1-4-2016

Amino Acid Profiles in the Tissues of Juvenile Bluegill (Lepomis Macrochirus) from the Wild and Commercially-fed Fish

Yongfang Zhang

Gregory A. Dudenhoeffer

Namrata Giri

James E. Wetzel

Amino Acid Profiles in the Tissues of Juvenile Bluegill (*Lepomis Macrochirus*) from the Wild and Commercially-fed Fish

Yongfang Zhang, Gregory A. Dudenhoeffer, Namrata Giri, James Wetzel and Thomas R. Omara-Alwala

Department of Agriculture and Environmental Sciences, Lincoln University of Missouri, Jefferson city, MO, 65102

Abstract

Amino acid profiles of fish tissues and fish eggs have been extensively investigated in some fish species. Amino acid profiles are helpful in quantifying the indispensable amino acid requirements for these fish. Bluegill is a major forage fish for the largemouth bass (*Micropterus salmoides*) and an important recreational fish throughout the US. The demand for bluegill as a food fish has increased recently. However, the information on the amino acid profiles of its eggs and tissues is lacking. The objective of this study was to determine the amino acid profiles of the muscles and whole body of the 1-2 g wild and the commercially fed bluegill. Wild fish were obtained from the ponds that relied on the natural food source. Commercially fed fish were grown indoors. Skinless muscles were obtained by dissecting both sides of 1-2 g bluegill. The results showed that lysine was the most abundant indispensable amino acids in muscles and whole body of both the wild and the farm-raised fish. The proportion of an individual indispensable amino acid to the sum of all detectable amino acids amount was similar for whole body and muscles in wild or raised fish. For whole body or muscle tissue, wild fish contained significantly higher crude protein but lower crude lipid levels than farm-raised bluegill ($p<0.05$). This study suggested that nutritional history affected tissue proximate compositions

Introduction

Bluegill (*Lepomis macrochirus*) is a promising aquaculture species in the North Central Region of the United States, due to its status as a popular sport fish, an important forage fish and recently as a food fish (Ali & Aayne, 1987; Brunson & Morris, 2000). Large-scale productions of this fish require the use of artificial diets for their optimal growth. The information of this species nutrient requirement, including indispensable amino acids (IDAA) requirement, is still lacking (NRC, 2011). The amino acid profiles of fish eggs and tissues have been extensively investigated in some fish species (Wilson, 2003). Such information is useful for quantifying the IDAA requirements of these fish. However, the information about the amino acid profiles of the bluegill eggs, muscles and whole-body tissues is lacking. Knowledge of the amino acid profiles is helpful in the studying of the IDAA requirements for bluegill and other promising aquaculture sunfish species. Therefore, the objective of this study was to determine the amino acid profiles of the eggs, the muscle and the whole body of 1-2 g wild or the commercially fed bluegill.

Materials and Methods

Collection of fish and fish eggs

- ✓ Bluegill eggs were collected by dissection from brood fish held at the Lincoln University (LU) Aquaculture Facility
- ✓ Commercially fed bluegill were obtained from within the LU Aquaculture Facility
- ✓ Wild bluegill of 1-2 g were seined from ponds and relied on the natural forage within the pond
- ✓ Skinless muscles were obtained by dissecting both sides of 1-2 g bluegill.
- ✓ The eggs, muscle and whole-fish samples were frozen on dry ice right away and stored at -80 ^{0}C

Chemical analysis

- ✓ *Proximate analysis* Crude proteins were analyzed by the micro-Kjeldahl method. Crude lipids were estimated using the ether extraction method (AOAC, 2000).
- ✓ *Amino acid analysis* Amino acid full profiles of the samples were analyzed by the method of cation-exchange chromatograph (cIEC-HPLC) coupled with post-column ninhydrin derivatization and quantitation, performed by Agricultural Experiment Station Chemical Lab at University of Missouri-Columbia.

Data analysis

Data were analyzed by a One-way ANOVA at $p<0.05$.

Conclusion

1. Nutritional history affected bluegill tissue crude protein and crude lipid contents.
2. Amino acids profile of bluegill eggs was different from that of whole body and muscle tissues.

Results

Table 1. *Crude protein and lipid contents (dry matter) of eggs, whole body and muscles of bluegill farm-raised or wild caught*

Fish Tissues	Crude Protein (%)	Crude Lipid (%)
R-WH[1]	49.33 ± 0.11^{e}	35.84 ± 0.72^{a}
R-M[2]	83.23 ± 0.08^{b}	11.32 ± 0.25^{d}
W-WH[3]	70.12 ± 0.30^{c}	12.20 ± 0.23^{c}
W-M[4]	90.90 ± 0.05^{a}	1.87 ± 0.40^{e}
Egg	67.55 ± 0.13^{d}	19.26 ± 0.12^{b}

Values are means ± SD. N=3. Means not sharing similar superscript within a column are significantly different ($p<0.05$)
[1]the whole body of raised fish; [2]the muscle of raised fish; [3] the whole body of wild fish; [4] the muscle of wild fish

Table 2. *Indispensable amino acids (IDAA) profiles of eggs, whole body and muscles of bluegill farm-raised or wild-caught (% total amino acids)*

IDAA	R-WH1	R-M2	W-WH3	W-M4	Egg
Thr	4.26 ± 0.02^{a}	4.50 ± 0.02^{b}	4.38 ± 0.03^{c}	4.54 ± 0.02^{d}	4.95 ± 0.02^{e}
Met+Cys	3.88 ± 0.13^{bc}	4.00 ± 0.01^{a}	3.78 ± 0.02^{c}	3.92 ± 0.02^{ab}	3.95 ± 0.01^{ab}
Val	5.00 ± 0.01^{c}	5.24 ± 0.00^{b}	4.90 ± 0.02^{d}	5.27 ± 0.03^{b}	6.85 ± 0.02^{a}
Ile	4.31 ± 0.02^{d}	4.91 ± 0.01^{c}	4.34 ± 0.03^{d}	5.00 ± 0.02^{b}	6.25 ± 0.06^{a}
Leu	7.44 ± 0.04^{c}	8.38 ± 0.01^{b}	7.51 ± 0.07^{c}	8.42 ± 0.03^{b}	8.96 ± 0.02^{a}
Phe+Tyr	7.04 ± 0.02^{e}	7.67 ± 0.01^{c}	7.25 ± 0.05^{d}	7.83 ± 0.08^{b}	8.12 ± 0.13^{a}
Lys	8.53 ± 0.02^{b}	9.57 ± 0.02^{a}	8.53 ± 0.07^{b}	9.56 ± 0.02^{a}	7.42 ± 0.02^{c}
His	2.85 ± 0.02^{c}	2.96 ± 0.01^{b}	2.74 ± 0.02^{d}	3.02 ± 0.01^{a}	2.63 ± 0.05^{e}
Arg	6.22 ± 0.02^{b}	6.07 ± 0.01^{c}	6.23 ± 0.03^{b}	5.91 ± 0.02^{d}	6.34 ± 0.03^{a}
Trp	0.91 ± 0.06^{c}	1.09 ± 0.02^{b}	0.94 ± 0.01^{c}	1.06 ± 0.02^{b}	1.35 ± 0.06^{a}

Values are means ± SD. N=3. Means not sharing similar superscript within a row are significantly different ($p<0.05$). [1]the whole body of raised fish; [2]the muscle of raised fish; [3] the whole body of wild fish; [4] the muscle of wild fish

Table 3. *Dispensable amino acids (DAA) profiles of eggs, whole body and muscles of bluegill farm-raised or wild-caught (% total amino acids)*

DAA	R-WH[1]	R-M[2]	W-WH[3]	W-M[4]	Egg
Tau	2.09 ± 0.01^{b}	2.16 ± 0.01^{a}	2.03 ± 0.03^{c}	1.99 ± 0.01^{d}	0.33 ± 0.01^{e}
H-Pro	1.60 ± 0.16^{a}	0.36 ± 0.04^{b}	1.48 ± 0.15^{a}	0.37 ± 0.08^{b}	0.18 ± 0.08^{b}
Asp	9.66 ± 0.02^{d}	10.56 ± 0.05^{b}	9.92 ± 0.06^{c}	10.66 ± 0.03^{a}	8.94 ± 0.03^{e}
Ser	3.76 ± 0.01^{c}	3.56 ± 0.03^{d}	3.87 ± 0.01^{b}	3.44 ± 0.01^{e}	6.01 ± 0.04^{a}
Glu	13.44 ± 0.05^{c}	14.49 ± 0.03^{a}	13.38 ± 0.05^{c}	14.26 ± 0.04^{b}	11.97 ± 0.04^{d}
Pro	4.57 ± 0.06^{a}	3.23 ± 0.04^{c}	4.46 ± 0.05^{b}	3.22 ± 0.05^{c}	4.39 ± 0.02^{b}
Gly	7.21 ± 0.04^{a}	4.69 ± 0.03^{c}	7.18 ± 0.16^{a}	4.89 ± 0.05^{b}	3.54 ± 0.03^{d}
Ala	6.35 ± 0.02^{c}	6.10 ± 0.01^{e}	6.47 ± 0.02^{b}	6.24 ± 0.00^{d}	7.63 ± 0.02^{a}
H-Lys	0.29 ± 0.01^{a}	0.09 ± 0.00^{c}	0.27 ± 0.01^{a}	0.08 ± 0.01^{c}	0.17 ± 0.02^{b}
Orn	0.09 ± 0.00^{b}	0.09 ± 0.01^{b}	0.09 ± 0.00^{b}	0.13 ± 0.00^{a}	0.03 ± 0.01^{c}

Values are means ± SD. N=3. Means not sharing similar superscript within a row are significantly different ($p<0.05$). [1]the whole body of raised fish; [2]the muscle of raised fish; [3] the whole body of wild fish; [4] the muscle of wild fish

Discussion

1. Wild bluegill had significantly higher crude protein but lower crude lipid levels than raised bluegill ($p<0.05$) for whole body or muscle tissues.
2. Lysine was the most abundant indispensable amino acids in the muscles and whole body of both wild and farm-raised fish, except in eggs.
3. Indispensable amino acids profile of eggs significantly differed from that of whole body and muscle from wild or farm-raised fish

Acknowledgements

This study was supported by USDA/NIFA through Capacity Building Grant research project. The project No. is MOLU-OMARA-2014-CBG.

References

1. Ali, A.B., and D.R. Bayne. 1987. Food related problems in bluegill population of West Point Reservoir. Proceedings of the Annual Conference South-eastern Association of Fish and Wildlife Agencies. 39 (1985):207-216
2. AOAC. 2000 Official Methods of Analysis. Association of Official Analytical Chemists, Arlington, VA.
3. Brunson, M.W., and J.E. Morris. 2000. Species profile: sunfish. Southern Regional Aquaculture Center. Delta Research and Extension Center, Publication 724, Stoneville, Mississippi.
4. NRC (National Research Council). *Nutrient Requirements of Fish and Shrimp*. Washington, DC: National Academy of Sciences, 2011.
5. Wilson, R.P., 2003. Amino acid requirement in fish and crustaceans. In: D'Mello, J.P.F.D. (Ed.), Amino acids in animal nutrition. CABI Publishing, UK, pp. 427–447