UTILIZATION OF AN AGRICULTURAL BYPRODUCT (CORN DDGS) IN COMMON CARP AQUAFEEDS

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Introduction

Replacement of costly marine protein sources with cheaper vegetable origin is an important and urgent issue of the present aquaculture. Evaluation of nutritional value of novel ingredients is however required for considering their potential to be included in least-cost feed formulation, and furthermore their effect on growth, feed utilization and health in fish. In the present study corn DDGS, a by-product from corn ethanol production have been investigated in the diets of common carp (*Cyprinus carpio*). Thereby, the objective of the experiment was to evaluate the nutrient availability of DDGS, especially the apparent digestibility of crude protein and macroelements in the diets for carp juveniles kept at two different water temperatures. The optimum water temperature for growth and propagation of common carp is 20–25 °C, but is necessary testing the conformity of fish to the rising environmental abiotic conditions.

Materials and Methods

Two extruded feeds were produced at Nofimas Feed Technology Centre (NOFIMA, Norway): a control feed with 60 % fish meal and a experimental feed composed of mixing 70 % of the formulated control feed with 30 % DDGS. As inert marker yttrium oxide was added to the feed. The diets contained respectively 44 and 40 % crude protein, and 18 kJ gross energy.

The feeds was used in a whole-diet substitution experiment for study of DDGS digestibility in Common carp at two different water temperatures (20 °C and 30 °C) for 4 weeks in a RAS system (NARIC, Hungary). Juvenile carp at 40 g was randomly distributed into 1 m^3 capacity tanks (30 fish/tank). The feeds were fed to triplicate tanks by automatic feeders. At the end of trial was there performed growth parameter measures, feed conversion rate calculation and pooled faeces samples were collected. Faeces were lyophilised and analysis for dry matter, crude protein, gross energy, phosphorous and yttrium oxide. Compositions of feed and faces determined digestibility of the control diet for the calculations of digestibility of the DDGS ingredient. The apparent digestibility coefficients (ADC) were calculated with formula published by Bureau et al (1999). To compare and evaluate results one- and two-way analyses of variance (ANOVA) in the SPSS 13.0 for Windows statistics software have been applied. The statistical IDs marked with different letters mean the significance level of $p<0.05$.

Results & Discussion

The 20 degrees Celsius DDGS group has the best growth parameters of all with significant difference between the diets and temperature. A similar result can be observed in the case of feed conversion ratio and specific growth rate (FCR, SGR), however, significant difference is exhibited only on a temperature basis. On the other hand, feeds do differ significantly in their PER values on 20 °C (1.08 g/g for control, 1.35 g/g for DDGS group, respectively).

The dry matter digestibility coefficient was between 66-76 % and was significantly different between the diets and water temperatures with the exception of the control. The experimental diet's phosphorus digestibility stands between 51 and 56 %. This value is nearly identical to the one determined for the rainbow trout (*Oncorhynchus mykiss*) in

the case of 25-50 % of DDGS in feed (Overland et al., 2013). ADC values on a lower temperature level are higher for both diets in contrast to those recorded at 30 degrees Celsius. This tendency is also visible in the case of protein and phosphorus.

DDGS feed ingredient's protein digestibility have been found between 83-87 %, which is somewhat higher compared to corn grain in the case of carp (80,64 %), but less than digestibility of wheat (91,89%) (Degani et al., 1997). The measured phosphorus digestibility of DDGS stands in the range 76-80 %, while the soy protein concentrate's value is 25-29 %, and the herring meal has a digestibility coefficient of 34 % (Kim et al., 1998).

The results support the evidence that the 30 degrees Celsius water temperature contributed to worst growth parameters compared to those kept at 20 degrees Celsius water. Carp can digest corn DDGS similarly to corn meal from the aspect of protein and dry matter according to the calculated apparent digestibility coefficients (ADCs). However, DDGS possesses phosphorus content, which is suitable for carp.

According to our results, DDGS is a good diet ingredient in complex diets for juvenile stage carps, since the tested experimental diet did not influence growth in a negative way and The calculated digestibility coefficient values support the assumption, that juvenile carp digest and utilize the 30 % DDGS diet nearly as good as they process fish meal-based diets.

References
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