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A COMPARISON OF MEAT QUALITY BETWEEN F1 AND F2 PIGS CROSSED BY VIETNAMESE NATIVE WILD BOAR AND LOCAL PIGS

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ABSTRACT

The hybrid wild boar has the advantages of both wild boar and domestic pig, including strong disease resistance, simplicity in captivity, low fat content meat while retaining tenderness and sweetness. This study assesses the meat quality from 8-month-old Vietnamese hybrid wild boars of the F1 and F2 generations. The research subjects are hybrids crossbreeding between the Vietnamese native wild boar with Mong Cai (WM pig) and local pigs in Dak Nong province (WDP pig). Evaluation criteria include carcass performance, pH, and sensory evaluation. The results showed that the hanging carcass ratio and carcass length in F2 hybrid wild boars were slightly higher than that in the F1 generation. Carcass yield in both F1 and F2 generations did not have a significant difference; however, the WM pigs showed a marginally higher carcass yield than the WDP pigs. Changes in pH were not significantly different between groups. WM pigs and WDP pigs exhibited a similarity in backfat thickness. Back skin thickness in group F2 was slightly elevated than F1. Sensory evaluations show that, although there is no difference in taste, F2 generation wild boar meat was gently juicier and more tender than F1 generation. These results indicate that the meat quality of the F2 pigs has not significantly altered from the F1 generation; in fact, several parameters, such as tenderness and juiciness, have slightly improved. This suggests that the F2 generation has maintained the same pork quality as the F1 generation.

Keywords: Carcass performance, hybrid pig, meat quality, sensory evaluation, Vietnamese native wild boards.

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INTRODUCTION

Systems for carcass grading are used to assess the eating quality and yield of marketable meat (Delgado-Pando et al., 2021). The marketing of retail muscle cuts is becoming more popular in the meat industries of developing countries, with the intention to increase the value of retail meat cuts. The important factors influencing carcass value are meat distribution and yield. The sensory assessment of pork involves the use of either consumer-trained sensory evaluation to ascertain consumer acceptability or the employment of trained sensory panels to grade variations in eating quality (O'Sullivan et al., 2003; Ruiz-Capillas et al., 2021; Liu et al., 2024). One of the methods to create pig breeds with high meat quality is crossbreeding (Johnson, 1981; Kadirvel et al., 2023). Crossbreeding produces heterosis, which indicates that an animal's genetic level is higher than the average of its parents (Ritchie et al., 1999; Labroo et al., 2021). This makes hybrid breeding extraordinarily advantageous.

In Vietnam, the production and consumption of hybrid pigs between wild boar and local pig breeds has begun to receive recent attention (Nguyen Ngoc Phuc et al., 2010; Ha Xuan Bo et al., 2021). However, the assessment of meat quality of cross-bred products has not been well described, especially the meat yield values or sensory assessments of meat quality. In this study, the F1 and F2 hybrid pigs were applied for meat analysis. The F1 pigs were hybridized offspring of a cross between a male Vietnamese native wild boar and a female Mong Cai pig (WM-F1 pig), or a local female pig in Dak Nong province (WDP-F1 pig). The F2 backcrossed pigs were the offspring of a cross between a male Vietnamese native wild boar and a female WM-F1 pig (WM-F2 pig) or a female WDP-F1 pig (WDP-F2 pig). Meat quality was assessed by using quality indicators, including carcass quality, sensory values, and pH value during preservation.

MATERIALS AND METHODS

Sample preparation

In a commercial slaughterhouse, 8-month-old pigs were slaughtered under standard operating procedures. Pigs were stunned with a captive-bolt stunner before they were slaughtered, and the carcass was not electrically stimulated. A total of 3 carcasses from each group were used for the evaluation of carcass performance and subjective classification. The samples were placed on gratings made of stainless steel and maintained at 4 degrees Celsius in the dark with a humidity of 85%. The samples were aged in a period that lasted 7 days, and sampling was performed on day 0 h, 24 h, 48 h, 72 h, and 7 d. 15 cm-thick samples were vacuum-packed and aseptically removed, and within an hour, they were moved in an ice box to the laboratory for examination.

Carcass performance

The hanging carcass ratio was calculated by hanging carcass weight/live weight × 100. The carcass yield parameter was calculated as the dressing % ([dressed carcass weight/live weight] × 100). The carcass length was measured by a line from the forward edge of the first rib to the forward edge of the aitch bone. The back skin thickness and back fat thickness were measured by a digital caliper (Mitutoyo, Japan).

pH analysis

A sample (5 g) was mixed with 45 mL of distilled water and homogenized for 60 seconds at 10,000 rpm. Technical buffer solutions with pH values of 4.0 for acidic and 7.0 for neutral were used to calibrate a pH meter, Orion 420 plus (Thermo Fisher Scientific, USA). The meat pH was measured and recorded.

Sensory evaluation

Using a seven-point hedonic scale, 10 customers participated in the sensory evaluation to assess the juiciness, flavor, and tenderness of the boiled pork samples, with scores ranging from 1 (very unsatisfactory) to 7 (very acceptable). The steak was sliced into

2 cm thick and boiled at 100℃ for 30 min. Before being served, the steak was chopped into 2 x 1 cm (length × width) after resting for five minutes on aluminum foil.

Statistical analysis

The data were analyzed for statistical significance by one-way ANOVA, where $p < 0.05$ was considered statistically significant.

RESULTS

The hanging carcass ratios for WM-F1 and WDP-F1 pigs were 74.0 ± 0.4% and 73.5 ± 0.2%, respectively (Fig. 1A). In comparison, WM-F2 and WDP-F2 pigs exhibited slightly higher values, at 75.5 ± 0.2% and 74.5 ± 0.3%. This result showed that F2 pigs exhibited a small increase in hanging carcass ratio, compared to F1 pigs. The subjective classification indicators measurements were also performed to determine the carcass length and carcass yield in these pigs. As seen in Figure 1B, the carcass length of the WM-F1 pig (83.0 ± 0.5 cm) was lower than WM-F2 pig (87.5 ± 0.9 cm). Moreover, the carcass length of the WDP-F1 pig (80.5 ± 0.7 cm) was lower than WDP-F2 pig (84.8 ± 0.6 cm). This result demonstrated an increase in carcass length in F2 pigs after backcrossing. Figure 1C showed that carcass yield in WM-F1 pig and WM-F2 pig were higher than WDP-F1 pig and WDP-F2 pig (64.7 ± 0.6% and 65.7 ± 1.0% compared to 63.1 ± 0.3% and 63.9 ± 0.5%). There was no difference in carcass yield between the F1 pig and F2 pig in each boar–pig hybridization group.

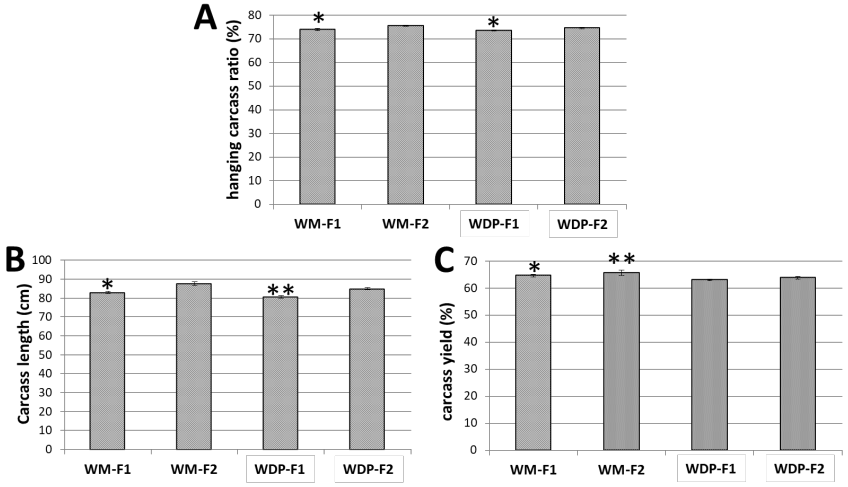

Figure 1. Hanging carcass performance and subjective classification indicators measurements. A, B, C: Hanging carcass ratio, carcass length, and carcass yield. ** indicates significant difference at $P \leq 0.01$; * indicates significant difference at $P \leq 0.05$

As shown in Figure 2A, the WM-F2 pig and WDP-F2 pig exposed a higher back skin performance than the WM-F1 pig and WDP-F1 pig (10.4 ± 0.6 cm and 10.2 ± 0.5 cm vs. 8.8 ± 0.4 cm and 9.3 ± 0.4 cm, respectively). The back skin thickness of the WDP-F1 pig was higher than WM-F1 pig. However, the WM-F2 pig and WDP-F2 pig showed a similarity in this parameter after backcrossing. There was no difference in back fat thickness in all groups in this study Figure 2B.

In this study, we also assessed the pH value changes in the carcass during preservation (Fig. 3). Pigs in all experimental groups showed pH values greater than 6.0 at 0 h. The pH value decreased to below 6.0 during preservation from 24 hours to 72 hours. After 7 d of preservation, the pH value of the carcass from the experimental groups recovered to be the same as at 0 h.

The juiciness values of the WM-F1 pigs and WDP-F1 pigs were 4.2 ± 0.3 and 4.2 ±

0.3, respectively (Fig. 4A). A higher juiciness value was found in WM-F2 pigs and WDP-F2 pigs compared to F1 pigs (4.9 ± 0.2 and 4.8 ± 0.3). This result showed that F2 pigs exhibited an increase in juiciness performance, compared to F1 pigs. As seen in Figure 4B, there was no difference in flavor value between F1 pig and F2 pig in each boar–pig hybridization group. Figure 4C showed that the tenderness value of WM-F2 pig and WDP-F2 pig were higher than WM-F1 pig and WDP-F1 pig (4.5 ± 0.3 and 4.9 ± 0.2 vs. 4.2 ± 0.3 and 4.3 ± 0.3, respectively). This result indicated that an increase in tenderness value was raised in F2 backcrossed pigs.

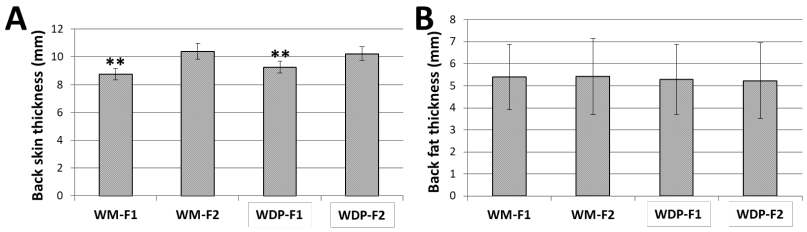

Figure 2. Back skin and back fat performance. A, B: back skin thickness and back fat thickness. ** indicates a significant difference at $P \leq 0.01$

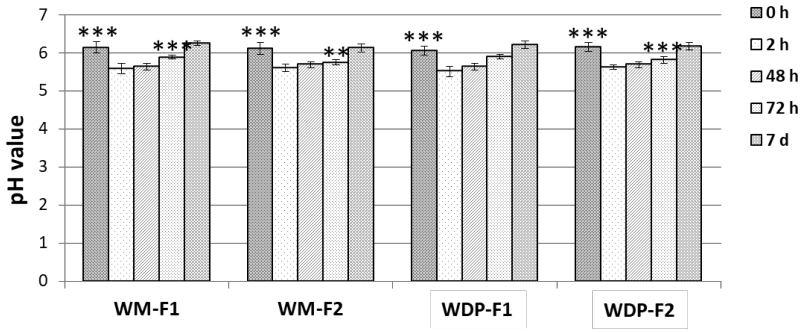

Figure 3. pH value performance. *** indicates significant difference at $P \leq 0.001$; ** indicates significant difference at $P \leq 0.01$

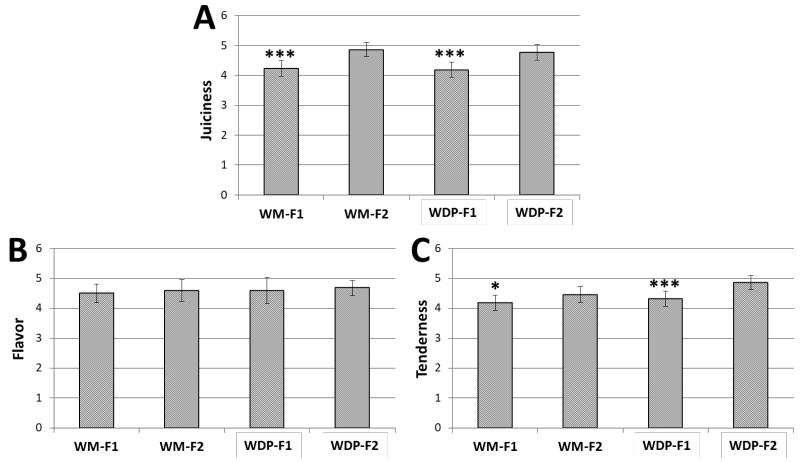

Figure 4. Consumer acceptance score of pork from different groups. *** indicates significant difference at $P \leq 0.001$; * indicates significant difference at $P \leq 0.05$

DISCUSSION

Meat quality has been more important to consumers and the public in recent years. People are becoming more conscious of the connection between nutrition and health, which is reflected in their desire for more information and for products that are consistently high-quality and healthy (Geletu et al., 2021). A group of characteristics that collectively characterize what we value in meat when we buy, consume, or choose it as a source material to be processed into meat products is known as meat quality (Scollan et al., 2006). It is axiomatic that definitions of meat quality can evolve along with societal shifts in our individual and collective preferences and appreciations.

Carcass performance is an important characteristic of meat quality assessment (Choi et al., 2019; Kress et al., 2020). The performance of hanging carcass traits such as hanging carcass ratio, carcass length, and carcass yield in pigs has been extensively studied, with recent research pointing to a complex interaction between these factors and various genetic and environmental influences. The hanging carcass ratio, which measures the percentage of the pig's weight that remains after slaughter (excluding inedible parts), is often used as an indicator of overall carcass quality (Spangler, 2024). A higher hanging carcass ratio is generally associated with leaner pigs, and breeding programs focus on selecting pigs with favorable traits that improve this ratio. Studies suggest that the carcass yield-the proportion of sellable meat-directly correlates with the carcass ratio and fat thickness (Stewart et al., 2024; Soares et al., 2022). Additionally, carcass length is often included as a measure of muscling and body composition, although its utility in predicting carcass value has been debated. Some studies report a positive correlation between carcass length and lean meat yield, while others find this correlation to be relatively low, suggesting other factors like muscle depth or fat distribution might play a more significant role (Wei et al., 2024; Li et al., 2021). Carcass yield is also a key economic measure for producers, as it directly impacts the marketability of pork products (Hoa et al., 2023). Genetic selection, feed composition, and management practices are continually adjusted to optimize these traits. The relationship between these carcass traits is integral to improving pig production efficiency and meat quality, with ongoing research focusing on refining selection methods to enhance these desirable characteristics. The present work found that the hanging carcass ratio of pigs in all groups ranged from 74% to 75.5% which was higher than F1 pig crossbred by Thailand wild boar and Khua pig (Nguyen Ngoc Phuc et al., 2010). However, the hanging carcass ratio of F1 and F2 pigs in this study were lower than F1 pig crossbred between wild boar and Meishan pig (origin of China) (Ha Xuan Bo et al., 2021). Moreover, the carcass yield and the back fat thickness of F1 and F2 pigs in this study were higher than F1 pigs Ha Xuan Bo and his colleagues. This result showed that depending on the origin of the wild boar as well as the origin of the local pig, crossbred pigs will have different carcass performance.

pH value affects meat quality, such as color, water holding capacity and preservation (Jeleníková et al., 2008; Knox et al., 2008; Hernández-García et al., 2022). Therefore, pH value is widely used as an indicator to evaluate meat quality. In addition, the pH value also affects the tenderness of meat. A high-quality meat product has a pH value between 5.5 and 6.2. In this study, we found that the pH value of meat in all groups markedly decreased at 24 hours of preservation. This value gradually increased with preservation time and reached its highest on day 7. Most of the pH values of the experimental groups were between 5.5 and 6.2 during preservation. This result showed that the quality of meat during preservation still met the pH value requirements of good meat quality. However, the pH value of the WM-F1 and WDP-F1 groups on this 7th day of storage was as high as 6.2. This shows that the stability of maintaining the pH value of meat in these 2 groups at 7 days began to decrease.

There are many factors involved in meat quality, including appearance, flavor, tenderness, and texture, which contribute to the eating quality of meat (Frank et al. 2016; Bergamaschi et al., 2023). The present study found that the pork of all groups had similar flavor values. This suggested that pigs from different crossbreeding groups exhibited stability in this value. Interestingly, the F2 hybrid pigs had higher juiciness values than the F1 hybrid pigs. The increase in juiciness value also correlated with the increase in tenderness value of F2 crossbred pigs compared with F1 crossbred pigs. This result revealed that backcrossing has improved two values related to market quality, concluding juiciness and tenderness values.

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