

# Role of lipogenic enzyme expression in breed-specific fatty acid composition in pigs

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## Introduction

Intramuscular fat, also called marbling fat (Fig. 1) is a key characteristic of the nutritional value of meat and is positively related to meat juiciness, tenderness and flavour.

Selective breeding has dramatically reduced not only undesirable subcutaneous fat but also desirable intramuscular fat.

Pig breeds with similar subcutaneous fat content largely differ in intramuscular fat content. This suggests that the mechanisms regulating fat partitioning are breed-specific.

Our previous work has shown that the lipogenic enzyme stearoyl-CoA desaturase (SCD) plays a key role in intramuscular fat formation in commercial pig breeds. The role of SCD in subcutaneous fat formation remains unknown. The role of other key lipogenic enzymes,  $\Delta 6$ -desaturase (D6D) and fatty acid synthase (FAS) in fat partitioning also remains unclear.

Understanding the molecular mechanisms of fat partitioning in pigs and identification of physiological candidate genes for high intramuscular and low subcutaneous fat would contribute to selective breeding toward genotypes with improved nutritional value.

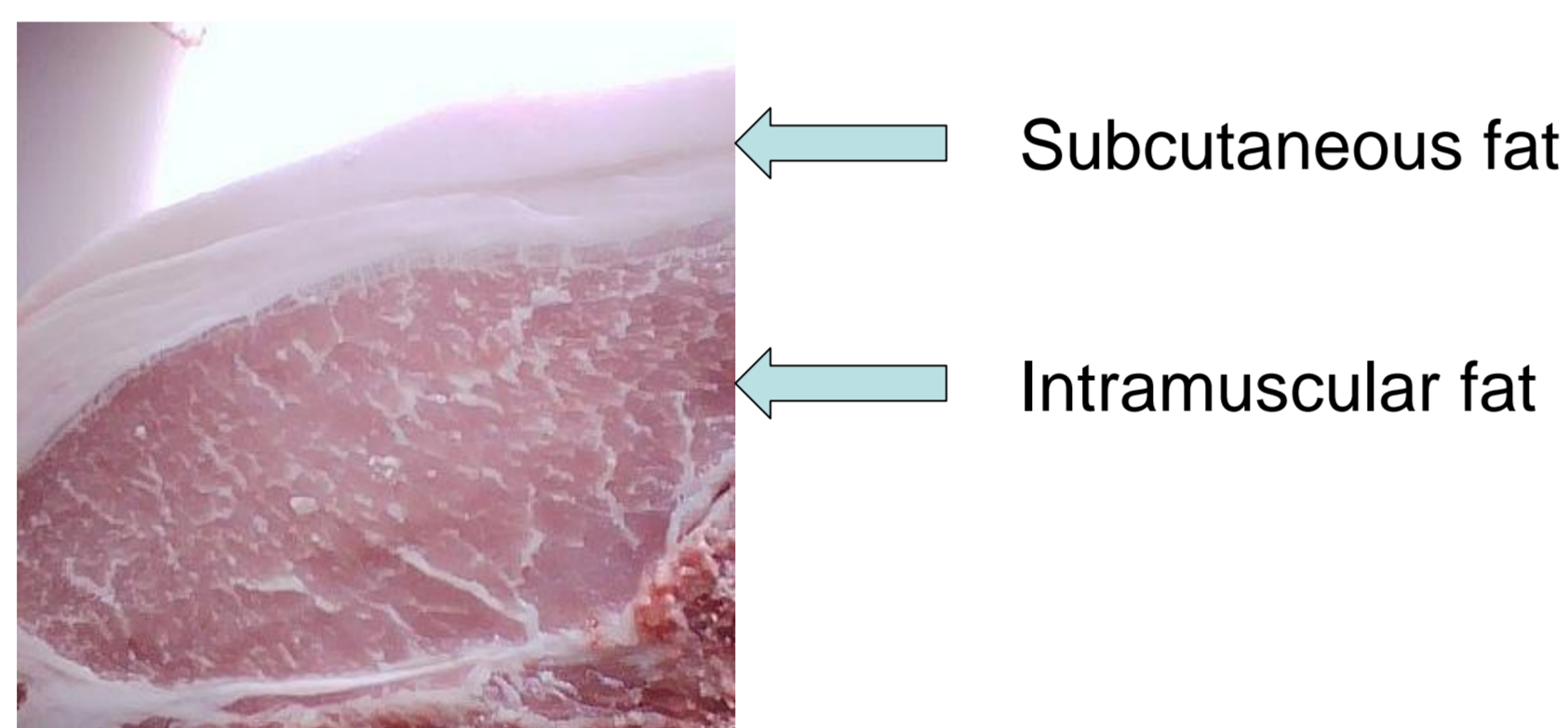


Fig. 1 Pork loin cross-section showing subcutaneous and intramuscular fat depots.

## Objective

To investigate the role of key lipogenic enzymes stearoyl-CoA desaturase (SCD), delta-6-desaturase (D6D) and fatty acid synthase (FAS) in subcutaneous fat formation in genetically diverse pig breeds.

## Methods

Entire male pigs from 3 different genetic lines were used in this experiment (12 animals per genetic line). In each line the maternal line was Large white x Landrace. The paternal lines were as follows:

- (i) Large White X Piétrain
- (ii) Piétrain
- (iii) Duroc X Piétrain

Samples of subcutaneous fat from the dorsal region at the last rib were taken 5 min after slaughter, frozen in liquid N<sub>2</sub> and stored at -80°C.

D6D and SCD protein expression was analysed by Western blotting of the microsomal fraction isolated from subcutaneous fat. FAS protein expression was analysed by Western blotting of the cytosolic fraction.

Fatty acid composition of subcutaneous fat was determined by high resolution gas chromatography.

## Conclusions

- Results of this study support the hypothesis of breed-specific mechanisms regulating fat partitioning in pigs.
- Saturated fatty acid content in the Large White x Piétrain breed (but not in other breeds) is correlated to enhanced expression of fatty acid synthase protein in subcutaneous adipose tissue
- Between-breed differences in monounsaturated and polyunsaturated fatty acid content cannot be explained by variations in expression of enzymes catalysing the formation of these fatty acids, namely SCD and D6D. However, this does not exclude the existence of breed-specific SCD and D6D DNA polymorphisms affecting the enzyme's activity and as result, influencing fatty acid composition.
- Experiments on detection of breed specific SCD and D6D polymorphisms are in progress.

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## Results

1. Immunoreactive bands for SCD, D6D and FAS proteins were observed in subcutaneous adipose tissue of all three pig breeds studied (Fig 2).
2. The following between-breed differences were observed:
  - (i) FAS protein expression was significantly higher in the Large White x Piétrain breed compared with Duroc x Piétrain (Fig. 3) and was positively correlated to the product of the FAS-catalysed reaction, saturated fatty acids (SFA) (results not shown).
  - (ii) D6D protein expression was significantly higher in Large White x Piétrain animals compared to the other two breeds.
  - (iii) No breed differences were observed in SCD protein expression.
  - (iv) D6D and SCD expression did not correlate with the level of polyunsaturated (PUFA) and monounsaturated fatty acids (MUFA) which are the products of D6D and SCD catalysed reactions respectively (results not shown).

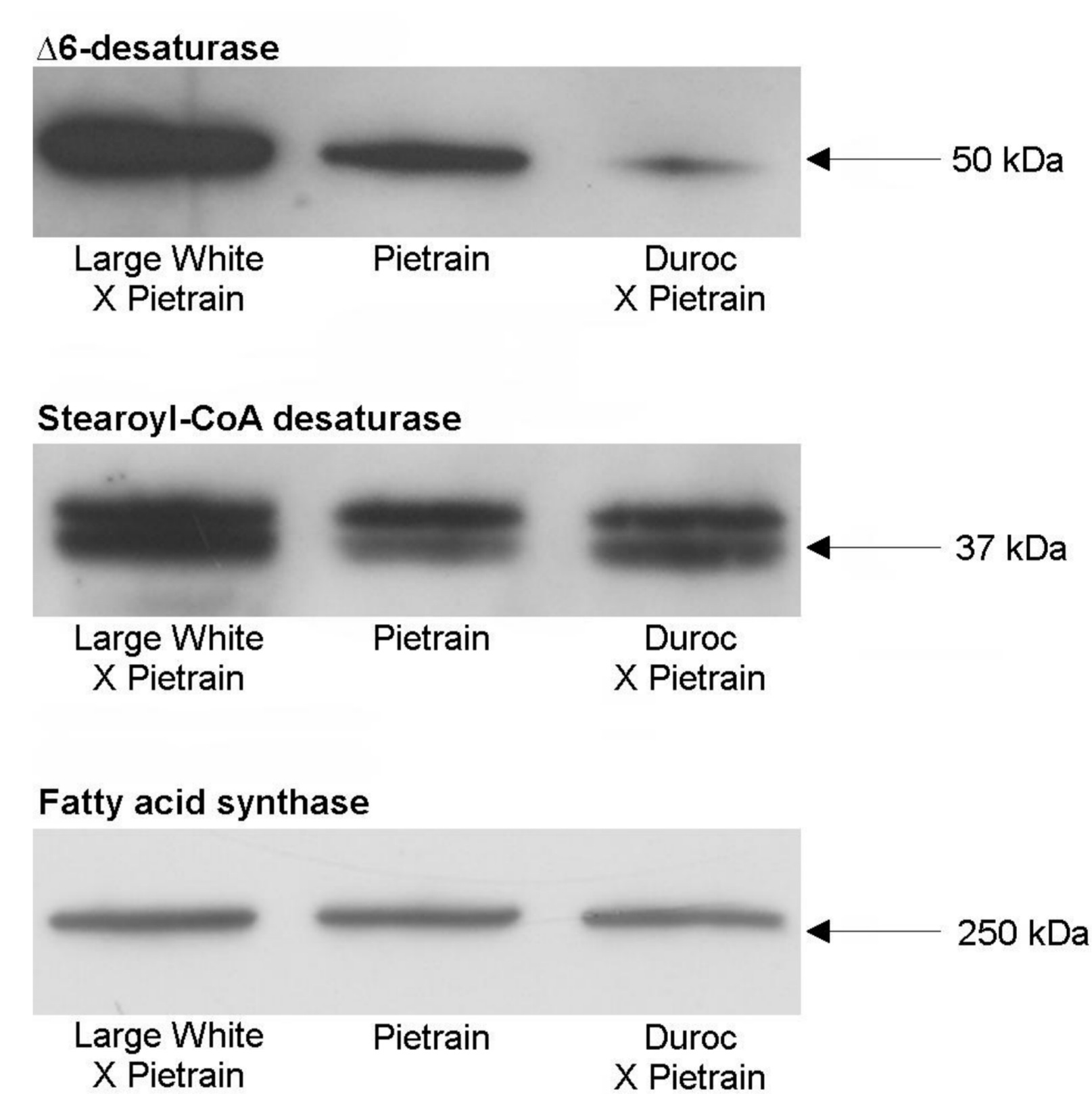


Fig. 2 Representative blots of  $\Delta 6$ -desaturase, stearoyl-CoA desaturase and fatty acid synthase protein expression in subcutaneous adipose tissue of Large White x Piétrain, Piétrain, and Duroc x Piétrain pigs. Each signal represents an individual animal.

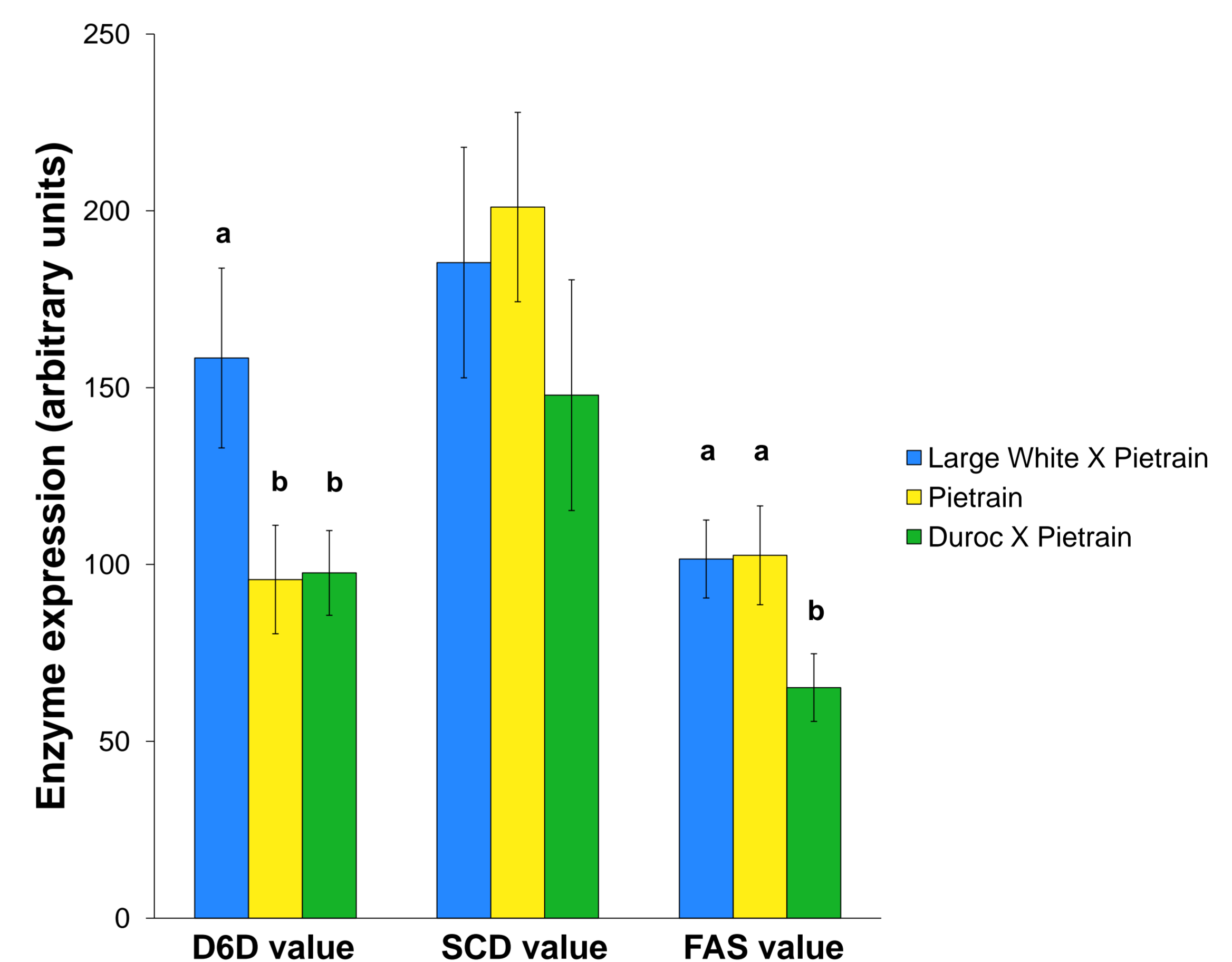


Fig. 3 Expression of delta-6 desaturase (D6D), stearoyl-CoA desaturase (SCD) and fatty acid synthase (FAS) proteins in subcutaneous adipose tissue of Large White x Piétrain (LW), Piétrain (P) and Duroc x Piétrain (D) pig breeds. The microsomal fraction was analysed in the case of delta-6 desaturase and stearoyl-CoA desaturase, the cytosolic fraction was analysed in the case of fatty acid synthase. Values are means of 12 animals. Error bars indicate standard error of mean (SEM). Bars with different superscripts differ significantly for a given protein ( $P < 0.05$ ).