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Nutritional composition analysis and quality evaluation of cattle in different regions of Guizhou Province (China)

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Abstract: This study aimed to investigate the variations in nutritional composition among different breeds of cattle in Guizhou. Specifically, this study selected Guanling, Weining, Sinan, Wuchuan, and Simmental cattle as experimental subjects. Assessing the nutritional quality of the *longissimus dorsi* muscle involves evaluating various parameters, including ultimate pH (pHu), meat colour, water-holding capacity, shear force, protein and fat content, levels of organic acids and amino acid composition. The study's findings indicated notable variations among the muscles of different cattle breeds tested. Guanling, Wuchuan, and Simmental cattle exhibited the highest water-holding capacity, while Wuchuan cattle displayed the highest shear forces. Guanling cattle and Simmental cattle had the highest levels of protein and fat. Weining cattle and Simmental cattle demonstrated the highest concentrations of lactic acid and oxalic acid. Guanling cattle exhibited the highest total amino acid and essential amino acid content. Moreover, Guanling cattle and Weining cattle showed the highest lightness (L^*) and yellowness (b^*) values, indicating lighter meat colour, while Weining cattle had the highest redness (a^*) value, indicating redder meat colour. No significant differences among the five cattle breeds were observed in pHu and propionic acid content. These results provide a theoretical basis and serve as a data reference for assessing the suitability of different beef varieties for various processing purposes.

Keywords: Guizhou cattle; Simmental cattle; amino acid; *longissimus dorsi* muscle

Guizhou Province is a provincial-level administrative region of the People's Republic of China, located in southwestern China. Guizhou experiences a subtropical humid monsoon climate, characterised by warm and humid conditions. Moreover, Guizhou is renowned for its abundant plant resources, benefiting from its conducive natural environment. This environment has contributed to the breeding of exceptional local cattle breeds such as Guanling cattle, Weining cattle, Sinan cattle, and Wuchuan cattle, making a valuable addition to the genetic pool of Chinese cattle breeds (Peng et al. 2019).

In addition, beef is an excellent source of high-quality protein, iron, zinc, and vitamin B12 (Vahma-

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ni et al. 2020). These nutrients are crucial for normal growth and development and for maintaining a healthy immune system. For instance, the amino acids and protein found in beef are especially important for promoting muscle growth and facilitating repair. Research has shown that beef is a rich source of eight essential amino acids that play a vital role in the body's functioning. In fact, the proportion of these essential amino acids in beef, accounting for 39.0% of total amino acids, surpasses that found in other meats such as lamb (37.2%), pork (38.3%), and chicken (33.5%) (Silva et al. 2018). Beef is renowned for its low-fat and low-cholesterol qualities, with just 2.3 g of fat and 59 mg of cholesterol per 100 g (Yang et al. 2018). This is lower compared to pork and lamb (Wang et al. 2023a). In recent years, as individuals' living standards have improved, health has been increasingly emphasised. Beef plays a vital role in optimising dietary structure due to its nutritional composition.

In the past two decades, global annual beef production and consumption have remained relatively stable at approximately 60 million tons. China ranks as the second-largest consumer and fourth-largest producer of beef, accounting for 17.3% and 12.1% of global consumption and production respectively. In 2021, Guizhou Province reported the sale of 1 806 million beef cattle and a production of 235 900 t of beef, reflecting a 2.1% year-on-year increase. This consistent growth presents promising potential for the beef consumption market. Conducting a nutritional analysis of different cattle breeds in Guizhou will aid in the development of the local cattle industry.

Guanling cattle are primarily raised in Guanling Buyi and Miao Autonomous County, located in Guizhou Province. Consequently, these cattle are named after the region they originate from, known as Guanling cattle (Zhou et al. 2022). The Guanling cattle breed is recognised for its resilient physique, sturdy limbs, and hooves, making it highly suitable for agricultural and grazing activities in mountainous regions (Liu 2015). As the social economy continues to develop and the needs of people's lives evolve, a notable transition in Guanling cattle breeding from draft purposes to meat production has emerged. In 2016, Guanling cattle were officially approved and registered as a national geographical indication product for agricultural purposes in China.

Wuchuan cattle, a highly esteemed local breed in the mountainous areas of northern Guizhou, are predominantly raised in Wuchuan County, Zunyi Prefecture, Guizhou Province. These cattle are known for their robust physique, symmetrical and compact bodies, and moderate build. Additionally, Wuchuan cattle have wide and short necks, well-developed and high shoulders, and strong limbs with sturdy joints. Their meat is renowned for its deliciousness and tenderness. These cattle demonstrate early maturity, adaptability to challenging feeding conditions, strong disease resistance, and consistent genetic performance. As a result, they are highly valued and find a significant place within China's local cattle breed gene bank (Wang et al. 2023b).

Weining cattle are primarily distributed in Weining, Hezhang, Bijie, Nayong, and other counties in the eastern region of the Wumeng Mountains on the Yunnan-Guizhou Plateau. This particular breed is recognised for its small size and ability to produce high-quality meat in the northwestern plateau of Guizhou Province (Wu et al. 2023). Weining cattle exhibit several distinct characteristics: high reproductive capacity, consistent genetic performance, disease resistance, cold tolerance, adaptability to coarse feeding conditions, and flexibility (Liu et al. 2022).

Sinan cattle primarily originate from Sinan County, located in Guizhou Province, which serves as their main production region. These cattle are distinguished by their sturdy build, robust limbs, and remarkable ability to navigate mountainous terrain. They are well-suited for farming and grazing in such regions and demonstrate outstanding meat production qualities. In January 2019, Sinan cattle was officially registered and granted protection as a national geographical indication for agricultural products in China (Yuan et al. 2022).

Previous studies on Guizhou's four characteristic cattle breeds have predominantly focused on genetic breeding techniques and disease prevention. However, limited attention has been given to quality analysis and food processing. This study aimed to address this gap by examining the nutritional indices of the *longissimus dorsi* muscle in Guanling, Weining, Sinan, and Wuchuan cattle breeds. The nutritional indices were compared with those of Simmental cattle, aiming to establish a theoretical framework and reference point for enhancing the fundamental data and the breeding and improvement efforts related to Guizhou cattle.

MATERIAL AND METHODS

Preparation of beef samples. For this experiment, the *longissimus dorsi* muscle was obtained from Guanling cattle, Wuchuan cattle, Weining cattle, Wuchuan

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cattle, and Simmental cattle. Male cattle aged between 24 and 30 months were selected for the study. Three meat samples from each breed of cattle were selected to measure all indicators. Each meat sample was measured three times. Following slaughter, the *longissimus dorsi* muscle was immediately removed. To maintain freshness, the muscle was then vacuum-sealed using plastic film. Subsequently, the packaged muscle was promptly transported to the laboratory for indicator testing. All beef samples were sourced from local cattle farms and all indicator tests were conducted within 48 h.

Determination of ultimate pH, meat colour, water-holding capacity and shear force. The ultimate pH value in beef was determined according to the GB standard (No. 5009.237-2016). This was achieved by measuring the change in electromotive force between the indicator electrode and the reference electrode and converting it into pH unit values using an ammeter (PHSJ-5T; INESA Scientific Instrument, China). The pH values of the beef samples were measured at multiple time points, including 45 min, 3, 6, 12, 24, 36, and 48 h after slaughter. The ultimate pH value of the beef was defined as the lowest pH value obtained during the measurement period.

The surface characteristics of the beef, including the lightness (L^*) value, redness (a^*) value, and yellowness (b^*) value, were measured using a colour colourimeter (CR-400/410; Konica Minolta, China).

The water-holding capacity of the beef was determined following the method outlined in section 6.3 of the NY/T 1333-2007 standard. The meat samples were cut into strips that were 2 cm thick, 5 cm long, and 3 cm wide. These samples were then hooked with thin iron wire and vertically hung at 4 °C for a period of 24 h. The weight of the meat samples before and after hanging was recorded, and the water-holding capacity was calculated as the difference between the initial and final weights.

The tenderness of the meat sample was determined according to the NY/T 1180-2006 standard. A muscle tenderness meter (C-LM4; Beijing Bulader Technology Development, China) equipped with Warner Bratzler shear was used to measure the force exerted during the cutting of the meat sample. The maximum measured shear force was considered as the measure of tenderness for the meat sample.

Determination of proteins, organic acids, fats, and amino acids. Protein content was determined using the Kjeldahl nitrogen determination method and the automatic Kjeldahl nitrogen analyser (KJEITEC8400; FOSS, Denmark). The analysis of organic acids in beef was carried out using high-performance liquid chromatography (HPLC). The SB-AQ column (SB – StableBond) was utilised for chromatography, while the mobile phase consisted of acetonitrile and a 0.02 mol·L^{-1} potassium dihydrogen phosphate aqueous solution adjusted to a pH of 2.34 with phosphoric acid. Before use, the mobile phase was filtered through a 0.22 μM aqueous phase filter membrane. The flow rate was set at 1 mL·min^{-1}, and detection was performed at a wavelength of 210 nm. The column temperature was maintained at 30 °C, and an injection volume of 10 μL was employed. The flushing method involved equal elution over a 15-min period. The determination of amino acids was conducted following the guidelines provided in GB 5009.124-2016. The analysis was performed using the automatic amino acid analyser (L-8900; Hitachi, Japan) To determine fat content in beef, the acid hydrolysis method outlined in GB 5009.6-2016 was utilised, and the fat content was measured using the fat analyser (Soxtec 8000; FOSS, Denmark). The data were presented as means ± standard deviation (SD) with three replicates for each assay. Statistical significance was determined using a one-way analysis of variance (ANOVA), followed by the post hoc Duncan's multiple range test at a significance level of $P < 0.05$.

RESULTS

Ultimate pH. No significant disparities in ultimate pH (pHu) were observed among the five cattle breeds ($P > 0.05$, Figure 1). The average pHu value recorded was 5.47 ± 0.09, indicating that there were no noticeable variations in pHu between the different cattle breeds. These findings suggest that the pHu levels in the muscle tissue of these cattle breeds were similar and did not differ significantly.

Meat colour. Meat colour is a crucial indicator of beef quality and freshness, primarily determined by the levels and chemical state of myoglobin and haemoglobin in the muscle tissue (Ming et al. 2020). According to Figure 2, this study found that Guanling and Weining cattle had the highest L^* values, measuring 38.34 ± 1.35 and 40.00 ± 1.36, respectively. Additionally, Weining cattle displayed the highest a^* value, measuring at 23.49 ± 1.36, while no significant difference in a^* value was observed among the other four cattle types. Finally, Guanling and Weining cattle exhibited the highest b^* value, measuring at 6.81 ± 1.07 and 6.83 ± 0.47, respectively.

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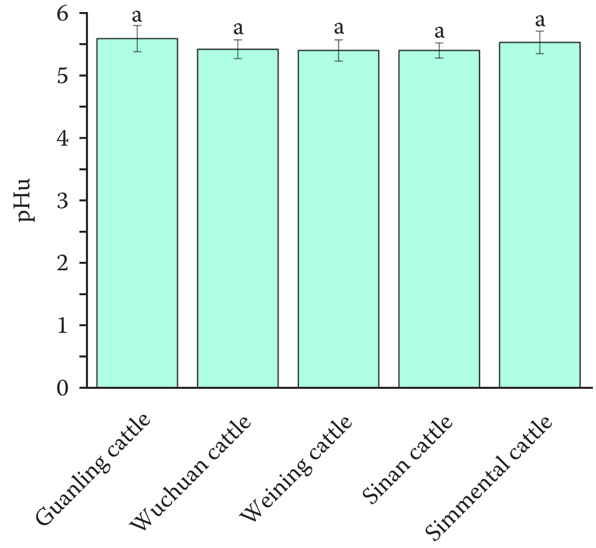

Figure 1. Variations in the ultimate pH (pHu) of different breeds of cattle in Guizhou

a – same letters indicate no significant difference at $P < 0.05$; pHu – ultimate pH

Water-holding capacity. According to Figure 3, Guanling, Wuchuan, and Simmental cattle demonstrate the highest water-holding capacity, with no significant difference observed among them. The respective values are 2.89 ± 0.27%, 3.00 ± 0.21%, and 2.71 ± 0.22%. On the contrary, Weining and Sinan cattle exhibit a meat holding capacity of 2.09 ± 0.20% and 2.18 ± 0.12%, respectively, with no significant difference between the two breeds.

Shear force. Figure 4 illustrates that Wuchuan cattle exhibited the highest shear strength, measuring at 99.63 ± 3.48 N. In contrast, the variance in shear strength among the other four types of cattle was not statistically significant, resulting in an average value of 84.59 ± 2.66 N.

Protein, fat and organic acid. Based on Table 1, Simmental and Guanling cattle exhibit the highest protein content, approximately 22.69 ± 0.28% and 22.44 ± 0.17%, respectively. On the other hand, there is no notable disparity in protein content among Wuchuan cattle, Weining cattle, and Sinan cattle, with an average value of approximately 21.18 ± 0.45%. Regarding fat content, Simmental and Guanling cattle have the highest levels, measuring at 4.40 ± 0.05% and

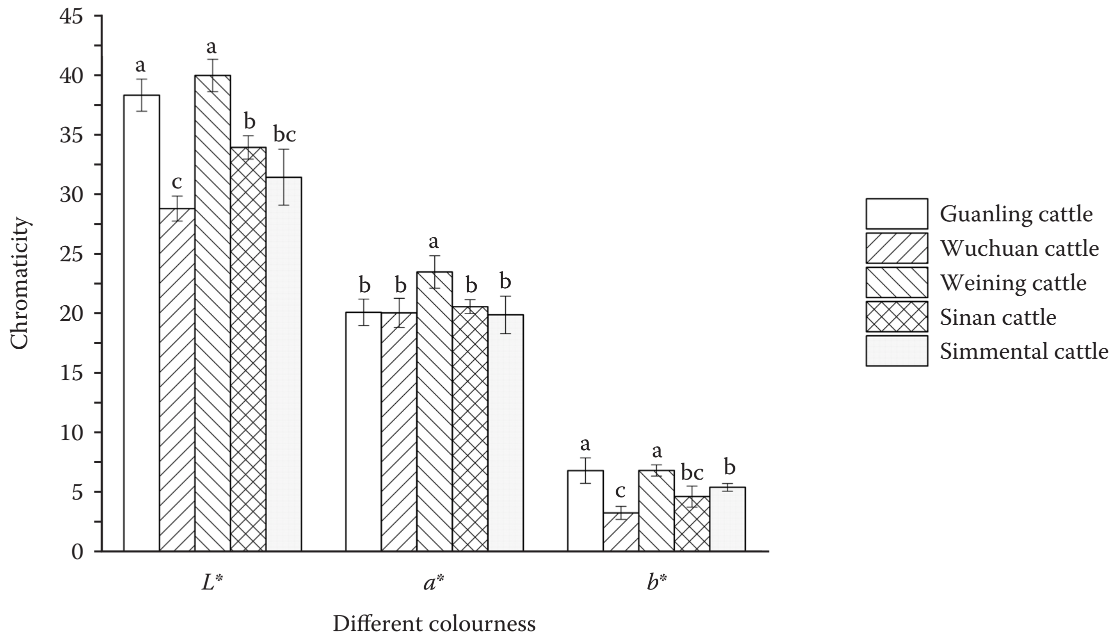

Figure 2. Variations in the meat colour of different breeds of cattle in Guizhou

a–c – different letters indicate significant differences at $P < 0.05$; L^* – lightness; a^* – redness; b^* – yellowness

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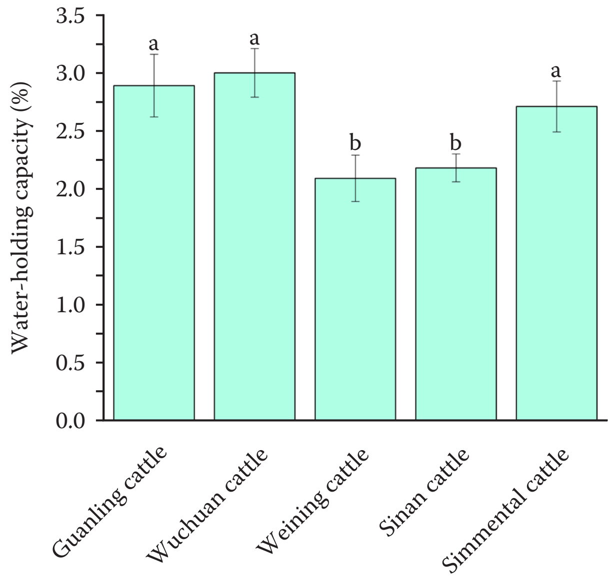

Figure 3. Variations in the water-holding capacity of different breeds of cattle in Guizhou

a–b – different letters indicate significant differences at $P < 0.05$

4.43 ± 0.07%, respectively. Regarding lactate content, Simmental cattle and Weining cattle have the highest levels, with no significant difference between these two types. No significant differences were found in propionic acid content among the five cattle varieties. The highest levels of oxalic acid were found in Weining, Simmental, and Sinan cattle, with no significant difference among these three types.

Amino acid. According to Table 2 and Figure 5, Guanling cattle had the highest total amino acid content at 15.23 ± 0.06 g·(100 g)$^{-1}$, followed by Simmental cattle with a total amino acid content of 14.58 ± 0.05 g·(100 g)$^{-1}$. Additionally, Guanling cattle exhibited the highest total and essential amino acid content, with a total amino acid content of 15.23 ± 0.06 g·(100 g)$^{-1}$ and a total essential amino acid content of 6.65 ± 0.02 g·(100 g)$^{-1}$ (Table 2). Conversely, Wuchuan and Sinan cattle had the lowest total and essential amino acid contents. Regarding the proportion of essential amino acids, a significant difference was once observed between Guanling cattle, Wuchuan cattle, and Simmental cattle, with proportions ranging from 42.89% to 43.93%. Based on a comprehensive analysis of the five cattle varieties tested in the experiment, it can be concluded that Glutamicacid (Glu) content was the highest, while Asparticacid (Asp), Leucine (Leu), Lysine (Lys), Arginine (Arg), and Alanine (Ala) content were relatively higher.

Correlation analysis. Based on the correlation coefficients of nutritional components among Guanling,

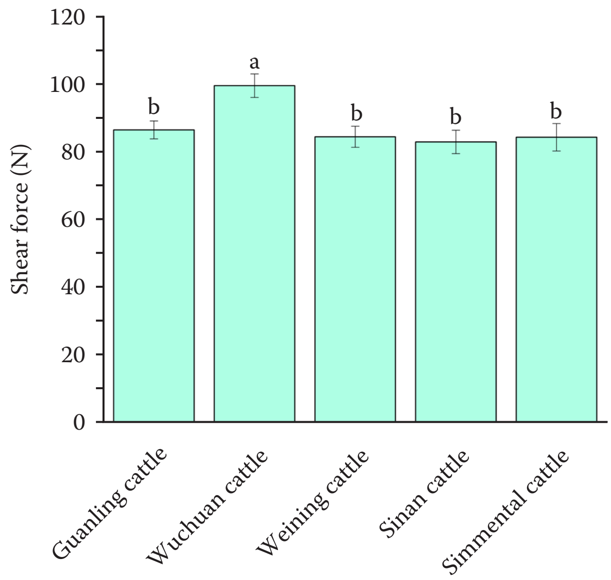

Figure 4. Variations in the shear force of different breeds of cattle in Guizhou

a–b – different letters indicate significant differences at $P < 0.05$

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Table 1. Content of protein, fat, and organic acids in different breeds of cattle in Guizhou

Cattle breeds	Protein	Fat	Lactic acid	Propionic acid	Oxalic acid
	(%)		(mg·g^{-1})		
Guanling	22.44^{a} ± 0.17	4.40^{a} ± 0.05	2.10^{b} ± 0.15	0.23^{a} ± 0.03	0.85^{b} ± 0.05
Wuchuan	21.15^{b} ± 0.52	3.28^{d} ± 0.07	1.43^{c} ± 0.16	0.20^{a} ± 0.04	0.84^{b} ± 0.11
Weining	21.31^{b} ± 0.46	3.90^{b} ± 0.03	2.95^{a} ± 0.32	0.21^{a} ± 0.03	1.08^{a} ± 0.09
Sinan	21.08^{b} ± 0.37	3.58^{c} ± 0.04	2.06^{b} ± 0.21	0.22^{a} ± 0.01	0.95^{ab} ± 0.12
Simmental	22.69^{a} ± 0.28	4.43^{a} ± 0.07	3.03^{a} ± 0.28	0.21^{a} ± 0.01	1.07^{a} ± 0.16

$^{a–d}$different superscript letters indicate significant differences at $P < 0.05$, same superscript letters indicate no significant difference at $P < 0.05$

Table 2. Content of amino acids in different breeds of cattle in Guizhou [g·(100 g)$^{-1}$]

Cattle breeds	Total amino acids	Total essential amino acids	Nonessential amino acid	Total essential amino acids/ total amino acids (%)
Guanling	15.23^{a} ± 0.06	6.65^{a} ± 0.02	8.58^{a} ± 0.07	43.67^{a} ± 0.26
Wuchuan	12.80^{d} ± 0.04	5.58^{d} ± 0.04	7.22^{d} ± 0.08	43.63^{a} ± 0.31
Weining	13.44^{c} ± 0.08	5.76^{c} ± 0.06	7.68^{c} ± 0.05	42.84^{b} ± 0.57
Sinan	12.76^{d} ± 0.06	5.38^{e} ± 0.06	7.38^{d} ± 0.09	42.15^{c} ± 0.33
Simmental	14.58^{b} ± 0.05	6.28^{b} ± 0.05	8.29^{b} ± 0.04	43.11^{ab} ± 0.22

$^{a–d}$different superscript letters indicate significant differences at $P < 0.05$, same superscript letters indicate no significant difference at $P < 0.05$

Wuchuan, Weining, Sinan, and Simmental cattle, it was observed that similar positive and negative correlations exist between various chemical components across the different cattle varieties, albeit with slight variations in the coefficients. Figure 6 illustrates the close relationship between pHu and water-holding capacity, shear force, organic acids, and essential amino acids, showing a positive correlation. Meat colour is positive-

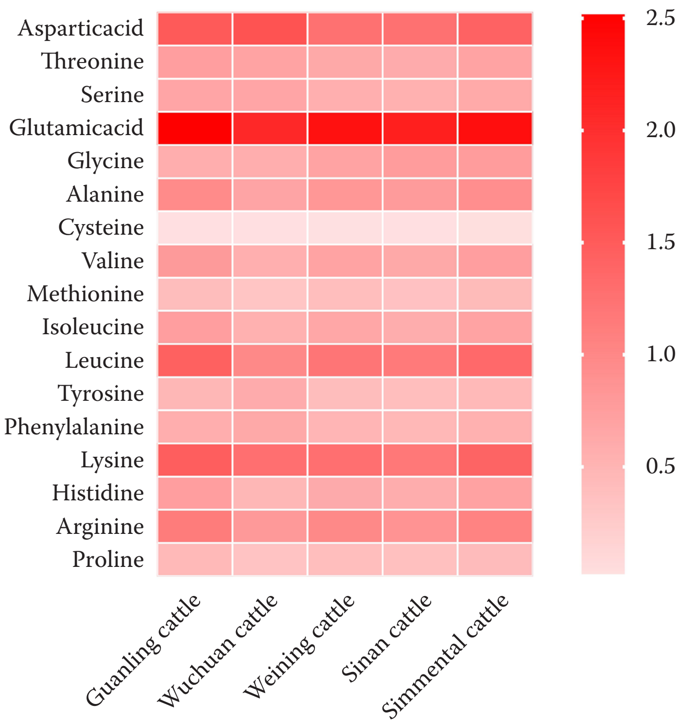

Figure 5. Heat map of 16 amino acid contents in different breeds of cattle in Guizhou

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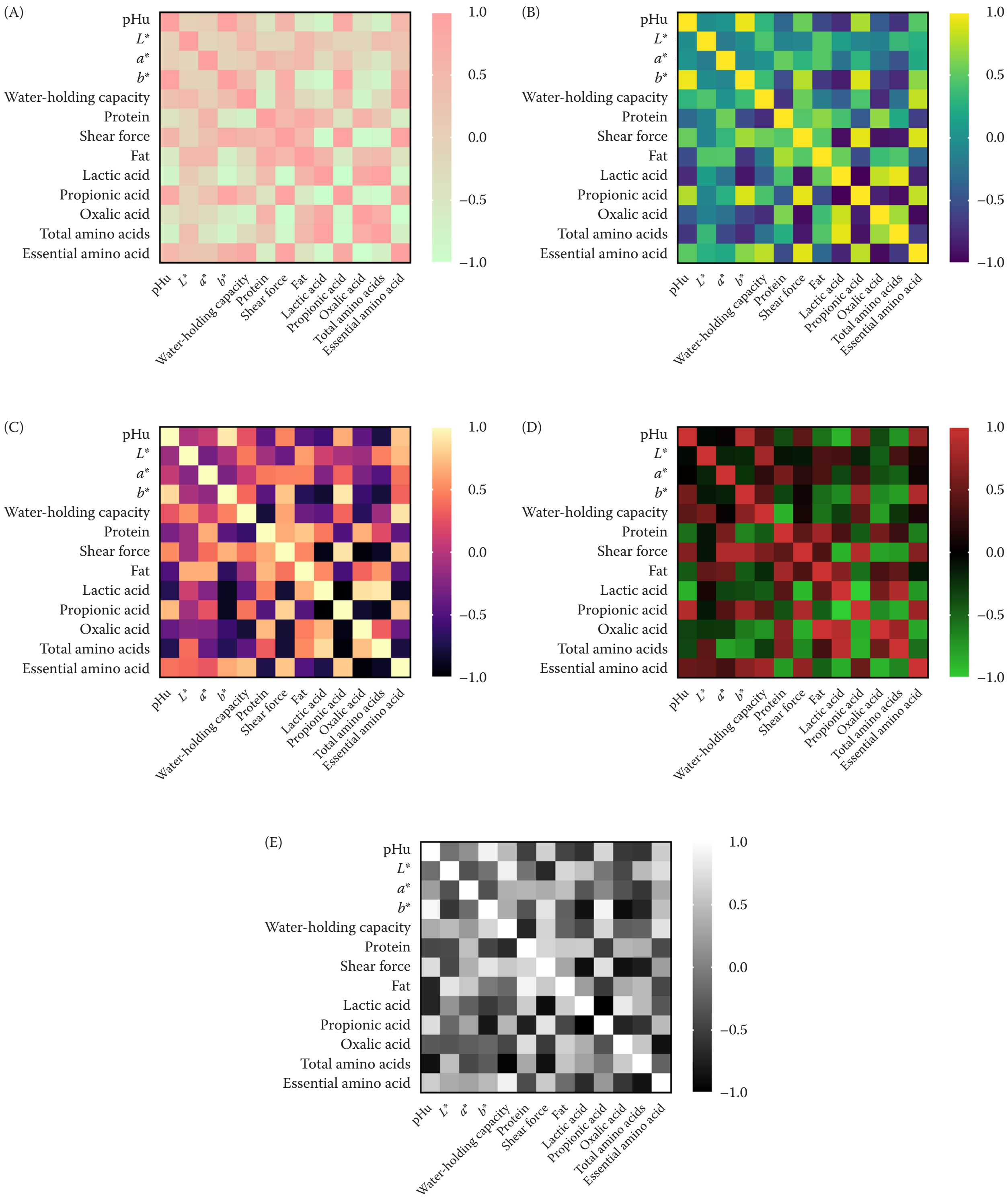

Figure 6. Correlation analysis of nutritional components of (A) Guanling cattle, (B) Simmental cattle, (C) Weining cattle, (D) Wuchan cattle, and (E) Sinan cattle in Guizhou

pHu – ultimate pH; *L** – lightness; *a** – redness; *b** – yellowness

ly correlated with the levels of fat, protein, and organic acids in the composition. The water-holding capacity and shear force, which are crucial factors affecting the texture and taste of the meat, also exhibit a positive correlation. Shear force is positively correlated with the content of protein, fat, and essential amino acids

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in beef, but negatively correlated with total amino acids. These consistent results correlate with the 13 nutritional indicators across the five cattle breeds.

DISCUSSION

In the context of meat consumption, beef is a commonly consumed variety that necessitates understanding its characteristic qualities and the appropriate selection of processing methods for optimal results. Before slaughter, animal muscles typically have a pH value between 7.2 and 7.4. Following slaughter, the pH value of the muscles decreases due to the accumulation of lactic acid resulting from glycogen metabolism. Once the glycogen is depleted or the glycolytic enzymes become inactive, the pH value reaches its lowest point, commonly called the pHu (Li et al. 2014). The reduction in pH value exerts substantial effects on multiple muscle attributes, such as water-holding capacity, colour, enzyme activity, and protein solubility (Zhang et al. 2018). The correlation analysis findings of this study align with the results depicted in Figure 6. The study indicates beef within the pH range of 5.40 to 5.79 displays a cherry red colour following cooking, demonstrating an enhanced level of brightness, redness, and yellowness. Conversely, beef with higher pH values (pH > 6.1) exhibits a lower water-holding capacity. Moreover, spoilage arises when the total bacterial count reaches 7–8 log (CFU·g^{-1}) (CFU – colony forming unit) (Wang et al. 2019). These findings suggest that beef's pH value substantially influences its colour, water-holding capacity, and bacterial growth. Lower pH values can improve the colour of beef but may impact its water-holding capacity. Additionally, a high total bacterial count can result in beef spoilage. These insights have practical implications for the selection and processing of beef. In this study, the average pHu value of five different Guizhou cattle samples was determined to be 5.47 ± 0.09, which falls within the normal range. Although there is no significant difference in pH values among the beef samples, the colour, shear strength, and water-holding capacity exhibit distinct characteristics, all inherently linked to pH values.

In terms of colour indicators, both Guanling cattle and Weining cattle demonstrated the highest L^* value, indicating greater brightness, and the highest b^* value, indicating increased yellowness. Weining cattle, in particular, displayed the highest a^* value, suggesting a greater level of redness. The colour of beef post-slaughter primarily originates from myoglobin, which exists in three forms: deoxymyoglobin (DeoMb), oxymyoglobin (OxyMb), and metmyoglobin (MetMb). The proportion of these three forms ultimately determines the colour of the meat (Wang et al. 2018). In freshly slaughtered muscle, myoglobin is reduced, known as DeoMb, and exhibits a purplish-red colour. However, during the early stages of storage, when there is an abundant supply of oxygen, myoglobin converts to OxyMb. This transformation causes the meat to acquire a bright red colour, which is generally preferred by consumers (Suman and Joseph 2013). As the storage time of meat increases, myoglobin undergoes oxidation and transforms into MetMb, resulting in a brown colouration of the meat. Unfortunately, many consumers tend to misinterpret this brownish change as an indication of meat spoilage or decay (Bekhit and Faustman 2005). In the study conducted by Ma (Ma et al. 2017), it was observed that variations in the L^* values of meat were attributed to differences in myoglobin content. Specifically, a higher amount of myoglobin resulted in higher L^* values. Conversely, variations in a^* values may be linked to different types of muscle fibres. Higher levels of type I fibres, which primarily undergo oxidative metabolism, can lead to myoglobin accumulation and surface discolouration, resulting in lower a^* values. On the other hand, the lower presence of type I fibres corresponds to higher a^* values. Nonetheless, it is important to note that muscle fibre composition is just one factor contributing to a^* values. Other factors, such as the cut and location of the meat sample, cooking methods, and the presence of other pigments, can also influence a^* values (Hwang et al. 2010). This suggests that meat colour can partially serve as an indicator of the quality of various beef products. Nevertheless, additional research is required to explore the molecular mechanisms that underlie the association between meat colour and beef quality.

The investigation revealed that tenderness decreases when the pH value is approximately 6.1. On the other hand, beef within the normal pH range (pH 5.40–5.80) and the higher pH range (pH > 6.1) exhibited enhanced tenderness. The pH values of the five beef types tested in the current study were within the normal range, implying optimal tenderness during this period (Jelenikova et al. 2008; Holdstock et al. 2014). The results of this study also indicated that Wuchuan cattle had the highest shear force and the lowest tenderness, while there were no significant differences in tenderness among Guanling cattle, Sinan cattle, Weining cattle, and Simmental cattle. These findings suggest that except for Wuchuan cattle, the tenderness of the other three local

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cattle breeds in Guizhou can match the quality of Simmental cattle.

The water-holding capacity of meat is strongly associated with the overall quality of the final product. Higher water-holding capacity results in a more tender and softer texture in the final product (Acevedo et al. 2019). This finding is consistent with the positive relationship observed between water-holding capacity and tenderness in the correlation analysis (Figure 6). It is worth noting that Weining and Sinan cattle have lower water-holding capacities compared to Guanling, Wuchuan, and Simmental cattle. However, this finding does not necessarily imply a direct relationship with tenderness, as tenderness is influenced by multiple factors, including fat, protein, and organic acids. It is important to consider that organic acids can affect the colour of meat products. Specifically, increased added acid concentration generally results in lighter meat colour and decreased redness. This phenomenon can be attributed to the reduction of oxygen content in the meat through the presence of organic acids, which promotes the conversion of Myoglobin to ferruginous Myoglobin and subsequently reduces its redness (Seyfert et al. 2007). In addition to addressing the challenge of insufficient beef tenderness, unique cooking methods can be employed. Wu's study (Wu et al. 2022) discovered that the unique cooking method in Guizhou, 'tomato sour soup cooking', can improve beef tenderness, water retention, and flavour. This method utilises tomato sour soup, which was found to have the highest concentrations of lactic acid (60%) and citric acid (20%). These findings reinforce the notion that treating meat products with organic acids can effectively tenderise them, presenting innovative avenues for meat tenderisation processing.

The classification of beef grades in countries such as the United States, Japan, Australia, and China incorporates the marbling fineness method, which is closely associated with fat content. According to the beef grading system established by the United States Department of Agriculture (USDA), Guanling cattle (4.40%) and Simmental cattle (4.43%) meet the criteria for the special grade Choice – (4–5% fat content). Weining cattle (3.9%) and Sinan cattle (3.58%) qualify for Select + (3.5–4% fat content), while Wuchuan cattle (3.28%) can be classified as Select – (3–3.5% fat content).

The protein and amino acid composition of beef is vital in its nutritional value. The FAO/WHO standards recommend a protein model in which 40% of the total amino acids should be essential amino acids, while non-essential amino acids should account for the remaining 60% of the total (Jin et al.2016). This experiment revealed that the ratio of essential amino acids to total amino acids in five cattle breeds exceeded 40%. This observation implies that the amino acid composition in the four native Guizhou cattle breeds (Guanling, Weining, Sinan, Wuchuan) is highly suitable for fulfilling human nutritional needs. Consequently, these breeds are excellent sources of high-quality, premium beef. Additionally, the analysis conducted within this study demonstrated that among the 16 amino acids assessed in the five cattle breeds, glutamic acid and aspartic acid exhibited the highest levels. This finding is consistent with previous studies by Li et al. (2022). Glutamic acid and aspartic acid substantially impact meat quality and flavour. Moreover, glutamic acid has been demonstrated to contribute to cognitive enhancement. Glutamine and asparagine are critical for protein and carbohydrate metabolism within the body, and they aid in safeguarding organ function by reducing blood ammonia levels (Kaur et al. 2014; Anouk et al. 2017). Functional amino acids encompass flavour amino acids such as glutamic acid, sweet flavour amino acids like alanine, glycine, serine, proline, and threonine, as well as bitter amino acids including methionine, valine, leucine, isoleucine, phenylalanine, tyrosine, tryptophan, histidine, lysine, and arginine (Torley et al. 2020). The findings of this experimental study suggest that the primary functional amino acids present in the four local cattle varieties in Guizhou are predominantly sweet, aligning with the proportions observed in the investigation of Yunling high-end beef by Jin et al. (2016).

CONCLUSION

The beef industry in Guizhou has developed relatively late compared to other regions. Current research primarily focuses on the genetic breeding of local cattle in Guizhou, with limited attention given to beef product processing and nutritional quality analysis. In this study, we experimented using the longest back muscle of four local cattle breeds and Simmental cattle in Guizhou. Various parameters were measured, including pH, meat colour, water-holding capacity, shear force, protein, fat, organic acids, and amino acids. The results indicate that Guanling cattle, among the four local breeds, exhibit the highest protein, fat, and amino acid content in the longest back muscle, thus demonstrating good nutritional quality. When comparing conventional nutrients such as protein, fat,

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and amino acids with Simmental cattle, no significant difference in nutritional value was observed between Guanling and Simmental cattle. The results obtained provide a theoretical basis and reference for studying processing methods and breeding improvement of different cattle breeds in Guizhou.

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