n*-3) fatty acids are taken into account as two significant indices for the nutritional evaluation of fat, and these ratios are highly important for human health (Department of Health, 1994**;** Raes et al., 2004). Hollo et al. (2001) reported that species and breed influenced the fatty acid composition and the quantities and proportions of saturated and unsaturated fatty acids in meat.

This study aimed to compare between beef and carabeef in terms of their chemical composition and fatty acid profile.

The objective of the study:

1. To determine the protein, fat, ash, moisture and ether extract of the collected sample
2. To compare the fatty acid profile of beef and carabeef meat.

Chapter 2

Materials and methods

2.1 Study area and period

The study was carried out in the department of animal sciences and nutrition, Faculty of Veterinary Medicine, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong-4202, Bangladesh during September to October of 2021.

2.2 Collection of samples

The meat has been collected from cattle and buffalo from different areas of Gobindrashree village, Madan Upazilla under Netrakona district during Eid-ul Adha. Immediate after the collection, the sample was brought to the laboratory and ground to obtain a uniform size and kept in an airtight plastic bag and placed into the freezer to avoid bacterial contamination.

2.3 Proximate analysis

The proximate analysis of meats showed the following composition: Dry Matter (DM), Moisture, Total Ash (TA), Crude Protein (CP), Crude Fiber (CF), Ether Extract (EE) in Animal Nutrition Lab at Chittagong Veterinary and Animal Sciences University, Chittagong.

Estimation of Dry matter and Moisture

In oven the petridish was dried which was regulated at 105°C and was cooled in a desiccator and weighted. 10 gm of feed sample was weighted into the petridish and kept into the oven for 24 hours. The petridish was removed from the oven with metal tong. After that it was cooled in desiccator and the final weight was taken after getting constant weight (AOAC, 2006).

$$\% \text{ DM} = \frac{\text{Initial weight (g)} - \text{Final weight (g)}}{\text{Sample weight (g)}} \times 100$$

% Moisture = 100 - % DM

Estimation of Ash

The crucible was dried in hot air oven. It was cooled in Dessicator. After that the weight of the empty crucible was taken. 5gm of meat sample was placed in the crucible and it was burned. Burning was done until no smoke was produced in heater. Then the sample with crucible was cooled and transferred to the muffle furnace. After that sample was ignited at 550-600°C for 6-8 hours until white ash is produced. The furnace was cooled at 150°C and the sample was transferred to the dessicator and weight was taken (AOAC, 2006).

$$\% \text{ Ash} = \frac{\text{Wt. of crucible and ash} - \text{Wt. of crucible}}{\text{Weight of feed sample (g)}} \times 100$$

Estimation of Crude Protein (CP)

5 gm of sample was weighted and taken into a digestion tube. Then one spoonful of catalyzer mixer (KOH, NaOH, Se) was added there. 10 ml concentrated H2SO4 was also added and the digestion flask was placed in Kzeldhal Digestion Set. After that heat was increased gradually and continued until clear residue (45 min to 1 hr) is formed. The flask was removed from the digestion set and then cooled. 10 ml 2% boric acid solution, 2 drops mixed indicator were taken in a conical flask. The conical flask was fitted in the collection arm of distillation set. 50 ml distilled H2O was added in the digestion tube and fitted in the distillation flask. 40 ml of 40% NaOH was added there and the distillation was continued up to 100ml. Then it was titrated against 0.1 N HCl. Titration was continued until the color was changed into pink. Then the reading of titration was taken. (AOAC, 2006).

$$\% \text{ CP} = \frac{(\text{Titre} - \text{blank}) \times \text{Normality of HCL} \times 14.007 \times 6.25}{\text{Sample weight (g)}} \times 100$$

Estimation of Ether Extracts (EE)

Two-gram dry sample was taken in an extraction thimble having porecity, then placed in the Soxhlet flask. The cork of thimble was above the syphone tube. A receiving flask was weighted and fitted with Soxhlet apparatus and was placed in water bath at 500 to 600 C. Ether extract was poured down in to the soxlet flask. The flask was filled up to ¾th portion with ether and it was assured that water was running through the condenser. When extraction was over, the thimble with sample was removed and heated in the water bath to remove all the ether from receiving flask. The receiving flask was placed into the oven at 1050C to eliminate left of the ether and water. After drying, the flask was taken out and weighted (AOAC, 2006).

$$\% \text{ EE} = \frac{\text{Initial weight (g)} - \text{weight after extraction (g)}}{\text{sample weight(g)}} \times 100$$

Chapter 3

Results and Discussion

The result of proximate analysis of meat samples are shown in below table:

Table 1. Proximate composition of the *Longissimus dorsi* muscle for beef and carabeef.

Type of meat	Moisture %	Crude protein %	Crude fat %	Ash %
Beef	70.57	22.87	3.04	0.93
Carabeef	69.02	23.1	3.58	1.07
SEM	0.12	0.10	0.04	0.12
P value	0.10	0.07	0.06	0.04

Table 2. Proximate composition of thigh muscle for beef and carabeef.

Type of meat	Moisture %	Crude protein%	Crude fat%	Ash %
Beef	78.26	20.48	1.96	1.076
Carabeef	72.31	21.35	1.1	1.074
SEM	0.22	0.07	0.02	0.12
P value	<.0001	0.03	0.001	0.18

The proximate composition of meat samples from cattle and buffalo are presented in Table 1.The results showed no significant ($p>0.05$) differences between beef and carabeef in terms of moisture, crude protein and crude fat contents, while ash differed significantly ($p<0.04$). Carabeef had 1.07% ash, significantly higher than beef with 0.93%. The crude fat and crude protein contents obtained from this study were higher than the findings of Lapitan and Arganosa (1976). They reported that beef and carabeef had crude fat contents of 1.1 and 1%, respectively and the crude protein of beef and carabeef were 19.2 and 20.2 %, respectively. Compared to the findings of Umali (2004), the average composition of carabeef obtained in this study was slightly lower in terms of moisture but slightly higher in protein and crude fiber fat. These differences may be attributed to some factors affecting the components of meat such as the meat cut used, age of the animal from which the meat was obtained, breed and feeding management. Moreover, the degree of trimming done on the samples may have caused variation in the results of the studies. This is especially true with the crude fat content. Aberle et al. (2001) reported that the amount of lipid in meat cuts depended on the amount of untrimmed fat within and between muscles and the external fat remaining after cutting and trimming.

Table 2 represents the proximate composition of thigh muscle. The protein, Ash, crude fat, moisture content of thigh of cattle were 20.48,1.07, 1.96, 78.26 percent respectively and buffalo were 21.35, 1.067, 1.01, 72.31 percent respectively from Table 2. Meat naturally contains about 75% moisture. According to Stercova et al. (2008), the moisture content of meat 76.66%. This study shows that the moisture content of beef is 78.26% which is higher than the recommended value. However, compared to the results obtained in this study, Williams (2007) and Bures et al. (2007) stated that the percentage of water in a cut can vary depending on time of the year, kind of meat and type of muscles. Meat from leaner animal on average contains slightly higher percentage of water, as the water content is related to the protein and not the fat portion of the product. Table 2 also reported the moisture content for the carabeef was 72.31% which is normal.

The protein content reported in this document is comparable with Stercova et al. (2008) and Peraza-mercado et al. (2006). Accordingly, the protein content reported in this document is also comparable with Stercova et al. (2008) report of 23.06% for thigh muscle but this study sample found to be lower in case of beef and carabeef but compare between those two meats carabeef is slightly higher than that of beef. Melton et al. (1974) reported a 19.40% crude protein for the beef sourced from Herford cattle. But it is in agreement with Willams (2007) range of 20-25g protein/100g and comparable with Bures et al. (2007) range of 20.6-21.29% for protein, 0.976-0.992% for ash and 73.74-74.98% for moisture contents.

Bures et al. (2007) reported that protein, ash, ether extract and moisture content significantly varies between breeds and ages of animals. Perza-Merco et al. (2006) reported a protein of 15.32%, moisture 74.35%, ash 1.38% respectively for thigh muscle of young cattle are comparable with these results. Jost et al. (1983) reported a protein content of 21.2%, moisture content 72.9% and Ash 0.99%, ether 1.08 %, respectively.

Carabeef had 21.35% protein, significantly higher than beef with 20.48%, the crude fat and moisture contents obtained from this study were lower compare with beef than the findings of Lapitan and Arganosa (1976).

Table 3: Fatty acid profile of beef and cara beef.

Fatty acid	Ret. Time(beef)	Ret. Time(carabeef)	Beef %	Carabeef %
1. Myristate	29.67	29.62	2.71	1.46
2. Myristoleic acid methyl ester	31.26	30.91	0.81	0.93
3. Pentadecanoate	31.52	31.76	0.51	4.15
4. Cis-10 pentadecanoic acid	33	32.96	0.49	0.46
5. Palmitate	33.32		29.89	26.72
6. Palmetoliate	34.56	34.50	3.82	2.96
7. Heptadecanoate	34.96	34.91	1.11	1.85
8. Cis-10 Heptadecanoic acid	36.11	36.07	1.19	1.06
9. Stearate	36.59	36.80	21.03	0.65
10. Elaidate	37.40	37.38	1.83	9.38
11. Cis-9 oleic acid	37.78	37.64	2.34	43.67
12. Linoleate	39.17	39.12	20.77	13.59
13. Linolenate	40.86	40.83	1.17	4.76
14. Heneiicosenoate	41.07	41.01	0.53	1.38
15. Behenate	42.64	42.59	0.74	0.60
16. Cis-8,11,14 Eicosatrienoic acid	43.28	43.48	1.32	0.40
17. Cis-5,8,11,14 Eicosatrienoic acid	44.24	44.19	7.26	5.27
18. Oleic acid	47.91	49.58	37.15	43.68
19. Docosahexaenoate	50.42	50.37	1.40	2.93

Table 3 shows the fatty acid composition of the intramuscular fat taken from the longissimus and thigh muscle from cattle and buffalo. The fatty acids present in large quantities in both meat samples were stearic, palmitic, lenoleic and oleic. The same findings were obtained by Varela et al. (2004). These findings conformed to the report of Aberle et al. (2001) that in all meat fats, the most abundant fatty acid is the monounsaturated oleic acid and the other fatty acids present in high proportions are palmitic and stearic. Among the principal fatty acids that were identified, the amount of oleic acid differed significantly between beef and carabeef. Carabeef had higher oleic acid content (43.68%) than beef (37.15%). This is a distinct advantage of carabeef over beef. Drysden and Marchello (1970) reported that oleic acid content is positively correlated with the sensory quality of meat. Moreover, it was shown that oleic acid is favored substrate for the liver enzyme that converts cholesterol to an inactive form. Grunday (1994) also reported that in several studies on relative carcinogenicity of fatty acids on their ability to suppress the immune system, oleic acid was the fatty acid with the least negative effect. Beef had linolenic acid content of 1.17% which was significantly lower than carabeef at 4.76%. On the other hand, linoleic acid content of beef and carabeef has differed.

The proportion of saturated fatty acid in carabeef was similar to that in beef. With the exception of stearic acid, saturated fatty acids tend to increase cholesterol lipoprotein and total cholesterol levels in the blood plasma (Grundy, 1994). The proportion of unsaturated fatty acid was significantly higher in carabeef. This can be attributed to the high oleic acid content of carabeef. In both meat samples, the proportion of saturated fatty acid was higher than unsaturated fatty acid. The amount of saturated fatty acid obtained in this study is close to the 54% in beef reported by Aberle et al. (2001). The saturated fatty acid content was lower than the findings of Varela et al. (2001) at 42%. This was because the animal used in this study was younger than those used by Varela et al. (2001). Zembayashi et al. (1995) reported that in younger steers, the proportion of saturated fatty acids in the carcass lipids was higher.

Chapter 5

Limitation

- In the proximate analysis, we estimate total N_2, not the ultimate protein & NPN (Non-Protein Nitrogenous Substance).
- Again, it estimates % CP from N_2 multiplying by 6.25 assuming that all protein contains 17-19% N_2. So over & under estimation of N_2 can be happened.
- Any deprivation in results may be due to environmental or experimental error.

Chapter 6
Conclusion

Meat quality and features of cattle and buffalo meat were found to be almost identical. The aim of this study was to compare proximate composition and fatty acid profile of beef and carabeef meats. Buffalo meat is less expensive and less popular in Bangladesh than cattle meat. It may be determined from this experiment that buffalo meat is superior to cattle meat after studying the chemical composition. The study showed that carabeef was as good as, if not better than beef in terms of nutritional quality.

Chapter 7

References

Arganosa, F.C., Sanchez, P.C., Ibarra, P.I., Gerpacio, A.L., Castillo, L.S., Arganosa, V.G. (1973). Evaluation of carabeef as potential substitute for beef. Philippine Journal of Nutrition, 26:128-143.

Association of Official Analytical Chemists (AOAC). (2000). Washington, DC. Bureau of Agricultural Statistics (BAS).

Bures, D., Barton, Zahradkova, L.R., Teslik, V. and Krejcova, M. (2007). Chemical Composition, Sensory Characteristics, and Fatty Acid Profile of Muscle from Aberdeen Angus, Charolais, Simmental, and Hereford Bulls. Czech Journal of Animal Science, 51: 279-284.

Callow, E. H. (1962). Comparative studies of meat. VIII. The percentage of fat in the fatty acid and muscular tissues of steers and the iodine number of the extracted fat, as affected by breed and level of nutrition. Journal of Agricultural Science, 58:295-307.

Drysden, F.D., Marchello, J.A. (1970). Influence of total lipid and fatty acid composition upon the palatability of three bovine muscles. Journal of animal science, 31: 36-40.

Flowers, S., Hamblen, H., Leal-Gutiérrez, J.D., Elzo, M.A., Johnson, D.D. and Mateescu, R.G. (2018) Fatty Acid Profile, Mineral Content and Palatability of Beef from a Multibreed Angus Brahman Population. Journal of Animal Science, 96: 4264-4275.

Forrest, J.C., Aberle, E.D., Hedrick, H.B., Judge, M.D., Merkel, R.A. (1975). Principles of Meat Science, W.H. Freeman, San Francisco, CA. MEAT QUALITY OF CATTLE AND CARABAO 603 © 2

Grunday, S.M. (1994). Influence of stearic acid on cholesterol metabolism to the long-chain fatty acids. American Journal of clinical Nutrition, 60: 986-991.

Irurueta, M., Cadoppi, A., Langman, L., Grigioni, G. and Carduza, F. (2008). Effect of aging on the characteristics of meat from water buffalo grown in the Delta del Parana region of Argentina. Meat Science, 79(3): 529-533.

Kaczor, U., Borys, B. and Pustkowiak, H. (2010). Effect of intensive fattening of lambs with forages on the fatty acid profile of intramuscular and subcutaneous fat. Czech Journal of Animal Science, 55(10): 408-419.

Kaczor, U., Borys, B. and Pustkowiak, H. (2010). Effect of intensive fattening of lambs with forages on the fatty acid profile of intramuscular and subcutaneous fat. Czech Journal of Animal Science,55: 408-419.

Lambertz, C., Panprasert, P. and Holtz, W. (2014). Carcass Characteristics and Meat Quality of Swamp Buffaloes (Bubalus bubalis) Fattened at Different Feeding Intensities. Asian-Australas Journal of Animal Science, 27(4):551-560.

Lapitan, R.M., Del Barrio, A.N., Katsube, O., Tokuda, T., Orden, E.A., Robles, A.Y., Fujihara, T., Cruz, L.C. and Kanai, Y. (2004). Comparison of feed intake, digestibility and fattening performance of Brahman grade cattle (Bos indicus) and crossbred water buffalo (Bubalus bubalis). Animal Science Journal, 75: 549– 555.

Litwińczuk, Z., Piotr Domaradzki, P., Florek, M. and Żółkiewski, P. (2016). Chemical Composition, Fatty Acid Profile, Including Health Indices of Intramuscular Fat, and Technological Suitability of the Meat of Young Bulls of Three Breeds Included in a Genetic Resources Conservation Programme Fattened within a Low-Input System. Animal Science Papers and Reports, 34: 387-397.

Mandell, I. B., Buchanan-Smith, J. G., Holub, B. J. and Campbell, C. P. (1997). Effect of fish meal in beef cattle diets on growth performance, carcass characteristics, and fatty acid composition of longissimus 58th International Congress of Meat Science and Technology, 12-17th August 2012, Montreal, Canada muscle. Journal of Animal Science, 75: 910- 919.

Oliveros, B.A., Ibarra, P.I., Arganosa, F.C., Lapitan, J.E. and Del Rosario, R. 1982. Studies on the utilization of meat products. II. Selected physical and chemical characteristics of carabeef by-products. Philippine Journal of Veterinary and Animal Science, 8: 8–19.

Yoshimura, T. and Namikawa, K. (1983). Influence of breed, sex and anatomical location of lipid and fatty acid composition of bovine subcutaneous fat. Japanese Journal of Zootechnology Science, 54: 97-105.

Zembayashi, M., Nishiura, K., Hunt, D.K. and Smith, S.B. (1995). Effect breed type and sex on the fatty acid composition of subcutaneous and intramuscular lipids of finishing steers and heifers. Journal of animal science, 73: 3325-3332.

Chapter 8

Biography

The author Md. Mozammal Hasan Chowdhury, son of Md. Sarwar Alam Chowdhury and Ripa Chowdhury passed his Secondary School Certificate (SSC) examination from Mohammadpur Govt. High School, Dhaka in 2012 and Higher School Certificate (HSC) examination from Government Science College, Dhaka in 2014. Thereafter he enrolled for Doctor of Veterinary Medicine (DVM) degree in Chattrogram Veterinary and Animal Sciences University (CVASU), Bangladesh and now is an intern student in this university.