

Fatty Acid Composition in Various Depot Fats of Fattened Japanese Black and Holstein Steers

Kyohei OZUTSUMI, Takatomo KAWANISHI*,
Ken ITO** and Toshio YAMAZAKI***

National Institute of Animal Industry, Tsukuba
Norindanchi P. O. Box 5 Ibaraki 305

(Received November 8, 1982)

Abstract In order to investigate the fatty acid composition in various depot fats of fattened Japanese Black and Holstein steers, three animals of each breeds were managed under a similar back condition from rearing to finishing. Thirteen different depot fats were sampled from the steers to compare their fatty acid composition. There were no statistical differences in the fatty acid composition of various depot fats between the two breeds. However, the depot fats of fattened Japanese Black steers contained more unsaturated fatty acids than those of fattened Holstein steers. The brisket fat in the two breeds contained more unsaturated fatty acids than other fats. With the two breeds, the total amount of unsaturated fatty acids tended to be larger in the outer parts than in the inner parts of the animals' bodies. There seems to be a breed difference for total amount of unsaturated fatty acids between the depot fats of the Japanese Black and those of Holstein steers. *Jpn. J. Zootech. Sci.*, 54 (8): 470-475, 1983

A number of studies have been conducted on the fatty acid composition of depot fats in various cattle¹⁻¹⁶⁾. There are a number of factors which affect the fatty acid composition of depot fats in cattle, such as age, stage of fattening, diet, season, breed, sex and location. Yet relatively little information has been obtained on fatty acid composition of various depot fats in fattened Japanese Black and Holstein steers, except for a few reports^{3,4,16)}.

The present research was intended to compare the fatty acid composition of various depot fats in Japanese Black and Holstein steers, which were managed under similar feeding conditions from rearing to finishing, because the effect of feeding regime¹⁵⁾ on fatty acid composition of depot fats is well known.

Materials and Methods

Three fattened Japanese Black and three Holstein steers were used to determine the fatty acid composition of various depot fats. These animals were grazed on hill pasture during rearing period and then fattened approximately one year in a house, fed concentrates (conventional fattening) and roughages *ad libitum*. Average slaughter

*Kanagawa-ken Animal Husbandry Research Institute, Hongo, Ebina-shi Kanagawa 243-04.

**Chiba-ken Animal Husbandry Center, Yatchimata, Chiba 289-11.

***National Grassland Research Institute, Nishinasuno-cho, Tochigi 329-27.

weight and age of the Japanese Black were 489.0 ± 17.4 kg and 731.0 ± 25.0 days, and those of the Holstein steers were 556.3 ± 65.8 kg and 753.0 ± 13.0 days, respectively.

The samples for fatty acid determination were taken from the various parts of carcasses of the two breeds. The samplings were made at the following sites: kidney fat—inside and outside of the kidney knob, channel fat—from a point situated half way along the line jointing the cranial tip of the pubis, thoracic fat—dorsal to the 5-6 sternbrae, cod fat—3-4 cm from the ventral border of *M. cutaneous trunci* on a horizontal line to the cranial tip of the *os pubis* at its symphysis, brisket—from the point situated on a horizontal line through the junction of the first and second sternbrae adjacent to the ventral midline, crop fat—on a horizontal line passing through the 15 cm from the dorsal edge of the tuber ischi, loin—opposite the midpoint of the centrum of the second lumber vertebrae and intermuscular fat from the thorax. Omentum and mesenteric fatty tissues were obtained immediately after slaughter. The fatty acid determination of these depot fats was carried out as described in a previous paper¹⁷⁾.

Results and Discussion

1. Effect of location:

Fatty acid composition of various depot fats of the Japanese Black and Holstein steers is shown in Table 1 and 2. There were no quantitative difference in composition of the fatty acids in the various depot fats of the two breeds. The sum of the major fatty acids (C 16:0, C 16:1, C 18:0 and C 18:1) was approximately 90% of the total fatty acids in the two breeds.

In both breeds, the total amount of unsaturated fatty acid was highest in the brisket fat among the various depot fats: for instance, the brisket fat of Japanese Black steers contained as high as 8.5% of C 16:1. NILSSON and NOREN⁷⁾ noted that the concentration of C 16:1 was below 5% in brisket fat. From these points, the brisket fat was considered to be a slightly different depot fat for fatty acid composition. Beef brisket fats have been found to differ from other depot fats for acid composition⁷⁾ and for moisture content⁹⁾.

In the two breeds, the external location fats, brisket, loin, round and thoracic fats had more total unsaturated fatty acids than the internal location fats, omentum, rib, mesenteric, channel, kidney and heart fats. The order of percentages of total unsaturated fatty acids in various depot fats was slightly different between the two breeds. The total amount of the unsaturated fatty acids in the Japanese Black steers ranged from 46.4 to 65.5 percent among the various depot fats, while those in Holstein steers were from 41.7 to 60.8 percent. These ranges in the two breeds showed a similar difference of approximately 20%.

As mentioned above, there was a tendency to decrease in total unsaturated fatty acids from external to internal depot fats in the two breeds. This observation is in agreement with the works reported by many researchers^{3,4,6,16)}. Although a little

Table 1. Fatty acid composition in various depot fats of fattened Japanese Black steers

Fatty acid Depot fat	Fatty acid composition											Total saturated	Total unsaturated
	C14:0	C14:1	C15:0	C16:0	C16:1	C17:0	C17:1	C18:0	C18:1	C18:2	C18:3		
Brisket	2.9	2.1	0.3	23.5	8.5	0.7	1.3	7.1	50.5	2.5	0.8	34.5	65.5
Lion	2.9	1.4	0.4	23.8	5.6	1.2	1.0	11.0	49.7	2.2	1.0	39.1	60.9
Round	2.9	1.2	0.4	23.4	5.1	1.1	1.2	11.7	50.3	2.3	0.8	39.5	60.5
Thoracic	2.2	0.6	0.3	23.2	3.5	1.3	0.9	16.2	48.7	2.4	0.8	43.1	56.9
Cod	3.0	1.0	0.4	24.3	4.2	1.4	0.9	15.4	46.2	2.4	0.9	44.5	55.5
Intermuscular	2.7	0.8	0.4	23.7	3.6	1.3	0.8	17.2	46.5	2.1	0.9	45.2	54.8
Omentum	2.2	0.4	0.3	22.5	2.8	1.5	0.7	21.0	45.5	2.2	0.9	47.4	52.6
Rib	2.8	0.6	0.3	24.3	3.4	1.6	0.8	19.3	44.1	2.4	0.7	48.3	51.7
Mesenteric	2.6	0.5	0.3	22.5	2.8	1.4	0.7	22.1	44.1	2.3	0.7	49.0	51.0
Channel	2.7	0.4	0.4	24.7	2.9	1.5	0.8	21.7	42.4	1.9	0.6	51.0	49.0
Kidney inside	2.7	0.4	0.3	23.7	2.7	1.5	0.7	23.4	41.9	2.0	0.7	51.6	48.4
Kidney outside	2.6	0.4	0.3	23.5	2.5	1.4	0.6	24.6	41.4	2.1	0.7	52.4	47.6
Heart	2.7	0.4	0.4	24.2	2.9	1.8	0.7	24.5	39.4	2.5	0.7	53.6	46.4
All depots	2.7	0.8	0.4	23.6	3.9	1.4	0.9	18.1	45.4	2.3	0.8	46.1	53.9
Mean \pm SD	± 0.2	± 0.5	± 0.1	± 0.5	± 1.6	± 0.3	± 0.2	± 5.4	± 3.5	± 0.2	± 0.1	± 5.6	± 5.6

Fatty acid contents are expressed as a percentage of 11 fatty acids measured (Wt. %).

Fatty Acid Composition in Depot Fats

Table 2. Fatty acid composition in various depot fats of fattened Holstein steers

Fatty acid Depot fat	Fatty acid composition in various depot fats of fattened Holstein steers											Total saturated	Total unsaturated
	C14:0	C14:1	C15:0	C16:0	C16:1	C17:0	C17:1	C18:0	C18:1	C18:2	C18:3		
Brisket	2.8	1.6	0.4	24.3	6.4	1.1	1.0	10.6	48.7	2.6	0.6	39.2	60.8
Loin	3.6	1.6	0.4	25.1	5.6	1.2	1.0	13.1	45.1	2.7	0.5	43.4	56.6
Round	3.6	1.2	0.4	25.2	5.9	1.8	1.0	13.5	44.8	2.1	0.5	44.5	55.5
Thoracic	2.8	0.6	0.4	24.4	3.3	1.5	0.6	24.4	38.7	2.9	0.5	53.5	46.5
Cod	3.6	1.1	0.4	24.9	4.4	1.5	0.9	18.3	42.0	2.3	0.5	48.7	51.3
Intermuscular	3.2	1.1	0.4	24.3	4.6	1.4	0.8	17.6	43.5	2.6	0.5	46.9	53.1
Omentum	3.6	0.8	0.5	23.6	3.4	1.6	0.8	19.6	42.3	3.2	0.7	54.6	45.4
Rib	4.0	0.7	0.5	25.9	3.1	1.5	0.6	23.8	37.3	2.8	0.5	55.1	44.9
Mesentric	2.6	0.5	0.4	22.2	2.8	1.6	0.5	32.5	34.0	2.6	0.4	59.3	40.7
Channel	3.1	0.7	0.5	26.0	3.0	1.4	0.5	24.5	37.0	2.9	0.5	55.5	44.5
Kidney inside	3.5	0.6	0.4	24.0	3.0	1.7	0.6	23.1	39.5	3.2	0.5	58.3	41.7
Kidney outside	3.1	0.6	0.4	25.3	2.8	1.5	0.5	28.2	34.2	2.7	0.7	58.5	41.5
Heart	2.8	0.5	0.5	24.8	2.9	1.7	0.5	28.5	34.4	2.8	0.6	58.3	41.7
All depots	3.3	0.9	0.4	24.6	3.9	1.5	0.7	21.4	40.1	2.7	0.5	52.0	48.0
Mean ± SD	±0.4	±0.4	±0.1	±1.0	±1.3	±0.2	±0.2	±6.3	±4.5	±0.3	±0.1	±6.4	±6.4

Fatty acid contents are expressed as a percentage of 11 fatty acids measured (Wt. %).

difference was shown in the kidney fat, inside kidney fat had more total unsaturated fatty acids than outside kidney fat.

ADACHI *et al.*¹⁶⁾ pointed out that the differences in the amount of unsaturated fatty acids in various depot fats seem to arise from the concentration of C 18:0. They also pointed out that the difference in fatty acid composition between internal and external location of depot fats may reflect the temperature gradient from internal to external portions of the animal's body and physiological properties of the animal¹²⁾.

2. Effect of breed

Each depot fat of the Holstein steers tended to have a larger amount of total saturated fatty acids than that of the Japanese Black steers, although no statistical difference in each corresponding depot fats in the two breeds was shown. On the contrary, the Japanese Black steers had more total unsaturated fatty acids than the Holstein steers in spite of the same feeding system during the fattening period.

The fatty acid composition of depot fats is influenced by diet, feeding of concentrates especially increases C 18:1 during the fattening period, as reported by many investigators^{7-11,14,15)}. The relative concentrations of C 16:0 and C 18:1 in depot fats were influenced by the diet and season⁷⁾. The Japanese Black steers had more carcass fat weight than the Holstein steers at the same age (K. OZUTSUMI, unpublished data). There is a clear difference in maturing type.

LEAT¹³⁾ reported that fatter animals had more unsaturated fatty acids in their depot fats. GILLIS *et al.*¹²⁾ also reported that there were variations in fatty acid composition in extractable fat and differences in unsaturated/saturated fatty acid ratio among breeds within several species. They assumed that genetic influences produced variations in the physiological growth rate which resulted in variations in fatty acid composition.

From these results, differences in the amount of total unsaturated fatty acids between the Japanese Black and Holstein steers may depend on breed difference.

Acknowledgements

We are grateful to Dr. Y. OHYAMA of the National Institute of Animal Industry for helpful suggestions in drafting this paper.

References

- 1) DUGAN, L. R., J. E. MARONEY and M. PETHERAM, *J. Am. Oil Chem. Soc.*, **29**: 298-300. 1952.
- 2) OSTRANDER, J. and L. R. DUGAN, *J. Am. Oil Chem. Soc.*, **39**: 178-181. 1962.
- 3) NAKANISHI, T. and K. WATANABE, *J. Agr. Chem. Soc. Jpn.*, **38**: 59-63. 1964.
- 4) TSUCHIYA, H., T. NISHINO, R. FUKUHARA and T. YAMAZAKI, *Bull. Chugoku Natl. Agr. Exp. Stn.*, B-13: 21-28. 1965.
- 5) HUBBARD, A. W. and W. D. POCKLINGTON, *J. Sci. Food Agric.*, **19**: 571-577. 1968.
- 6) WALDMAN, R. C., G. G. SUESS and V. H. BRUGARDT, *J. Anim. Sci.*, **27**: 632-635. 1968.
- 7) NILSSON, R. and I. NOREN, 15th European Meeting of Meat Res. Workers, 343-351. 1969.
- 8) TERRELL, R. N., G. G. SUESS and R. W. BRAY, *J. Anim. Sci.*, **28**: 449-453. 1969.
- 9) SUMIDA, D. M., D. W. VOST, E. H. COBB, I. IWANAGE and D. REIMER, *J. Anim. Sci.*, **35**: 1058-1063. 1971.
- 10) RUMSEY, T. S., R. R. OLTJEN, K. P. BORARD and B. M. PRIODE, *J. Anim. Sci.*, **5**: 1069-1075. 1972.

Fatty Acid Composition in Depot Fats

- 11) DRYDEN, F. D., J. A. MARCHELLO, W. C. FIGROID and W. H. HOLE, *J. Anim. Sci.*, **36**: 19-24. 1973.
- 12) GILLIS, A. T. and N. A. M. ESKIN, *J. Food Sci.*, **38**: 409-411. 1973.
- 13) LEAT, W. M. F., *J. Agric. Sci., Camb.*, **85**: 551-558. 1975.
- 14) LEAT, W. M. F., *J. Agric. Sci., Camb.*, **89**: 575-582. 1979.
- 15) WESTERLING, D. W. and H. B. HEDRICK, *J. Anim. Sci.*, **48**: 1343-1348. 1979.
- 16) ADACHI, S., K. SUYAMA, J. TSUCHIDA and H. DANBARA, *Meat Sci.*, **7**: 139-145. 1982.
- 17) OZUTSUMI, K., K. ITO and T. KAWANISHI, *Jpn. J. Zootech. Sci.*, **53**: 559-564. 1982.

黒毛和種およびホルスタイン種肥育去勢牛 における各種蓄積脂肪の脂肪酸組成

小堤 恭平・川西 隆智*

伊藤 健**・山崎 敏雄***

農林水産省畜産試験場，茨城県筑波農林団地 305

*神奈川県畜産試験場，神奈川県本郷海老名市 243-04

**千葉県畜産センター，千葉県八街町 289-11

***農林水産省草地試験場，栃木県西那須野町 329-27

同一条件で育成・肥育した各3頭の黒毛和種およびホルスタイン種去勢牛における蓄積脂肪の脂肪酸組成について調べた。蓄積脂肪はそれぞれ13種類の異なった部位から採取し、それぞれについて分析した。両品種において、それぞれの脂肪酸組成については統計的に差がなかった。しかしながら、肥育した黒毛和種去勢牛の各々の蓄積脂肪はホルスタイン種去勢牛の各々のものより多くの不飽和脂肪酸を含有していた。ブリスケの脂肪は他

の蓄積脂肪に比較して不飽和脂肪酸が多かった。両品種とも全不飽和脂肪酸量は皮下脂肪に多く、筋間、内臓脂肪と動物体の内部に入るにしたがって減少する傾向が見られた。しかしながら、黒毛とホルスタイン種去勢牛の蓄積脂肪における全不飽和脂肪酸含量に関しては品種の差があるように思われる。

日畜会報, 54 (8): 470-475, 1983