

# EFFECT OF VARYING DIETARY NON PROTEIN ENERGY LEVEL AND SOURCE ON ENERGY UTILIZATION EFFICIENCY IN COMMON CARP (*CYPRINUS CARPIO*)

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## Introduction

The diversification in fish feed ingredient composition is expected to increase due to the limited availability of fishmeal and fish oil as dietary protein and fat sources. This diversification has been seen through the substantial amount of ingredients from oilseeds, pulses and cereals in fish diets, which increases the variability in dietary nutrient composition. Moreover, the dietary carbohydrate content of fish diets will inevitably increase. Energy evaluation in fish feed formulation assumes that the utilization of energy of digestible energy (DE) for growth ( $\text{kg}_{\text{DE}}$ ) is a fixed value without considering differences induced by dietary macronutrient composition. However, in Nile tilapia it was found that changing diet composition (dietary starch replacing dietary fat) would change  $\text{kg}_{\text{DE}}$  (Schrama et al., 2012). The current study investigated whether the digestible energy originating from different types of non-protein energy sources (starch vs. fat) will affect the utilization of energy for growth ( $\text{kg}_{\text{DE}}$ ) and in Common carp.

## Materials and method

Triplicate aquaria were randomly assigned to one of 8 experimental treatments, which were arranged in a 2x4 factorial design: two feeding levels (low vs. high, respectively 50% and 90% of satiation) and four diets. The experiment was run in 2 trials. For the four diets, a contrast in both starch and fat content of the diets were made. Control diet was formulated to meet all the essential requirements for carp. This diet then was supplemented with 300 g starch (Starch); or 125 g fat (Fat) or both 300 g starch and 125 g fat (Fat|Starch). Fish were fed twice daily at (9:00 and 15:00 hours). From the relationship between retained energy (RE) and DE, ( $\text{kg}_{\text{DE}}$ ) and digestible energy for maintenance ( $\text{DE}_m$ ) was estimated. At the start of each trial, carp of mixed sex were randomly divided over 12, 200L tanks. The initial density was 35 fish per tank and fish weight was 29 g. All tanks were connected to the same recirculation system and water quality was kept within the optimal range for common carp. Each trial lasted 4 weeks for measuring energy and nitrogen balances. During the last 2 weeks faeces were collected per tank for measuring nutrient digestibility.

## Results

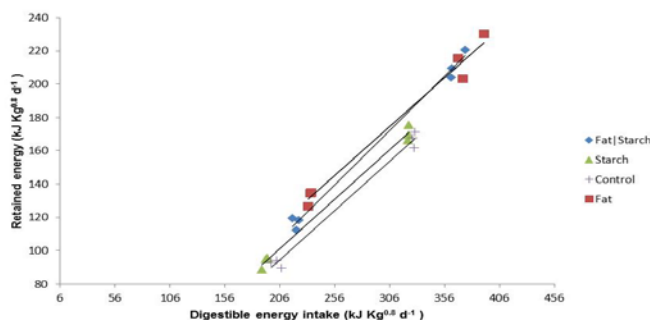


Fig. 1. The relation between retained energy and digestible energy intake in Common carp (*Cyprinus carpio*) fed diets differing in the type of non protein energy source: Control, Fat, Starch and Fat|Starch. The estimated regression lines at all diets are given in equations 1- 4.

$$\begin{aligned} \text{RE (Control)} &= -30.208(\text{SE}\pm 8.92)+0.611*\text{DE}(\text{SE}\pm 0.03) & R^2=0.986 & (1) \\ \text{RE (Fat)} &= -5.776(\text{SE}\pm 12.59)+0.591*\text{DE}(\text{SE}\pm 0.04) & R^2=0.983 & (2) \\ \text{RE (Starch)} &= -22.339(\text{SE}\pm 12.21)+0.603*\text{DE}(\text{SE}\pm 0.05) & R^2=0.994 & (3) \\ \text{RE (Fat|Starch)} &= -28.035(\text{SE}\pm 12.30)+0.659*\text{DE}(\text{SE}\pm 0.04) & R^2=0.994 & (4) \end{aligned}$$

The digestible energy requirements for maintenance was 49.4, 9.8, 37.1 and 42.5 kJ kg<sup>-0.8</sup> d<sup>-1</sup>. For the Control, Fat, Starch and Fat|Starch diets, respectively.

## Discussion and conclusion

The utilization efficiency of energy for growth found in the current study (about 60 %) is lower compared to what was found in Common carp (about 76%) by (Schwarz and Kirchgeßner, 1995) but comparable to Mirror carp (Meyer- Burgdorf et al., 1989). However, the composition of the non protein energy source led only to numerical differences between treatments. However, when looking at energy balance data, we found differences in retained energy between the treatments (P<0.001). Theoretically, it is expected that the production of ATP is more efficient when glucose is used as the substrate (Blaxter, 1989), therefore, kg<sub>DE</sub> would increase with increasing dietary carbohydrates content. However, when glucose is used as substrate for de novo fat synthesis, kg<sub>DE</sub> would decrease. This might explain the similar kg<sub>DE</sub> in the control, fat and starch diets and the numerically higher kg<sub>DE</sub> for fish fed the fat|starch diet. In other words this might indicate that when combining starch and fat into the diet, fat is used for fat synthesis and starch is used as substrate for ATP production. Although not significant the observed numerical differences between diets suggest that kg<sub>DE</sub> is affected by the type of digested macronutrients. Currently, the data are analysed for estimating a net energy formula for carp.

## References

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