Examination of the Potential of a Mycotoxin Deactivation Product to Improve Growth and Nutrient Utilization in Juvenile Rainbow Trout (Oncorhynchus mykiss) Fed High Protein Distiller Dried Grains

Chris G. Hooley*, Kurt A. Rosenstrater, T. Gibson Gaylord, Frederic T. Barrows and Wendy M. Sealey

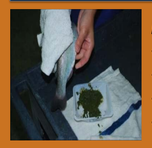
Introduction

Dried distiller grains (DDGS)
- A byproduct of the ethanol industry
- Of increasing interest as a protein source for numerous fish species (Cheng and Hardy, 2004)

Concerns about using DDGS as animal feed
- Detectable mycotoxins in DDGS (Garcia et al., 2008; Wu and Munkvold, 2008)
- Variability in DDGS quality
- These factors could explain previously observed limitations in the utilization of DDGS as a fishmeal replacement by rainbow trout.

The purpose of the current study was:
- To determine apparent digestibility coefficients (ADCs) for three DDGS products
- To determine whether a mycotoxin deactivation product could improve the ability of DDGS to replace fishmeal in rainbow trout diets.

Materials & Methods



***In Vivo* Digestibility Trial**
- Three DDGS products (Wentworth, Valero, HPDDG)
- 70:30 blend with reference diet
- 15-300g fish/tank; Fed 2 wks
- Fish manually stripped to collect fecal matter

Feeding Trial 1
- 2x2 Factorial design
  - Protein source
    - Fishmeal or 50:50 FM:HPDDG
  - Biofix-plus (Biomin)
    - With 0.2% and without
- Diets (Table 1) and Feeding
  - 40% digestible protein and 20% crude lipid
  - Balanced for digestible lysine, methionine and threonine and P
  - Fed twice daily to apparent satiation
- Fish and Culture Conditions
  - 30 fish/ tank (32.9 ± 1.0g)
  - 15°C recirculating system
  - 13:11 diurnal lighting
  - 8 wks

Table 1. Diets for feeding trials

Ingredient (%DM)	FM	HPDDG
HPDDG	0.0	23.8
FM Average	24.9	13.5
Wheat flour	17.7	3.0
Corn Protein	5.0	5.0
Poultry blood meal	3.1	3.2
Soybean meal	14.9	15.1
Chicken concentrate	14.2	14.4
Menhaden fish oil	13.7	13.5
Lecithin	0.9	0.9
Stay-C 35	0.2	0.2
Vitamin premix ARS	0.9	0.9
TM ARS 640	0.1	0.1
NaCl	0.3	0.3
Magnesium Oxide	0.1	0.1
Potassium chloride	0.5	0.5
Choline Cl 50%	0.9	0.9
Taurine	0.5	0.5
Ytrium	0.1	0.1
Dical Phosphate	0.0	1.2
DL-Methionine	0.4	0.5
Lysine HCl	1.5	1.9
Threonine	0.1	0.2

Feeding Trial 2
- Feed from Trial 1 was re-pelleted
- Feeding trial repeated as described above

Pellet Quality Determinations
- Pellet Durability Index
  - Holman pellet quality analyzer
  - 50g feed sample, 60sec
- Percent fines: Sifting for two min, 2.5 mm screen

Statistical Analyses

Factorial analysis of variance was performed using SAS version 9.1 (SAS Institute Inc., Cary, NC, USA). Tukey's means separations were used to determine differences within main effects (Tukey 1953). Treatment effects were considered significant at P<0.05.

Abstract

Two proposed explanations for the decreased performance of rainbow trout fed DDGS include trout-specific sensitivity to variability in DDGS protein digestibility, and potential low-level mycotoxin contamination. Therefore, the objectives of the current study were to compare digestibility values of three DDG products and then determine if the DDG product with the best available nutrient profile can replace fish meal in practical-type rainbow trout diets when supplemented with a mycotoxin deactivator.

The first phase of the study consisted of an *in vivo* digestibility trial using two DDGS products (Valero and Wentworth) and a high-protein DDG (HPDDG, Poet) to determine apparent digestibility coefficients (ADCs) for protein, lipid, energy, DM as well as phosphorus and amino acid apparent availability coefficients (AACs). A 2 X 2 factorial feeding trial that examined protein source (menhaden fish meal (MFM) or HPDDG) with or without Biofix-plus (Biomin USA Inc., San Antonio, TX) was then conducted. Diets were fed to four replicate tanks of juvenile rainbow trout per treatment, initial weight (39.2g ± 1.0g), for nine weeks in a 15°C recirculating system. However, because a significant amount of fines were observed during the first feeding trial, diets were ground and re-pelleted and a second feeding trial that utilized the same methods and controlled for pellet quality was performed.

The digestibility trial indicated that protein ADCs for Wentworth, Valero and HPDDG were high at 81, 88, and 83%, respectively. Results from the first feeding trial demonstrated significant negative effects for fish meal replacement by HPDDG on growth (P<0.0002) and FCR (P<0.0001) and no benefit of Biofix- plus supplementation. However, at the conclusion of the second feeding trial, no negative effects of fishmeal replacement on growth (P=0.5861) or FCR (P=0.5031). These data indicate that when rainbow trout diets are balanced for digestible proteinand pellet quality is maintained, 50% of dietary fishmeal can be successfully replaced by a high quality DDG product without compromising growth or necessitating mycotoxin deactivator inclusion.

Results

In Vivo Digestibility

Table 2. DDGS Proximate Composition

(%DM)	HPDDG	Valero	Wentworth
Dry Matter	93.5	85.8	84.3
Protein	40.8	30.5	32.5
Lipid	5.4	10.5	12.9
Energy (kcal/kg)	5335	5452	5705
Phosphorus	0.4	0.9	1.0

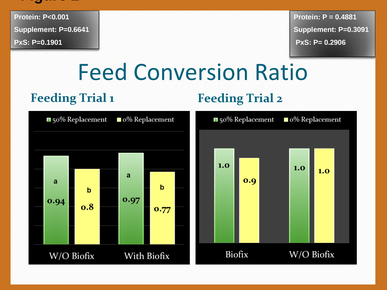
Table 3. DDGS Apparent Digestibility

ADCs	HPDDG	Valero	Wentworth
Dry Matter	52	50	40
Protein	79	79	83
Lipid	83	88	81
Energy (kcal/kg)	59	59	54
Phosphorus	80	91	78

Feeding Trials

Figure 1

Figure 2



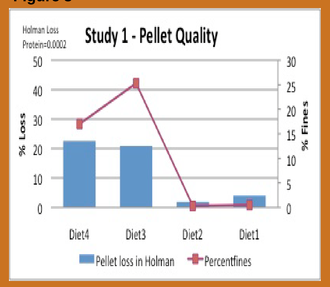
Discussion

Compromised pellet quality in study one likely explains the different results between the feeding trials.

- Significant increases in fines (P=0.004) and loss (P<0.002) were observed in diets containing HPDDG in study one.
- After re-pelleting the diets for study two, fines were not different (P>0.05) between the diets (data not shown).

Pellet Quality

Figure 3



Substantial "fines" were observed for the HPDDG containing diets (right) in Study 1.

Conclusion

The results from the current study demonstrated that when rainbow trout diets are balanced for digestible protein, lysine, methionine and threonine that 50% of dietary fishmeal can be successfully replaced by a HPDDG product without compromising growth or necessitating mycotoxin deactivator inclusion. However, alterations in the feed manufacturing process may be necessary to ensure that the amount of fines is minimized.

Funding Acknowledgement

Funding for this study was provided by the Western Regional Aquaculture Center through a grant from USDA, NIFA.

References

Cheng, Z.J. and R.W. Hardy. 2004. Nutritional value of diets containing distiller's dried grain with solubles for rainbow trout. *Oncoryhynchus mykiss*. J. Applied Aquaculture.15: 101-113.

Garcia, P., B. Martinez, J. M. Obeso, and A. Rodriguez. 2008. Bacteriophages and their application in food safety. Lett. Appl. Microbiol. 47: 479-485.

Stone, D.A., Hardy, R.W., Barrows, F.T., and Z.J. Cheng. 2005. Effects of extrusion on nutritional value of diets containing corn gluten meal and corn distiller's dried grain for rainbow trout, *Oncorhynchus mykiss*. J. Appl. Aquac. 17: 1–20.

Wu F, and G.P. Munkvold. 2008. Mycotoxins in ethanol co-products: modeling economic impacts on the livestock industry and management strategies. J Agric Food Chem. 11: 3900-3911.