# Effects of Xylooligosaccharides on Plasma Biochemical Parameters and Muscle Fatty Acid Composition in Growing-Finishing Pigs: Postprint

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## Abstract

This experiment was conducted to investigate the effects of xylo-oligosaccharides (XOS) on plasma biochemical parameters and muscle fatty acid composition in growing-finishing pigs. A total of 110 Duroc × Landrace × Large White crossbred pigs at 70 days of age with an average body weight of approximately 30 kg were randomly allocated to 11 groups of 10 pigs each (half barrows and half gilts) and housed individually. The experimental treatments included: a control group (fed the basal diet throughout), an antibiotic group (fed the basal diet supplemented with 0.04 kg/t Suda Fei and 0.2 kg/t Kangdisu throughout), three XOS supplementation groups at 100, 250, and 500 g/t during the 30–65 kg stage (fed XOS-supplemented diets during the 30–65 kg stage and the basal diet during the 66–100 kg stage), three XOS supplementation groups at 100, 250, and 500 g/t during the 66–100 kg stage (fed the basal diet during the 30–65 kg stage and XOS-supplemented diets during the 66–100 kg stage), and three XOS supplementation groups at 100, 250, and 500 g/t during the 30–100 kg stage (fed XOS-supplemented diets throughout the entire experimental period). When the average body weight of the experimental pigs reached 100 kg (approximately 170 days of age), blood samples were collected from the anterior vena cava and plasma was separated by centrifugation for determination of biochemical parameters. After slaughter, samples of the longissimus dorsi and biceps femoris muscles were collected for fatty acid composition analysis. The results showed that: compared with the control group, during the 30–65 kg stage, dietary supplementation with 100 or 500 g/t XOS significantly decreased the heptadecanoic acid (C17:0) content in the biceps femoris muscle ($P<0.05$); during the 65–100 kg stage, dietary supplementation with 250 g/t XOS significantly increased the saturated fatty acids (SFA) + monounsaturated fatty acids (MUFA) content in

the biceps femoris muscle (P<0.05), and supplementation with 100 or 500 g/t XOS significantly increased the eicosenoic acid (C20:1) content in the biceps femoris muscle (P<0.05); during the 30–100 kg stage, dietary supplementation with 100 g/t XOS significantly increased the oleic acid/linoleic acid ratio in the longissimus dorsi muscle and the C20:1, MUFA, and SFA+MUFA contents in the biceps femoris muscle (P<0.05), supplementation with 100 or 250 g/t XOS significantly decreased plasma total cholesterol concentration (P<0.05), and supplementation with 500 g/t XOS significantly increased plasma high-density lipoprotein cholesterol concentration (P<0.05). In conclusion, dietary supplementation with appropriate doses of XOS can improve pork flavor and nutritional value by regulating plasma biochemical parameters related to lipid metabolism and increasing MUFA and SFA+MUFA contents in muscle, with supplementation of 100 g/t XOS during the 30–100 kg stage being optimal.

## Full Text

# Effects of Xylo-Oligosaccharide on Plasma Biochemical Parameters and Fatty Acid Composition of Muscle in Growing-Finishing Pigs

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### Abstract

This study investigated the effects of dietary xylo-oligosaccharide (XOS) supplementation on plasma biochemical parameters and muscle fatty acid composition in growing-finishing pigs. A total of 110 Duroc × Large White × Landrace pigs at 70 days of age (initial body weight ~30 kg) were randomly allocated to 11 groups with 10 pigs per group (male:female = 1:1) and fed individually. The experimental groups included: a control group (basal diet only), an antibiotic group (basal diet supplemented with 0.04 kg/t Stafac and 0.2 kg/t Acrasin), XOS supplementation groups receiving 100, 250, or 500 g/t XOS during the 30–65 kg stage (with basal diet during the 66–100 kg stage), XOS supplementation groups receiving 100, 250, or 500 g/t XOS during the 66–100 kg stage (with basal diet during the 30–65 kg stage), and XOS supplementation groups receiving 100, 250, or 500 g/t XOS throughout the entire 30–100 kg stage. When the average body weight reached approximately 100 kg (around 170 days of age), blood samples were collected via precaval vein and plasma was obtained by

centrifugation for biochemical analysis. Samples of longissimus dorsi (LD) and biceps femoris (BF) muscles were collected for fatty acid composition analysis.

The results showed that, compared with the control group: (1) during the 30–65 kg stage, supplementation with 100 or 500 g/t XOS significantly decreased the daturic acid (C17:0) content in BF muscle ($P < 0.05$); (2) during the 66–100 kg stage, supplementation with 250 g/t XOS significantly increased the sum of saturated fatty acids (SFA) and monounsaturated fatty acids (MUFA) in BF muscle ($P < 0.05$), while supplementation with 100 or 500 g/t XOS significantly increased the arachidic acid (C20:1) content in BF muscle ($P < 0.05$); (3) during the 30–100 kg stage, supplementation with 100 g/t XOS significantly increased the oleic acid to linoleic acid ratio (C18:1n9/C18:2n6c) in LD muscle ($P < 0.05$) as well as the C20:1, MUFA, and SFA+MUFA contents in BF muscle, supplementation with 100 or 250 g/t XOS significantly decreased plasma total cholesterol concentration ($P < 0.05$), and supplementation with 500 g/t XOS significantly increased plasma high-density lipoprotein cholesterol concentration ($P < 0.05$).

These findings suggest that dietary XOS supplementation can increase muscular MUFA and SFA+MUFA contents by regulating plasma biochemical parameters related to fat metabolism, thereby improving pork flavor and nutritional value. Supplementation with 100 g/t XOS during the 30–100 kg stage appears optimal for growing-finishing pigs.

**Keywords:** xylo-oligosaccharides; growing-finishing pigs; plasma biochemical parameters; muscle; fatty acids

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## 1. Materials and Methods

### 1.1 Experimental Animals and Design

The animal experiment was conducted from June to September 2015 at the experimental farm of the Institute of Subtropical Agriculture, Chinese Academy of Sciences. A total of 110 Duroc × Large White × Landrace crossbred pigs at 70 days of age, with an average initial body weight of approximately 30 kg, were randomly assigned to 11 dietary treatment groups with 10 pigs per group (equal numbers of barrows and gilts). Pigs were housed individually in pens measuring 0.6 m × 1.1 m and had ad libitum access to feed and water throughout the experiment.

The dietary treatments included: (1) control group (basal diet without additives); (2) antibiotic group (basal diet supplemented with 0.04 kg/t Stafac and 0.2 kg/t Acrasin); (3–5) XOS supplementation at 100, 250, or 500 g/t during the 30–65 kg stage (basal diet during the 66–100 kg stage); (6–8) XOS supplementation at 100, 250, or 500 g/t during the 66–100 kg stage (basal diet during

the 30–65 kg stage); and (9–11) XOS supplementation at 100, 250, or 500 g/t throughout the entire 30–100 kg stage. The basal diet was formulated according to NRC (2012) standards for growing-finishing pigs. The XOS product (XOS content $\geq$ 35%) was provided by Shandong Longli Biotechnology Co., Ltd.

### 1.2 Sample Collection

When the average body weight reached approximately 100 kg (around 170 days of age), blood samples (approximately 10 mL) were collected from each pig via the precaval vein into heparinized tubes. Plasma was separated by centrifugation at 3,000 r/min for 15 minutes and stored at -20°C until analysis. After blood collection, all pigs were humanely slaughtered, and samples of longissimus dorsi muscle (LD) and biceps femoris muscle (BF) were collected. Visible connective tissue and fat were removed, and the samples were stored at -20°C for subsequent fatty acid analysis.

### 1.3 Plasma Biochemical Parameters

Plasma concentrations of total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C) were determined using a Beckman CX4 automatic biochemical analyzer with commercial kits according to the manufacturer' s instructions.

### 1.4 Fatty Acid Composition Analysis

Fatty acid composition was analyzed according to the method described by Folch et al. (1957). Briefly, approximately 2 g of muscle sample was homogenized with 10 mL of chloroform:methanol (2:1, v/v) solution. The lipid extract was methylated with 0.4 mol/L KOH-methanol solution at 70°C for 15 minutes. Fatty acid methyl esters were extracted with 10 mL of n-hexane and analyzed by gas chromatography (Agilent 7890A) equipped with a flame ionization detector and a capillary column (30 m $\times$ 0.25 mm $\times$ 0.25 m). The injector and detector temperatures were maintained at 250°C and 280°C, respectively. The column temperature was programmed from 150°C (held for 2 minutes) to 240°C at a rate of 3°C/min (held for 10 minutes). Fatty acids were identified by comparing retention times with known standards and expressed as percentages of total fatty acids.

### 1.5 Statistical Analysis

All data were processed using Excel 2010 and analyzed using SAS 9.2 software. One-way ANOVA was performed to determine treatment effects, and differences among means were tested using LSD multiple comparison tests. Results are presented as means with standard errors. Statistical significance was declared at $P < 0.05$.

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## 2. Results

### 2.1 Effects of XOS on Plasma Biochemical Parameters

As shown in , compared with the control group, supplementation with 100 or 250 g/t XOS during the 30–100 kg stage significantly decreased plasma total cholesterol concentration ($P < 0.05$). Supplementation with 500 g/t XOS significantly increased plasma HDL-C concentration ($P < 0.05$). No significant effects were observed on plasma TG or LDL-C concentrations ($P > 0.05$).

### 2.2 Effects of XOS on Fatty Acid Composition of Biceps Femoris Muscle

The effects of XOS on fatty acid composition of BF muscle are presented in . During the 30–65 kg stage, supplementation with 100 or 500 g/t XOS significantly decreased the C17:0 content ($P < 0.05$). During the 66–100 kg stage, supplementation with 250 g/t XOS significantly increased the SFA+MUFA content ($P < 0.05$), while supplementation with 100 or 500 g/t XOS significantly increased the C20:1 content ($P < 0.05$). During the 30–100 kg stage, supplementation with 100 g/t XOS significantly increased the C20:1, MUFA, and SFA+MUFA contents ($P < 0.05$). Additionally, 100 g/t XOS supplementation during the 30–100 kg stage significantly increased the C18:1n9/C18:2n6c ratio in LD muscle ($P < 0.05$).

### 2.3 Effects of XOS on Fatty Acid Composition of Longissimus Dorsi Muscle

As shown in , XOS supplementation had limited effects on fatty acid composition of LD muscle. However, during the 30–100 kg stage, supplementation with 100 g/t XOS significantly increased the C18:1n9/C18:2n6c ratio ($P < 0.05$). Supplementation with 500 g/t XOS during the 30–100 kg stage also tended to affect this ratio ($P < 0.05$).

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## 3. Discussion

The present study demonstrated that dietary XOS supplementation can modulate plasma lipid parameters and muscle fatty acid composition in growing-finishing pigs. The significant reduction in plasma total cholesterol concentration with 100–250 g/t XOS supplementation is consistent with previous reports showing that non-digestible oligosaccharides can lower cholesterol levels by altering gut microbiota and bile acid metabolism [13, 14]. The increase in HDL-C concentration with 500 g/t XOS suggests a dose-dependent effect on lipid metabolism.

The observed changes in muscle fatty acid composition, particularly the increased MUFA and SFA+MUFA contents, are nutritionally significant. Mo-

nounsaturated fatty acids, especially oleic acid (C18:1n9), are associated with improved meat flavor and tenderness [18]. The increased C18:1n9/C18:2n6c ratio in LD muscle with 100 g/t XOS supplementation indicates an improved fatty acid profile that may enhance pork palatability. The reduction in C17:0 content during the 30–65 kg stage suggests that XOS may alter de novo fatty acid synthesis or desaturation processes during early growth phases.

The stage-specific effects observed in this study highlight the importance of supplementation timing. The 30–100 kg stage appears to be the most effective period for XOS supplementation to improve muscle fatty acid profile, possibly due to greater fat deposition rates during this phase. The lack of significant effects on PUFA content suggests that XOS primarily influences SFA and MUFA metabolism rather than essential fatty acid incorporation.

These findings align with previous research showing that prebiotics like XOS can modulate lipid metabolism through multiple mechanisms, including short-chain fatty acid production, regulation of lipogenic gene expression, and alteration of intestinal microbiota composition [1, 3, 6]. The optimal dose of 100 g/t XOS identified in this study provides practical guidance for pork producers seeking to improve meat quality through nutritional interventions.

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## 4. Conclusion

Dietary supplementation with xylo-oligosaccharides can effectively regulate plasma biochemical parameters related to fat metabolism and increase the contents of monounsaturated fatty acids and total saturated plus monounsaturated fatty acids in muscle tissue of growing-finishing pigs. These changes contribute to improved pork flavor and nutritional value. Based on the results, supplementation with 100 g/t XOS during the 30–100 kg growth stage is recommended as the optimal strategy for enhancing meat quality in finishing pigs.

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[9] Additional references cited in the original text but not fully listed in the corrupted section would be included here based on the complete manuscript.

*Note: Figure translations are in progress. See original paper for figures.*