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COMPARISON OF SOME FAT QUALITY ATTRIBUTES OF JAPANESE AND AUSTRALIAN BEEF

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INTRODUCTION

Meat grading and specification systems usually include a number of attributes describing the amount and quality of fat such as thickness, degree of marbling, fat colour, texture and lustre. Japan imports considerable quantities of meat from Australia and the demand for grain-finished product is likely to increase. However, while grain-feeding of Australian cattle does increase product uniformity and marbling score and reduce fat colour, it results in harder carcase fat which has a poor lustre and is not desirable on certain markets. In addition, hard fat on carcases causes industrial problems and procedures used by processors to ensure softer fat for boning usually result in a reduction of product quality.

It has been observed that carcase fat of domestic beef in Japan is relatively soft at time of boning and often has a lustrous appearance. Therefore, as part of a project to investigate how fat quality attributes affect meat quality, we have determined some physical and chemical properties of subcutaneous fat from both Japanese and Australian beef in an attempt to explain the observed differences.

MATERIALS AND METHODS

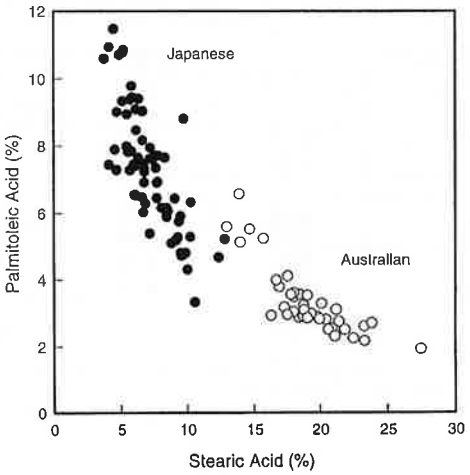
A large number of subcutaneous fat samples were collected from the loin region of carcases after overnight chilling. They were taken from a wide range of breeds and environments and were kept frozen at -20°C until analysis. For comparison, we have selected fat samples from long-term grain-fed (>300 days) Angus, Angus x Hereford and Jersey steers in Australia and those from traditionally fed Wagyu, Holstein and Wagyu x Angus steers in Japan. The fatty acid profile of the fat was obtained by gas-liquid chromatography (GLC) with a capillary column. Of these samples, six from each of the above five breeds were chosen for separation of triglycerides into molecular species by high-performance liquid chromatography (HPLC). The HPLC system consisted of a silver nitrate-loaded silica column and an evaporative light scattering detector. The eluted components were collected, concentrated and identified by GLC. Thermal properties of representative samples were determined by differential scanning calorimetry (DSC).

RESULTS AND DISCUSSION

The tactile and visual difference in the hardness of the subcutaneous fat between the Japanese and Australian beef was confirmed by the physical and chemical properties determined. The thermal properties measured by DSC showed that while a large component of the Japanese fat melted at ~13°C and a very small amount melted at ~32°C, a relatively small proportion of the Australian fat melted at ~20°C and the rest at ~37-46°C.

The difference in the fatty acid composition between the Japanese and Australian fat is demonstrated in Table 1. The Japanese fat had considerably less saturated fatty acids and more unsaturated fatty acids leading to much higher unsaturated/saturated ratios (1.9 to 2.1) compared with the Australian samples (0.8 to 0.9). This resulted primarily from the high contents of oleic and palmitoleic acids and the low stearic acid content of the Japanese samples. This inverse relationship between palmitoleic acid and stearic acid is presented in Figure 1 which clearly shows Japanese and Australian samples as two distinct groups.

Fig. 1. The relationship between palmitoleic (C16:1) and stearic acids (C18:0) of subcutaneous fat from Japanese (n=69, ●) and Australian (n=40, O) steers



Separation of triglycerides into molecular species by HPLC resulted in 8 identifiable fractions which are summarised in Table 2. Figure 2 shows typical chromatograms of this separation from Japanese and Australian fat samples. There were marked differences between these two groups of fat samples. The triglycerides from the Japanese fat had considerably less tri-saturated (SSS) and di-saturated (SSM) fatty acids and more di-monounsaturated (SMM) and tri-monounsaturated (MMM) fatty acids in their structure.

CONCLUSION

The hardness of fat was predominantly determined by its fatty acid composition; the soft character of fat from Japanese cattle results primarily from its low content of stearic acid.

Table 1. Fatty acid profile of subcutaneous fat from Japanese and Australian steers (% distribution, fatty acids of <0.5% not shown)

Fatty acids	Japanese			Australian		
	Wagyu	Holstein	Wagyu x Angus	Angus	Angus x Hereford	Jersey
	n=18	n=45	n=6	n=26	n=6	n=8
C14:0	2.3	2.5	2.4	3.2	3.1	3.3
C14:1	1.9	1.7	1.8	0.7	0.5	0.7
C16:0	21.9	22.4	22.7	25.9	25.9	24.8
C16:1 *cis*	8.0	7.2	6.7	3.3	2.9	3.7
C17:0	0.7	0.9	0.7	1.3	1.3	1.2
C17:1	1.2	1.2	0.9	0.8	0.7	0.9
C18:0	6.3	7.5	7.6	18.7	21.8	18.3
C18:1 *trans*	1.4	2.4	1.6	2.3	2.3	2.1
C18:1 *cis*	48.7	47.7	47.7	39.0	37.2	40.3
C18:2 *cis*	3.0	2.7	3.3	1.4	1.2	1.3
Saturated (S)	32.0	34.0	34.2	52.5	55.5	50.8
Monounsaturated (M)	61.8	60.7	59.2	44.0	41.5	45.7
Polyunsaturated (P)	3.9	3.4	4.2	2.1	1.8	1.9
M+P/S	2.11	1.91	1.88	0.88	0.78	0.94

Table 2. Triglyceride composition (% distribution) of subcutaneous fat from Japanese and Australian steers (n=6)

	Japanese		Australian		
	Black Wagyu	Holstein	Angus	Angus x Hereford	Jersey
SSS	0.3	1.6	10.6	10.4	12.3
SSM-1	2.5	2.3	1.5	2.9	2.5
SSM-2	14.6	28.0	41.0	42.1	41.9
SSM-*trans*	1.8	4.4	4.8	3.9	4.4
SMM	58.2	49.7	36.8	35.7	34.8
SMM-*trans*	4.4	2.6	2.2	2.0	1.7
MMM	16.5	9.3	2.3	2.3	1.9
SMD	1.7	2.0	0.8	0.8	0.8

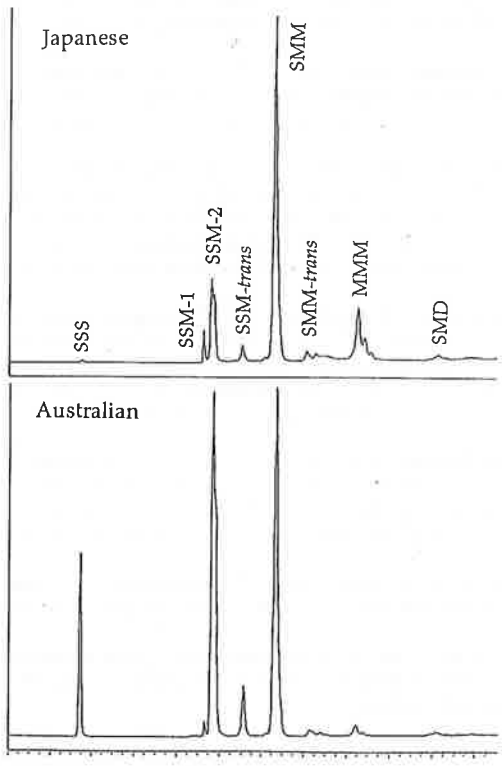


Fig. 2. Typical HPLC separation of triglycerides of subcutaneous fat from Japanese and Australian cattle (S: saturated, M: monounsaturated, D: diunsaturated)