



EDITORIAL

Marbled Japanese Black cattle

Wagyu is a general term used for native Japanese beef breeds ('wa' means 'Japanese' and 'gyu' means 'cattle'). Wagyu cattle consist of four beef breeds, all of which belong to *Bos taurus*: the Japanese Black, Japanese Brown, Japanese Shorthorn and Japanese Polled. In 2010, a total of 737 281 breeding cows of all four Japanese beef breeds were counted nationwide; the Japanese Black cattle is the predominant breed and accounted for 97% with nationwide distribution. The other three breeds are minor and regional breeds; the Japanese Brown is mainly distributed in Kumamoto Prefecture in Kyushu island and Kochi Prefecture in Shikoku island, the Japanese Shorthorn in Tohoku region (north-eastern areas in main island) and the Japanese Polled only in Yamaguchi Prefecture (western area in main island).

About 510 thousand heads of Japanese beef (Wagyu) feedlot steers and heifers and culled cows are slaughtered annually, and beef supply from Japanese beef cattle was 155 thousand tons (17.8% of total beef supply including imported beef) in 2010. The average retail prices in meat shops for outside-loin and sirloin cuts from Japanese beef cattle are \$55 and \$113/kg, respectively, whereas those from the USA beef are \$21 and \$40/kg for the same parts.

Historically, over approximately 1200-year span from the year 676 until the Meiji Revolution in 1868, there had been no meat consumption culture in Japan because Buddhism prohibited eating meat. Japanese native cattle were used only as a draft tool for paddy rice cultivation, mining and transportation. During the early 19th century, inbred strains based on dam lines were built up by breeders (wealthy farmers and cattle dealers) in mountain areas in Chugoku districts at the west side of Japan's main island, Honshu. These strains were named 'Tsuru', which means 'vine plants'. Interestingly, the breeding procedure used was similar to the close and continued inbreeding of Hereford and Shorthorn cattle practiced by Robert Bakewell and the Collong brothers in England. It is notable that the same types of inbred strains of cattle were established during the same period in both the Western world and the Far East although there was no academic or cultural exchange between the two worlds in those years.

After the Meiji Revolution, the new government discontinued the prohibition on eating meat to

introduce Western food habits and other aspects of Western culture. Various British and continental breeds such as Shorthorn, Brown Swiss, Devon, Simmental and Ayrshire were imported into Japan and were crossed with native cattle by local prefectural governments. However, none of these crossing efforts were successful, due to the inferior draft performance of the crossbreds, although crossbred animals were larger and produced more milk. No further crossing with foreign breeds was conducted after 1910. Nevertheless, because of the crossbreeding under local governments, the genetic diversity of the breeds was greatly expanded.

In 1919, a registration system was organized in each prefecture according to the decision of the Japanese government, and selection on favourable traits utilizing variation from both native and foreign ancestors was started with the aim to have uniform conformation and quality of the cattle. Consequently, the cattle raised in the prefectures formed the four breeds; the Japanese Black, Japanese Brown and Japanese Polled were established as pure breeds in 1944, followed by the Japanese Shorthorn in 1957. Since the 1960s, with the rapid growth of the Japanese economy and the mechanization of crop production at the time, the use of the breeds has shifted from draft animals to beef production. The official cattle performance and progeny testing programmes for beef production started in 1968, and the testing schemes in central stations were established.

In Japan, the carcass value has been determined by meat quality, primarily the degree of marbling. Since the liberalization of beef importations in 1991, marbling has been emphasized more and more as a reason to differentiate domestic beef from imported beef. Clear positive genetic trends for marbling of Japanese beef breeds have been realized by introducing field progeny testing programmes using carcass records collected at slaughter houses and processed by the BLUP method (Sasaki *et al.* 2006, *J. Anim. Sci.*, **84**, 317–323).

Marbling is evaluated using the 12-point beef marbling standard (BMS score 1–12) with number 12 being best. The Japanese Black is known to have extremely superior marbled beef-producing ability among the four breeds. There is much genetic variation in the BMS score in the Japanese Black (Oyama

2012, *Anim. Sci. J.*, **82**, 367–373), and it is noticeable that there is a low or even negative genetic correlation between the BMS score and the subcutaneous fat thickness for Japanese Black (Oyama 2012) and also Japanese Brown (Hirooka *et al.* 1996, *J. Anim. Sci.*, **74**, 2112–2116). These favoured characteristics of the breeds encourage the breeders who want to produce highly marbled beef without increasing external fat.

Why do only Japanese beef breeds (in particular, the Japanese Black) have the ability to produce extremely highly marbled beef? It is said that most native breeds are products of the natural environment and the humans who raise them. Japan is located at the north-eastern edge of the Asian monsoon climate belt, and the climate is thus temperate and humid, which is quite suitable for rice production. However, there are limited grazing and pasture areas in Japan because of the very marked changes of the four seasons (hot and humid summer and cold winter), especially in remote sites in the mountain and hilly areas, where Japanese native cattle (especially the ancestors of the Japanese Black) have been raised for draft use. Kato *et al.* (*J. Anim. Sci.*, 2011, **89**, 951–958) reported that a highly negative genetic correlation between the serum vitamin A concentration and the BMS score was obtained in the final stage in the feedlot period for crossbreeds (so-called 'F₁' breed in Japan) of Japanese Black sires and Holstein dams raised under vitamin A restriction in the finishing diet, which is widely practiced in feedlot situations in Japan. This result was the first report for a negative genetic correlation between the serum vitamin A concentration and the degree of marbling, although it is well known that restriction of dietary vitamin A produces higher marbling scores for Japanese Black cattle (Oka *et al.* 1998, *Meat Sci.*, **48**, 159–167).

It is hypothesized that, as the adipose tissue is one of the primary storage sites of vitamin A (Tsutsumi *et al.* 1992, *J. Biol. Chem.*, **267**, 1805–1810), Japanese cattle may have genetic potential by itself to increase the fat content in muscle (marbling) for storing vitamin A when the dietary vitamin A level is low. Japanese native cattle have usually been kept in barns over the winters in mountain and hilly areas, because green forage (with an abundance of vitamin A) is not available in the winter due to withering and the heavy snow cover. This poor environment may have made Japanese native cattle tolerant against vitamin A shortages, and it might have enhanced their genetic potential to increase intramuscular fat deposits (marbling) by natural and artificial selection over the long term.

In the USA, marbling has long been used as a factor in the USDA beef quality grading system as a visual indicator of quality. In fact, some US consumers consider marbling indicative of quality and palatability, whereas others prefer lean beef in light of health preference. Marbling is also related to tenderness, which is one of the most important factors influencing the acceptability of beef. Again, Japanese beef breeds (Wagyu) raised in Japan are very pure breeds; foreign genes have not been introduced into the breeds for over a century. The Japanese breeds could well become international breeds in the near future due to their unique characteristics.

H. Hirooka
Graduate School of Agriculture,
Kyoto University,
Kyoto, Japan
E-mail: hirooka@kais.kyoto-u.ac.jp