

# Effects of supplementing low-protein diets with palm oil on amino acid deposition, lipid metabolism, and muscle fiber type in growing-finishing pigs

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## Introduction

Reducing the protein content of pig diets to enhance cost-efficiency and improve the environment caused by increased breeding scale is particularly important. Although there are many advantages to using a low-protein diet, it may also damage pigs' growth performance and meat quality. One of the world's most widely used vegetable oils, palm oil (PO), presents a promising solution.

PO has a relatively balanced fatty acid composition, and saturated and non-saturated fatty acids are almost equal, positively influencing fatty acid transformation and distribution. PO can make piglets grow and absorb nutrients better, and it is an ideal source of energy and nutrition. This experiment aims to provide valuable data to support pig production and promote the wider application of low protein diets while investigating the effects of PO supplementation on the performance and muscle quality of growing-finishing pigs.

## Methods and Materials

➤ Sixty crossbred castrated male pigs with an average body weight of  $67 \pm 0.9$  kg were randomly assigned to three treatment groups over a 58 day period, including a normal protein level (CON) diet, low-protein diet (LP, with 2% lower protein level compared to the CON diet), and LP diet supplemented with an additional 2% PO (LPO).

## Results and Discussion

➤ Pigs fed the LP diet had lower pH values of the longissimus dorsi (LD) muscle at 45 min post-mortem, lower  $a^*$  values at 24 h post-mortem, lower colour score by NPPC, and reduced amino acid contents in the LD muscle compared to the CON group and a higher proportion of fast muscle fibers ( $P < 0.05$ ). Compared to the LP group, the LPO diet increased the  $a^*$  values of LD muscle at 24 h post-mortem and decreased the  $L^*$  values at both 45 min and 24 h post-mortem ( $P < 0.05$ ). The LPO diet significantly increased the amino acid (including Arg, Ser, Asp, Glu, and Lys) contents ( $P < 0.05$ ). The LPO diet also increased intramuscular fat deposition, the relative expression level of fatty acid binding protein 4 and acetyl-CoA carboxylase mRNA and the proportion of slow muscle; and reduced muscle diameter compared to the LP group ( $P < 0.05$ ).

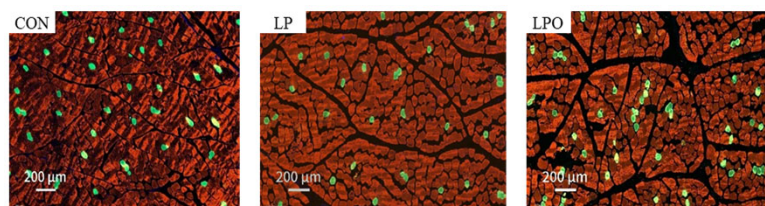


Fig. 1 Immunofluorescence staining results of fast and slow muscle in longissimus dorsi muscle. Red fluorescence represents fast muscle fibers; Green fluorescence represent slow muscle fibers

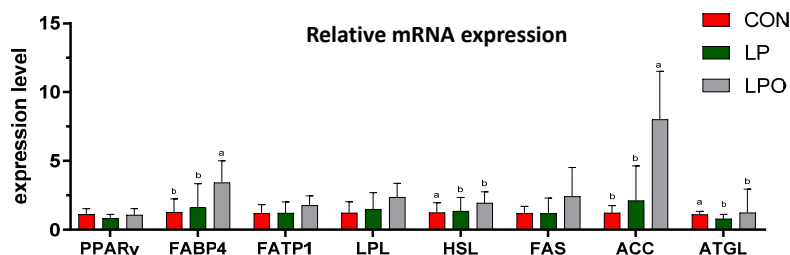


Fig. 2 Effects of low-protein diets supplemented with palm oil on relative mRNA expression levels of lipid metabolism related genes in longissimus dorsi muscle

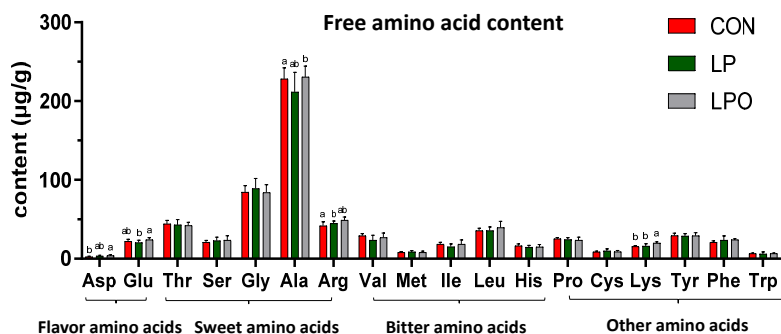


Fig. 3 Effects of low-protein diets supplemented with palm oil on free amino acid composition of longissimus dorsi muscle of pigs (fresh sample)

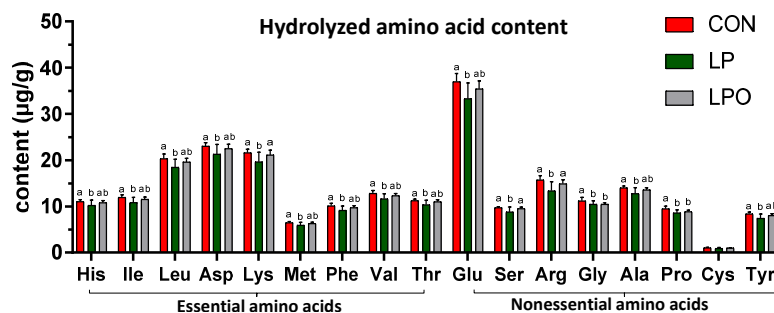


Fig. 4 Effects of low-protein diets supplemented with palm oil on hydrolyzed amino acid composition of longissimus dorsi muscle of the pigs (fresh sample)

Table 1 Effects of low-protein diets supplemented with palm oil on the pork quality of the pigs

Items	CON	LP	LPO	P-value
Color score by NPPC	3.84±0.13 <sup>a</sup>	3.30±0.15 <sup>b</sup>	3.70±0.14 <sup>ab</sup>	0.03
Marbling score	1.47±0.15	1.33±0.13	1.30±0.14	0.67
Water loss rate (%)	29.30±1.10	25.10±2.03	24.30±2.01	0.13
Drip loss (%)	3.29±0.39	3.00±0.30	3.20±0.43	0.85
Cooking loss (%)	36.90±0.88	38.70±0.80	37.00±0.82	0.20
Shear stress (%)	52.07±2.46	49.87±2.46	47.18±2.35	0.38

## Conclusions

In conclusion, supplementing low-protein diets with palm oil can increase the redness value  $a^*$  and decrease the brightness value  $L^*$  of the longissimus dorsi of finishing pigs, increase the muscle fiber density and the proportion of slow muscle fibers, increase the lipid and amino acid deposition, and finally improve the pork quality. Altogether, these findings suggest that supplementing low-protein diets with palm oil has the potential to enhance pork quality, making it a valuable strategy in pig production.