UNIVERSIDAD AUTÓNOMA DEL ESTADO DE MÉXICO

Facultad de Medicina Veterinaria y Zootecnia

DIETARY XYLANASE ADDITION AND NUTRIENT DIGESTIBILITY, RUMEN FERMENTATION AND DUODENAL FIBER DIGESTION IN SHEEP

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Food and Agriculture Organization of the United Nations

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Project

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International Atomic Energy Agency

Organization: International Atomic Energy Agency (IAEA), joint FAO/IAEA, division of Nuclear Techniques in Food and Agriculture

Project No.: ***MEX 16307*.**

***Project period* :** **2010-2015**

Proposal title*:** ***Influence of Exogenous Enzymes on the Nutritive Value of Some Mexican Fibrous Forage in Ruminants

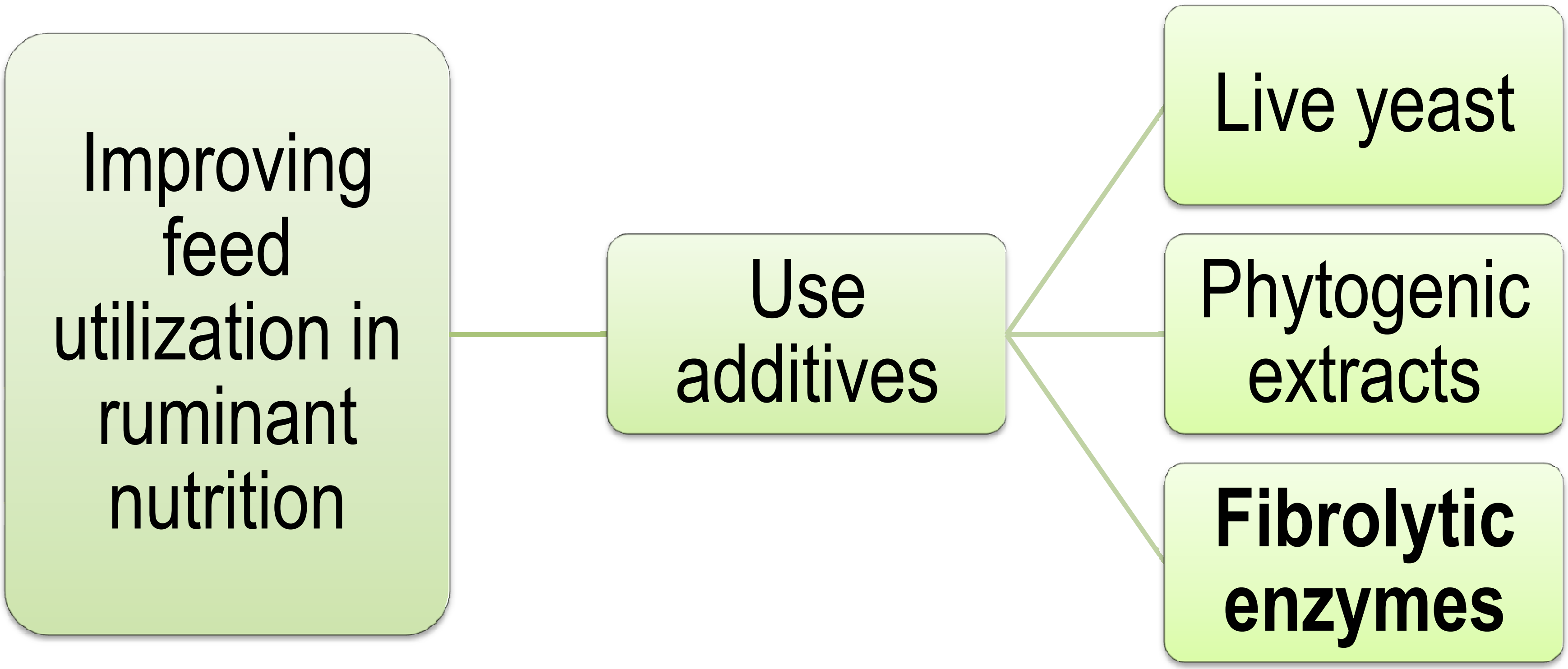
Participants:

Dr. A. Z. M. Salem (Chief Scientific Investigator)

PROJECT MAIN OBJECTIVE

Improve the nutritive value of fibrous feeds using the exogenous enzymes as feed additives

Introduction



Fibrolytic enzymes

- Commercial enzyme products, either from fungal or bacterial sources, have been widely used in livestock feeding
- Feeding fibre-degrading enzymes has been shown to improve feed utilization and animal performance but the mode of action has remained unclear

ENZYMES IN RUMINATES FEEDING

Enhancing attachment and colonization to the plant cell wall by ruminal microorganism

Enhance fibre fermentation and digestibility

Enhance ruminal microorganism's activities

Reduced digesta viscosity

Influence gut permeability, and modulate immune function

Modify the balance of intestinal microorganisms, adhere to intestinal mucosa and prevent pathogen adherence or activation

IMPROVING THE ANIMAL PERFORMANCE

Mode of action

- Hydrolysis of dietary fibre before ingestion
- Synergistic enhancement with endogenous microbial enzymes in the rumen
- Altering ruminal fermentation
- Enhanced ruminal microorganisms attachment and colonization to the plant cell wall

Factors implicated in enzyme efficiency

Differences in enzyme activity

Application rate and composition

Animal physiological Stage

Time of enzyme delivery

Ruminal activity

Enzymes stability

Objetive

Determine the effects of adding different levels of Xylanase enzyme on feed intake, ruminal fermentation, nutrient digestibility, duodenal NDF and ADF digestibility sheep fed a basal diet with 30% corn stover.

Material and methods

Animals

Four males Rambouillet sheep, weighing 39±1.8 kg

With permanent cannulas in the rumen and duodenum

The sheep were housed in individual cages equipped with high automatic water valve steel bowls and fed a basal diet composed of 30% corn stover *ad libitum* for 84 days

Ingredients and chemical composition of the basal diet fed to the Rambouillet sheep (g/kg DM).	
Ingredient	**g/kg DM**
Corn stover	300
Ground sorghum grain	520
Soybean meal	60
Molasses	80
Urea	40

The basal diet was balanced for minerals and vitamins and formulated to cover the nutrient requirements of sheep according to NRC (1985) recommendations plus a 10% margin.

Sheep were randomly assigned to four treatments i.e. four doses of xylanase (XY; Xylanase® plus, Dyadic® PLUS, Dyadic international, Inc., Jupiter, FL, USA) at 0 (XY0), 1 (XY1), 3 (XY3), and 6 (XY6) µL /g DM of the basal diet in 4×4 Latin square design

The experimental periods consisted of 21 days with days 1-15 considered as the adaptation period to the experimental diets, and days 16 to 21 as the sample collection period

Parameters

- Enzyme activity
- Nutrient digestibility
- The duodenal ADF and NDF digestibilities were determined on days16 and 17. About 500 mL of duodenal fluid was taken from each sheep 4 h after morning feeding
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- **Rumen fluid** was collected directly through the rumen cannula from the ventral sac of each sheep at 3, 6 and 9 h after morning feeding. The rumen samples (approx. 50 mL/ sheep) were immediately filtered through four layers of cheesecloth, strained and stored in 45-mL glass bottles.

Ruminal methane (CH_4) production (L/d) was calculated according to the equation of Shibata *et al*. (1993) as:

$$CH_4 \text{ (L/d)} = - 17.766 + 42.793 X - 0.849 X^2;$$

where X = DMI (kg/d)

Microbial protein production (g/d) was calculated according to AFRC *et al*. (1984) as:

$$\text{Microbial protein production (g/d)} = 32 \text{ g /kg OM digested in the rumen}$$

Results

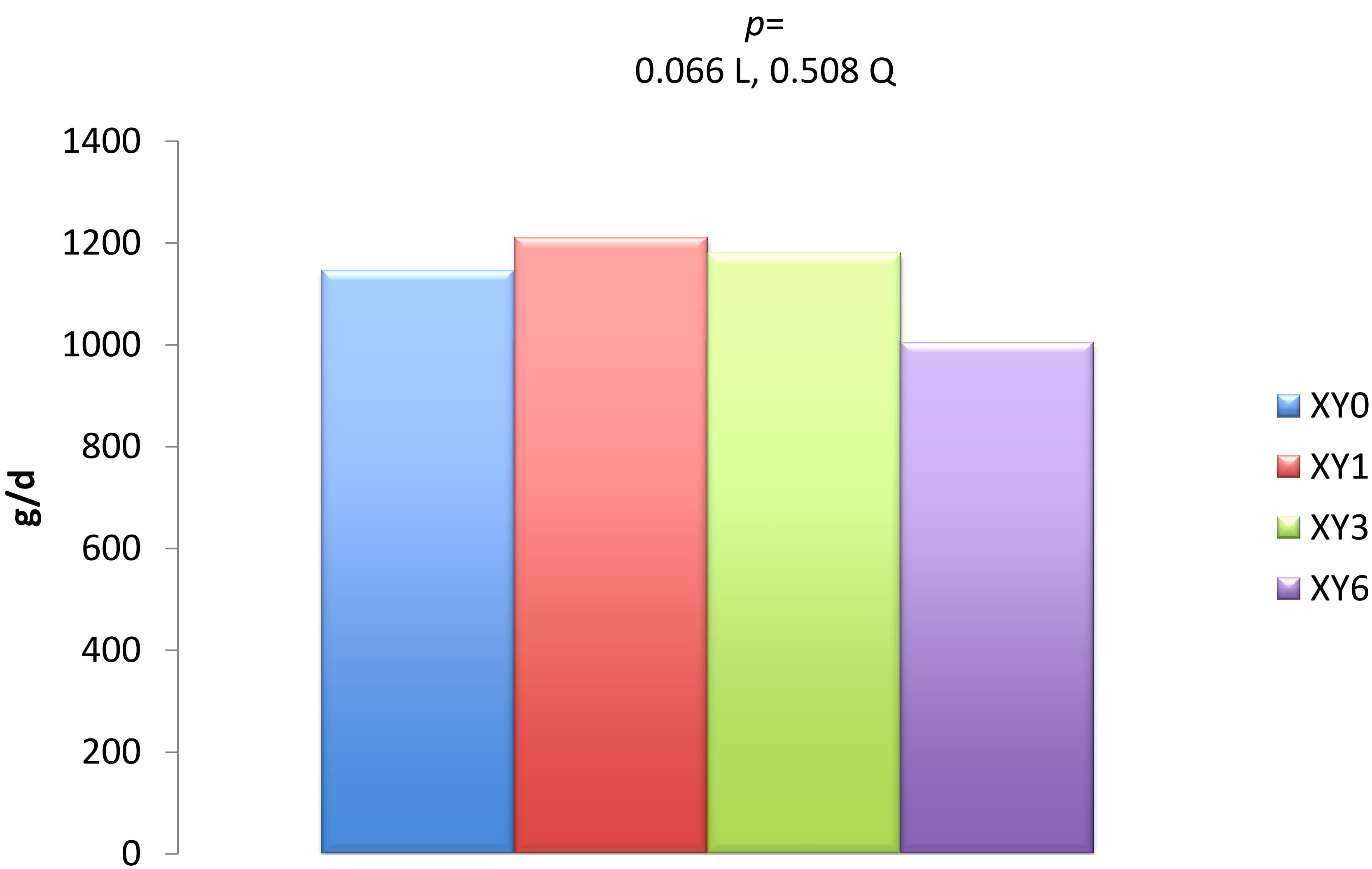

Fig. 1. Daily **dry matter intake** of a basal diet with different doses of xylanase (µL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

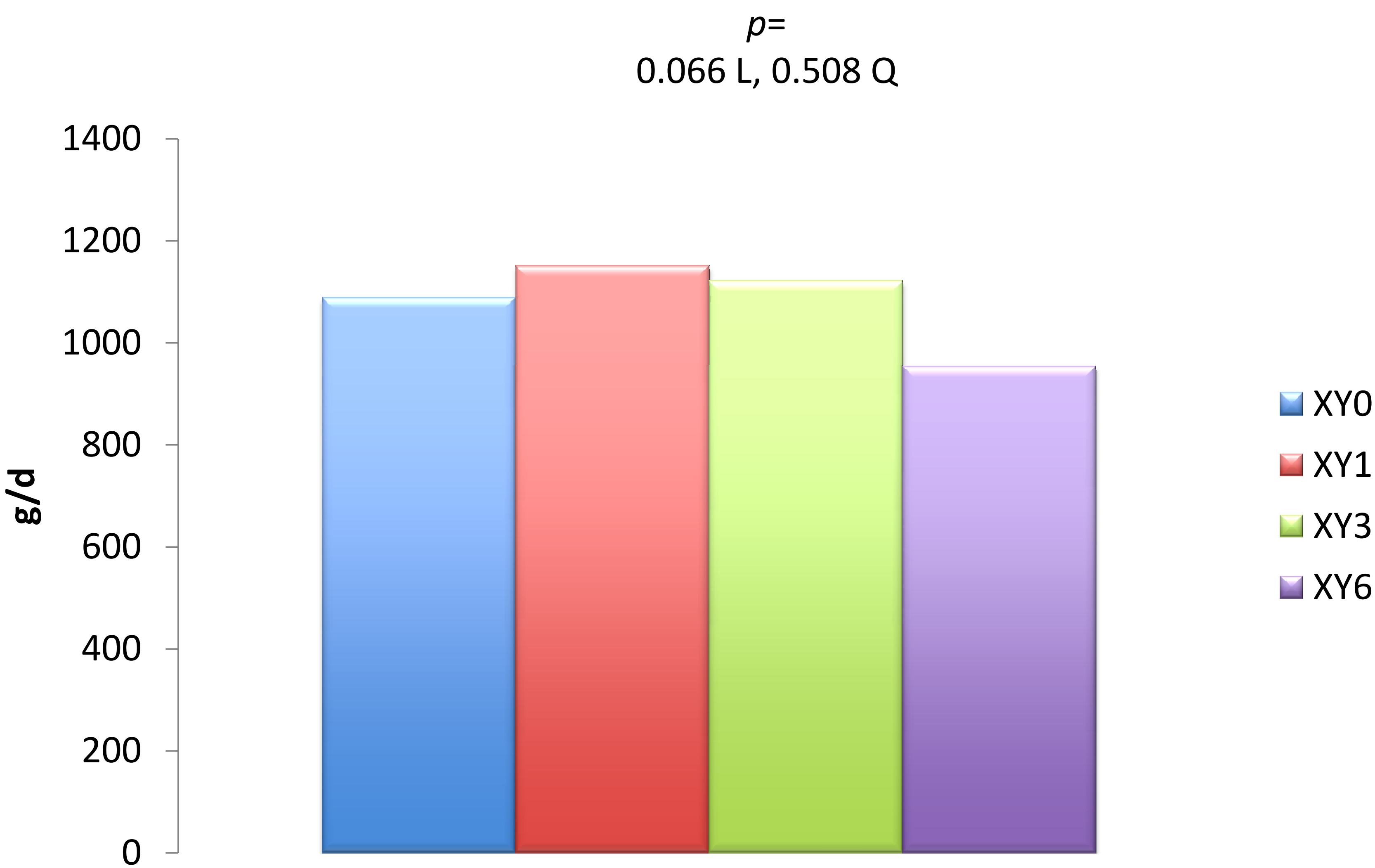

Fig. 2. Daily **organic matter intake** of a basal diet with different doses of xylanase (µL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

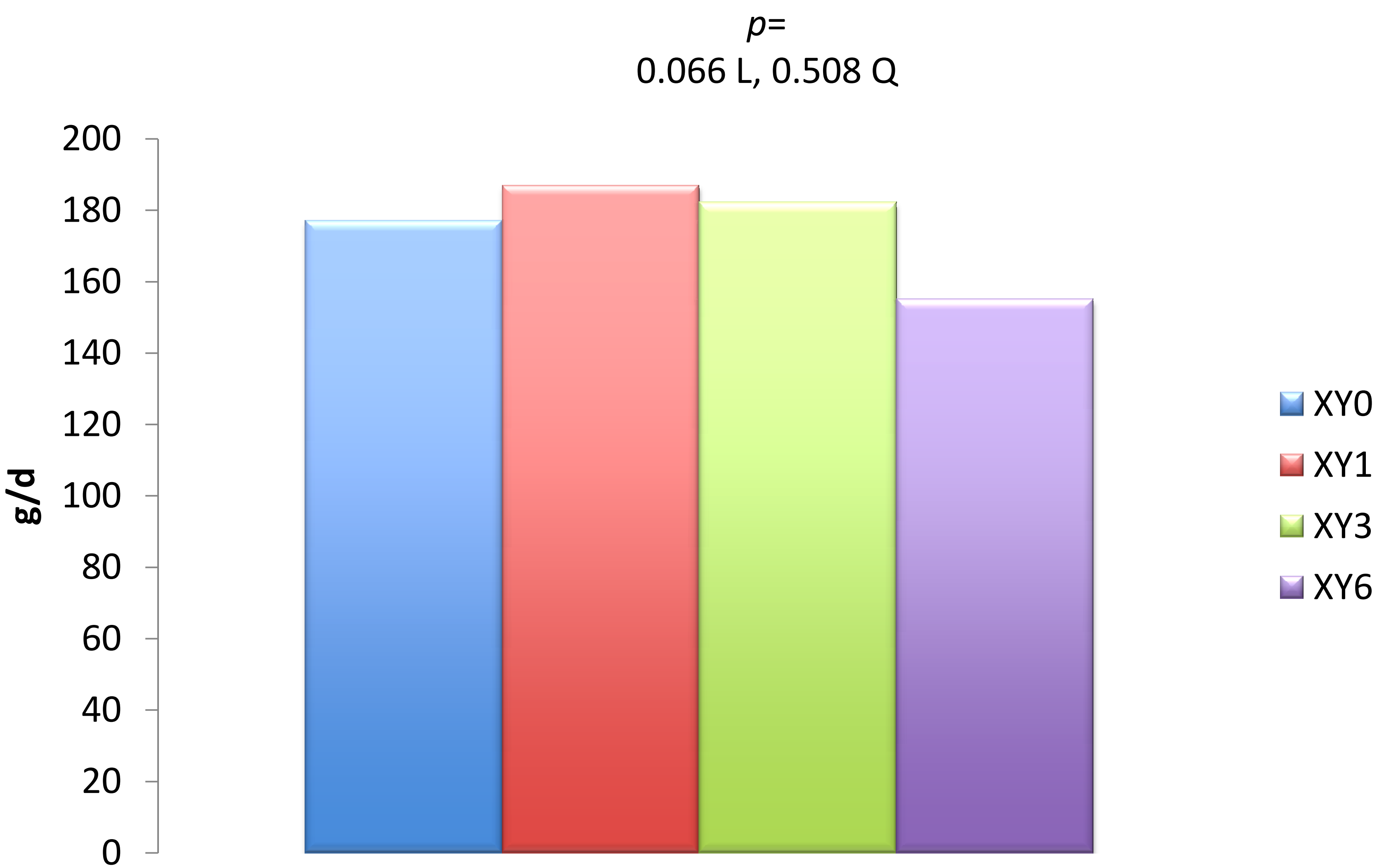

Fig. 3. Daily **crude protein intake** of a basal diet with different doses of xylanase (µL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

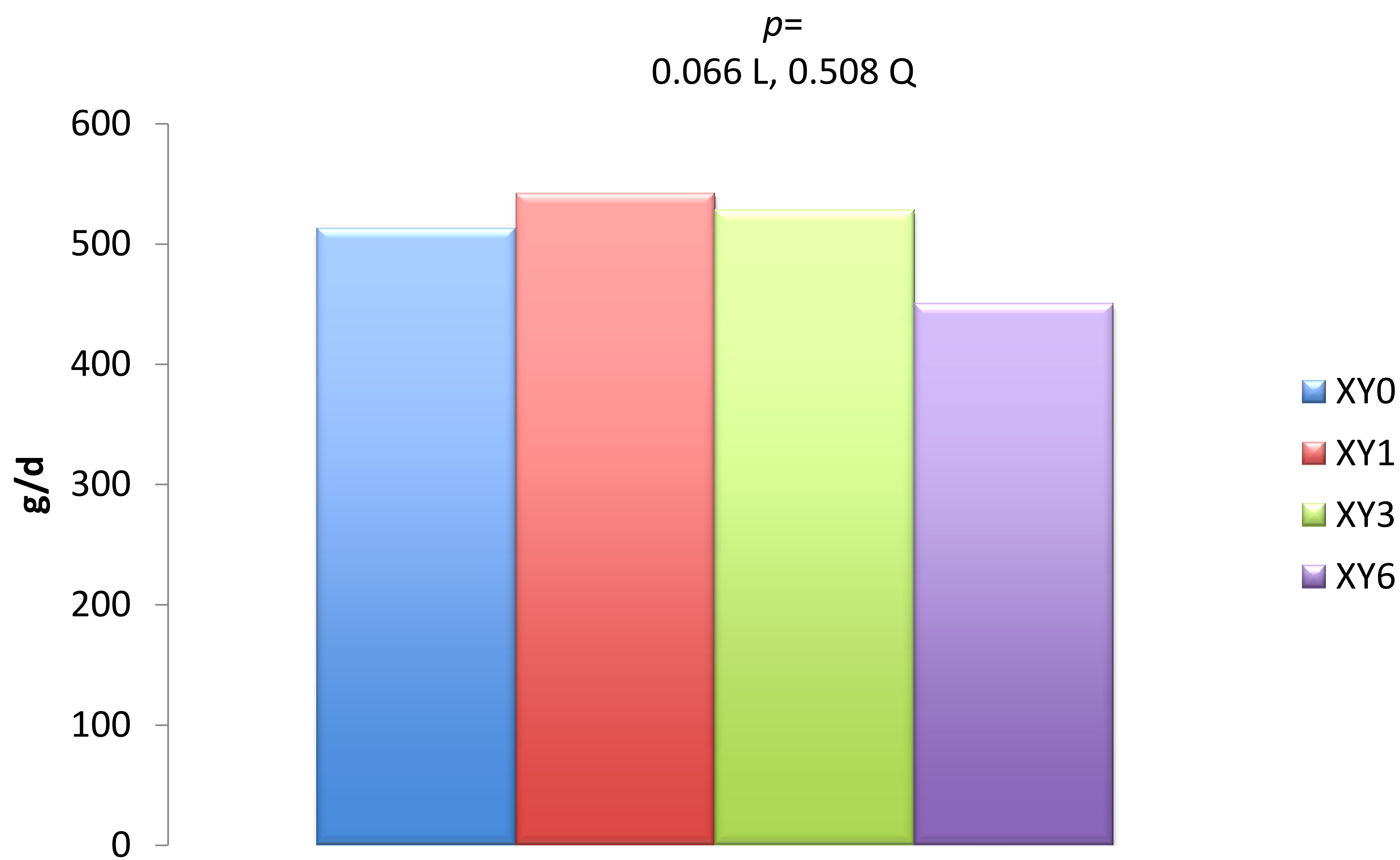

Fig. 4. Daily **NDF intake** of a basal diet with different doses of xylanase (μL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

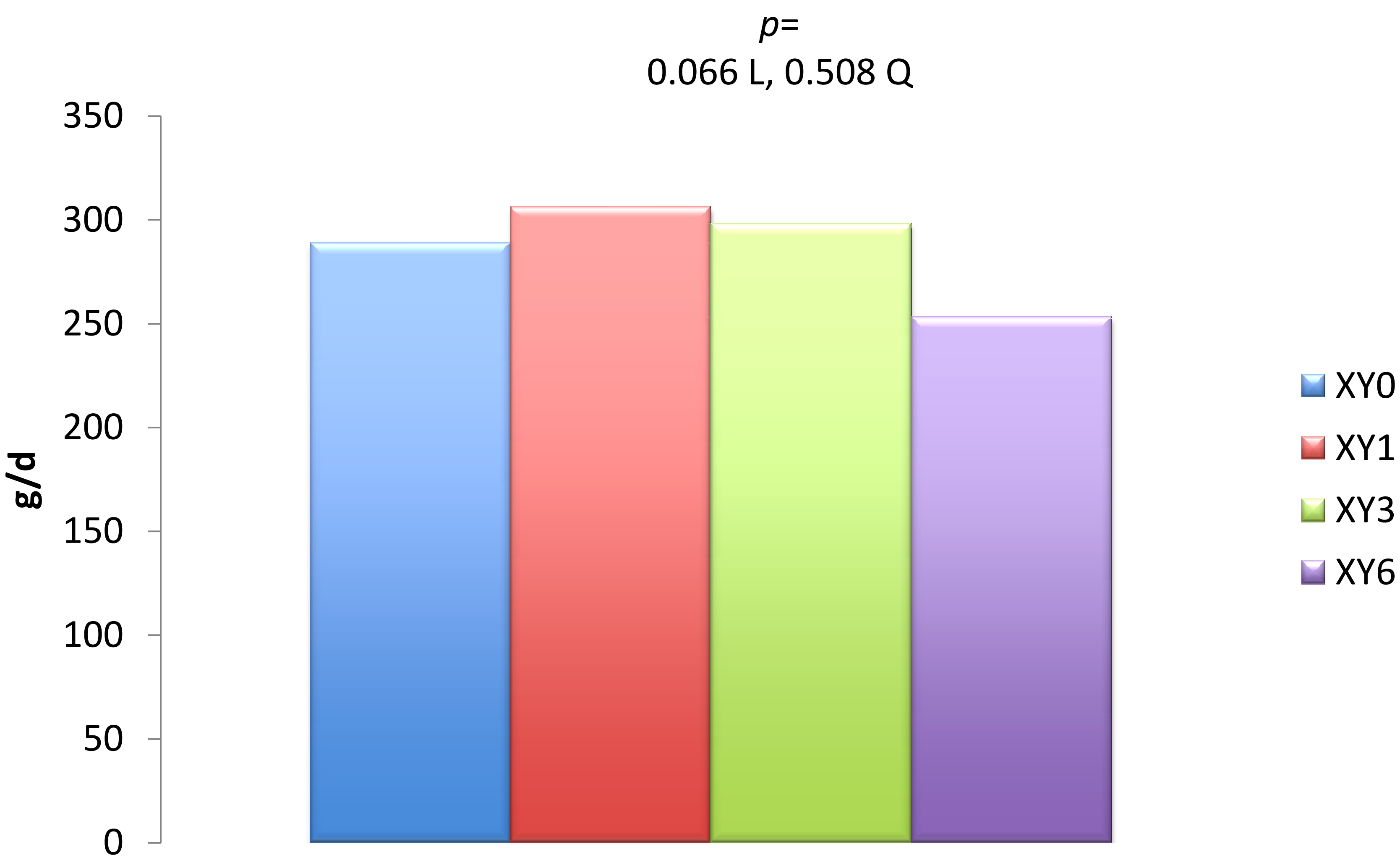

Fig. 5. Daily **ADF intake** of a basal diet with different doses of xylanase (µL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

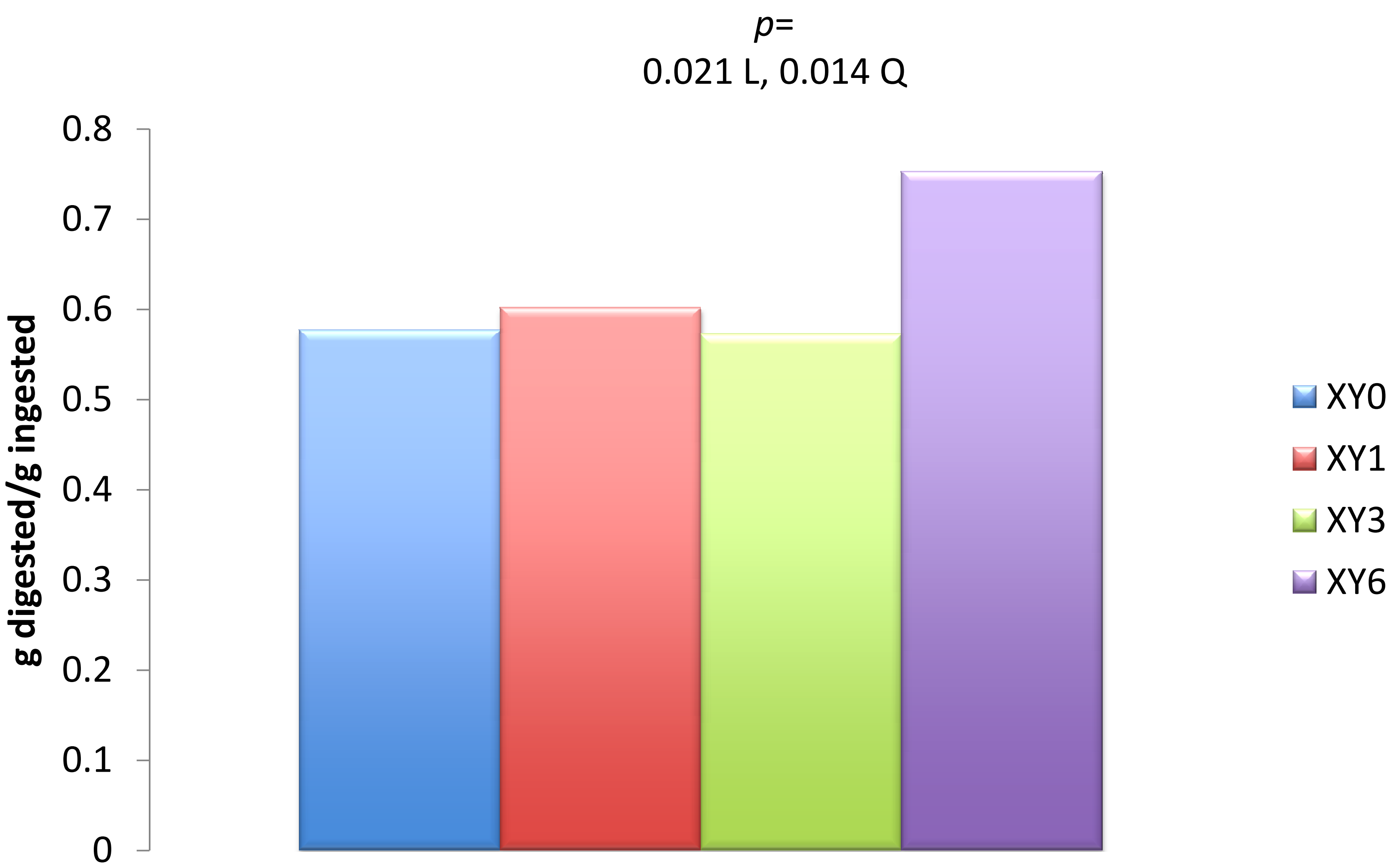

Fig. 6. **Dry matter digestibility** of a basal diet with different doses of xylanase (μL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

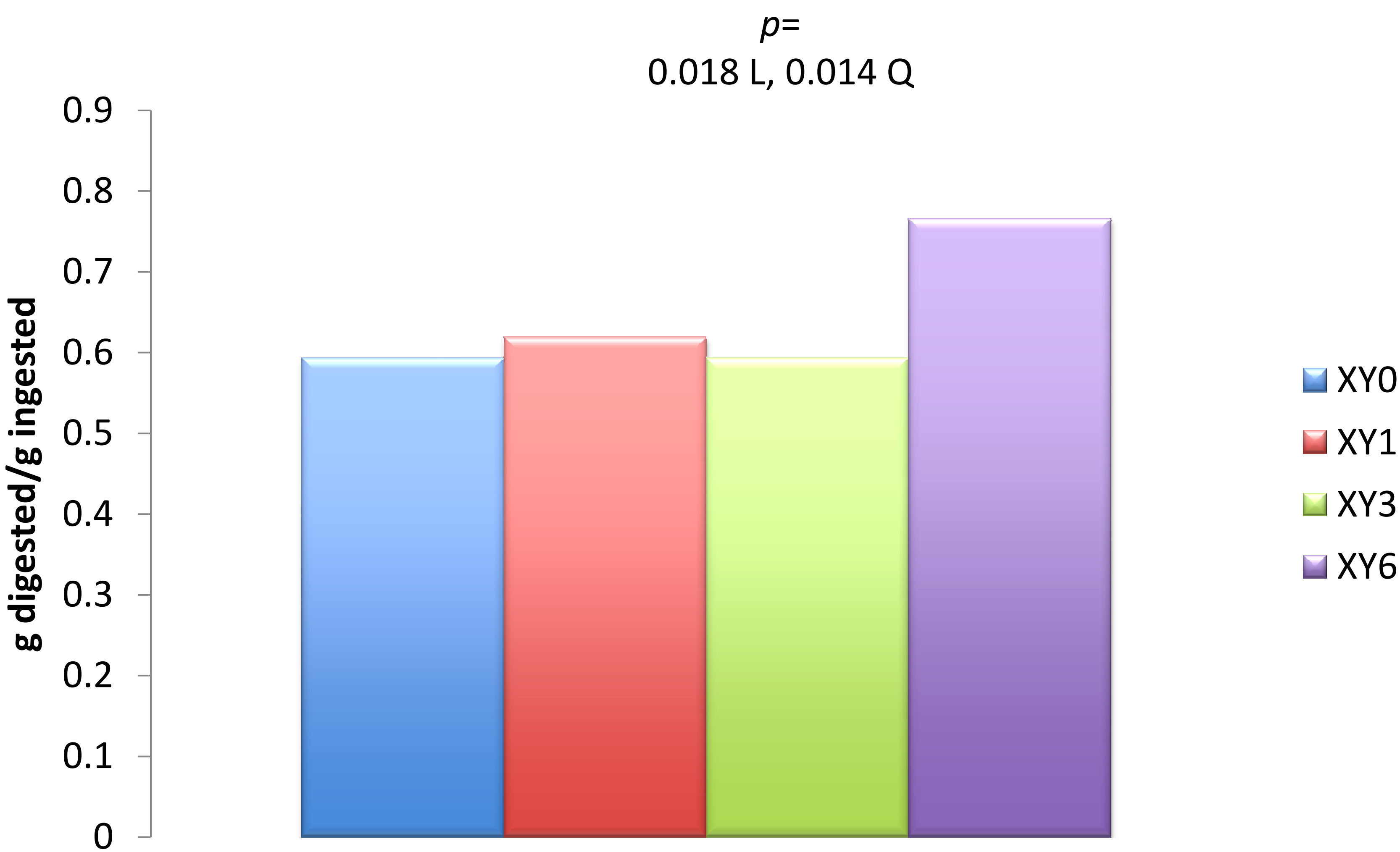

Fig. 7. **Organic matter digestibility** of a basal diet with different doses of xylanase (µL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

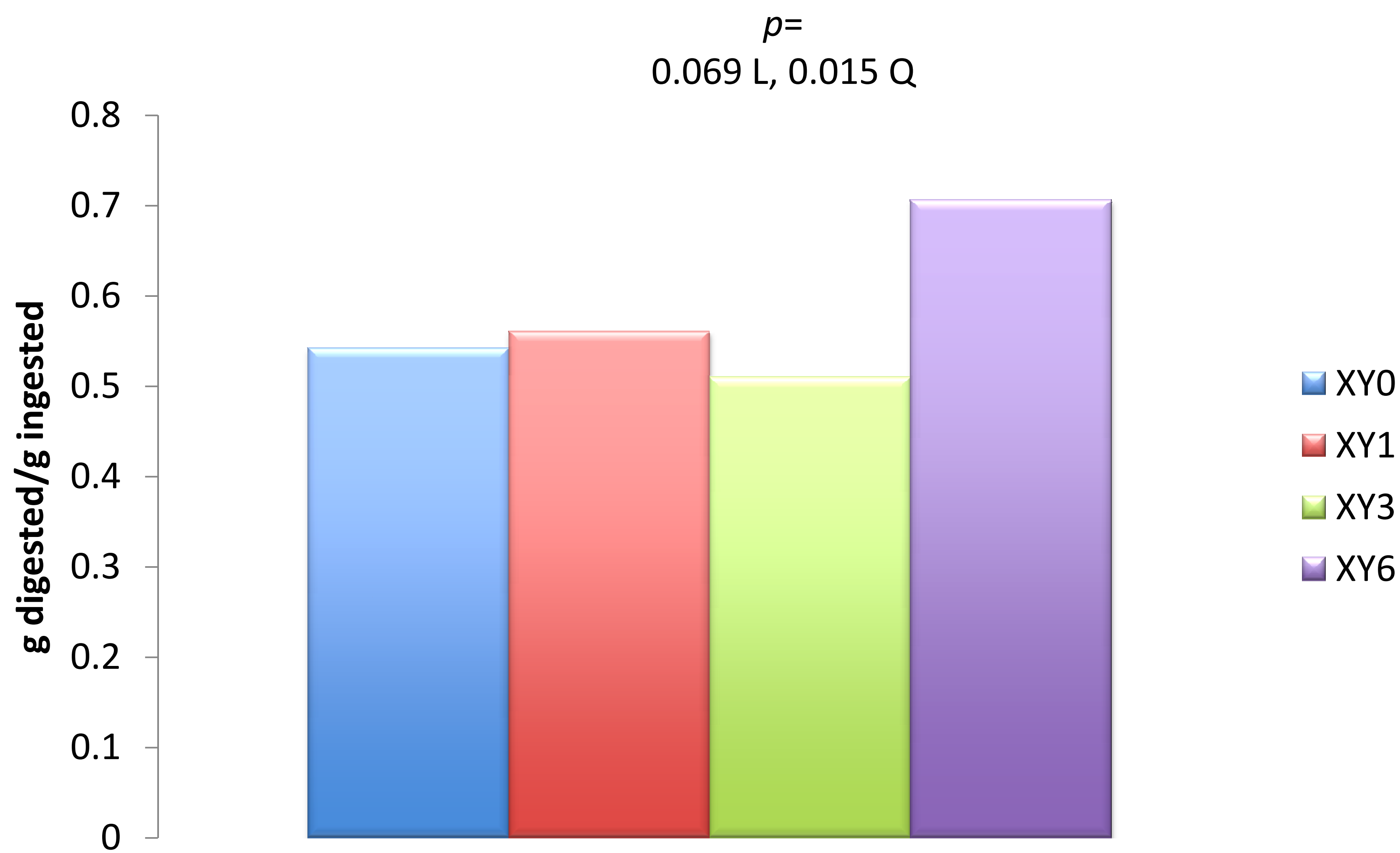

Fig. 8. **Crude protrein digestibility** of a basal diet with different doses of xylanase (µL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

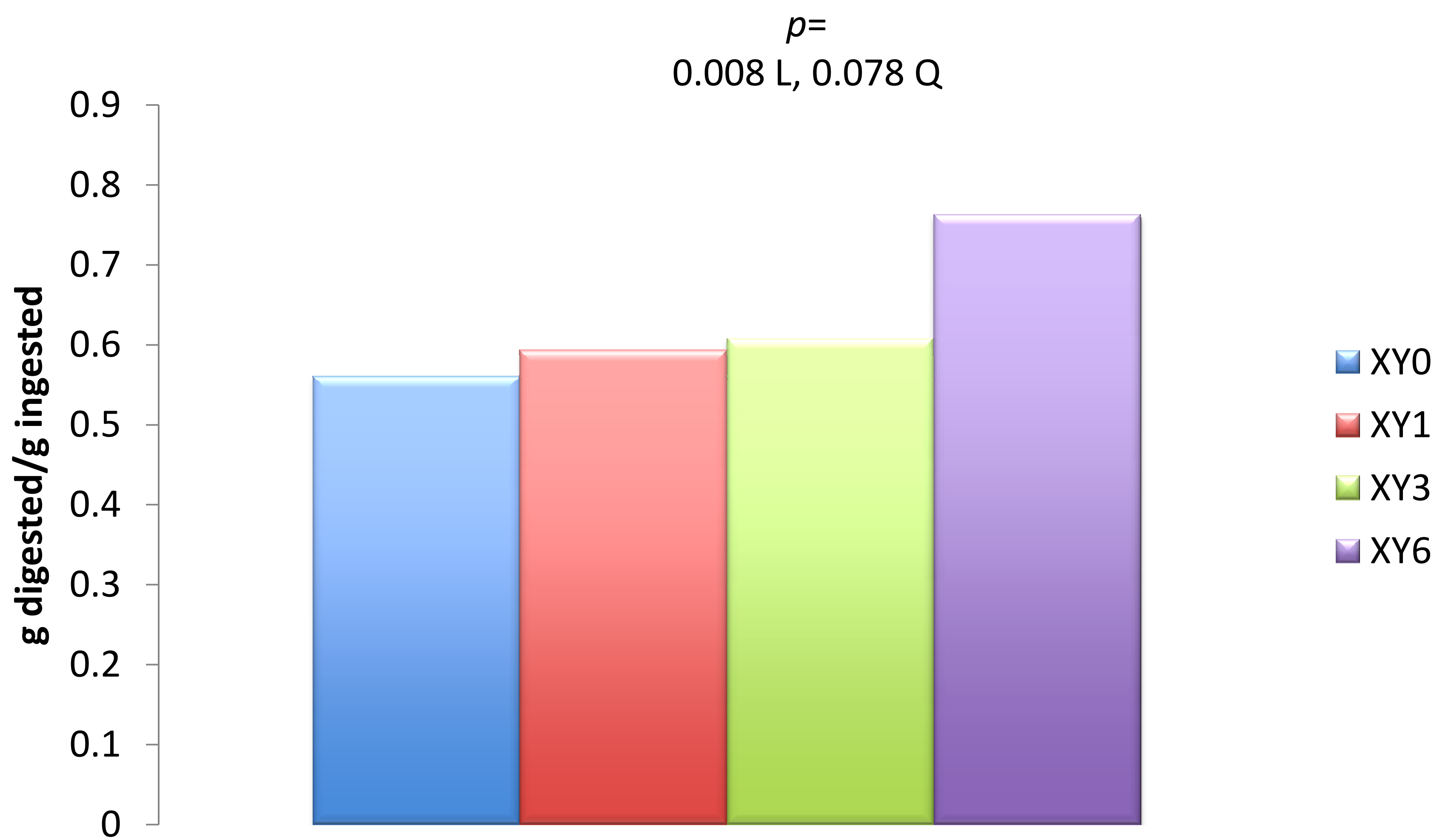

Fig. 9. **NDF digestibility** of a basal diet with different doses of xylanase (µL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

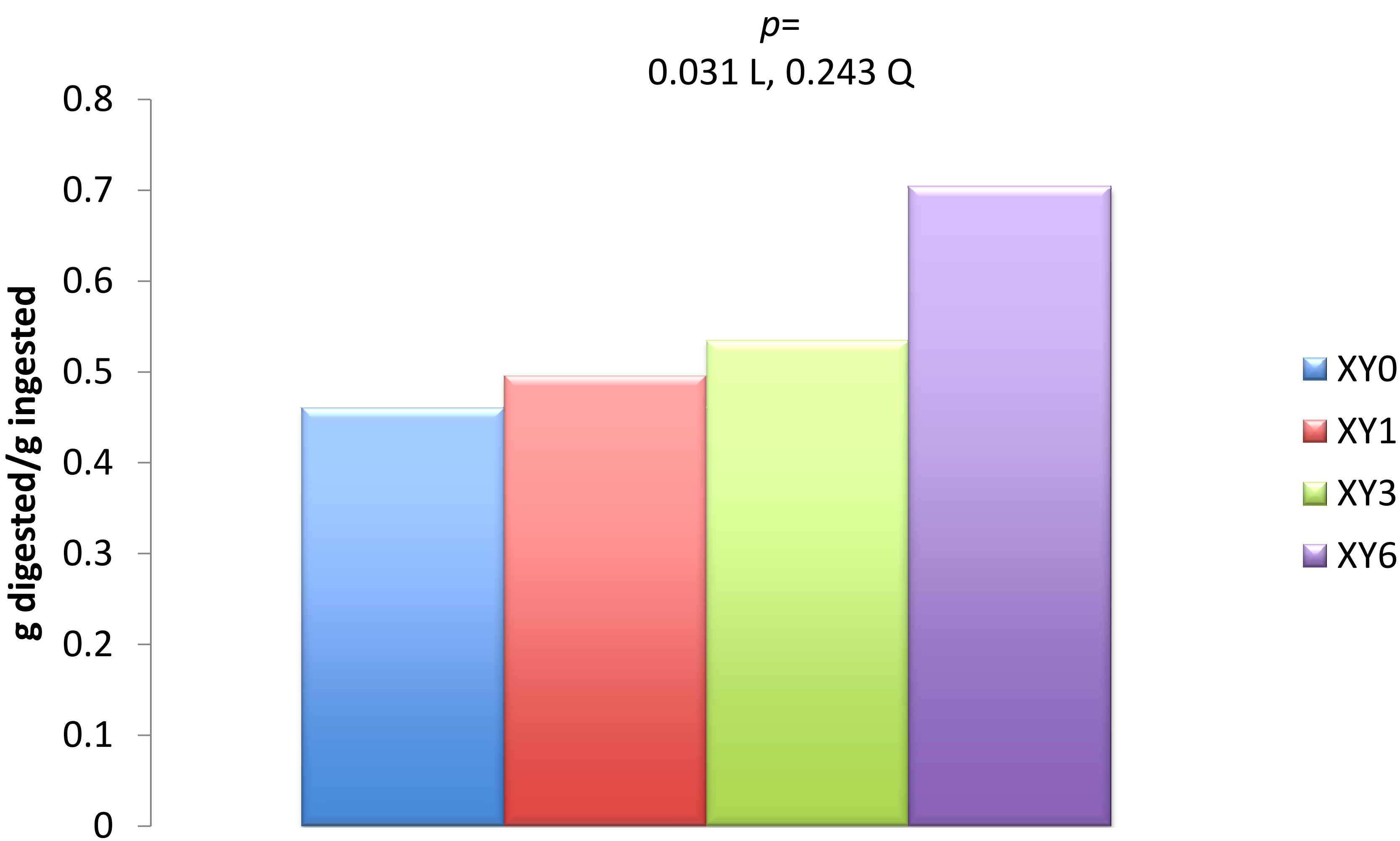

Fig. 10. **ADF digestibility** of a basal diet with different doses of xylanase (µL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

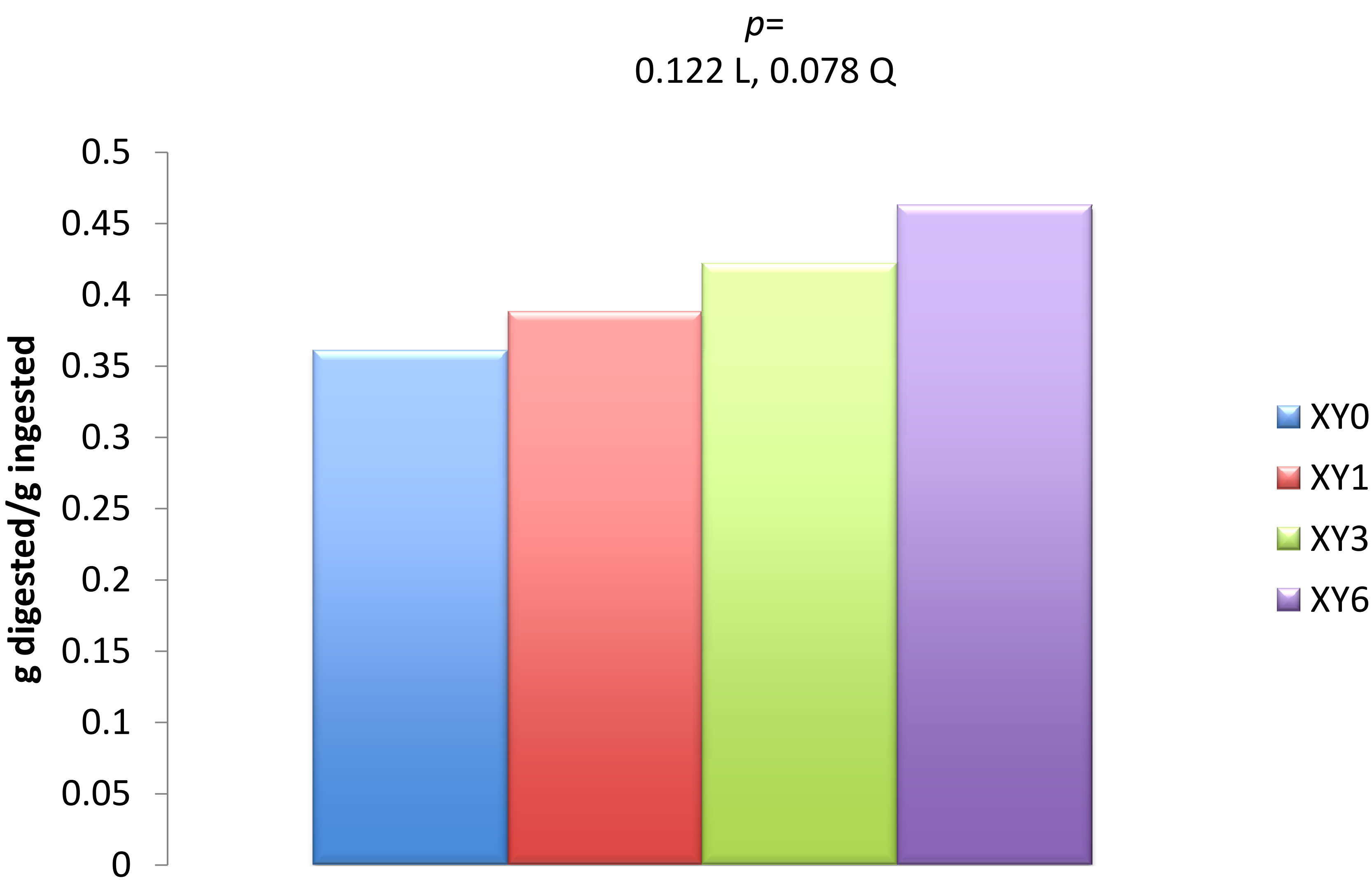

Fig. 11. **Duodenum NDF digestibility** of a basal diet with different doses of xylanase (µL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

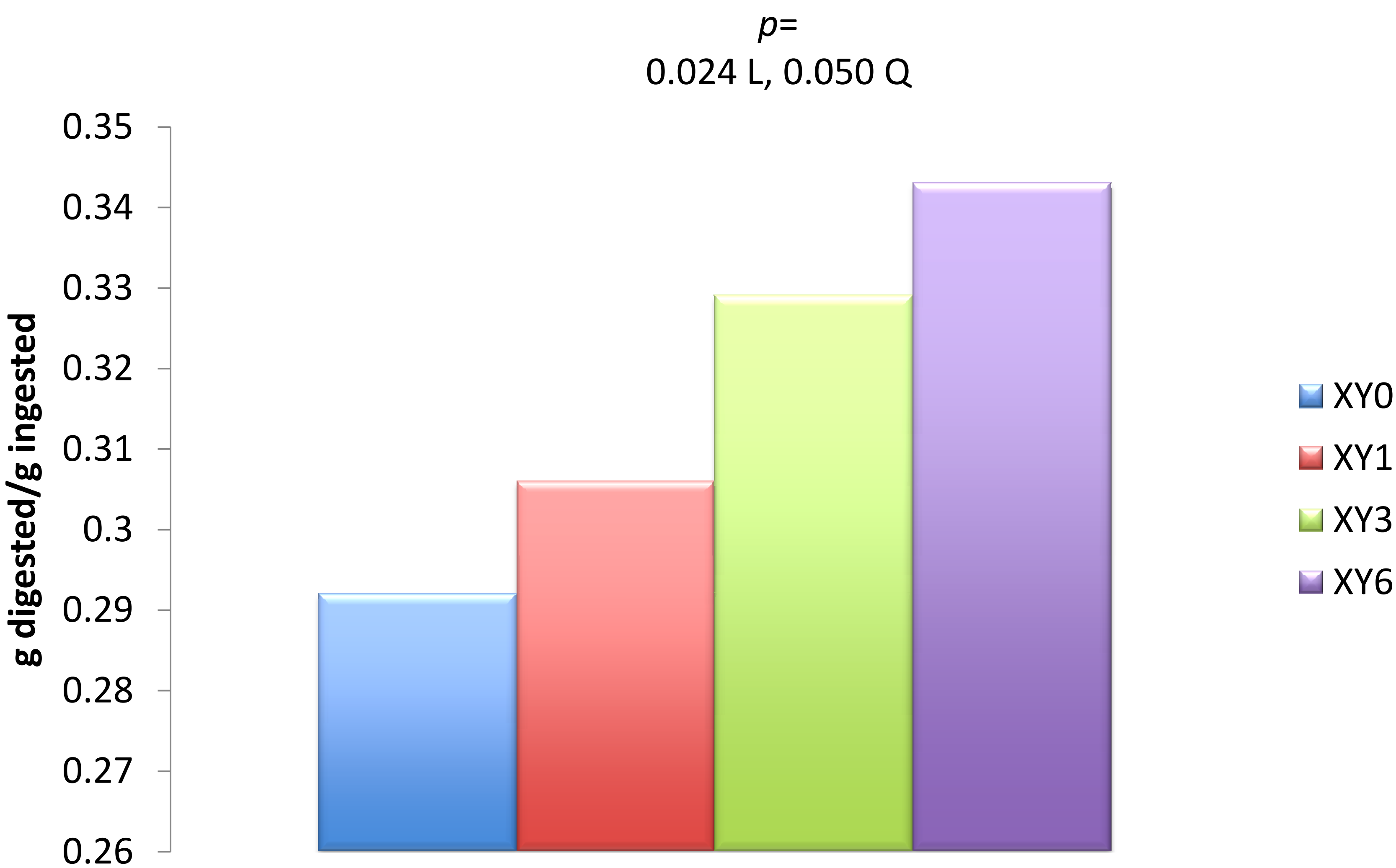

Fig. 12. **Duodenum ADF digestibility** of a basal diet with different doses of xylanase (µL /g DM of the basal diet) and fed to the Rambouillet sheep (n=4)

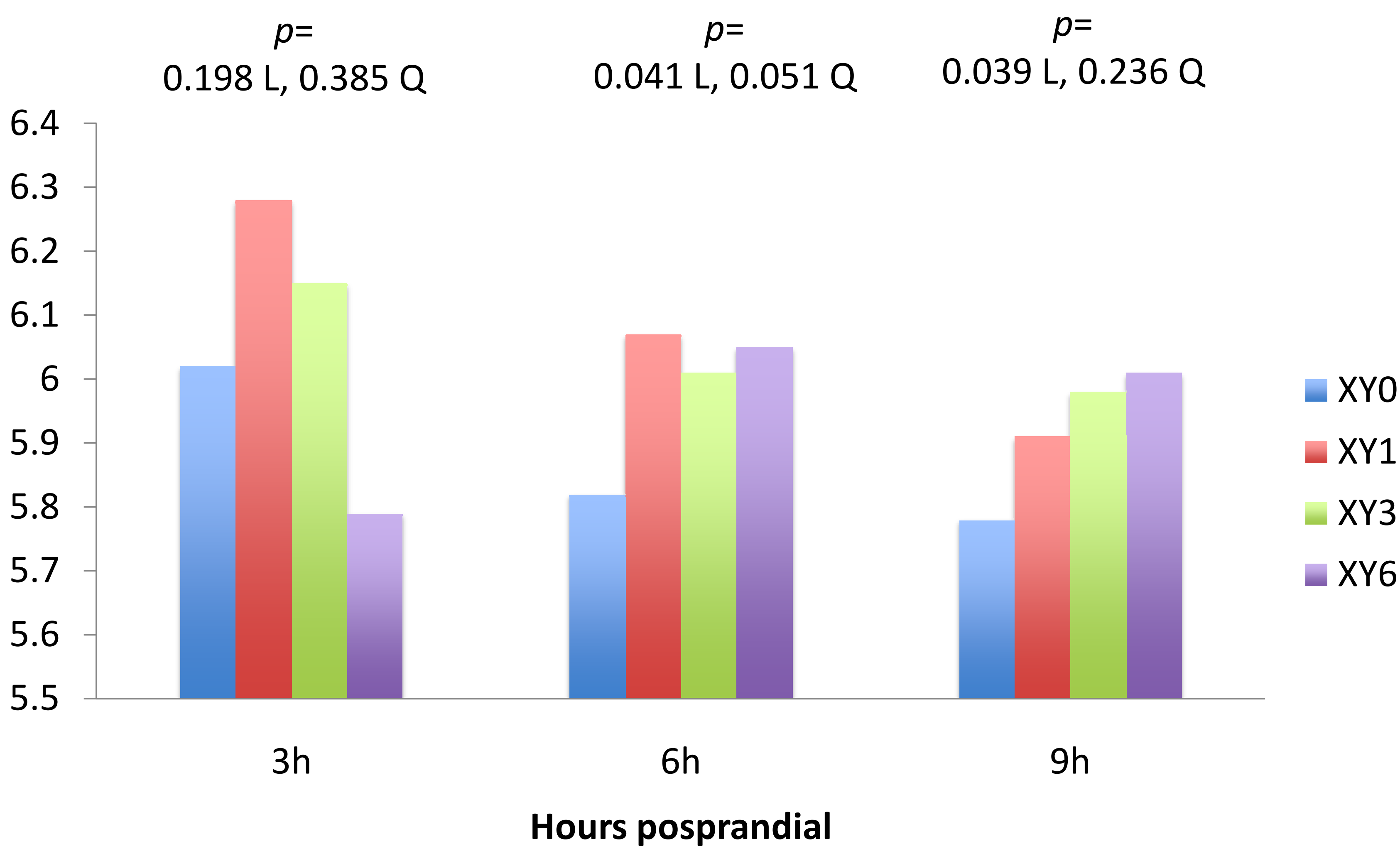

Fig. 16. pH of rumen fermentation of Rambouillet sheep fed on a basal diet with different doses of xylanase (XY, µL /g DM of the basal diet) (n=4)

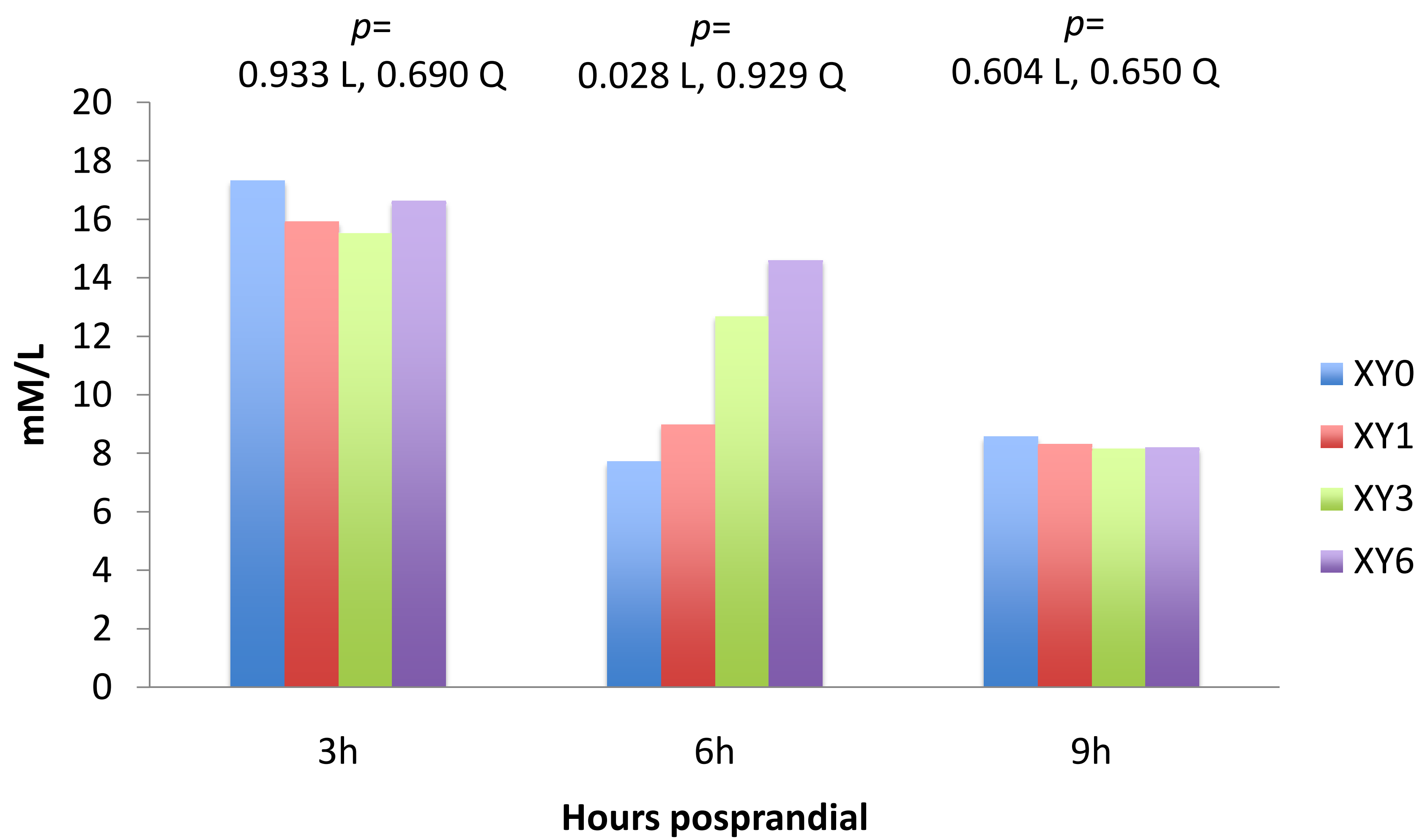

Fig. 17. Ammonia-N of rumen fermentation of Rambouillet sheep fed on a basal diet with different doses of xylanase (XY, µL /g DM of the basal diet) (n=4)

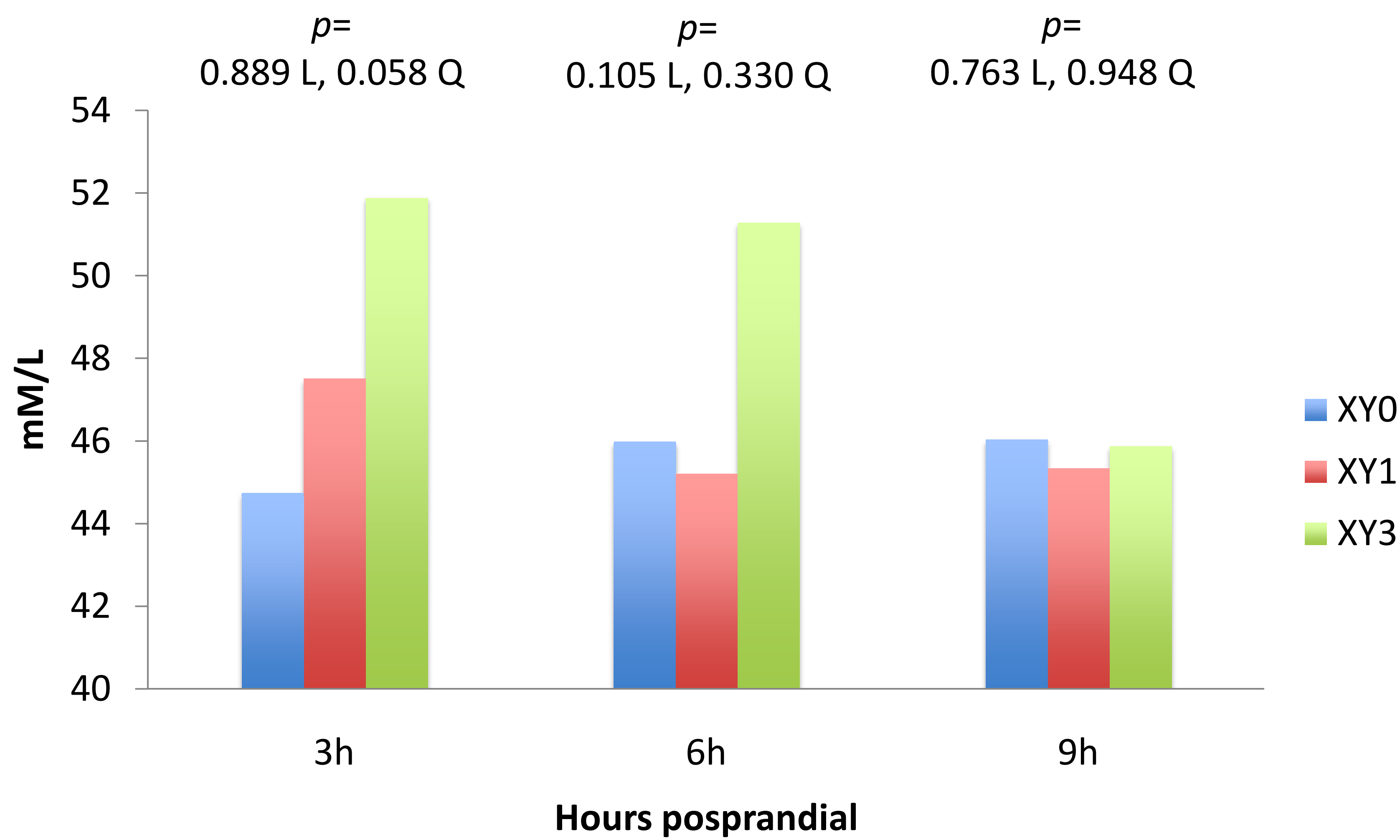

Fig. 18. Acetic acid of rumen fermentation of Rambouillet sheep fed on a basal diet with different doses of xylanase (XY, µL /g DM of the basal diet) (n=4)

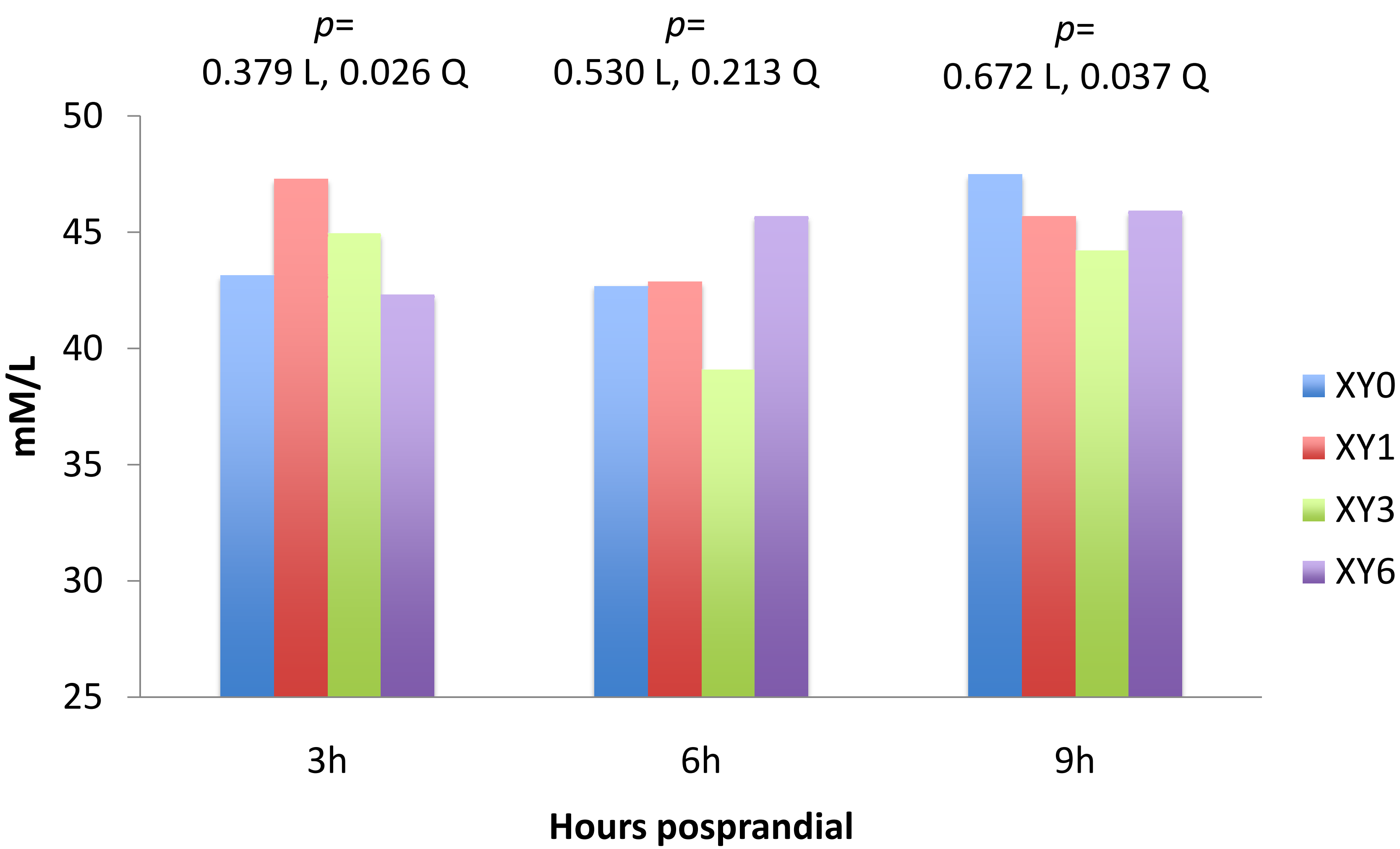

Fig. 19. Propionic acid of rumen fermentation of Rambouillet sheep fed on a basal diet with different doses of xylanase (XY, µL /g DM of the basal diet) (n=4)

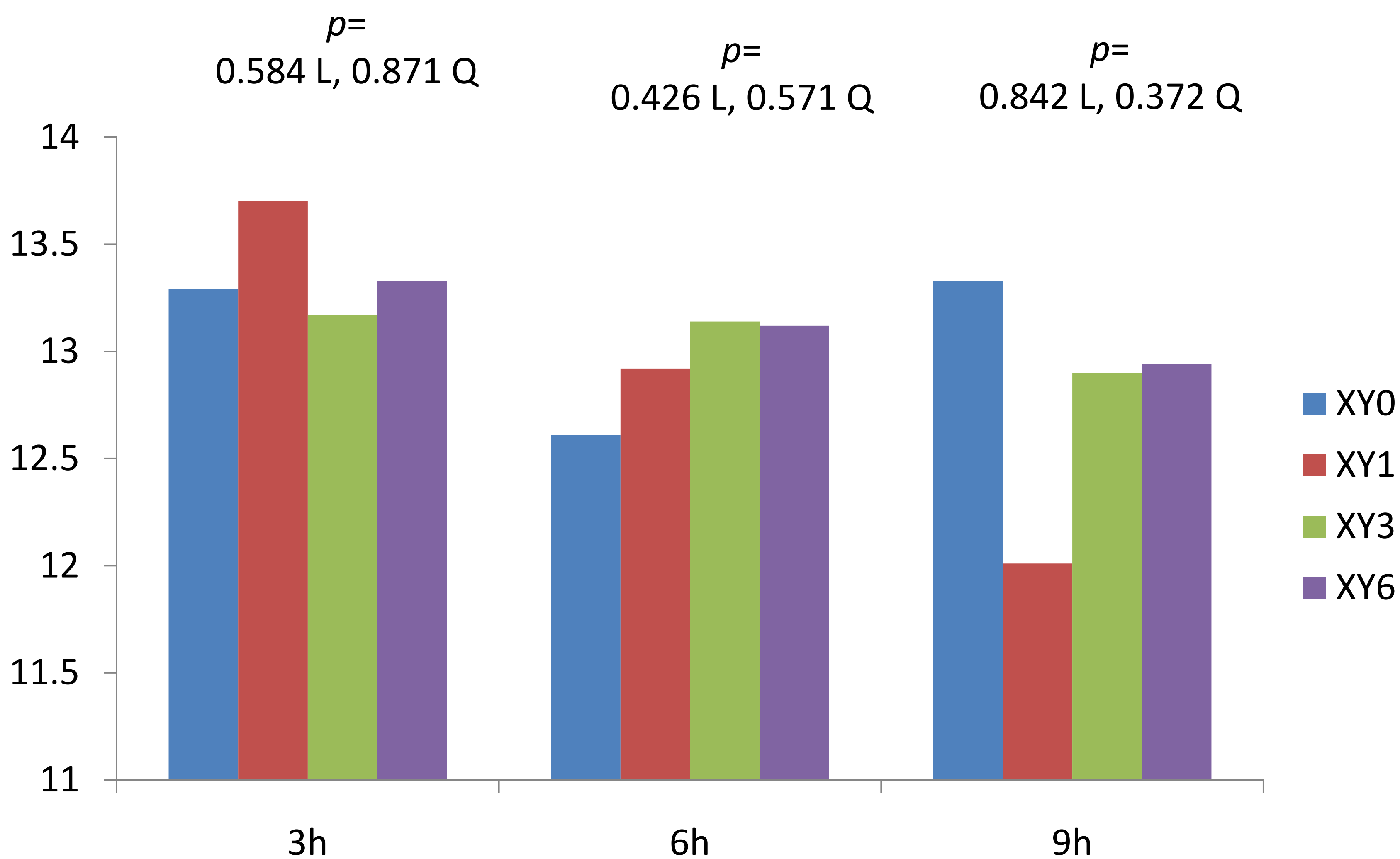

Fig. 16. Butiric acid of rumen fermentation of Rambouillet sheep fed on a basal diet with different doses of xylanase (XY, µL /g DM of the basal diet) (n=4)

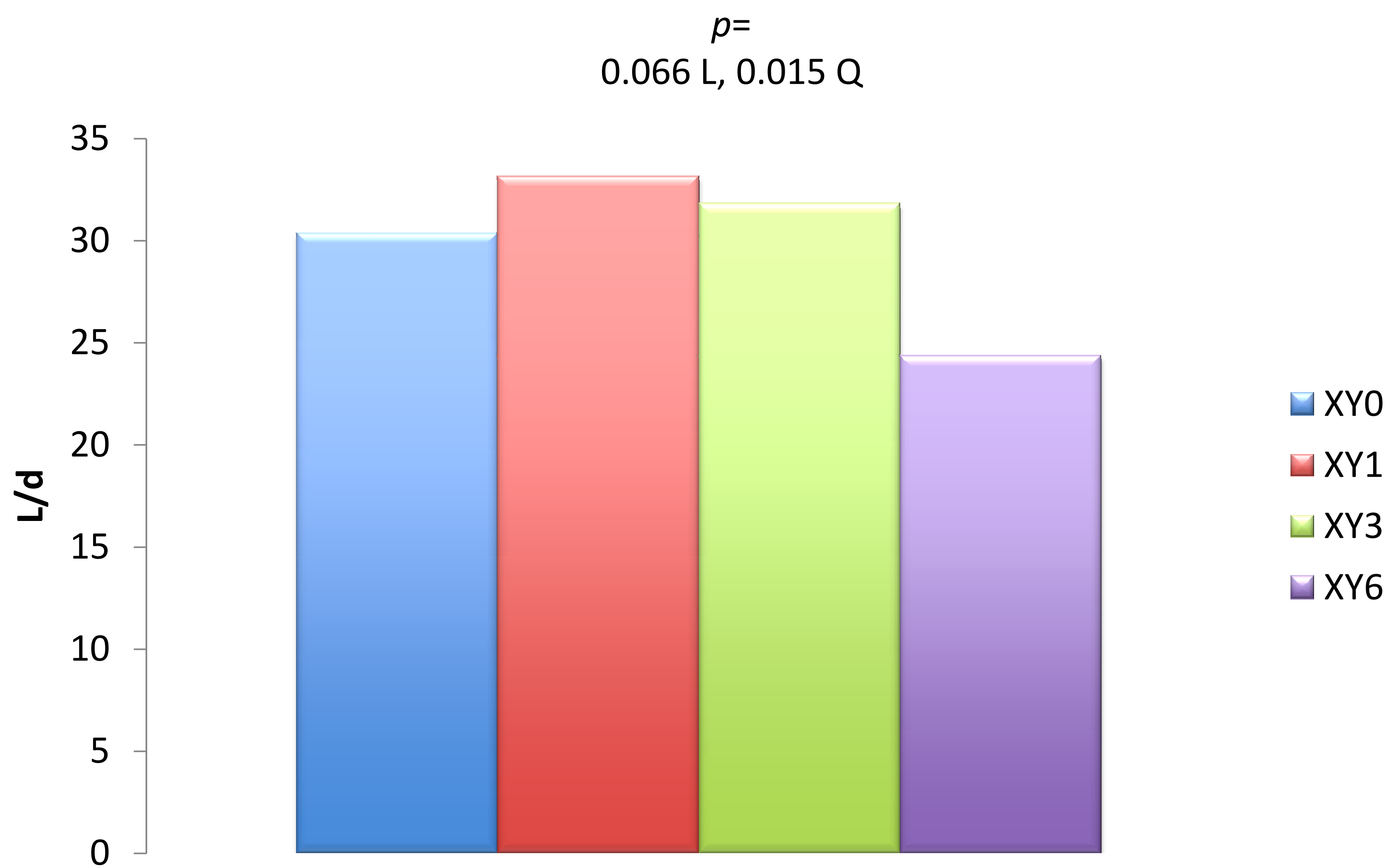

Fig. 21. Methane of rumen fermentation of Rambouillet sheep fed on a basal diet with different doses of xylanase (XY, µL /g DM of the basal diet) (n=4)

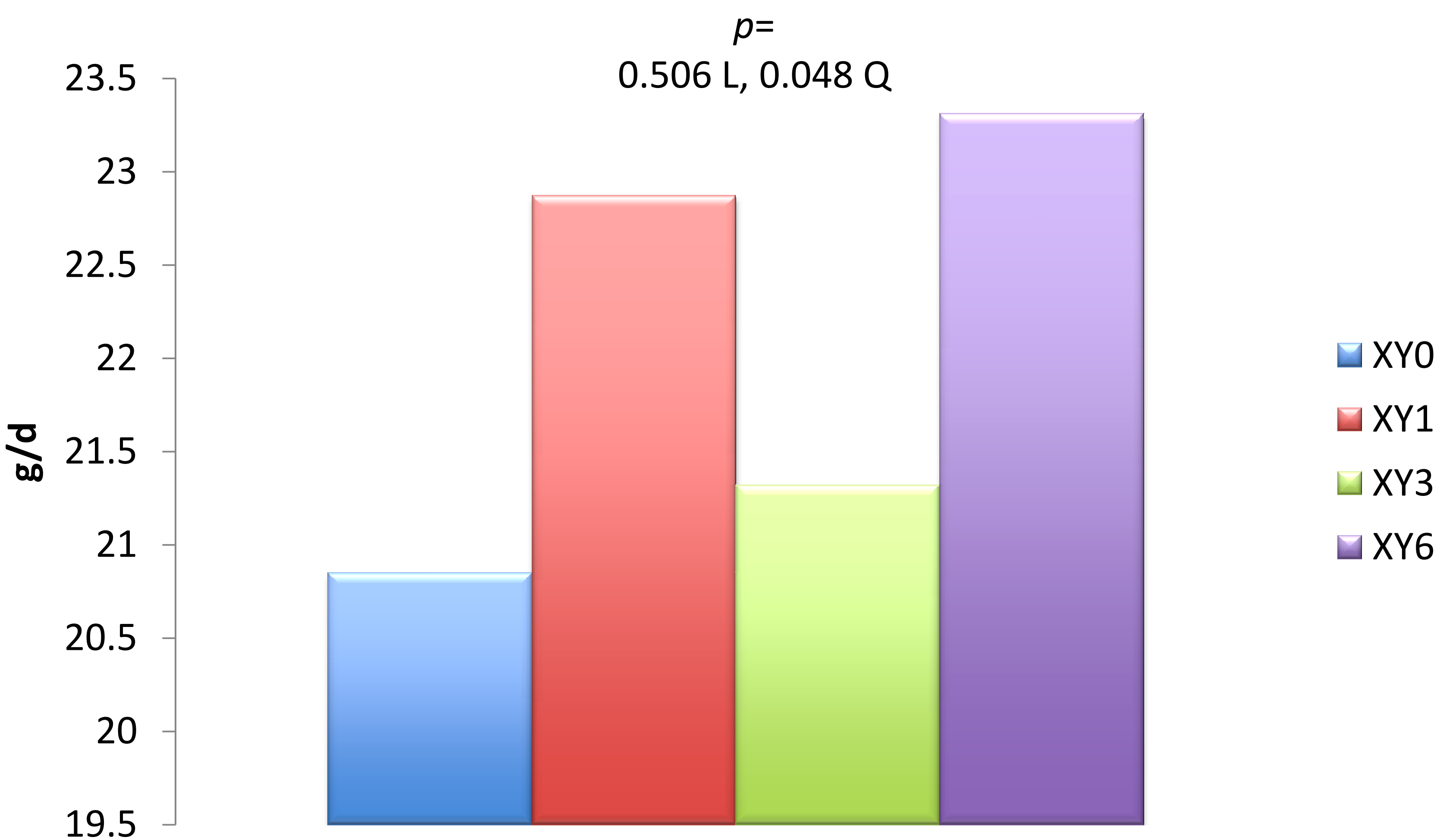

Fig. 16. Microbial PC of rumen fermentation of Rambouillet sheep fed on a basal diet with different doses of xylanase (XY, µL /g DM of the basal diet) (n=4)

Conclusion

The levels of 3 and 6 µL xylanase/g DM of the basal diet had the highest nutrient digestibility and ruminal fermentation parameters. However, 6 µL xylanase/g DM of the basal diet of Rambouillet sheep elevated ruminal ammonia-N and individual VFA compared to the other levels.