Dietary D-xylose Levels Differentially Affect the Expression of Hepatic Genes Involved in Lipid and Glucose Metabolism in Broilers

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Outline

- Introduction
- Materials and Methods
- Results
- Summary and Conclusions

Introduction

- D-xylose has been evaluated as a source of energy in different animal species (Peng et al., 2004; Schutte et al., 1991; Longstaff et al., 1988).

- Chicks are unable to utilize D-xylose at high dietary levels (Wagh and Waibel, 1966).

- Reduced growth and feed conversion efficiency have been reported in male chicks fed D-xylose at 40% (Wagh and Waibel, 1967).

Introduction…

- Feeding 200 g D-xylose/kg of diet reduced ileal and fecal DM and OM, GE, and N digestibility in pigs (Schutte et al., 1991).

- High dietary D-xylose increases plasma total reducing sugars content and severely depletes liver and muscle glycogen (Peng et al., 2004).

- We examined the effects of dietary D-xylose levels on the expression of hepatic enzymes and transcription factors involved in glucose and lipid metabolism.

Hypothesis

Concentration of xylose in the diet affects the expression of hepatic enzymes and transcription factors involved in glucose and lipid metabolism in broiler chickens.

Objective

Examine the effects of increasing dietary levels of D-xylose on the expression of hepatic enzymes and transcription factors involved in glucose and lipid metabolism.

Materials & Methods

Experimental design

D1, 360

T1 (0% D-xylose) (n = 6)

T2 (5% D-xylose) (n = 6)

T3 (15% D-xylose) (n = 6)

Serial slaughter and collection of liver samples (0, 3 and 5 hr)

Isolation of total RNA

cDNA synthesis

qRT-PCR

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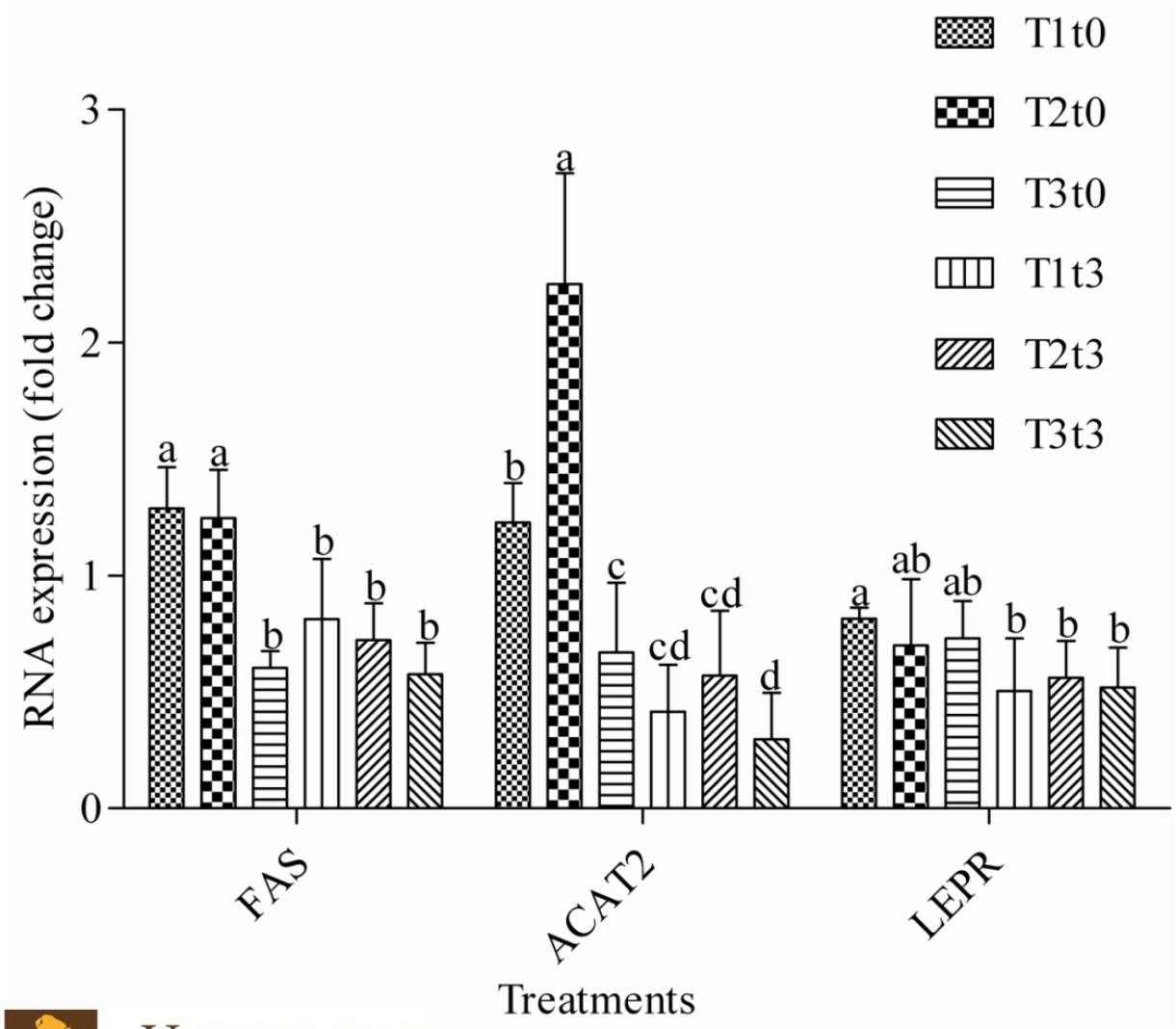
Materials and Methods…

- **T1** = control diet based on corn-soybean meal + 25% cornstarch
- **T2** = 20% cornstarch + 5% D-xylose
- **T3** = 10% cornstarch + 15% D-xylose
- 24 battery cages each with 5 birds
- 12 h fasting on d 15 - 18
- 30 min feeding on d 18
- Liver samples taken at 0, 3 and 5 h post-feeding

Materials and Methods…

- qRT-PCR data were generated using ΔΔCt method.
- Expression of the target genes were normalised to a housekeeping gene (GAPDH).
- Mean fold change values were compared using LSD (SAS, 1998) and declared significant ($P < 0.05$).

Results



t0 = immediately after 12 h fasting on d 18
t3 = 3 hr post 30 min feeding

FAS = Fatty acid synthase
ACAT2 = Acetyl-CoA acetyl transferase 2
LEPR = Leptin receptor

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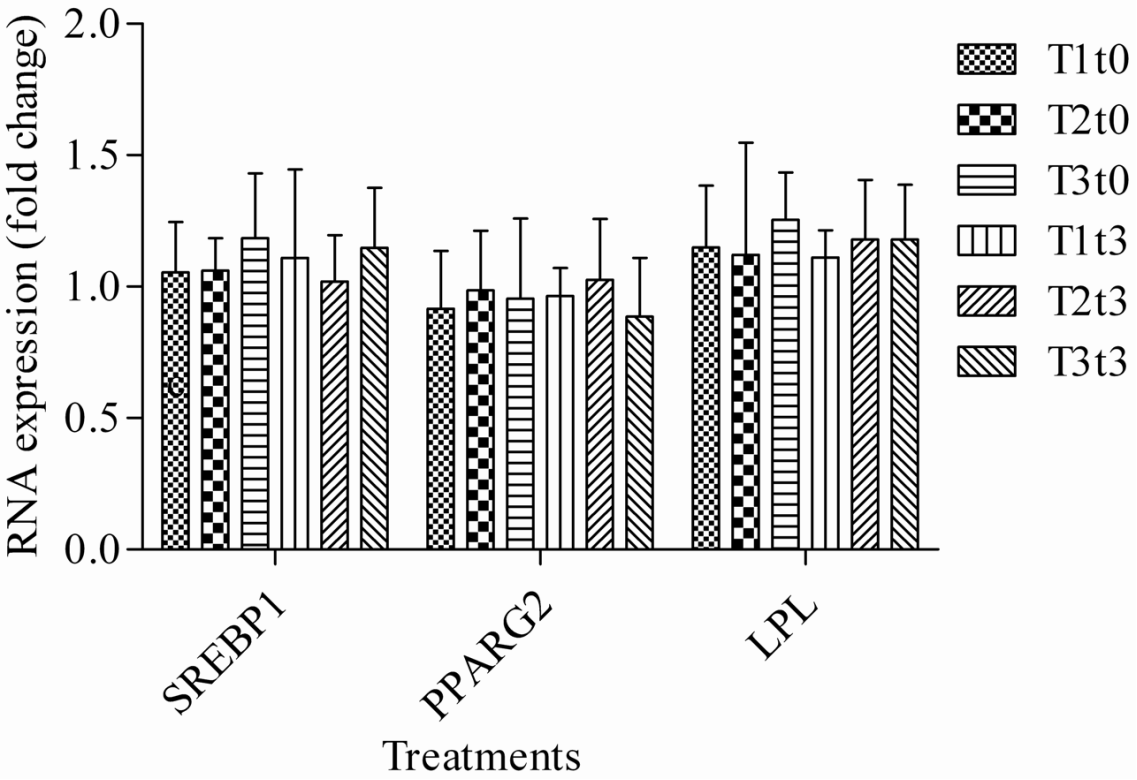
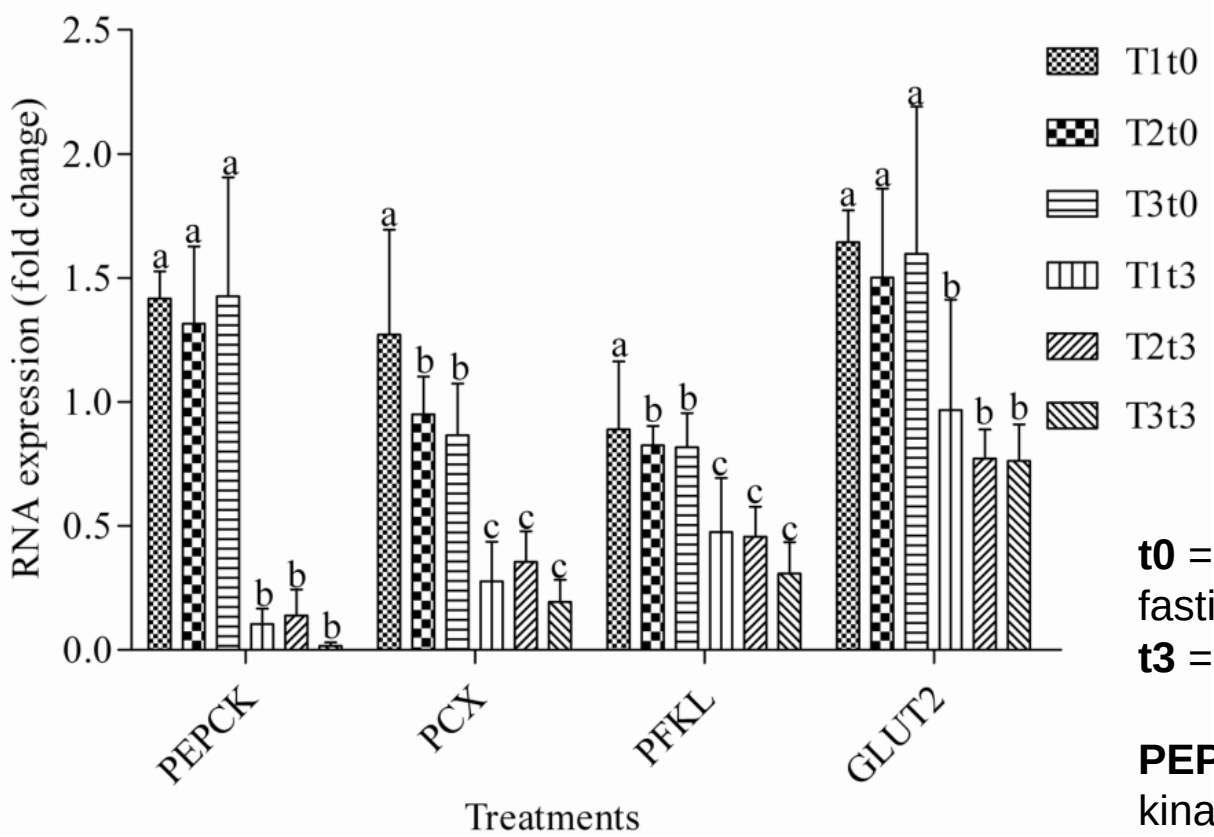
Results…



t0 = immediately after 12 h fasting on d 18
t3 = 3 hr post 30 min feeding

SREBP1 = Steroid regulatory element binding protein 1
PPARG2 = Peroxisome proliferator-activated gamma 2
LPL = Lipoprotein lipase

Results…



t0 = immediately after 12 h fasting on d 18
t3 = 3 hr post 30 min feeding

PEPCK = Phosphoenolpyruvate kinase
PCX = Pyruvate carboxylase
PFKL = Phosphofructokinase
GLUT2 = Glucose transporter 2

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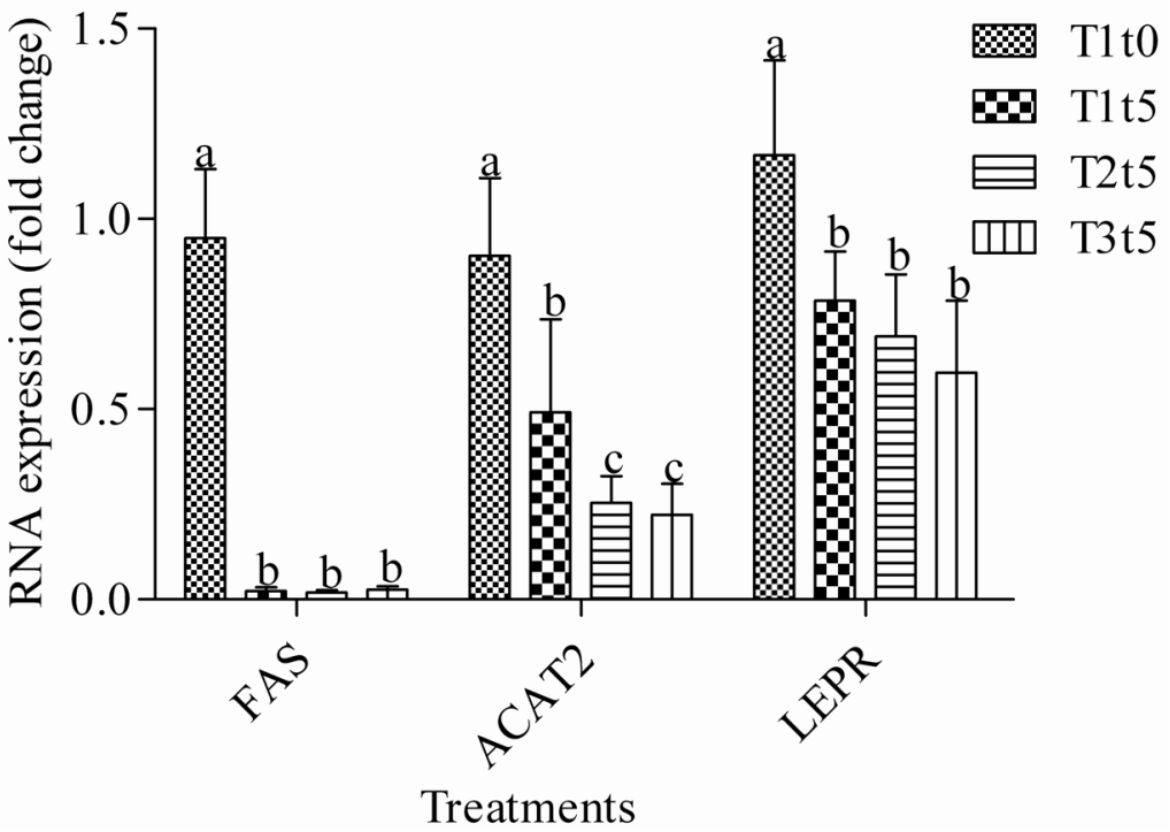
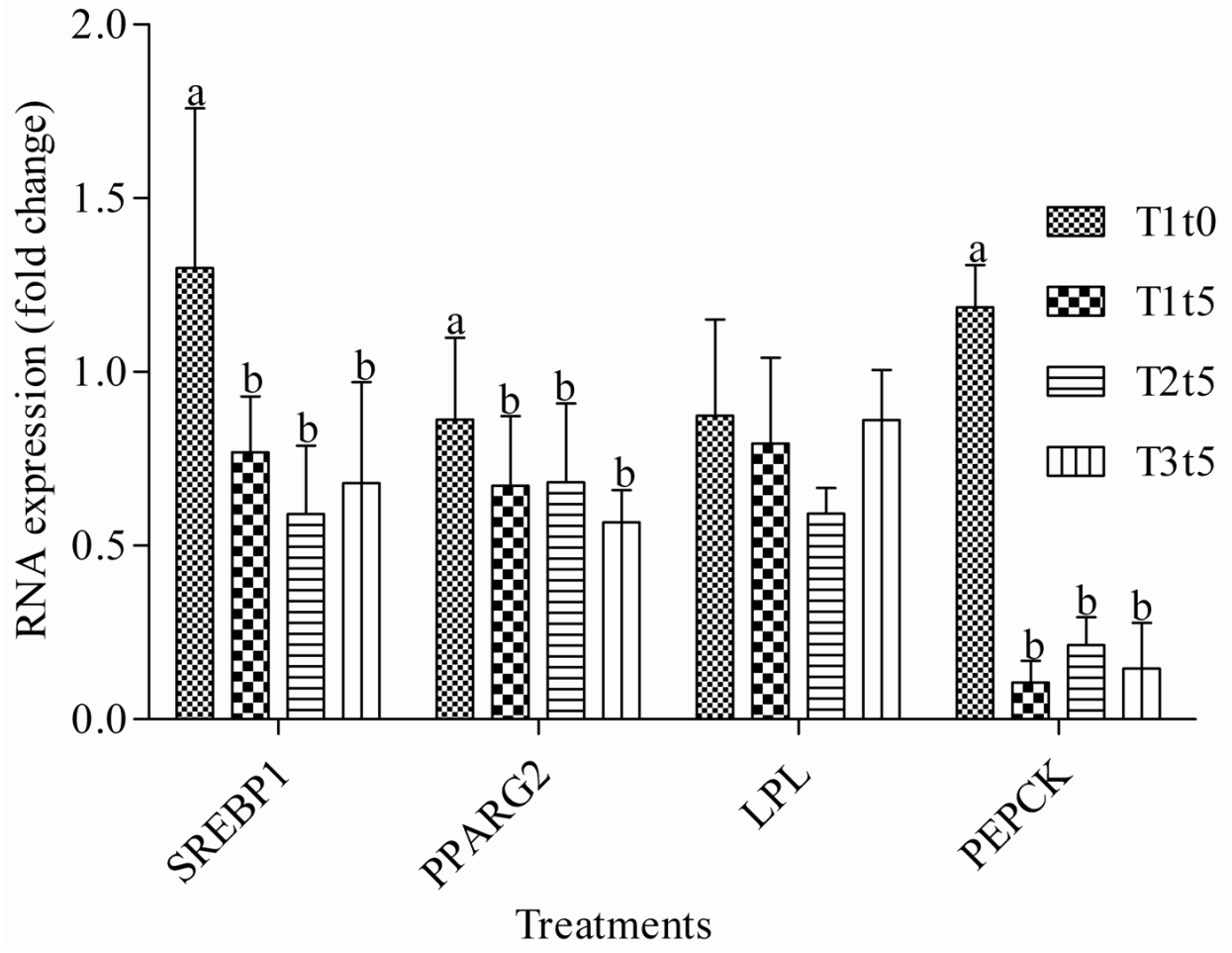
Results…



t0 = immediately after 12 h fasting on d 18
t5 = 5 hr post 30 min feeding

FAS = Fatty acid synthase
ACAT2 = Acetyl-CoA acetyl transferase 2
LEPR = Leptin receptor

Results…



t0 = immediately after 12 h fasting on d 18
t5 = 5 hr post 30 min feeding
SREBP1 = Steroid regulatory element binding protein 1
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LPL = Lipoprotein lipase
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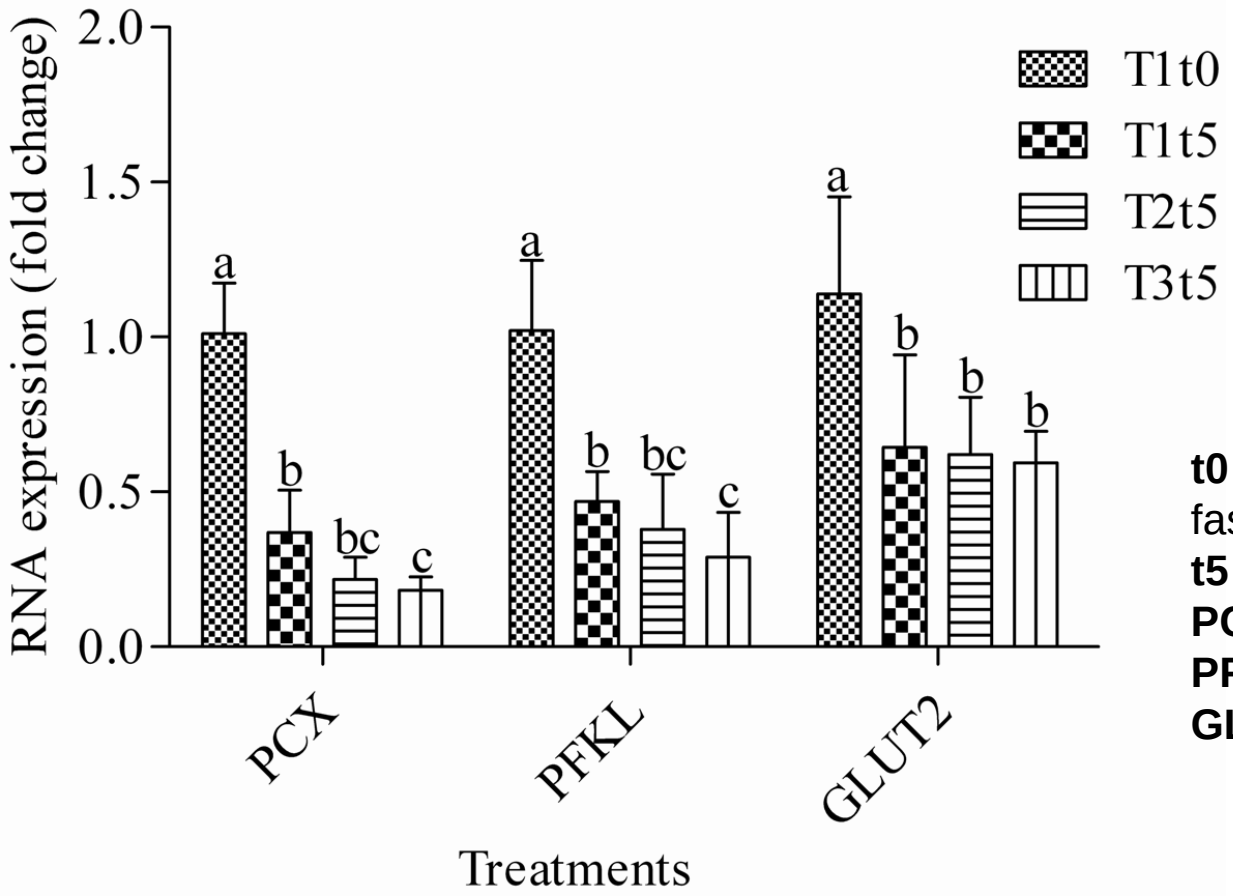
Results…



t0 = immediately after 12 h fasting on d 18
t5 = 5 hr post 30 min feeding
PCX = Pyruvate carboxylase
PFKL = Phosphofructokinase
GLUT2 = Glucose transporter 2

Summary and Conclusions

- In the fasting state, the dietary xylose supplementation groups (T2t0 or T3t0) reduced ($p < 0.05$) the the expression of some of the genes involved in glucose metabolism (PCX and PFKL) and lipid metabolism (ACAT2 and FAS) compared to the glucose supplementation group (T1t0).

- The gene expression pattern of ACAT2, PCX, PFKL, and FAS in the xylose treatments during the fasting state was similar to that of the feeding state, indicating that xylose in the body appears to have biochemical effects on glucose and lipid metabolism.

Summary and Conclusions

- The expression of most of the genes involved in glucose and lipid metabolism were reduced ($p < 0.05$) in birds that were fed for 30 minutes and euthanized after 3 or 5hr compared to birds euthanized immediately after 12hr fasting, suggesting that feeding and fasting are key factors regulating glucose and lipid metabolism regardless of dietary treatments.

- At 5hr post re-feeding, the xylose supplementation groups (T2t5 and T3t5) significantly reduced the expression of ACAT2 mRNA, indicating that xylose supplementation potentially reduces cholesterol biosynthesis in the body by reducing the production of 3-hydroxyl-3-methylglutaryl-CoA (HMG-CoA).

Summary and Conclusions

- The study demonstrated that dietary xylose influences the expression of hepatic enzymes and transcription factors involved in glucose and lipid metabolism in broiler chicks.

- Further studies are required to fully understand the underlying mechanisms.

Thank you!