

Evaluation of the Chinese indigenous pig breed Dahe and crossbred Dawu for growth and carcass characteristics, organ weight, meat quality and intramuscular fatty acid and amino acid composition

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The objectives of the experiment were to evaluate growth and carcass characteristics, organ weight, meat quality and intramuscular fatty acid (FA) and amino acid composition between the Chinese indigenous pig breed Dahe and the crossbred Dawu. The Dahe pigs had lower average daily gain ($P < 0.001$) and a higher feed conversion ratio ($P < 0.001$) compared with the Dawu pigs. The Dahe pigs contained less lean meat percentage ($P < 0.001$) and more carcass fat percentage ($P < 0.001$) compared with the Dawu pigs. For organ weight, the Dahe pigs had lower relative heart weight and small intestine weight, respectively, compared with that of the Dawu pigs ($P < 0.001$). In addition, the Dahe pigs showed higher pH values (at 45 min and 24 h, $P < 0.001$ and $P < 0.001$, respectively), higher Marbling score ($P < 0.05$), lower Minolta L values (at 45 min and 24 h, $P < 0.001$ and $P < 0.05$, respectively) and lower muscle fiber area ($P < 0.05$) than did the Dawu pigs. C18:1, C16:0, C18:0 and C18:2 were the main FAs and nine essential amino acids were found in the Longissimus dorsi of the two breeds.

Keywords: growth and carcass characteristics, meat quality, organ weight, fatty acid composition, amino acid composition

Implications

The Dahe pig is a Chinese indigenous pig breed and the Dawu pig is a crossbred using the Duroc × Dahe breeding scheme through five generations of selection. This is the first study to evaluate growth and carcass characteristics, organ weight, meat quality, and intramuscular fatty acid and amino acid composition of the two breeds. The results showed that the Dahe pigs retained good meat but poor growth and carcass composition, whereas the Dawu pigs not only retained good meat quality as did the Dahe pigs but also had good growth performance and carcass composition. These results indicated that the two breeds could be used in commercial pig production in China to provide high taste quality niche products.

Introduction

The Chinese swine industry is by far the largest of its kind in any country in the world. Jiang and Li (2010) reported the

2009 standing population to be 463 million heads and the slaughter at 668 million in China. There are about 100 local swine breeds in existence in China and the native pig breeds have high reproductive rates, good meat quality, good adaptability for extensive feeding and management and the ability for high utilization of green crude. However, owing to undesirable traits such as slow growth rate, low dress percentage and low lean meat percentage, few local breeds are utilized on large commercial farms in China (Jones, 1998). One of the reasons for the increasing interest in local pig breeds is the better quality of their meat compared with modern breeds (Dunn, 1996; Labroue *et al.*, 2000). According to the literature, pigs of Chinese local breeds present poorer growth performance; moreover, they are fatter and less conformed than pigs of modern breeds (Lan *et al.*, 1993; Cesar *et al.*, 2010). As for the quality of meat or meat products, the abovementioned studies report an advantage of local pig breeds in relation to pigs of modern breeds.

The Dahe pig is a traditional commercial pig breed that is raised in southwest China in the Yunnan province. Owing to the poor growth performance and carcass composition, it is

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endangered by extinction. Nowadays, the Dahe pig is included in the national preservation program for autochthonous breeds. In order to utilize the precious genetic resource, we used the Duroc × Dahe breeding scheme and bred the crossbred Dawu pig through five generations of selection. The Dahe pig and the Dawu pig have good adaptability for extensive feeding and management and the ability for high utilization of green-crude feed. The meat of the two breeds is the excellent raw material of Xuanwei-Ham. Nowadays, there are few reports about the germplasm characteristics of the two breeds. Therefore, the objectives of the experiment were to evaluate the growth and carcass characteristics, organ weight, meat quality and intramuscular fatty acid (FA) and amino acid composition of the two breeds.

Material and methods

The experiment was conducted in compliance with the requirements of the Animal Ethics Committee of Sichuan Agricultural University.

Animals and management

The experiment was organized by the Qujing Farming Bureau and Sichuan Agricultural University and conducted on the Dahe pig preservation farm in Qujing city. A total of 40 castrated male pigs ($n = 20$ per breed) were randomly selected at 60 days of age (with similar weight at about 20 kg). All pigs were housed in individual pens (2 m²) located in the same room. Owing to the Dahe and the Dawu pigs being usually slaughtered at about 80 kg in the production system, the feeding experiment lasted for 150 days for the Dawu pigs and 180 days for the Dahe pigs in order to gain similar slaughter weight after 7 days of the adaptation period. All pigs were fed twice a day with the same diet, and pigs had *ad libitum* access to diet and water (nipple drinkers). The experimental diets were based on corn and soybean meal, and were formulated with crude protein concentrations, trace minerals and vitamins to meet or exceed the National Research Council (NRC, 1998) recommendations for the different growth phases. Chemical analyses of the basal diet were carried out according to the methods of Association of Official Analytical Chemists (AOAC, 1990). During the experimental period, the corn–soybean meal diet was offered to pigs as shown in Table 1.

Growth and carcass measurements and organ weight

In the experimental period, the data of initial live weight, final live weight and feed consumption were recorded. At their predestinated slaughter age, all pigs were slaughtered to determine carcass composition according to the methods described by Xiao *et al.* (1999). Briefly, all pigs were transported to an abattoir. The pigs received no feed on the day of slaughter, but were allowed to rest for 2 h after about 1 h of transportation (including loading and unloading), after which they were electrically stunned (90 V, 10 s and 50 Hz), exsanguinated, dehaired and eviscerated. The head was removed and the carcass was longitudinally split. The left

Table 1 Ingredients and nutrients of the basal experiment diets

Item	20 to 50 kg	50 to 90 kg
Ingredients (g/kg)		
Corn	700.0	772.0
Soybean	270.0	200.0
CaHPO ₄	9.0	8.0
Limestone	8.0	7.0
Salt	3.0	3.0
Lysine	0.3	–
Premix [†]	10.0	10.0
Nutrients [‡]		
DE (MJ/kg)	13.90	13.83
CP (g/kg)	180.0	154.0
Ca (g/kg)	6.0	5.2
P (g/kg)	5.0	4.6
Lysine (g/kg)	9.5	7.5

DE = digestible energy.

[†]Provided the following (unit/kg): 1600 mg of Cu, 10 000 mg of Fe, 3000 mg of Mn, 10 000 mg of Zn, 40 mg of I and 30 mg of Se, 6 05 000 IU of vitamin A, 1 55 000 IU of vitamin D₃, 1800 IU of vitamin E, 200 mg of vitamin K₃, 300 mg of vitamin B₁, 400 mg of riboflavin, 200 mg of vitamin B₆, 1.5 mg of vitamin B₁₂, 1500 mg of pantothenic acid, 2800 mg of niacin and 12 500 mg of choline.

[‡]All data were analyzed values except DE, which was calculated using swine National Research Council (1998) values.

carcass was physically dissected into bone, muscle and subcutaneous fat and skin, and each of the dissected tissue was weighed to the nearest gram. The organs were removed and weighed. The *Longissimus dorsi* area was determined by tracing its surface area at the 10th rib and by using a planimeter (Planix 5.6, Tamaya Digital Planimeter, Tamaya Tecnic Inc., Tokyo, Japan). The backfat thickness was taken in the midline with a sliding caliper on the 10th rib. Carcass dressing percentage was determined from the live weight (fasted overnight but given free drinking water and weighed at the farm) and the hot carcass weight.

Meat quality measurements

pH was measured using a pH star (Osaka, Japan) at 45 min and 24 h *postmortem* on the *L. dorsi* according to the procedure described by Verónica *et al.* (2009). Color parameters were determined using a Minolta CR-300 colorimeter (Minolta Camera, Osaka, Japan) with an illuminant D65, a 10° standard observer and a 2.5 cm port/viewing area according to the procedure described by Miao *et al.* (2009). Drip loss was defined as the weight loss of a meat sample (50 g), placed on a flat plastic grid and wrapped in foil, after a storage time of 24 h in a refrigerator (4°C; Miao *et al.*, 2009). Cooking loss was measured by a meat sample packaged under vacuum – in a circulating water bath at a temperature of 75°C. Subjective Marbling scores were evaluated approximately at 24 h *postmortem* according to the method of the National Pork Produces Council (NPPC, 2000). The analysis of intramuscular fat (IMF) content was measured according to the AOAC (1990) procedures. Muscle fiber area was determined using the procedure described by Gint and Vigilijus (2008).

Table 2 Means and s.e. of growth and carcass traits in the two breeds

Traits	Breeds		s.e.	Significance
	Dahe	Dawu		
	Means	Means		
Daily live weight gain (g/day)	435.4 ^b	647.3 ^a	13.5	***
Feed-to-gain ratio	4.48 ^a	3.31 ^b	0.34	***
Carcass weight (kg)	62.85	67.31	1.57	ns
Carcass length (cm)	69.40 ^b	77.00 ^a	1.17	***
Dressing percentage (%)	72.19	73.47	1.40	ns
Backfat thickness (cm)	4.12 ^a	2.23 ^b	0.22	***
Loin muscle area (cm ²)	15.43 ^b	26.66 ^a	0.85	***
Carcass lean (%)	42.06 ^b	55.35 ^a	0.71	***
Carcass fat and skin (%)	50.41 ^a	36.20 ^b	0.81	***
Carcass bone (%)	7.53 ^b	8.78 ^a	0.23	***

^{a,b}Means within a row with different superscripts indicate significant differences; ns at $P > 0.05$; *** significant at the 0.1% level.

Analysis of FA and amino acid composition

FA composition was analyzed by gas chromatography (Agilent 6820, Agilent Technologies, USA) using a capillary column (HP-Innowax, Agilent, 30 m long, 0.32 mm internal diameter and 0.25 μ m film thickness) according to the method described by Yang *et al.* (2005). The temperature program was started at 200°C for 2 min, followed by ramping to 202°C at a rate of 0.4°C/min, and then followed by another ramping to 207°C at a rate of 0.7°C/min and holding for 14 min. The temperature of the injection port was 250°C and that of the flame ionization detector was 275°C. The velocity of the carrier gas (N₂) was set at 2.8 ml/min and the head pressure of the carrier gas was 11.9 psi. FAs in three fractionations were quantified using C17:0 as an internal standard. All FAs in the samples were identified by the retention times according to the standard compounds of FAs (Sigma Chemical Co., St. Louis, MO, USA).

Amino acid composition was determined using the method described by Lu *et al.* (2008). The wet muscle samples were cut into slices and dried in a vacuum-freeze dryer, allowed to equilibrate with atmospheric moisture for 24 h, and then finely ground to pass a 60-mesh sieve. The amino acid composition of the muscle powder was analyzed using ion-exchange chromatography with an automatic amino acid analyzer (L-8800 Hitachi Automatic Amino Acid Analyzer, Tokyo, Japan) after hydrolyzing with 6 N HCl at 110°C for 24 h. Methionine, cystine and tryptophan were partly destroyed under acid hydrolysis. Tryptophan was determined after alkaline hydrolysis with 4 N NaOH for 22 h at 110°C. Methionine and cystine were analyzed after cold formic acid oxidation for 16 h before acid hydrolysis. Duplicate analyses were performed on all six samples in each breed.

Statistical analyses

Statistical analysis was performed using the ANOVA procedure of the SAS System for Windows Release 8.0 (SAS Institute Inc., Cary, NC 27513, USA). The model included breed as the main effect. Duncan test was applied to compare

the mean values of the breed. Mean values and standard errors are reported in the tables. Differences were considered significant if $P \leq 0.05$.

Results and discussion

Growth and carcass traits

Growth performances in the two breeds are shown in Table 2. The average daily live weight gain of the Dahe pigs was lower than that of the Dawu pigs ($P < 0.001$); meanwhile, the Dahe pigs had a higher feed-to-gain ratio compared with the Dawu pigs ($P < 0.001$). The results were in accordance with previous reports (Young, 1992a, 1992b, 1995 and 1998), which showed that the Chinese native breeds (Meishan, Fengjing and Minzhu) had low daily live weight gain and high feed-to-gain ratio, but the growth performances of hybrid pigs from Yorkshire \times Meishan, Yorkshire \times Fengjing and Yorkshire \times Minzhu were largely improved.

The carcass characteristics of the two breeds are shown in Table 2 and there are big differences between the two breeds. The carcasses of the Dahe pigs were shorter ($P < 0.001$); meanwhile, they contained less lean meat and carcass bone ($P < 0.001$) than did the carcasses of the Dawu pigs. By contrast, the Dahe pigs had more carcass subcutaneous fat and skin compared with the Dawu pigs ($P < 0.001$). In addition, the Dahe pigs had thicker backfat and smaller loin muscle area compared with the Dawu pigs ($P < 0.001$). No significant differences in dressing percentage and carcass weight were attributable to the two breeds. These above results indicate not only that the Dahe pig has a strong ability to deposit lipids showing high subcutaneous fat percentage and low lean meat percentage as well as another Chinese native breeds by contrast, the Dawu pig, which has a large proportion of Duroc, has high lean meat percentage as well as foreign breeds.

These results were in accordance with previous reports (Xu, 1994; Miao *et al.*, 2009), which showed that the Jinhua pig was characterized by stronger fatty deposition,

lower lean meat percentage and reduced growth performance compared with the Landrace pig. Gispert *et al.* (2007) compared five different genetic types of pig (Landrace, Large White, Duroc, Pietrain and Meishan) and found that the Meishan pigs had lighter carcass weight, lower lean meat percentage and higher subcutaneous fat percentage compared with the pig breeds. Wanger *et al.* (1999) also found differences in the carcass composition from different genetic types of swine. The higher backfat thickness and lower carcass lean content in Chinese native pigs were related to their lower muscle growth potential. The greater ability of Chinese native pigs to deposit lipids is probably related to an indirect effect of concomitant breed difference in protein accretion and an increase in extra energy available for lipid synthesis (Renaudeau and Mouro, 2007). Similar results were reported when Meishan (White *et al.*, 1993; Litten *et al.*, 2004), Iberian pigs (Morales *et al.*, 2003) or Creole pigs (Renaudeau and Mouro, 2007) were compared with conventional lean pigs.

The crossbred Dawu pigs, crossing the modern Duroc breed and local Dahe breed, had better carcass characteristics than the Dahe pigs. The results were in accordance with previous reports (Lan *et al.*, 1993), which showed that the crossbred pigs from Yorkshire × Meishan, Yorkshire × Fengjing and Yorkshire × Minzhu were characterized by lower fat deposition and higher lean meat percentage compared with the purebreds of Meishan, Fengjing and Minzhu.

Weight of organs

As shown in Table 3, the relative weight of organs showed differences in the two breeds. The Dahe pigs had lower relative weight of the heart and small intestine compared with the Dawu pigs ($P < 0.001$, respectively). Several factors, such as the diet protein level, slaughter weight and breed, have been reported to influence both the actual and relative organ weight of slaughter pigs (Chen *et al.*, 1999; Miao *et al.*, 2009). In this study, the relative heart weight and the small intestine weight were lower in the Dahe pigs than in the Dawu pigs. The results are in accordance with previous findings reported by Cliplef and McKay (1993) and Yang and Lin (1997), which showed that pigs with leaner carcasses and faster growth rate had a larger heart and small intestine. However, Miao *et al.* (2009) found that the Jinhua pigs had a higher relative weight of heart compared with the Landrace pigs. No significant differences in other organ weight was found between the two breeds, and the results were in agreement with previous findings (Ruusunen *et al.*, 2007), which showed that the relative weight of the liver and kidneys did not differ significantly between breeds of pigs at the age of 165 days. But many findings indicated that the organ weight was affected by breeds (Chen *et al.*, 1999; Kouba *et al.*, 1999; Miao *et al.*, 2009; Barea *et al.*, 2011).

Meat quality parameters

Meat quality in the two breeds is shown in Table 4. pH₁ (at 45 min *postmortem*) and pH_u (at 24 h *postmortem*) of the

Table 3 Means and s.e. of relative organ weight in the two breeds

Traits (%)	Breeds		s.e.	Significance
	Dahe	Dawu		
Heart	0.27 ^b	0.41 ^a	0.02	***
Liver	0.15	0.15	0.01	ns
Kidney	0.29	0.33	0.01	ns
Lung	1.30	1.38	0.07	ns
Spleen	0.02	0.02	0.01	ns
Stomach	0.08	0.10	0.01	ns
Small intestine	0.27 ^b	0.41 ^a	0.02	***
Large intestine	2.13	1.99	0.10	ns

^{a,b}Means within a row with different superscripts indicate significant differences; ns at $P > 0.05$; ***significant at the 0.1% level.

Table 4 Means and s.e. of meat quality in the two breeds

Traits	Breeds		s.e.	Significance
	Dahe	Dawu		
pH ₁ ¹	6.45 ^a	6.25 ^b	0.07	***
pH _u ¹	6.08 ^a	5.79 ^b	0.08	***
Minolta L ₁ ¹	39.11 ^b	42.42 ^a	0.61	***
Minolta L _u ¹	40.44 ^b	44.61 ^a	1.06	*
Marbling score ¹	4.35 ^a	3.50 ^b	0.21	*
Intramuscular fat content (%) ¹	6.04	5.23	0.88	ns
Drip loss (%) ¹	2.19	1.88	0.12	ns
Cooking loss (%) ²	22.18	25.92	1.91	ns
Myofiber area (μm ²) ¹	2291.99 ^b	2912.83 ^a	232.72	*

^{a,b}Means within a row with different superscripts indicate significant differences; ns at $P > 0.05$; *significant at the 5% level; ***significant at the 0.1% level.

¹Longissimus dorsi at 10th rib.

²Greater psoas; pH₁, Minolta L₁ (at 45 min *postmortem*); pH_u, Minolta L_u (at 24 h *postmortem*).

Dahe pigs were significantly higher compared with the Dawu pigs ($P < 0.001$, respectively). pH was a major parameter of meat quality which affected both the technological and eating qualities of pork (van Laack *et al.*, 1994; van der Wal *et al.*, 1995). Sellier (1998) reported that reference was commonly made to three distinct pH-related abnormalities. These were specifically the PSE (pale, soft, exudative) meat condition (associated with pH₁ values < 5.9 to 6.1 depending on the muscle), the DFD (dark, firm, dry) meat condition (associated with pH_u values > 6.0 to 6.2) and the 'acid meat' condition (associated with pH_u values < 5.4 to 5.5). In this study, the two breeds showed high pH₁ values. Warriss *et al.* (1996) and Yang and Liu (2009) also reported higher muscle pH₁ for local breeds. By contrast, Labroue *et al.* (2000) reported lower muscle pH₁ (*L. dorsi*) and higher muscle pH_u (*Semimembranosus*) for local breeds in comparison with Large White breed; however, no indication was given of the stress susceptibility gene status of their local breeds. In the two breeds, the pH values were within normal scopes and the meat showed no characteristics of PSE, DFD and 'acid meat'.

Lower Minolta *L* values (at 45 min and 24 h *postmortem*) in the *L. dorsi* were found for the Dahe pigs compared with the Dawu pigs ($P < 0.001$ and $P < 0.05$, respectively). Similar results were reported between the Iberian and Landrace pigs (Serra *et al.*, 1998) or between the Creole and Large White pigs (Renaudeau and Mouro, 2007). Miao *et al.* (2009) found that the Jinhua pig meat had lower Minolta *L* value and tended to be darker than that of the Landrace pigs. Ramírez *et al.* (2007) also found that the Minolta *L* value was influenced by the genotype of pigs. However, these results conflict with those of earlier studies (Edwards *et al.*, 2003), which observed that objective Minolta *L* values were not different between breeds (Duroc- and Pietrain-sired pigs). According to the meat color standards of NPPC (2000), color score levels of 3 to 5 or Minolta *L* value levels of 37 to 49 are considered to be good. In this study, the Minolta *L* values were perfect in the breeds, which indicated that the two breeds had good meat color.

Regarding drip loss and cooking loss, no significant differences were found in the two breeds ($P > 0.05$, respectively). Water is the major meat constituent representing approximately 75% of the meat weight. It is an essential quality parameter, both for the industry and the final consumer. High water holding capacity (WHC) values might cause advantages both in processed meats for the industry and in the fresh meat appearance for the consumer (den Hertog-Meischke *et al.*, 1997). The main factors that affected WHC and thus drip loss were: genotype (*HAL* and *RN* genes), pre-slaughter management and stunning methods (Claeys *et al.*, 2001; Schäfer *et al.*, 2002). According to den Hertog-Meischke *et al.* (1997), another important feature that affected WHC was the predominant type of fiber in the muscle. Muscles with a major amount of glycolytic fibers, also called white muscle fibers (fast contraction, type II A, anaerobic), had a lower WHC and a high pH drop rate after death (Lawrie, 2005), as well as a lower final pH. In this study, the two breeds had high WHC showing low drip loss

and cooking loss. Very high pH levels in the two breeds probably result in high WHC.

Higher Marbling score was found in the Dahe pigs compared with the Dawu pigs ($P < 0.05$) and no significant difference was found in the IMF content in the two breeds, both of which interestingly had high IMF content. The high IMF content of the Dawu pigs probably results from the outstanding specificity of Duroc pigs with high IMF content. IMF content was related to the organoleptic characteristics of pig meat and influences meat and meat product quality (Wood *et al.*, 1988), and IMF depended on the genotype of pigs (Affentranger *et al.*, 1996). Generally, fat is an important holder of flavor. Consequently, IMF content seems to have a decisive influence on the tenderness, juiciness and flavor of pig meat. Meat with a low fat content is insipid, strawy and dry. In this study, the two breeds had high Marbling score and high IMF content, which indicated that the Dahe and the Dawu pigs had good quality characteristics in the meat. From these results, one can assume that the two breeds have a strong level of lipid synthesis activity. Similarly, an increase in lipogenic enzyme activities in adipose and muscle tissue was reported by Serra *et al.* (1998) and Morales *et al.* (2003) when Iberian pigs were compared with Landrace pigs. An IMF content of 2% to 3% was suggested to be optimal for eating quality (Bejerholm and Barton-Gade, 1986; DeVol *et al.*, 1988). However, owing to the selection of high lean meat content, the average IMF content of pig meat has decreased below this optimum these days, especially in many commercial pig populations. Therefore, to improve the IMF content is the new objective for pig genetics and breeding. The high IMF content in the two breeds can meet the demand for high taste quality niche products.

The Dahe pigs had a lower fiber area than the Dawu pigs ($P < 0.05$). The result was in accordance with previous results (Lan *et al.*, 1993), which reported that Yorkshire pigs had a larger fiber area than Meishan (4, 206 μm^2 v. 3, 213 μm^2 at ~ 100 kg live weight). The muscle fiber area is an important factor affecting numerous *pre-* and *post-mortem* biochemical processes and thus also meat quality (Klosowska and Fiedler, 2003). The pork muscle fiber area had influence on meat quality and pork with high muscle fiber area had high shear force, drip loss and cooking loss (Gint and Vigilius, 2008). These results may help explain why the two breeds had high WHC because of the small fiber area.

According to the meat quality characteristics of the two breeds, this study confirms that the two breeds have good meat quality. From our results, it can be suggested that the two breeds could be used in production systems to provide high taste quality niche products to the market.

FA and amino acid composition

Table 5 shows the FA composition of the *L. dorsi* in the two breeds. In this study, C18:1, C16:0, C18:0 and C18:2 were the main FAs; meanwhile, monounsaturated fatty acid (MUFA) and saturated fatty acid (SFA) were by far the most abundant components ($> 87\%$) in the *L. dorsi*. These results were in good agreement with the results obtained from IMF

Table 5 FA composition of *Longissimus dorsi*¹ (mg/g)

FA	Breeds		s.e.	Significance
	Dahe	Dawu		
	Means	Means		
12:00	2.95	2.38	2.22	ns
14:00	5.17 ^b	8.10 ^a	3.72	*
14:01	1.46	1.46	0.43	ns
15:00	1.34	2.19	1.63	ns
15:01	2.08	2.08	0.18	ns
16:00	22.00 ^a	17.91 ^b	4.50	*
16:01	5.52 ^b	8.06 ^a	1.96	*
18:00	10.74	11.08	0.77	ns
18:01	40.89 ^a	28.12 ^b	12.35	***
18:02	8.10 ^b	14.35 ^a	6.14	**
18:03	3.72 ^b	7.18 ^a	3.59	**
20:00	0.60	0.84	0.42	ns
20:01	0.32	0.60	0.31	ns
22:00	0.20	0.41	0.23	ns
22:01	1.40 ^b	3.32 ^a	1.76	*
OFA	0.48	0.82	0.68	ns
TFA	106.47	108.08	28.96	ns
SFA	42.99	42.91	10.35	ns
UFA	63.48	65.17	18.79	ns
MUFA	51.67	43.63	16.17	ns
PUFA	11.81 ^b	21.53 ^a	4.87	***
UFA/SFA	1.48	1.52	0.35	ns
PUFA/SFA	0.27	0.50	0.13	ns

FA = fatty acid; OFA = other FA; TFA = total FA; SFA = saturated FA; UFA = unsaturated FA; MUFA = monounsaturated FA; PUFA = polyunsaturated FA; UFA/SFA = the ratio of UFA to SFA; PUFA/SFA = the ratio of PUFA to SFA.

¹*L. dorsi* at 10th rib.

^{a,b}Means within a row with different superscripts indicate significant differences; ns at $P > 0.05$; *significant at the 5% level; **significant at the 1% level; ***significant at the 0.1% level.

(Muriel *et al.*, 2007; Martin *et al.*, 2008 and 2009; Yang *et al.*, 2010) in different pig breeds. Some other investigations showed that SFAs were much lower than MUFAs (Daza *et al.*, 2007; Larrea *et al.*, 2007; Ramirez *et al.*, 2007; Tikik *et al.*, 2007), or that SFAs were a little higher than MUFAs (Martin *et al.*, 2008) or that polyunsaturated fatty acids (PUFAs) were much higher than usually described by Bee *et al.* (2002) and Daza *et al.* (2007) in intramuscular neutral lipids. These differences could be related to the different breeds, experimental diets and feeding regimes in various studies.

Table 6 shows the amino acid content of *L. dorsi* in the two breeds, and no significant differences were found in the two breeds. In this study, nine essential amino acids (EAAs) were found in the two breeds, which had higher EAA percentages (49.55% in the Dahe pigs and 49.60% in the Dawu pigs, respectively) compared with the total amino acid contents. The EAAs at the highest concentration in pig meat were lysine and leucine. Okrouhlá *et al.* (2006) reported that the highest content of essential and semi-essential amino acids was determined in lysine (9.71% to 10.54%), leucine (8.18% to 9.21%) and arginine (7.28% to 7.88%). However, Belitz *et al.* (2001) reported values of 7.8% to 8.1% for lysine and

Table 6 Amino acid composition of *Longissimus dorsi*¹ (g/100 g, dry meat)

Amino acids	Breeds		s.e.	Significance
	Dahe	Dawu		
	Means	Means		
Essential				
Lysine	7.05	6.95	0.11	ns
Leucine	6.93	6.81	0.13	ns
Isoleucine	3.81	3.70	0.10	ns
Valine	3.74	3.62	0.07	ns
Threonine	3.52	3.40	0.06	ns
Phenylalanine	3.18	3.08	0.09	ns
Histidine	3.11	3.01	0.13	ns
Tyrosine	2.94	2.90	0.06	ns
Cystine	2.34	2.51	0.07	ns
Methionine	1.75	1.79	0.06	ns
Non-essential				
Glutamine	12.12	12.32	0.20	ns
Aspartic acid	6.86	6.68	0.17	ns
Arginine	5.39	5.24	0.09	ns
Alanine	4.68	4.56	0.07	ns
Glycine	4.21	3.86	0.21	ns
Serine	3.29	3.16	0.06	ns
Proline	2.53	2.57	0.08	ns
EAA	30.64	30.16	0.14	ns
EAA/TAA	49.55	49.60	0.38	ns
TAA	77.46	76.15	0.15	ns

EAA = essential amino acid; TAA = total amino acid; EAA/TAA = the ratio of EAA to TAA.

¹The percentage of amino acid to dry matter and *L. dorsi* at 10th rib. ns ($P > 0.05$).

7.5% to 7.6% for leucine. In this study, the lowest content among the EAAs was measured in methionine, whereas Okrouhlá *et al.* (2006) reported that phenylalanine showed the lowest content among the EAAs. Okrouhlá *et al.* (2008) indicated that the amino acids composition was affected by lean meat proportion. On the basis of the comparison of the total chemical composition in the dependence on the lean meat proportion in the carcass, the best appears to be the muscle with 54.9% to 60.0% lean meat proportion and more.

Conclusions

Above all, the Dahe pigs had good meat quality but poor growth performance and carcass composition. The Dawu pigs not only retained good meat quality characteristics of the Dahe pigs but also growth performance and carcass composition were greatly improved. C18:1, C16:0, C18:0 and C18:2 were the main FAs in the *L. dorsi* in the two breeds. Nine EAAs from the *L. dorsi* were found in the two breeds and they had higher EAAs percentages. These results indicated that the two breeds could be used in commercial pig production in China to provide high taste quality niche products.

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