

COMPARISON OF INTRAMUSCULAR FAT AND COLLAGEN CONTENT BETWEEN DUROC PUREBRED AND CROSSBRED PIGS

W. Kheawrod^{1,*} and C. Chaosap¹

¹ Agricultural Education Department, Faculty of Industrial Education, King Mongkut's Institute of Technology Ladkrabang, Bangkok, 10520, Thailand

*Corresponding author email: wanwipakheawrod@gmail.com

Abstract – The objectives of this study were to compare intramuscular fat content, collagen content, and shear force value in Duroc purebred and crossbred pigs. The animals used were from 3 groups of Duroc (D), D × [Large White × Landrace] (DLWLR), and Large white × Land race (LWLR), with 5 barrows and 5 gilts in each group. All pigs were reared under the same housing and feeding condition for 6 months prior to slaughter at 110±5 kg live weight. After slaughtering, *Longissimus dorsi* (LD) muscle was taken to determine fat content, collagen content, and shear force value. Results showed that the percentage of intramuscular fat from D and DLWLR were higher than from LWLR (P<0.05). For collagen content, soluble collagen, and % collagen solubility were not significant difference between three groups of pigs. While insoluble collagen and total collagen of D and DLWLR were higher than from LWLR (P<0.05). Shear force value at both 1 day and 5 day after slaughtering of LD muscle from D was lower than from DLWLR and LWLR (P<0.05).

Key Words – Duroc purebred pig, Crossbred Pig, Intramuscular fat, Collagen

I. INTRODUCTION

The quality of meat depends on the characteristics of the meat such as color, flavor, and tenderness. Tenderness is one of the most important attribute of meat quality perceived by the consumers. The variation of meat tenderness depends on species, breeds, muscle types, nutrient composition as well as the amount of connective tissue. Breed is one of the most important factors affecting meat quality. Pork producers widely use crossbreeding to gain the effect of heterosis, that lead to better performances in the crossbred population compared to parental purebred populations [5]. Pure breeds for crossbreeding systems are selected for their ability to add some traits to the final crossbred market pig. Fertility, milking

ability, and litter size are inherited through the maternal line, while meat productivity and meat quality are inherited through the paternal line [13, 14]. A white breed such as Large white (LW) or Landrace (LR) is usually included in the crossbreeding system for its maternal traits. A colored breed such as Duroc (D) or Hampshire is normally included for its paternal traits such as growth rate, feed efficiency, or carcass characteristics. It has been demonstrated that intensive selection for increased leanness is associated with decreased pork quality [3]. Intramuscular fat (IMF) has been found to be positively correlated with flavor, tenderness, and acceptability [2]. The study of [7] proposed that a minimum threshold of IMF for acceptable eating quality in fresh pork was 1.5%, while [6] suggested that levels of 2 to 3% IMF were required to ensure desirable eating quality. Presently, IMF levels in the majority of modern commercial breeds are typically less than 1.5% [8, 9] due to the intensive selection for lean growth. It is generally known that shear force is an important index for evaluating the tenderness of pork. As reported by [11], shear force (meat tenderness) decreases with increasing intramuscular fat content. Connective tissue, especially collagen content in meat is one of a major factor that impact on meat tenderness. The study of [18] showed a negative correlation values between collagen content and tenderness measurements (either sensory panel or instrumental) in pork. Three way crossbred pigs (D x [LW x LR]) are mainly utilized for production of commercial pork and have more great production efficiency than pure or two-way crossbreds [15]. Duroc pigs are considered to have high eating quality, due to their high intramuscular fat content. Therefore, the Duroc breed is used as a terminal sire when commercial pigs are produced. Also, this breed

has used for fattening commercial pigs [17]. The present study attempts to investigate the influence of Duroc purebred on intramuscular fat and collagen content as well as shear force value when used as terminal sires with two-way crossbreds (LWLR) as dam line.

II. MATERIALS AND METHODS

Animals and Samples collection

Three groups of pigs were used in this study, Duroc purebred (D), three-way crossbred (D x [LW x LR] ; DLWLR) and two-way crossbred Large white x Landrace (LWLR). Thirty pigs were randomly distributed into 3 treatments, with 5 barrows and 5 gilts in each group. All pigs were reared for 6 months prior to slaughter under the same housing and feeding condition in contract farming in Lopburi province, Thailand. At 110 ± 5 kg. live weight, they were transported to a commercial slaughter house in Lopburi province. After 2 h resting, they were electrically stunned before exsanguination. After slaughtering, carcasses were then chilled immediately and held at 2 - 4 °C for 24 h before taking the *Longissimus dorsi* (LD) muscles for analyzing fat and collagen content. Two pieces of LD muscle were cut for measuring shear force value at 1 and 5 day postmortem which kept in vacuum bag then stored at -20 °C until shear force value analysis.

Samples analysis

LD muscle samples were used to determine intramuscular fat [1], collagen content [10], and shear force value [4].

Statistical analysis

Statistical analysis was performed using SPSS statistics 19.0 (SPSS Inc., 2010). Data were analyzed by the analysis of variance (ANOVA) to test for the effects of breed with sex as blocking effect. A Duncan's multiple range test procedure was used to determine significant differences among means at a 5% level of significance.

III. RESULTS AND DISCUSSION

The results of this study were summarized in Table 1. The intramuscular fat percentage of

Duroc purebred (D) (2.07%) and crossbred (DLWLR) (1.86%) was higher than from LWLR (0.93%) ($P < 0.05$). For collagen content, soluble collagen and % solubility were not significant difference between three groups while D and DLWLR had higher level of insoluble and total collagen content than in LWLR ($P < 0.05$). Duroc purebred had lower shear force value than DLWLR and LWLR at both 1 day and 5 day postmortem ($P < 0.05$).

Duroc purebred had the highest content of intramuscular fat. However, it was not significantly different with Duroc crossbred (DLWLR). While LWLR showed the lowest content of intramuscular fat. In agreement with [12] that reported Duroc purebred had higher fat content than crossbred. In this study, Duroc purebred and crossbred had higher level of insoluble and total collagen than LWLR ($p < 0.05$). However, only Duroc purebred that had lower shear force value than LWLR ($p < 0.05$). While shear force value of DLWLR and LWLR was not significant difference ($p > 0.05$). Normally, muscle that contain higher level of connective tissue, as was the case in D and DLWLR compared to LWLR, are less tender. As [18] reported a negative correlation values between collagen content and tenderness measurements (either sensory panel or instrumental) in pork. Inverse relationships were found in the present study in which the muscles of Duroc purebred pigs, which exhibited a greater proportion of collagen content, were characterized by lower shear force values compared to the muscles of LWLR pigs. These differences are probably related to the organization of collagen fibres in the connective tissue stroma, as indicated by [16], who demonstrated that meat tenderness is determined not only by collagen levels but also by the size and organization of collagen fibres that form the connective tissue stroma of the muscles. Intramuscular fat which deposits mainly in intramuscular connective tissue, makes it looser, thus affecting the tenderness of meat [16, 19].

IV. CONCLUSION

Duroc breed was desirable in the meat quality characteristics compared to LWLR, because intramuscular fat and collagen content of Duroc

purebred (D) and three-way crossbred (DLWLR) were higher than two-way crossbred (LWLR). That means Duroc pig could transfer intramuscular fat and collagen content traits. This information can be useful in bringing Duroc pig in the selection and breeding for the improvement of pork quality to supply consumer demand.

Table 1. Intramuscular fat, collagen content and shear force value of Duroc purebred and crossbred pigs

Traits	D	DLWLR	LWLR	P-value
Intramuscular fat (%)	2.07 ^a	1.86 ^a	0.93 ^b	0.012
Collagen content (mg/g)				
Soluble	0.32	0.29	0.25	0.158
Insoluble	2.29 ^a	2.23 ^a	1.68 ^b	0.025
Total	2.62 ^a	2.52 ^a	1.93 ^b	0.021
Collagen Solubility (%)	12.75	11.60	11.69	0.423
Shear force (kg)				
1 day	4.56 ^b	5.48 ^a	5.89 ^a	0.005
5 day	4.48 ^b	5.29 ^a	5.56 ^a	0.030

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