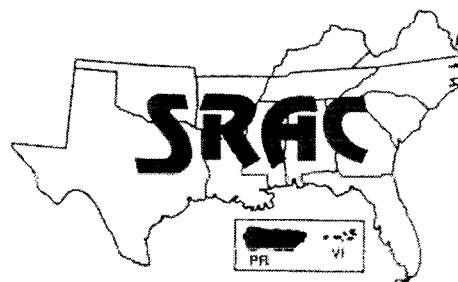


**Southern  
Regional  
Aquaculture  
Center**



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## Channel Catfish

### Dietary Effects on Body Composition and Storage Quality

Catfish diets must provide enough energy, protein, vitamins and minerals in the proper proportions for fast, efficient growth and health maintenance. Choosing the right feed plays an important role in determining the productivity and profitability of aquaculture operations. But, producers aren't the only people who are interested in diet quality. Certain characteristics of the diet influence the quality of catfish products during processing and storage. As a result, catfish processors, wholesale marketers and retailers also depend on proper feed quality to yield desirable results.

#### Effects of dietary protein

Because excess fat decreases the dress-out yield and potential shelf-life of processed catfish, questions regarding the impact of diet composition on product quality have arisen. Research projects evaluated the effects of dietary protein content on body composition of various-sized catfish in different production systems.

#### Catfish grow-out in ponds

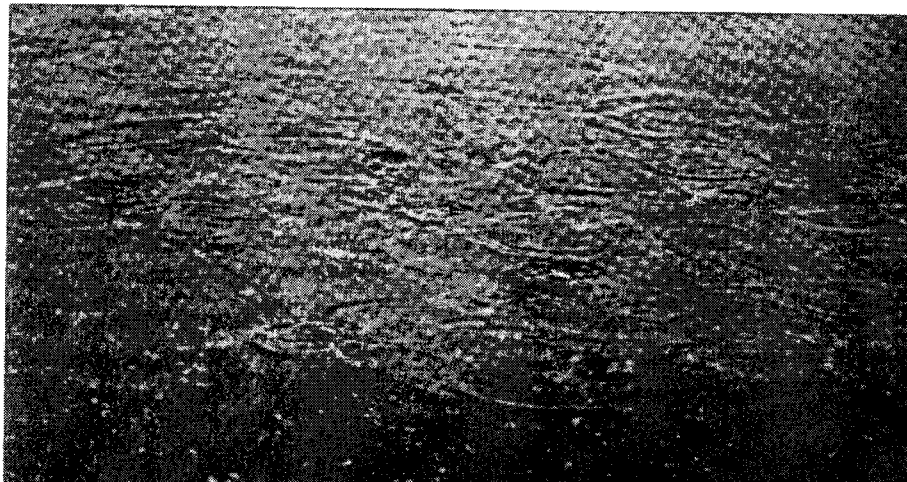
At Kentucky State University, fingerlings stocked in intensively managed ponds were fed commercial-type diets containing 34 or 38 percent protein to satiation once or twice daily. At the end of 170 days

*The Southern Regional Aquaculture Center has supported research to determine how diet affects the composition and quality of processed channel catfish products. The results of these research projects should help producers and processors modify management practices to improve the value and marketability of their products. This publication was compiled by James T. Davis, D.M. Gatlin, III and Max R. Alleger, based on research conducted at Auburn University, University of Georgia, Kentucky State University and Texas A&M University. Details are available from the applicable publications listed.*

the fish weighed an average of 1 pound. Results of this experiment indicated that neither feeding frequency nor protein content of the

diet within this range affected growth or important body composition characteristics such as fat content or fillet yield.

In an Auburn University study, fingerlings were fed commercial-type diets containing 26, 32 or 36 percent protein for 125 days on either a restricted basis or to satiation. Dressing percentage increased as dietary protein was increased from 26 to 32 percent, but then decreased as protein concentration was increased to 36 percent. Whether fed on a restricted basis or to satiation, body fat decreased as the diet's protein level increased. Body fat content of fish fed to satiation was higher than those fed on a restricted basis,



**Choosing the right feed plays an important part in profitability of aquaculture operations.**

suggesting that feeding rate does influence important body composition variables.

Another study conducted at Auburn University measured the effects of feeding commercial-type diets containing 24,28,32,36 or 40 percent protein to fingerlings in ponds. Fingerlings were fed to an average of 1 pound in 151 days. They were fed to satiation once daily during the growing season. Dressing percentage increased as dietary protein was increased from 24 to 36 percent, but decreased when increased to 40 percent. Fat content in fillets decreased, while protein and moisture increased when dietary protein was increased.

### **Conclusions**

These studies suggest that fillet yield may improve as dietary protein is increased up to 36 percent, and that feeding to satiation may increase body fat concentrations. However, the same studies suggest that producers can save money without sacrificing weight gain by feeding diets that contain much less than 36 percent protein. These trade-offs between economic savings and potential changes in product quality deserve further attention, especially if fat content and other body composition characteristics are proven to reduce the quality and consumer acceptance of catfish products.

### **Catfish grow-out in cages**

Cage culture offers an opportunity to produce fish in ponds that may be poorly suited for conventional pond culture because of their size, depth or the presence of other fish. However, successful cage culture also provides unique management challenges to the producer.

A study conducted at Kentucky State University focused on the nutritional needs of fingerling channel catfish stocked in cages. Fish in cages were fed to satiation once or twice daily for 105 days with complete, commercial-type feeds con-

taining either 34 or 38 percent protein.

Body composition of fingerlings in this study was not affected by feeding frequency or dietary protein level. Fish grew faster on the higher protein diet, and fish fed twice daily had a higher dressing percentage than those fed only once per day.

### **Grow-out of third-year fish in ponds**

Little information is available regarding how diet affects the growth or body composition of third-year fish. Studies conducted at Auburn University and Kentucky State University measured the effects of feeding commercial-type diets containing various concentrations of protein to third-year catfish in ponds. Results of these studies indicate that, although body fat decreases when dietary protein is increased, fish growth and dressing percentage were unaffected. It remains unclear whether diets containing more than 32 percent protein improve the quality of fillets from third-year fish enough to justify the accompanying higher feed costs.

### **Supplementing amino acids in catfish diets**

Amino acids are the building blocks of protein; they are essential for good fish growth and weight gain. Several research projects have focused on the effects of specific amino acid supplements in catfish diets. These studies were conducted with catfish fingerlings in aquaria maintained under optimum conditions.

Lysine is one of ten amino acids that must be provided by the diet; it is also the least abundant amino acid in many feedstuffs. As a result, extra care must be taken to provide enough lysine when formulating catfish diets containing a large percentage of protein from plant sources. Also, lysine supplementation above requirement levels has been shown to reduce body

fat of some terrestrial animals. Researchers at Texas A&M University compared diets that contained either 25 or 30 percent protein from soy isolate or casein and gelatin, and either 0 or 0.5 percent supplemental lysine. Fingerlings fed diets with protein from casein and gelatin gained more weight than those fed diets containing soy-based protein. Also, fish fed soy-based diets contained more lipid and less protein than those fed the casein-based diet.

Supplemental lysine improved protein conversion efficiency and feed efficiency of catfish fed soy-based diets, but not of those fed casein-based diets. Fish fed a 30 percent protein soy-based diet without added lysine performed better than those fed a 25 percent protein soy-based diet with extra lysine. However, supplementally lysine did not influence body composition characteristics at any protein level.

Results suggest that both the source and concentration of dietary protein impact catfish performance, and that supplemental lysine does not influence body composition.

Carnitine is a naturally-occurring compound that animals typically produce from lysine. Some research suggests that providing supplemental carnitine in the diet increases the quality of processed animal products by reducing fat content. A study conducted at the University of Georgia compared the benefits of feeding diets that contained 0.1 percent carnitine and 1.1, 1.4 or 1.7 percent lysine. Feeding diets that included both supplemental carnitine and lysine proved most beneficial. When carnitine was added to diets containing lysine close to or above the required dietary level (1.4 and 1.7 percent, respectively), fat content in the viscera and dark muscle tissue decreased and whole-fish protein levels increased.

Results indicate that feeding high-quality diets supplemented with

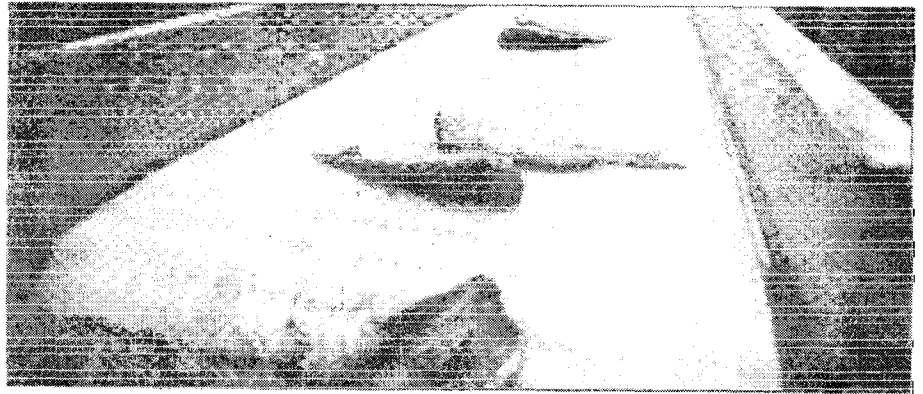
carnitine may reduce body fat content.

## Effects of vitamin fortification

Improved storage quality depends on management practices during grow-out, as well as procedures carried out during and after processing. Storage quality of poultry and some kinds of fish has been improved by feeding diets that increased concentrations of vitamin E in muscle tissues prior to processing. Vitamin E, and similar synthetic products, are called antioxidants because they help reduce lipid oxidation and maintain the freshness of products during storage.

Researchers at Texas A&M University evaluated the benefits of adding synthetic and natural antioxidants to channel catfish diets. Fingerling catfish were fed experimental-type diets that satisfied all known requirements and contained one of two concentrations of vitamin E (60 or 240 mg/kg), either alone, or in combination with one of four synthetic antioxidants. None of the synthetic antioxidants affected weight gain, feed efficiency, survival or tissue composition. Fillet samples from fish receiving each diet were frozen at -10°F for six months. The TBA number, a measure of rancidity caused by oxidation, was determined for fillets to assess how stability during frozen storage was affected by diet composition. Fish fed the higher level of vitamin E had reduced TBA numbers, but synthetic antioxidants did not affect this measure of storage quality.

Fortification of catfish diets with high levels of vitamin E probably offers an effective means of maintaining fillet stability during frozen storage. Results from another study indicate that maximum benefits from vitamin E supplementation are achieved within 2 weeks of feeding a diet fortified with 1,000 mg vitamin E/kg. Feeding diets fortified with this high level of vitamin E throughout the



**Dietary protein concentration does not appear to affect storage quality of catfish fillets.**

grow-out period may be unnecessary.

Vitamin C is essential for normal fish growth and has some properties that allow food products to resist oxidation. Rutin, a compound classified as a bioflavonoid, may produce beneficial responses similar to vitamin C when available in the diet. A Texas A&M University study compared diets containing various concentrations of vitamin C and rutin. By the end of eight weeks, no differences in weight gain, feed efficiency or survival due to diet were observed. But, within 10 weeks, fish fed diets without supplemental vitamin C or rutin had developed deformed spinal columns, external hemorrhages and eroded fins. By week 12, fish receiving supplemental rutin but no vitamin C showed the same symptoms. By the end of 16 weeks all fish that had not received supplemental vitamin C had reduced weight gain and feed efficiency and decreased survival. Rutin had no significant effect on weight gain, feed efficiency or other variables, either alone or when fed with added vitamin C.

According to this study, high concentrations of supplemental vitamin C (1,500 and 3,000 mg/kg) improved the oxidative stability of channel catfish fillets, but supplemental rutin was not beneficial.

## Dietary impacts on storage quality

Studies at the University of Georgia focused on how dietary protein concentration and packaging method may affect the quality of frozen catfish fillets. Year-2 and year-3 catfish stocked in research ponds were fed diets containing 24,28,32,36 or 40 percent protein to an average harvest weight of 3.3 pounds. Upon processing, fillets were packaged using PVDC film overwrapping, vacuum packaging with Eva bags or vacuum skin packaging and stored at -10°F. Fillets were removed from frozen storage after 0, 30 and 90 days for chemical analysis and sensory evaluation. Chemical analyses included pH, TBA number, ammonia and free fatty acid content. A consumer panel evaluated broiled samples for off-flavor, greasiness and texture. Although lower dietary protein increased fillet fat content, it did not directly affect TBA number, pH or sensory attributes. Sensory panelists reported that all fillets became tougher, but greasiness decreased as storage time increased. Packaging treatment did not impact the free fatty acid characteristics of fillets.

Results indicate that lower protein diets may increase the fat content of catfish fillets, but not to a degree that reduces consumer satisfaction. Also, current processing and packaging methods for catfish provide adequate quality protection for up to 3 months of frozen storage.

Another University of Georgia study evaluated the impact of dietary protein on channel catfish stored on ice. Fish were fed to an average size of 3.3 pounds on commercial-type diets containing either 24, 28, 32, 36 or 40 percent protein in production ponds. Fish were processed upon harvest, and fillets were placed on polystyrene trays overwrapped with plastic wrap and stored in drained ice chests.

Sensory and chemical evaluations of iced fillets were conducted after 1, 7, 14 and 21 days. Catfish fed the lowest-protein diet had more body fat than those fed higher-protein diets, but fillet fat content had no direct effects on free fatty acid content during storage. Also, dietary protein did not affect ammonia concentration, pH, TBA number or bacterial counts of fillets stored on ice for up to 2 weeks. Sensory panelists reported that the texture of fish fed the 32 percent protein diet was superior to those fed 36 percent protein after 1 day of storage. After 1 week, fish fed 28 percent protein were more greasy than those fed the other diets, but other differences were not detected.

Results suggest that dietary protein does not influence important quality attributes of channel catfish fillets, and that fillets can be stored on ice for up to 2 weeks without compromising quality.

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