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Abstract

Hanwoo is a premium beef product highly valued by Korean consumers for its exceptional flavor and taste. However, despite its high domestic market price, it remains relatively unknown in international markets. Therefore, this study aims to explore the history and characteristics of Hanwoo to enhance understanding and seek opportunities for global market expansion. Although the exact origin of Hanwoo is unclear, it is presumed to have migrated to the Korean Peninsula from Africa, the Middle East, or northern China and Manchuria. Over time, frequent regional exchanges may have led to genetic interbreeding between Hanwoo and cattle from China and Japan. Hanwoo is classified into four primary coat color types—yellow-brown, black, white, and spotted—but more than 90% of Hanwoo exhibit a yellow-brown coat. Hanwoo has been selectively bred to enhance marbling and fat content, and it has been shown to exhibit higher intramuscular fat and marbling scores compared to foreign breeds. Furthermore, other Korean breeds such as Heukwoo and Jeju black Cattle have demonstrated higher levels of oleic acid and amino acids than Hanwoo, suggesting even richer flavor profiles. These characteristics indicate that Hanwoo possesses competitive potential in the global premium beef market.Developing differentiated branding strategies based on breed-specific traits could further promote Hanwoo exports. However, since Hanwoo has been selectively bred according to the preferences of Korean consumers, additional research is needed to assess its acceptance in other major international markets. Moreover, limited production volume and high production costs present significant challenges for large-scale exports.

Keywords: hanwoo, yanbian yellow cattle, wagyu, market status, meat characteristics

1. Introduction

Korea, China, and Japan are located in East Asia, a region where each country has its own native cattle breeds. Most of these breeds are humpless and are taxonomically classified as *Bos taurus* (Mannen et al., 2004). While the domestication history of Hanwoo, the native Korean cattle breed, has not been fully documented, some evidence suggests that cattle in East Asia migrated from the Fertile Crescent, Mongolia, and northern China, through the Korean Peninsula and eventually into Japan (Mannen et al., 1998; Kim et al., 2002).

In Korea, approximately 3.8 million Hanwoo cattle are raised, and they are typically fattened for an average of 30 months until they reach a live weight of 700–800 kg before slaughter (MAFRA, 2024). Due to its high fat content, Hanwoo is regarded as a premium beef product and is highly preferred by Korean consumers, commanding significantly higher prices than imported beef. Although the specific reasons for this preference have not been clearly identified, Hanwoo has been reported to have superior intramuscular fat content, ossification scores, and marbling scores compared to Australian Angus. Furthermore, its oleic acid content (50.62%) is higher than that of Australian crossbreeds (40.09%) and American crossbreeds (44.15%) (Joo et al., 2017; Hwang and Joo, 2017). Larick and Turner (1990) also reported that oleic acid plays a significant role in influencing the flavor of cooked beef. Increased intramuscular fat contributes to improved flavor, juiciness, and overall consumer acceptance, and is particularly suited to grilling, a common cooking method in Korean cuisine (Joo et al., 2017).

Despite of the previously mentioned quality attributes, Hanwoo has relatively low international recognition compared to Japanese Wagyu or European breeds. Unlike Japanese and European cattle that are actively raised and distributed in countries such as the United States and Australia, Hanwoo is primarily consumed domestically, and its total production

volume is limited. In addition, the lack of aggressive trade promotion policies has resulted in minimal export activity for Hanwoo (Seo, 2023).

Moreover, research and academic literature on Hanwoo remain limited compared to major international beef breeds. Government-level promotional efforts and export support policies are also insufficient (Seo, 2023). Therefore, the objective of this study is to analyze the history, breed characteristics, meat quality traits, and market status of Hanwoo, and to establish a theoretical foundation for evaluating its international competitiveness through comparison with other globally recognized beef breeds.

2. History of livestock in East Asia

Identifying the precise ancestors of beef cattle, as well as the timeline and methods of their improvement and regional distribution, remains challenging. However, Korea, China, and Japan—the major economic powers in East Asia—were historically connected as one continent and engaged in numerous exchanges over time. These interactions likely influenced livestock development across the region. The major cattle breeds of Korea, China, and Japan—Hanwoo (Korea), Yanbian yellow cattle (China), and Wagyu (Japan)—have the same origin but have been genetically modified according to national interest, direction of improvement, and history of breeding (Shin et al., 1999). However, Asian cattle breeds have been shown to have higher genetic diversity than European and African breeds (Sharma et al., 2016). The origin and domestication of Hanwoo has been debated, with many suggestions including a crossbreed of *Zebu* and *Taurine* cattle or independent domestication (Han, 1996; Yoon et al., 2005; Mannen et al., 2004). In a recent study, McTavish et al. (2013) explained that the Hanwoo and Wagyu are of hybrid *Taurine-Indian* origin, and PCA plots showed that Hanwoo and Wagyu are different from Hereford and Angus cattle (Lee et al., 2014). Cattle in China have been domesticated since about 11,000-10,000 B.C. and may have originated from the *Bos taurus/indicus* group (Zhang et al., 2013). In addition, Japan

has four distinct breeds (Japanese Black, Brown, Polled, and Shorthorn), and it is possible that the P haplogroup of Northeast Asian cattle migrated eastward to reach Japan (Kawaguchi et al., 2022; Mannen et al., 2020). Based on current research, Hanwoo, Yanbian yellow cattle and Wagyu share the same origin but have been geographically separated and selectively bred for different purposes, leading to increasing genetic divergence. Therefore, further research is needed to understand the origin of Hanwoo and its genetic relationship with neighboring breeds.

3. History and Breeds of Hanwoo

Hanwoo is known to be a *Bos taurus* type breed that originated from a hybrid of European cattle *Bos primigenius* and Indian cattle *Bos indicus* and is known to have been introduced to the Korean Peninsula via northern China and Manchuria (National Folk Museum of Korea, 2020). In addition, it is confirmed that it has been bred for more than 5,000 years for agricultural and transportation purposes due to its small body size and well-developed forelimbs that can withstand the mountainous terrain of Korea, and its low feed intake and slow maturation (di Caracalla, 1994; Lee et al., 2014; National Folk Museum of Korea, 2020).

It was bred primarily for agricultural purposes before the 1960s, but it was not until the 1960s, when Korea began to experience high economic growth, that it was significantly improved as beef cattle (National Folk Museum of Korea, 2020). Before improvement, the calf live weight of Hanwoo was about 2-30 kg, and the adult live weight reached 300-400 kg. By improving the high fat content (marbling) preferred by Koreans, it was bred into a medium- to large-sized breed with an adult live weight of 700-800 kg (Kim et al., 2014; MAFRA, 2024).

Based on fur color, Korean cattle are largely divided into four types: Korean yellow-brown cattle, Korean black cattle, Korean brown cattle, and White Hanwoo (Figure 1). Hanwoo, the most representative breed with its tan color, has a population of approximately 3.8 million head (MAFRA, 2024). In contrast, Chickso, Korean black cattle, and White

Hanwoo are kept at approximately 4000, 1400, and 20 heads, respectively (Choi, 2015; Kang, 2018; Suh, 2021). Since the adoption of the Convention on Biological Diversity, global interest in preserving genetic resources and securing genetic diversity has increased. Consequently, research efforts have intensified to restore and multiply endangered conventional cattle breeds, resulting in an increase in the number of Korean black cattle and Chickso since the 2000s (NIAS, 2010). In 2012, Tan Hanwoo, Korean black cattle, and Chickso were registered in the Domestic Animal Diversity Information System of the Food and Agriculture Organization of the United Nations. White Hanwoo was listed in 2014, and Jeju Korean black cattle were designated as a national cultural property, Natural Monument No. 546, in 2013 (Kim et al., 2012; Suh et al., 2015). However, despite these efforts, only the tan-colored Hanwoo is economically viable, while the population of Korean black cattle, Chickso, and White Hanwoo remains limited.

In recent years, as consumer preferences have diversified, demand has increased for rare and high-end Hanwoo varieties, such as Chickso, Jeju Korean black cattle, and Whasik (cooked feed) cattle raised on conventional troughs. However, conventional breeds such as Chickso and Korean black cattle tend to accumulate less intramuscular fat (IMF) compared to that of Hanwoo, resulting in lower feed efficiency (Hoa et al., 2024). Therefore, they are disadvantaged when evaluated under the same grading system as Hanwoo, highlighting the need for breed-specific assessment criteria. Despite this, research on tailored grading methods remains limited. Since Chickso and Korean black cattle have high production costs, developing a method to enhance the marketability of premium roasting cuts and increase the value of less-preferred parts is necessary.

4.1. Hanwoo

Hanwoo commonly refers to the traditional brown cattle to Korea; however, in a broader context, it encompasses all native Korean cattle breeds. Under this inclusive definition, Hanwoo includes not only the brown Hanwoo but also other traditional Korean breeds such as the Korean black cattle, Chikso, and White Hanwoo, which differ in coat color and genetic characteristics. (Hanwoo Self-help Fund Management Committee, 2018) (Figure 1). In this review, the term Hanwoo refers to the brown-coated/haired native Korean cattle breeds.

For thousands of years since their introduction to the Korean peninsula, Hanwoo has been kept mainly as agricultural draught cattle. Several attempts to improve the breed began in the late 1960s with the introduction of exotic cattle as part of the Hanwoo breeding improvement project (Won et al., 2009; Kim et al., 2014). However, the strong consumer perception that only yellow-coated cattle qualify as Hanwoo led to the discontinuation of crossbreeding with exotic cattle of different coat colors. Consequently, Hanwoo improvement has mainly relied on nonbreeding methods and optimized feeding strategies.

Although European meat and dairy breeds are typically slaughtered at 21–23 months of age, Hanwoo are often slaughtered at 30–55 months. Currently, Korean consumers prefer well-marbled meat, making marbling the primary criterion in the quality grading system for Hanwoo (GS&J Institute, 2016; Joo et al., 2017). Their preference for IMF content and the flavor of heated fat, rather than the flavor of lean meat, has driven the selective breeding of highly marbled Hanwoo.

4.2. Chickso

The Chickso (Korean brindle cattle, tiger cattle) is one of the oldest indigenous cattle breeds, alongside Hanwoo. It is also known as the Hoban Hanwoo because of its dark brown and black vertical stripes, which resemble arrowroot vines on a tan background. Historically, Chik Hanwoo was a term used for castrated cattle-fed arrowroot, but it has no relation to the

Chickso, one of the breeds of Hanwoo. Once commonly known as speckled cattle, the Chickso are currently only approximately 4,000 head left. In response, various local governments have implemented breeding programs to preserve the breed (Sohn et al., 2000). However, due to the small breeding population and the challenges of natural reproduction, Chickso faces a high risk of genetic inbreeding. The lack of a structured pedigree management and breeding system further exacerbates this issue. Additionally, widespread perceptions of Chickso as inferior to Hanwoo regarding growth and carcass performance may contribute to their continued decline. Claims that Chickso is classified and registered as Hanwoo in the Cattle traceability system are ongoing (Animal and Plant Quarantine Agency, 2023), but there are frequent cases of non-Hanwoo being registered as beef cattle due to their different appearance. Therefore, measures should be taken to establish Chickso as a separate breed within the Korean cattle classification.

Comparative studies between Chikso and Hanwoo have been conducted, focusing on chromosomal patterns, karyotypes, genotypes, and growth characteristics. Song et al. (2018) analyzed the genotypes of Chikso and Hanwoo and reported that Hanwoo exhibited higher genetic diversity than Chikso; however, the differences between the two breeds were not clearly defined. In contrast, Choy et al. (2015) demonstrated that individual identification and parentage verification of Chikso could be achieved using 11 microsatellite markers, supporting the feasibility of genetic differentiation between the two breeds. Furthermore, Lee et al. (2013) reported that, in terms of carcass quality traits, Hanwoo showed superior quality in cattle with the CC genotype, whereas Chikso exhibited better quality in those with the CG genotype. Several patents related to Chikso-specific parentage verification compositions also exist (Lee and Choy, 2016; Sohn et al., 2000; Park et al., 2012).

Taken together, these previous studies provide scientific evidence—through genetic analysis, identification markers, carcass trait differentiation, and parentage verification

methods—that significant differences exist between Chikso and Hanwoo. Therefore, Chikso can be regarded as an independent breed, distinguishable from Hanwoo.

Chickso weighs less than Hanwoo at birth (Lee and Choy, 2016) and requires at least 33 months of management, up to three times the age of Hanwoo, to meet the carcass grading standards of Hanwoo. Therefore, opinions that differentiate management strategies are needed to compensate for their disadvantages, such as low IMF deposition, slow fattening rate, and high production cost. Although Chickso has less marbling than Hanwoo, studies report that they contain a higher oleic acid content, which gives the meat a savory flavor, making it more tender and unique (Utama et al., 2018). Chickso exhibits a redder meat color and a stronger flavor than that of Hanwoo, necessitating further research and commercialization efforts in aging, processing, cutting, and cooking methods. Therefore, research on the meat quality and functional characteristics of Chickso is necessary to establish it as a distinct breed different from Hanwoo and lay the foundation for its industrialization.

4.3. Korean black cattle

The Korean black cattle closely resemble regular Hanwoo, but they are smaller in size, have black fur all over, and exhibit a strong constitution and good endurance. However, due to their slow growth rate and small body size, they require economic management (Moon, 2012). Currently, domestic Korean black cattle are classified into Jeju Korean black cattle and inland Korean black cattle, with the former found exclusively on Jeju Island and the latter in other inland regions. Although they belong to the same breed, Jeju Korean black cattle typically have a darker black coat than that of inland Korean black cattle (Kang, 2018). The Jeju Korean black cattle are recognized as an indigenous genetic resource that has been bred only in Jeju. Since 1994, they have been specially protected and managed in Jeju, with regulations prohibiting the export of resources (such as semen and fertilized eggs) outside the

province to protect and nurture them (Kim, 2006). Historical records, such as the *Tamna Ginyeon, Tamana Sunryeokdo, and The Annals of the Joseon Dynasty*, indicate the use of black cattle as incense and delicacies, highlighting their significant historical and cultural value. Until the 1980s, the cattle industry policy focused on meat production, which led to a significant population decline, nearing extinction. However, since 1993, with support from the Jeju Island local government, breeding efforts have been revitalized, and the cattle population has steadily increased (Kim, 2006). Owing to its small population, limited distribution, and slow growth efficiency, Jeju Korean black cattle currently lack the competitiveness for full industrialization. However, if the number of raised cattle is increased using technologies such as *in-vivo* embryo production and transplantation, coupled with systematic meat quality analysis, Jeju Korean black cattle could be developed into a meat product with international competitiveness alongside Korean beef (Alam et al., 2021; Moon, 2012).

4.4. White Hanwoo

White Hanwoo is a traditional Korean cattle resource that exhibits albinism traits with no pigmentation in the hair and retina due to a base sequence mutation at position c.871 in the exon 2 region of the Tyrosinase gene (TYR gene) (Kim et al., 2015c; Kim et al., 2021). Due to this unique color pattern, it can be used as an important research material for genetic and trait expression studies, but it is currently at risk of extinction due to the extremely small number of existing individuals (Kim et al., 2015c). Since its first report in 2007, White Hanwoo has been preserved and managed by the National Institute of Animal Science, Livestock Genetic Resources Center, and is listed as a unique livestock genetic resource in Korea in the Domestic Animal Diversity Information System (DAD-IS) of the FAO. Various studies are being conducted to preserve White Hanwoo, and biotechnology approaches including artificial insemination and genetic analysis are being applied (Kim et al., 2021). Kim

et al. (2015b) reported that the breed belongs to *Bos taurus* and is genetically closely related to black cattle and Yanbian yellow cattle through mtDNA cytochrome b gene analysis of White Hanwoo. In addition, haplotype diversity and base sequence diversity analyses performed to evaluate genetic diversity showed that White Hanwoo showed relatively low genetic diversity compared to Korean cattle or mud cattle (Kim et al., 2015b; Kim et al., 2021). In addition, a study on individual preservation using cloning technology was conducted, and as a result of comparing the hematological indicators between cloned White Hanwoo and general Hanwoo, no abnormalities in health were found in cloned individuals (Kim et al., 2015a). These results suggest that cloning technology can be used to preserve White Hanwoo while maintaining its physiological stability. To date, multifaceted research has been continuously conducted to identify genetic, nutritional, and physiological characteristics of the White Hanwoo, along with artificial insemination and cloning research to increase the population of the White Hanwoo (Kim et al., 2021; National Institute of Animal Science, 2014).

5. Current status of the Hanwoo beef industry

South Korea is undergoing rapid demographic and lifestyle changes, significantly affecting the food industry (Cha and Lee, 2021). As per capita income rises, consumers are investing in food to make their meals more delicious and are increasingly seeking foods that boost immunity. Meat consumption in South Korea has been steadily increasing, reaching 60 kg per capita in 2023 (KMTA, 2023). Accordingly, the population of Hanwoo has grown consistently since 2016, exceeding 3.5 million head in May 2022 (Statistics Korea, 2022b). In 2024, the number of livestock will exceed 3.8 million and over 1 million Hanwoo are expected to be slaughtered, the largest number on record (MAFRA, 2024). As of 2024, Korean beef accounts for about 5% of the total slaughtered cattle, pigs, and chickens, but it accounts for a high proportion of about 28.5% in terms of production value (KMTA, 2024; KAPE, 2020).

253 Therefore, it is expected that it will be important for the Korean Korean beef industry to have
254 taste, quality, and safety to meet consumer preferences.

255 Efforts to improve the meat quality and increase marbling of Korean beef have continued
256 steadily from the past to the present, and the appearance rate of Korean beef of grade 1 or
257 higher has been steadily increasing (KAPE, 2024). In addition, according to the Hanwoo Self-
258 help Fund Management Committee (2024), the results of a survey of Korean consumers
259 showed that Hanwoo received high scores in terms of taste, quality, and safety compared to
260 beef and imported beef. However, the price satisfaction of Hanwoo did not show a big
261 difference from that of beef and imported beef, but the total online shopping transaction
262 amount has been increasing recently, and the demand for imported beef is increasing.
263 Accordingly, it has been confirmed that Korea's beef self-sufficiency rate is gradually
264 decreasing (Hanwoo Self-help Fund Management Committee, 2024). According to Statistics
265 Korea (2022a), the total transaction value of concentrated agricultural products in online
266 shopping—an indicator of at-home meat consumption—rose 24% year-over-year to KRW
267 747.6 billion in August 2022. The convenience of online meat purchases has led to a
268 significant increase in the consumption of imported beef, which is less expensive (Hanwoo
269 Self-help Fund Management Committee, 2024).

270 In addition, to stabilize and sustain the Korean beef industry, Hanwoo exports have been
271 started since 2015. Currently, the countries available for export are Hong Kong, Macau, UAE,
272 Cambodia, and Malaysia. Among them, Hong Kong has relatively easy quarantine procedures
273 and high beef consumption, so it is currently exporting the most from Hong Kong (Seo, 2023;
274 Korean Beef Export Research Group, 2021; Korean beef export information portal, 2025).
275 Wagyu, which has similar meat quality to Hanwoo, is actively being exported from Japan to
276 foreign countries. Wagyu exports are currently being exported stably overseas because the
277 Central Livestock Association manages and supports them, but Korean beef still has issues

such as budget and slaughter volume, so it is expected that much effort will be needed (Seo, 2023; Korean Beef Export Research Group, 2021).

Therefore, experts argue that it is essential to develop a variety of domestically produced native cattle breeds with excellent meat quality to compete with imported breeds. Accordingly, a single-breed-centered production structure is required, and a premium market differentiation strategy based on breed diversity is required. In addition, to secure the stability of overseas exports, along with the establishment of distribution and marketing strategies, policy support and expansion of research investment for a sustainable Korean beef industry should be carried out in parallel.

6. Comparative study of quality characteristics of Hanwoo beef

Korea has implemented a livestock grading system since 1992, and the carcass characteristics and quality of Hanwoo beef, including carcass weight and marbling score, have been continuously improving (Cho et al., 2010; Joo et al., 2017). The marbling score is the primary determinant of Hanwoo beef grading, which is expressed as 1^{++}, 1^{+}, 1, 2, and 3. On average, 54% of slaughtered Hanwoo steers and 75.7% of Hanwoo cows receive a grade of 1 or higher, whereas only 10.7% of Holstein steers and 0.6% of Holstein cows meet that threshold (Cho et al., 2010). These results reflect Hanwoo's status as a high-marbling breed and the increasing proportion of higher-grade carcasses over time (Cho et al., 2010). These results reflect Hanwoo's status as a high-marbling breed and the increasing proportion of higher-grade carcasses over time.

Due to this quality, cases of imported or crossbred beef being falsely marketed as Hanwoo have increased. In response, since 2009, the distribution channels of all Hanwoo cattle have been traceable, and detailed information from "farm to table" has been made accessible to consumers through individual identification numbers (Hwang, 2010). In Korea, carcass

303 grading is mandatory for both cattle and pigs, and key data—such as birth, production,
304 husbandry, vaccination, and slaughter history—are systematically recorded and shared with
305 consumers (Go, 1996; Jung, 2017). These animal identification and traceability systems have
306 contributed effectively to quality assurance, fraud prevention, and consumer trust in Hanwoo
307 beef.

308 The Hanwoo breed is typically raised for approximately 30 months and is renowned for
309 its high genetic potential to produce beef with high marbling (Joo et al., 2017), as well as rich
310 flavor due to its high monounsaturated fatty acid (MUFA) ratio (Joo et al., 2017). In Korea,
311 Hanwoo is classified into quality grades 1++, 1+, 1, and 2 based on marbling scores. Lim et
312 al. (2014) classified 500 Hanwoo carcasses into quality grades 1++, 1+, 1, and 2 and analyzed
313 the fat content. They report that the 1++ group has the highest fat content and the lowest
314 moisture content. The 1++ group also reports lower shear force values than that of the other
315 groups and shows higher preference scores for flavor, tenderness, and juiciness in sensory
316 evaluations. Additionally, Hanwoo 1++ and 1+ grades have a higher oleic acid (C18:1) ratio
317 than that of Grade 2. Therefore, as the grade increases, the fat content and oleic acid ratio are
318 expected to increase, which will promote the expression of flavor compounds during cooking
319 and support competitiveness as high-quality meat (Larick and Turner, 1990).

320 Methods to increase IMF for improving marbling of beef include the control of breeding
321 months and feeding methods. In Korea, Hanwoo is bred for an average of 31 months, and
322 Kwon et al. (2022) show slaughtering Hanwoo at weights of 651–700 kg and 701–750 kg at
323 28.23 and 29.83 months of age could optimize the quality and quantity grades of Hanwoo.

324 In addition, the feeding method for Korean cattle is divided into the growing and
325 fattening seasons, and grain feed is fed during the fattening season to increase the IMF content
326 and improve meat quality (Korea Improvement Agency, 2011). Hwang and Joo (2017)
327 investigated the fatty acid profiles associated with meat quality and sensory palatability in

grain-fed and grass-fed Hanwoo, as well as American and Australian hybrid cattle. They report that grain-fed Hanwoo contains a significantly lower saturated fatty acid (SFA) ratio and a higher MUFA ratio than that of grass-fed beef. Additionally, grain-fed Hanwoo exhibits a significantly higher percentage of oleic acid than that of Australian hybrid and American hybrid cattle. Sensory panel scores for the overall palatability of grain-fed beef were significantly higher than that of grass-fed beef, with oleic acid content showing a strong positive correlation with fat content and overall palatability (Hwang and Joo, 2017). These results suggest that when fed grain feed, IMF and oleic acid contents are greater in Hanwoo than in foreign breeds, which is advantageous in producing meat with high marbling and sensory preference.

Comparisons of the quality of Hanwoo and imported breeds are mainly conducted through research on fatty acids, amino acids, IMF, and meat quality. Cho et al. (2011b) report that in a fatty acid composition study, Australian crossbred meat contains significantly higher contents of palmitic, stearic, and linolenic acids in the tip, loin, and rump than that of Hanwoo. However, Hanwoo contains significantly lower contents of palmitoleic, vaccenic, and eicosenoic acids. In addition, the IMF content in Hanwoo was twice as high as that of Angus, and its backfat thickness was twice as thick (Cho et al., 2005). In addition, Oh et al. (2012) investigated the nutritional composition of the Longissimus lumborum muscle in Korean beef (Hanwoo and Holstein, both born and raised in Korea) and imported beef (from Australia, reared in Korea for approximately 6 months). They found that Hanwoo exhibits a higher water-holding capacity than that of Holstein and Angus muscles, while the oxymyoglobin and metmyoglobin contents are similar across all three breeds. Hur et al. (2008) compared the meat quality of Hanwoo and Holstein bulls from Korea, reporting that Holstein contains higher crude protein and ash content, as well as a higher percentage of unsaturated fatty acids. However, sensory evaluations reveal that Hanwoo has a higher flavor than that of Holstein.

In addition, Hwang et al. (2004) compared the quality of sirloin from four Wagyu, four Angus, four Grade 1, and three Grade 3 Hanwoo during storage, reporting that Wagyu, Angus, Grade 1 Hanwoo and Grade 3 Hanwoo contain IMF of 22%, 8%, 13%, and 4%, respectively. No significant differences were observed in meat quality between Hanwoo grades or imported beef cattle. They report that imported beef has significantly lower shear force values than those of Hanwoo, while organoleptic evaluation and juiciness did not differ between grades of beef. However, Hanwoo beef scores significantly higher in flavor, indicating that its cooked meat is perceived to have a superior aroma. Cho et al. (2011a) compared the general composition, meat color, shear force, cooking loss, fatty acid composition, amino acid profile, and mineral content of castrated Hanwoo (26–28 months) grades 1+ and 1 with chilled imported beef from New Zealand. Samples included the tip, sirloin, rump, and tenderloin. The results show differences between Hanwoo and imported New Zealand black, but overall, Hanwoo contains higher IMF and MUFA content. Conversely, New Zealand black has relatively higher protein and amino acid content. New Zealand black also has a longer refrigeration age, although the shear force values are similar for sirloin, top sirloin, and rump cuts (Cho et al, 2011a).

In addition to comparing Hanwoo with foreign breeds, studies are being conducted to compare amino acids, fatty acids, meat quality, etc. by breed to increase the diversity of utilization of Korean native breeds and preserve the breed. Lee et al. (2019) compared the fatty acid and amino acid profiles of Jeju Korean black cattle, a Hanwoo breed, with those of Hanwoo and Wagyu, and the results show that Jeju Korean black cattle exhibit the highest oleic acid content, which enhances flavor, and the lowest palmitic acid content, which negatively affects flavor (Westerling and Hedrick, 1979; Lee et al., 2019). Regarding amino acids, Jeju Korean black cattle exhibit higher levels of alanine, which enhances flavor, while Hanwoo has the highest content of glutamic acid, which contributes to umami (Lee et al., 2019). Lee et al. (2025) conducted a comparative study on meat quality, including fatty acid

content, amino acid profiles, and transcriptome profiles, in Hanwoo, Korean black cattle, and Jeju Korean black cattle. The results show that Hanwoo exhibits higher levels of SFA, such as pentadecanoic, palmitic, and margaric acids, than that of the other breeds. In contrast, Korean black cattle show higher levels of linolenic acid, an omega-3 polyunsaturated fatty acid. Additionally, the free amino acid profile reveals that Hanwoo and Jeju Korean black cattle have significantly higher levels of glutamic acid, glycine, and phenylalanine than those of Korean black cattle. Utama et al. (2018) compared the meat quality of Hanwoo and Chickso, reporting that Hanwoo beef sirloin has a higher fat content (15.37%) than that of Chickso (12.01%), but no significant differences were observed. No significant differences were observed in meat pH, water-holding capacity, cooking loss, shear force values, meat color, and fatty acid composition. However, they report that grilled Chickso emits a stronger aroma than that of grilled Hanwoo, based on total area units of identified volatiles. Among these volatiles, toluene, heptanal, octanal, and nonanal contents are higher in grilled Chickso (Utama et al., 2018).

From meat composition to sensorial characteristics, meat derived from Korean native cattle breeds provide numerous reasons on why these cattle breeds need support towards breed improvement and commercialization. When desirable characteristics have become stable among Korean native cattle breeds, Korean native cattle-derived products are expected to be sufficiently competitive in the overseas market. Thus, academic, industrial, and governmental efforts are important to improve quality, increase the production, and enhance regulatory support, respectively.

7. Conclusion

Hanwoo is a premium beef product highly regarded by Korean consumers for its superior flavor and taste. However, Hanwoo remains relatively unknown in international markets.

Compared to foreign cattle breeds, Hanwoo exhibits a higher content of oleic acid, which contributes to marbling and flavor. Based on these quality characteristics, Hanwoo has the potential to compete in the high-end beef market alongside Japanese Wagyu and U.S. Prime-grade beef. In particular, by developing branding strategies focused on flavor profiles according to breed characteristics, and by tailoring products to suit grill-oriented consumption patterns, Hanwoo may enhance its export potential in global markets. However, since Hanwoo has been bred primarily to meet the preferences of Korean consumers, it remains uncertain whether its sensory qualities and perceived quality will receive similar evaluations in key overseas markets. Thus, further consumer-based studies are needed. Additionally, Hanwoo faces challenges such as limited production volume and high rearing costs, resulting in low price competitiveness. Nevertheless, for successful expansion into export markets, it is essential to improve production efficiency and adopt a strategic approach focused on global commercialization.

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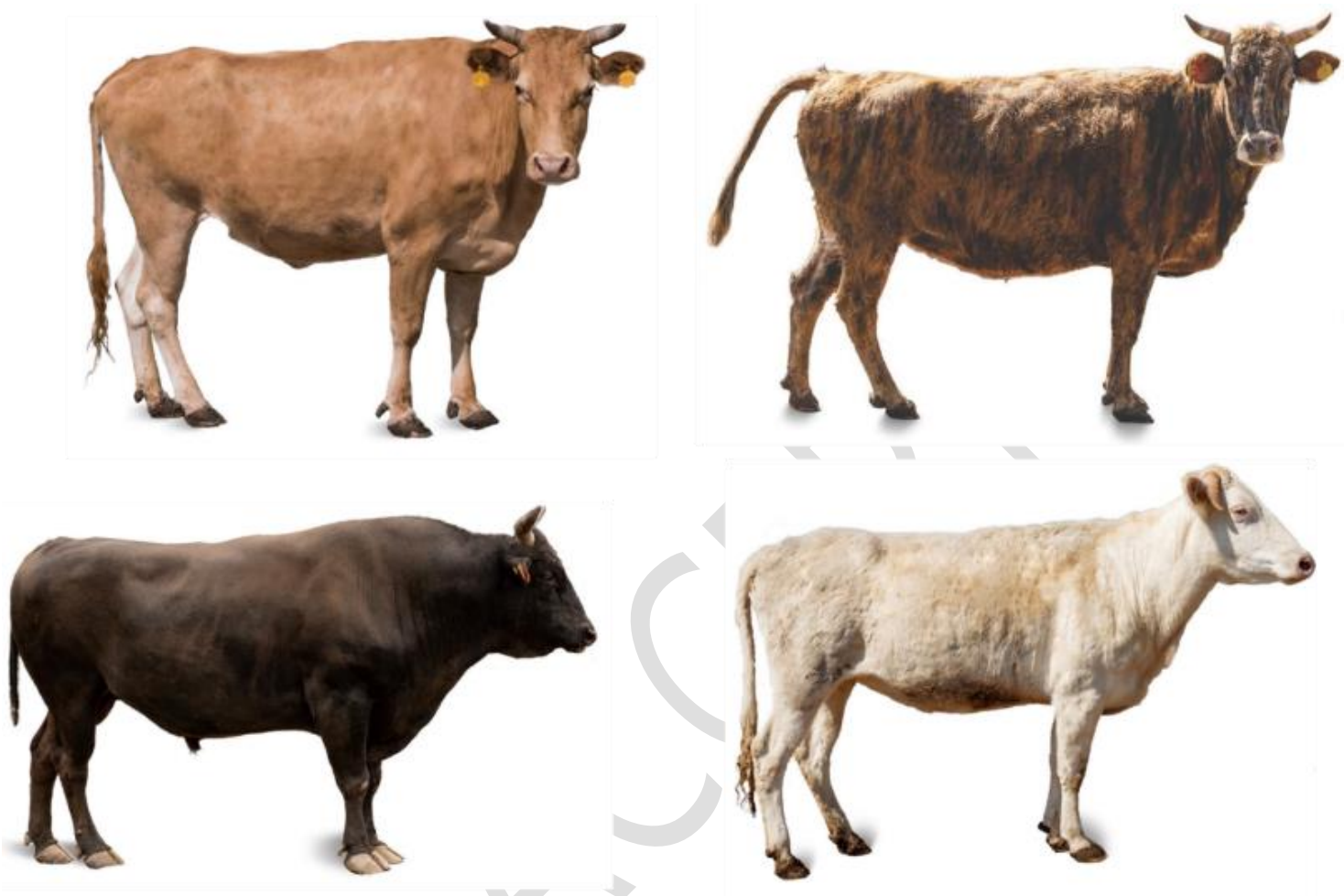

Figure 1. Types of Korean native cattle breed (top left: Hanwoo, top right: Chikso, bottom left: Korean black cattle, and bottom right: White Hanwoo). Adapted from Hanwoo Self-help Fund Management Committee (2018).