View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Lincoln University: Blue Tiger Commons@LincolnU

Lincoln University
Blue Tiger Commons@LincolnU

Cooperative Extension Research Publications

Cooperative Extension and Research

1-5-2016

The Distribution of α-Amylase Activity along the Digestive Tract of Juvenile Bluegill (Lepomis macrochirus) and its Comparison with Selected Fish Species

Namrata Giri

Yongfang Zhang

Gregory A. Dudenhoeffer

Thomas R. Omara-Alwala

Follow this and additional works at: https://bluetigercommons.lincolnu.edu/lucer-pubs

Part of the Aquaculture and Fisheries Commons

Recommended Citation

Giri, Namrata; Zhang, Yongfang; Dudenhoeffer, Gregory A.; and Omara-Alwala, Thomas R., "The Distribution of α-Amylase Activity along the Digestive Tract of Juvenile Bluegill (Lepomis macrochirus) and its Comparison with Selected Fish Species" (2016). *Cooperative Extension Research Publications*. 5.
https://bluetigercommons.lincolnu.edu/lucer-pubs/5

This Book is brought to you for free and open access by the Cooperative Extension and Research at Blue Tiger Commons@LincolnU. It has been accepted for inclusion in Cooperative Extension Research Publications by an authorized administrator of Blue Tiger Commons@LincolnU. For more information, please contact MartinD2@lincolnu.edu.

The Distribution of α-Amylase Activity along the Digestive Tract of Juvenile Bluegill (*Lepomis macrochirus*) and its Comparison with Selected Fish Species

N. Giri, Y. Zhang, G. A. Dudenhoeffer, T. R. Omara-Alwala
Department of Agriculture and Environmental Science, Lincoln University in Missouri, Jefferson City, MO 65101

Abstract

Carbohydrates are the least expensive form of dietary energy for animals. Although fish don't have specific requirements for dietary carbohydrates, they must be provided with the appropriate levels of carbohydrates in their diets. Moderate levels of carbohydrate could support fish better growth performance and may decrease the use of the more expensive protein and lipids in the diet. Different fish have different ability to utilize digestible carbohydrates, which may relate to the relative amount of amylase activity present in the digestive systems of the various species. α-amylase is a key enzyme for carbohydrate digestion. Bluegill, an important forage and recreational as well as a newly emerged food fish, is the most commonly produced sunfish in the North Central Region. Information on the digestive amylase activity and the dietary carbohydrates utilization in Bluegill is lacking. The objective of this study was to determine the distribution of α-amylase activity along the digestive tract of juvenile Bluegill and to compare its activity with selected fish species. The α-amylase analysis followed Worthington (1993) with a slight modification. α-amylase was detected in the stomach, pyloric cecum, proximal intestine, mid intestine and distal intestine in Bluegill. The lowest α-amylase activity was found in the stomach. No difference in α-amylase activity among three parts of intestine was detected. α-amylase activity in Bluegill along the digestive tract is higher than that in Black Crappie, but significantly lower than that in Grass Carp ($p<0.05$). Knowledge of α amylase may provide useful information for estimating the carbohydrates level for juvenile Bluegill diets.

Introduction

Bluegills are common and highly prized game fish throughout the United States. Food production of Bluegill has increased recently. No diets specifically developed for Bluegill exist at this time (Masagounder et al., 2011). The Bluegill producers generally use trout or catfish diets, which could cause high body fat deposition or poor growth (Tidwell et al., 1992). Carbohydrates are excellent sources of dietary energy for animals and can reduce feed cost by replacing a portion of the more expensive proteins and lipids in a diet. Fish do not have specific requirements for dietary carbohydrates. Their ability to utilize carbohydrates is relatively limited compared to poultry and farm mammals (NRC, 2011).The amount of α-amylase activity present in fish digestive system may relate to the carbohydrates utilization of the species. The information about the digestive amylase activity and the dietary carbohydrates utilization of bluegill is lacking.

Objectives

- To determine the distribution of α-amylase activity along the digestive tract of juvenile Bluegill
- To compare α-amylase activity in Bluegill with Grass Carp *(Ctenopharyngodon idella)* and Black Crappie (*Pomoxis nigromaculatus)*

Materials and Methods

- Experimental Fish

✓Bluegill , Black Crappie and Grass Carp

✓Fish body weight and total body length were measured

- Tissue Sample Analysis:

✓Digestive tissue analyzed was the stomach and the pyloric cecum of the Bluegill and Black Crappie ; and the proximal, mid and distal intestines of the three species

✓Three pools of above digestive tissue were analyzed for each species. The pools consisted of eight Bluegill , eight Black Crappie and three GrassCarp

✓Tissue samples were homogenized with a Polytron and the homogenates supernatant collected and stored at – 80 ^{0}C

✓ Activity of a-amylase was evaluated by using a modified method of Worthington (1993)

✓Maltose was used as a standard at 540 nm absorbance

✓Soluble protein was determined by the Bradford method

✓(Bradford, 1976), using bovine serum albumin as the standard

- Statistical Analysis:

✓A one-way analysis of variance (ANOVA) at $P<0.05$ was used for the analysis of the data using SAS software, Version 9.1 of the SAS System for Windows

Results

Table 1. The body weight (g) and total body length (mm) of juvenile fish

Fish species	Average Weight (g)	Average Length (mm)
Bluegill	24.86	109.23
Black Crappie	43.38	140.71
Grass Carp	128.01	231.19

Figure 1. α-amylase activity(Umg^{-1}Protein)along the digestive tract of Bluegill

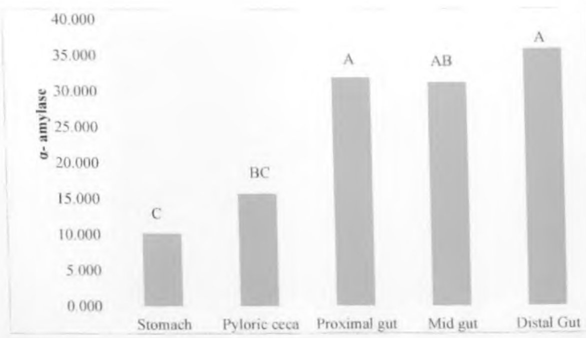


Figure 2. α- amylase activity (Umg^{-1}Protein) along the digestive tract of Black Crappie

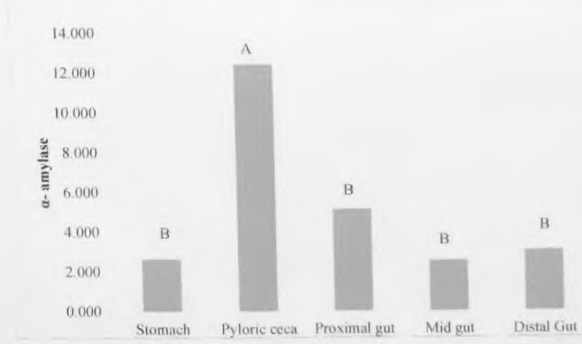


Figure 3. α- amylase activity (Umg^{-1}Protein) along the digestive tract of Grass Carp

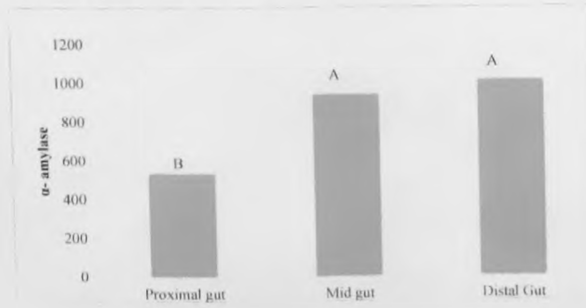


Figure 4. α- amylase activity(Umg^{-1}Protein)in stomach

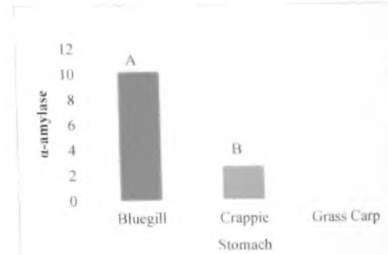


Figure 5. α- amylase activity (Umg^{-1}Protein) in pyloric ceca

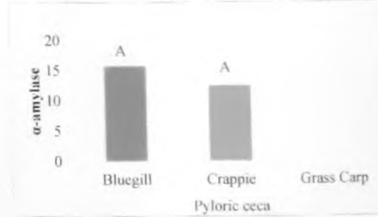


Figure 6. α-amylase activity (Umg^{-1}Protein) in proximal intestine

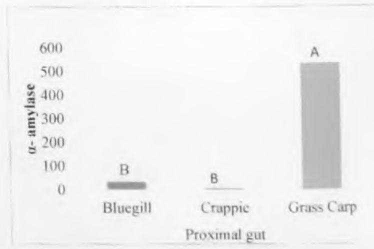


Figure 7. α-amylase activity (Umg^{-1}Protein) in mid intestine

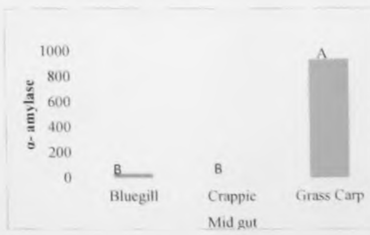
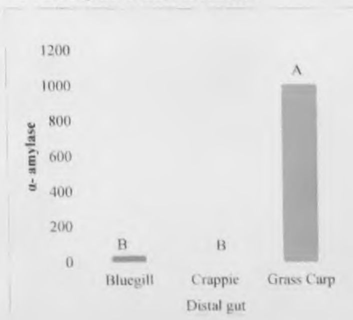


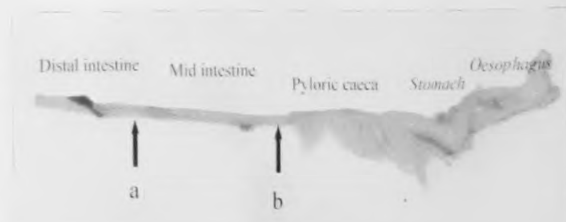
Figure 8. α-amylase activity (Umg^{-1}Protein) in distal intestine



Bluegill

Grass Carp

Black Crappie



Different parts of a digestive tract in Fish

Discussion

✓Alpha-amylase was detected in the stomach, pyloric cecum, proximal intestine, mid intestine and distal intestine of Bluegill

✓The activity of α-amylase in intestine was higher than that in the stomach and pyloric ceca of Bluegill

✓The activity of α-amylase in bluegill was much lower than the activity in Grass Carp but higher than the activity in Black Crappie

Conclusion

✓Alpha-amylase activity is present in all parts of Bluegill digestive tract

✓The study suggested that Bluegill had the capacity to utilize carbohydrates. However, the levels of utilization of carbohydrates were significantly less than observed in Grass Carp but higher than in of Black Crappie

Acknowledgements

This study was supported in part by the USDA/NIFA Evans-Allen Cooperative Research and Institutions Capacity Building Grants., Lincoln University in Missouri, Jefferson City.

Literature Cited

Bradford, M.M. (1976) A dye binding assay for protein. *Anal. Biochem.* 72, 248-254.

Masagounder K., Hayward R.S. and Firman J.D., 2011.Volume 17,pages e559–e571. Comparison of dietary amino acid requirements determined from group housed versus individually housed juvenile bluegill, Lepomis macrochirus. Aquaculture Nutrition.

National Research Council, 2011. Nutrient Requirements of Fish and Shrimp. National Academy of Sciences. Washington, DC, USA

Tidwell James H., Webster Carl D. and Clark Julia A., 1992. Growth, Feed Conversion, and Protein Utilization of Female Green Sunfish × Male Bluegill Hybrids Fed Isocaloric Diets with Different Protein Levels. Volume 54, pages 234-239.

Worthington V,1993. Alpha amylase. In: Worthington Enzyme Manual. Worthington Biochemical Corp. Freehold, NJ, pp. 36-4