

IV. TERMINATION REPORTS

A. EFFECT OF NUTRITION ON BODY COMPOSITION AND SUBSEQUENT STORAGE QUALITY OF FARM-RAISED CHANNEL CATFISH

Termination Report
For the Period
May 2, 1989 to December 31, 1992

University of Georgia
Food Science
& Technology

J.J. Jen
Y.W. Huang
D.A. Lillard
P.E. Koehler
R. Eitenmiller

Ga. Exp. Station,
Griffin, Ga.
Coastal Plains Exp.
Station, Tifton, Ga.

M. Erickson
G. Burtle

FUNDING LEVEL:

Year 1	\$275,000
Year 2	\$275,000
Year 3	\$275,000
Total	\$825,000

ADMINISTRATIVE ADVISOR:

Gale A. Buchanan
Associate Director
Georgia Agricultural Experiment Station
Tifton, Georgia

PARTICIPANTS:

Auburn University (Lead Institution)	
Fisheries	R.T. Lovell
Agric. Economics	Upton Hatch
Kentucky State University	
Aquaculture Research Center	J.H. Tidwell C. Webster
Louisiana State University	
Forestry, Wildlife & Fisheries	R.C. Reigh
Food Science	J.S. Godber
Mississippi State University	
Delta Research and Extension Center	E.H. Robinson
Biochemistry	R.P. Wilson
Wildlife & Fisheries	H.R. Robinette
Agri. Economics	J.E. Waldrop
Food Science & Human Nutrition	J.Hearnberger
Texas A & M University	
Wildlife & Fisheries Sciences	D.M. Gatlin

PROJECT OBJECTIVES:

1. Determine effects of diet composition and feeding strategies (energy, protein and type and amount of lipid) on yield, dressing percentage, body fat, subsequent frozen storage quality and profitability of catfish grown to 0.5-1.0 kg (1-2 lb) sizes under conditions that reflect management practices used by most of the catfish industry.

2. Determine effects of finisher diets or alternative feeding rates and schedules on yield, dressing percentage, body fat, subsequent frozen storage quality and profitability of catfish grown to 0.5-1.0 kg (1-2 lb) sizes under conditions that reflect management practices used by most of the catfish industry.

3. Determine effects of diet supplements on chemistry and sensory qualities of fat in fish flesh and stability of fish during subsequent frozen storage.

4. Develop procedures for disseminating these findings to appropriate clientele groups.

ANTICIPATED BENEFITS:

The research conducted in this project showed that varying protein and/or energy in practical catfish feeds can influence fat in the fish, but this does not significantly affect frozen keeping quality of the processed fish. The research also showed effects of various protein levels in catfish feeds on pond production under various feeding strategies which fish farmers can use to make economic decisions on feeds. The study showed that fish size has much more effect on body fat content than diet, and large fish have a great amount of fat on the outside of the muscle which if removed during skinning will reduce autoxidation of the frozen flesh. Increasing dietary vitamin E will reduce autoxidation of the fish muscle in low temperature storage.

PROGRESS:

OBJECTIVE 1

Reducing protein in practical feeds to 24 to 26% (and thereby increasing energy/protein ratio) did not cause a reduction in growth but caused a slight increase in body fat, but this change in fat did not affect frozen keeping quality.

OBJECTIVE 2

Raising or lowering the protein content of finishing feeds (fed the last 4 weeks of grow-out period) did not affect growth or body composition of the fish.

OBJECTIVE 3

Vitamin E fed at four times the dietary requirement protected the lipids in catfish muscle from autoxidation during abused (high temperature) frozen storage conditions. Adding various commercial antioxidants, lysine and carnitine, to the diet did not affect autoxidation of muscle lipids during storage.

OBJECTIVE 4

An extension fact sheet, "Channel Catfish Production--Impacts of Diet Composition and Feeding Practices" (SRAC #187) has been

prepared which describes major findings of this project in practical language. Many publications in technical and trade journals have been prepared and are listed at the end of this report (pages 9-12).

IMPACTS:

Results from this project have indicated to the catfish industry that protein, or protein/energy ratio, in catfish feeds can be decreased without reducing fish production and with no effect on frozen storage quality of the processed fish. This has allowed the protein percentage to be reduced in commercial feed from 32 to 28% which lowers the cost approximately \$10 per ton. In 1992, many farmers changed to the lower protein feed. One large feed mill reported that 30% of the feed manufactured in 1992 was 28% protein as compared to less than 10% the previous year.

The study demonstrated to processors that large catfish have a thick layer of fat on the surface of the muscle and that removing this will enhance frozen storage quality. Processors have adjusted skinning machines to remove this layer of fat from the fish.

This funding has initiated research in various areas of catfish nutrition and processing at several institutions which has been continued with other funding. An example is the University of Georgia, Food Science Department, which was not previously involved in catfish research but has 16 publications on processing (listed below) from this project and is continuing research in this area.

PUBLICATIONS:

Bai, S. C. and D. M. Gatlin, III. 1993. Dietary vitamin E concentration and duration of feeding affect tissue-tocopherol concentrations of channel catfish (*Ictalurus punctatus*). *Aquaculture* 113:129-135.

Bai, S. C. and D. M. Gatlin, III. 1993. Effects of L-lysine supplementation of diets with

different protein levels and sources on channel catfish, (*Ictalurus punctatus*) (Rafinesque). Aquaculture Fish Mgmt. In press.

Bai, S. C. and D. M. Gatlin, III. 1992. Dietary rutin has limited synergistic effects on vitamin C nutrition of fingerling channel catfish (*Ictalurus punctatus*). Fish Physiology and Biochemistry 10:183-188.

Erickson, M. C. Compositional parameters and their relationship to oxidative stability of channel catfish. J. Agric. Food Chem. In press.

Erickson, M. C. 1992. Variation of lipid and tocopherol composition in three strains of channel catfish (*Ictalurus punctatus*). J. Sci. Food Agric. In press.

Erickson, M. C. and S. T. Thed. 1992. Storage stability of tilapia in relation to lipid and tocopherol composition. Proc. 16th Ann. Tropical Subtropical Fisheries Tech. Conf., Sept. 29 - Oct. 3, 1991, Raleigh, NC. pp. 129-137.

Erickson, M. C. 1991. Acceleration of lipid oxidation during cooking of refrigerated minced channel catfish muscle. 4th Chemical Congress of North America. August 25-30, New York, NY. Abstract. Paper 124.

Erickson, M. C. 1991. Extraction and quantitation of tocopherol in raw and cooked channel catfish. J. Food Sci. 56:1113-1114.

Erickson, M. C. 1991. Frozen storage stability of two channel catfish strains. Annual Meeting of Institute of Food Technologists. June 2-5, Dallas, Texas. Abstract. p. 145.

Erickson, M. C. 1991. Measurements of oxidative stability in frozen stored channel catfish. Proc. 19th Annual Catfish Processors Workshop, Jan. 9, 1991. Mississippi State University Information Bulletin 209, pp. 1-6.

Erickson, M. C. 1991. Susceptibility of

striped bass and hybrid striped bass to oxidation during frozen storage. 88th Annual Meeting Southern Association of Agric. Scientists, Food Science and Human Nutrition Section, Feb. 3-6, Fort Worth, Texas. Abstract. pp. 14-15.

Gatlin, D. M., III, and S. C. Bai. 1992. Effects of dietary lipid and reduced glutathione on composition and storage quality of channel catfish, (*Ictalurus punctatus*). Aquaculture Fish Mgmt. 24:425-431.

Gatlin, D. M., III, S. C. Bai, and M. C. Erickson. 1992. Effects of dietary vitamin E and synthetic antioxidants on composition and storage quality of channel catfish, (*Ictalurus punctatus*). Aquaculture 106: In press.

Huang, Y. W., R. T. Lovell and R. A. Dunham. 1993. Carcass characteristics of channel and channel-blue hybrid catfish, and subsequent quality changes during storage. J. Food Science. In press.

Huang, Y. W., C. K. Leung, M. A. Harrison, and K. W. Gates. 1992. Fate of *Listeria monocytogenes* and *Aeromonas hydrophila* on catfish fillets cooked in a microwave oven. Abstract. Annual Meeting Institute of Food Technologists. June 20-24, New Orleans, La.

Huang, Y. W., P. E. Koehler, R. R. Eitenmiller, and D. A. Lillard. 1992. Effects of film overwrapping, vacuum packaging and vacuum skin packaging on psychrotrophic counts and chemical changes on iced channel catfish. J. Food Processing & Preservation. 16:205-213.

Huang, Y. W. and C. K. Leung. 1992. Microbiological assessment of channel catfish grown in cage and pond culture. J. Food Microbiology. In press.

Huang, Y. W., D. A. Lillard, R. R. Eitenmiller, and P. E. Koehler. 1992. Frozen stability of channel catfish as affected by feed, packaging method, and storage temperature. Abstract.

Annual Meeting Institute of Food Technologists.
June 20-24, New Orleans, La.

Huang, Y. W., P. E. Koehler, R. R. Eitenmiller, and D. A. Lillard. 1991. Effect of packaging on storage quality of iced catfish. Proc. Tropical and Subtropical Fisheries Tech. Conf. of the Americas. University of Florida, Gainesville, Fl. pp. 362-368.

Huang, Y. W., R. R. Eitenmiller, D. A. Lillard and P. E. Koehler. 1991. Storage quality of iced channel catfish fed different protein levels. Journal of Food Quality 14:345-354.

Huang, Y. W., D. A. Lillard, P. E. Koehler and R. R. Eitenmiller. 1991. Chemical changes and sensory evaluation of channel catfish as affected by diet, method of packaging and frozen storage. Journal of Food Quality.

Huang, Y. W., P. E. Koehler, R. R. Eitenmiller and D. A. Lillard. 1991. Quality improvement of packaged channel catfish fed diets containing various levels of protein during iced storage. Journal of Food Quality.

Huang, Y. W. and M. Zheng. 1991. Chemical, microbiological and sensory qualities of vacuum skin packaged channel catfish stored at 4°C. Abstract. Annual Meeting of Institute of Food Technologists. June 1-5, Dallas, Texas.

Huang, Y. W., R. R. Eitenmiller, D. A. Lillard and P. E. Koehler. 1991. Chemical microbial quality of packaged fresh and frozen farm-raised catfish. Abstract. 8th World Congress of Food Science and Technology, September 29 - October 4, Toronto, Canada.

Leung, C. K., Y. W. Huang, and M. A. Harrison. 1992. Fate of *Listeria monocytogenes* and *Aeromonas hydrophila* on packaged channel catfish fillets stored at 4°C. J. Food Protection 55:728-730.

Leung, C. K. 1991. Microbiological method

and further processing and packaging conditions. M.S. Thesis. University of Georgia, Athens, GA.

Li, Menghe and R. T. Lovell. 1992. Comparison of satiate feeding and restricted feeding of channel catfish with various concentrations of dietary protein in production ponds. Aquaculture 103:165-175.

Li, Menghe and R. T. Lovell. 1992. Growth, feed efficiency and body composition of second and third year channel catfish fed various concentrations of dietary protein to satiety in production ponds. Aquaculture 103:153-163.

Li, Menghe and R. T. Lovell. 1992. Response of channel catfish to variable concentrations of dietary protein. Alabama Agric. Exp. Station, Auburn University, Al., 22 pp.

Li, Menghe and R. T. Lovell. 1992. Effect of dietary protein concentration on nitrogenous waste in intensively fed catfish ponds. J. World Aqua. Soc.

Li, Menge and R. T. Lovell. 1991. Comparison of second and third year catfish for feed conversion, dress-out and muscle composition. Progressive Fish-Culturist.

Liu, Q. Interaction of supplementary carintine and lysine on growth, tissue lipid and protein content of fingerling channel catfish. M.S. Thesis. University of Georgia.

Munsiri, Prasert and R. T. Lovell. 1992. Comparison of satiate and restricted feeding of channel catfish with diets of varying protein quality in production ponds. Journal World Aquaculture Society. Submitted for publication.

Reigh, R. C. 1990. Effects of diet on body composition and storage quality of farm-raised catfish. Pages 34-36, Proceedings of the Louisiana Aquaculture Conference 1990. La. State University Agric. Center, Baton Rouge, La.

Robinson, E. H. and H. R. Robinette. 1992. Effects of dietary protein level and feeding regimen on growth and on fattiness of channel catfish, (*Ictalurus punctatus*). J. Applied Aqua. In press.

Alleger, Max, Delbert Gatlin and J. T. Davis. 1993. Channel Catfish Production--Impacts of Diet Composition and Feeding Practices. SRAC Publication No. 187.

Stowell, S. L. and D. M. Gatlin, III. 1992. Effects of dietary pantethine and lipid levels on growth and body composition of channel catfish, (*Ictalurus punctatus*). Aquaculture 108:177-188.

Stowell, S. L. 1991. Effects of dietary pantethine and lipid on growth and body composition of channel catfish. M.S. Thesis. Texas A&M University, College Station, Texas. 32 pp.

Tidwell, J. H., C. D. Webster, and Clark, J. A. 1992. Effects of feeding, starvation, and refeeding on the fatty acid composition of channel catfish, (*Ictalurus punctatus*), tissues. Comp. Biochem. Physiology 103:365-368.

Tidwell, J. H., C. D. Webster, and J. A. Clark. 1991. Proximate and fatty acid composition of channel catfish, (*Ictalurus punctatus*), during feeding, starvation, and refeeding. Abstracts of Annual Meeting of the World Aquaculture Society, San Juan, Puerto Rico, p. 62.

Webster, C. D., J. H. Tidwell, L. S. Goodgame, J. A. Clark, and D. H. Yancy. In review. Effect of starvation on fatty acid composition of muscle, liver, and abdominal fat in channel catfish, *Ictalurus punctatus*. J. World Aqua. Soc.

Webster, C. D., J. H. Tidwell, and D. H. Yancy. 1992. Effect of feeding diet with two protein levels at two feeding frequencies on growth and body composition in cage-reared channel catfish. Prog. Fish-Cult. 54:92-96.

Webster, C. D., J. H. Tidwell, J. A. Clark, and D. H. Yancy. 1992. Effects of feeding diets

containing 34 or 38% protein at two feeding frequencies on growth and body composition of channel catfish. J. Appl. Aqua. 1(3):67-80.

Webster, C. D., J. H. Tidwell, L. S. Goodgame, J. A. Clark, and D. H. Yancy. 1992. Effects of protein level and feeding frequency on growth and body composition of third year channel catfish reared in ponds. Abstracts of Annual meeting of the World Aquaculture Society, Orlando, Florida, p. 229.

Zidack, W., U. Hatch, R. T. Lovell, and Menghe Li. 1992. Economics of feeding different percentages of protein at restricted and satiation rates in channel catfish production: A case study analysis of experimental results. J. World Aqua. Soc. Submitted for publication.

B. HARVESTING, LOADING AND GRADING SYSTEMS FOR CULTURED FRESHWATER FINFISHES AND CRUSTACEANS

Termination Report

For the Period

May 2, 1989 to April 30, 1993

FUNDING LEVEL:

Year 1	\$125,000
Year 2	\$125,000
Year 3	\$125,000
Total	\$375,000

PARTICIPANTS:

Louisiana State University (Lead Institution) -
Robert P. Romaine, T. B. Lawson,
J. L. Avery

Auburn University - J. W. Jensen, John M.
Grizzle, L. L. Lovshin, R. K. Goodman

Clemson University - John A. Collier,
Thomas E. Schwedler