THE IMPACT OF XYLANASE, PHYTASE AND THEIR COMBINATION ON PERFORMANCE, NUTRIENT UTILIZATION AND NITROGEN/ENERGY BALANCE IN NILE TILAPIA *Oreochromis niloticus*

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Introduction

The expected future growth of the aquaculture sector increases the pressure of using more sustainable and novel feed ingredients in aqua feeds (Tacon & Metian 2015). However, with the inclusion of plant ingredients such as soybean and rapeseed meal, the content of non-starch polysaccharides (NSP) as well as phytate will increase in the fish feed. Both NSP and phytate are undesired in feed formulation due to their anti-nutritional properties (Choct 1997; Francis *et al.* 2001; Sihna *et al.* 2011).

Recently, the use of exogenous carbohydrase enzymes and phytase in aqua feeds is getting more attention. Multiple responses have been addressed to exogenous carbohydrase enzyme and phytase supplementation like improved feed intake, improved growth rate and nutrient digestibility (Castillo & Gatlin 2015; Goda *et al.* 2012; Lin & Tan 2007; Pimentel-Rodrigues & Oliva-Teles 2007). However, besides the nutrient digestibility and improved growth, enzymes might improve energy availability in general. This i.e. by lower energetic cost for digestion. However, in fish information is lacking on the impact of enzyme application on the growth composition and energy partitioning and balance. In addition, synergy between different types of dietary enzymes regarding their impact on the performance of fish is expected.

The main objective of the presented study is to assess the impact of exogenous enzyme supplementation to the diet on body composition and energy partitioning in Nile tilapia. This was tested using xylanase and phytase in a two by two factorial arrangement, to quantify the individual effects and synergistic effects of the two enzymes

Materials & Methods

A recirculating aquaculture system was used, resulting in a common water supply and ensuring the same water quality for the inflow of each tank. Four experimental diets were formulated according to a 2 x 2 factorial arrangement, using the enzymes phytase and xylanase as factor. This resulted in a control diet (CON) without enzymes, phytase diet (PHY, Buttiauxella-phytase at 1000 FTU/kg), xylanase diet (XYL, included at 4000 U/kg; Danisco Animal Nutrition/ Dupont, UK) and a diet with both xylanase and phytase (PHY+XYL). The protein in the diets is of plant origin, sunflower meal, rapeseed meal and wheat DDGS were included to increase the amount of NSP and phytate in the diet. In total 24 tanks (6 replicates/treatment) were used with 30 tilapia/tank. with initial mean body weight of 42 g. Fish were restrictively fed twice daily with the experimental diets for 38 days. Growth rate, body composition, digestibility and the energy, nitrogen and phosphorus balances were measured.

Results

Both phytase and xylanase supplementation enhanced growth and improved the FCR ($P<0.05$), with the combination of the two resulting in the greatest improvement of growth (g/d; $P<0.05$; Figure 1), and the strongest reduction in FCR, although not significant ($P>0.05$). The FCR of the diet (1.15; control) was reduced to 1.13, 1.04 and 0.99 with xylanase, phytase and xylanase + phytase supplementation, respectively. Supplementation of phytase improved apparent digestibility coefficient (ADC) of DM, CP, carbohydrates, energy, ash, phosphorus and calcium ($P<0.001$). The supplementation of xylanase enhanced the digestibility of DM, CP, carbohydrates and energy ($P<0.05$). An interaction between phytase and xylanase was found for growth, N retention and energy retention as protein. The synergetic effect of the combination of phytase and xylanase on the performance was not reflected in the digestibility (Figure 2; $P>0.05$). Energy and Nitrogen balance measurements showed that the synergistic effect on growth was predominantly due the synergistic effect on the energy retained as protein (Figure 3).

Conclusion

Supplementation of both phytase and xylanase showed to be an effective tool to improve nutrient digestibility and enhance growth in Nile tilapia. The combination of phytase and xylanase resulted in synergetic effect on growth, most likely due to the interaction effect on energy retention as protein.

Key words: Nile tilapia, enzymes, energy balance

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Figure 1. Effect of phytase, xylanase and their combination on growth in Nile Tilapia

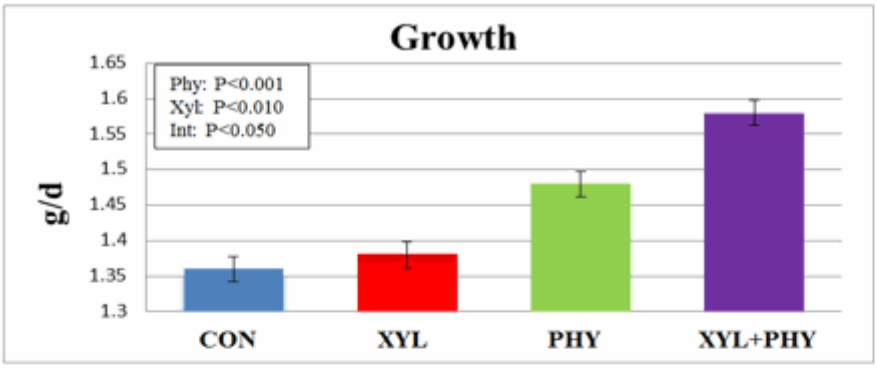

Figure 2. Effect of phytase, xylanase and their combination on energy retained as protein in Nile Tilapia

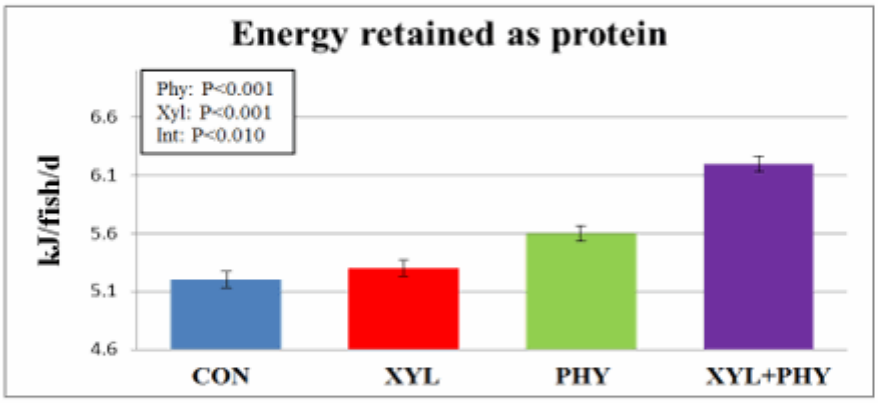

Figure 3. Effect of phytase, xylanase and their combination on protein digestibility in Nile Tilapia