National Program 106 Aquaculture Annual Report for 2018

The **vision** for ARS aquaculture research and technology transfer is *to enable science-based use of our natural resources to meet the seafood demands of a growing global population.*

Mission: The mission of National Program (NP) 106, Aquaculture, is to conduct research and deliver technologies that improve domestic aquaculture production efficiency and product quality while minimizing impacts on natural resources.

The aim of the ARS Aquaculture Program is to support a safe and affordable domestic supply of seafood products for 330 million U.S. consumers that is produced in a healthy, competitive, and sustainable aquaculture sector; a sector supported by more than 3000 aquaculture farmers producing more than $1.4 billion worth of goods annually. In 2013 the USDA National Agricultural Statistics Service published the Census of Aquaculture updating these statistics for the first time since 2005. The report details many features of aquaculture in the United States, and shows that since 2005, the overall number of farms has dropped (from about 4300 to 3090). However, sales in 2016 increased to over $1.5 billion.

Fiscal year 2018 was the fourth year of externally-reviewed five-year project plans (2015- 2019) that fall under the five Components of the 2015 – 2019 National Program NP 106 Aquaculture Action Plan which are:

1. Selective Breeding, Directed Reproduction, and Development of Genomic Tools
2. Nutrient Requirements and Alternative Sources of Protein and Lipid
3. Health of Aquatic Animals
4. Sustainable Production Systems
5. Product Quality and New Products

Although these project plans guide most of the efforts of the laboratories, we remain flexible to respond to unanticipated challenges and opportunities. NP 106 research covers the spectrum from fundamental to applied research and is focused on solving problems through long term high impact research. NP 106 scientists published 86 articles in peer-reviewed scientific journals in fiscal year 2018 along with 9 articles in trade journals and 2 book chapters.

In 2018 NP106 conducted a Retrospective Review where a panel of external experts evaluated the success of the program in meeting Action Plan goals. The panel's report can be found here. In summary the panel provided the following ratings for each Problem Statement in the Action Plan.

Component and Problem Statement	**Impact Rating**
1A Genomics	HIGH IMPACT
1B Breeding	HIGH IMPACT
1C Reproduction	HIGH IMPACT
2 Nutrition	MEDIUM IMPACT
3A Fish Health	HIGH IMPACT
3B Disease Prevention	MEDIUM-HIGH IMPACT
4A RAS and Flow Thru System	HIGH IMPACT
4B Pond Production Systems	HIGH IMPACT
4C Shellfish Production Systems	MEDIUM-HIGH IMPACT
5 Product Quality and New Products	LOW-MEDIUM IMPACT

In 2018 NP106 held listening sessions with stakeholders that led to a revision of the Action Plan for 2020-2024 which is available here.

National Program 106 conducts research through nine different locations on 17 projects performed by approximately 47 ARS scientists and University or private cooperators on 9 congressionally mandated agreements.

During fiscal year 2018, ARS base funding for aquaculture research was approximately $28.3 million, not including incoming funds from grants and agreements. Technology transfer activities included: 1 new patent awarded, 1 new CRADA, 16 new Material Transfer Agreements (MTAs), and 3 new Material Transfer Research Agreements (MTRAs).

NP 106 scientists were active in serving on committees and as advisors/mentors for undergraduate and post-doctoral students and serving as adjunct/affiliate faculty members (Table 1).

TABLE 1. NP-106 scientist participation in mentoring and/or engagement activities.

Student and Other Outreach:	**No.**
Students and Post-Docs	43
SYs Serving as Advisors	2
Mentorships	5
Adjunct or Other Appointments	7
Other Outreach Activities	81

In 2018, NP 106 scientists participated in research collaborations with scientists in the following countries:

BELGIUM:

- Identifying the host-derived factors that govern the susceptibility or resistance to *Flavobacterium columnnare* infection to better understand how this bacterium infects an array of aquaculture species.

- Studying how biofilms are formed by different clinical isolates of F. columnare to better understand how this bacterium infects an array of aquaculture relevant species.

CANADA:

- Providing assistance to Wild-West Steelhead, a commercial trout producer in Canada, with a Weissella ceti (Wc) outbreak occurring at their facility in southwest Saskatchewan.

- Working with the Atlantic Salmon Federation in Canada to organize the 2018 Aquaculture Innovation Workshop to be held in Miami, Florida, December 4-6, 2018.

CHINA:

- Evaluating and developing effective parasiticides for controlling and preventing parasite Ichthyophthirius multifiliis in cultured fish and study fish immune responses against parasites.

DENMARK:

- Providing information on peracetic acid used in aquaculture. Collaboration takes place by phone and email exchanges.

FRANCE:

- Gaining a better understanding of immunity in catfish and ultimately design better vaccines through shared ideas and novel techniques.
- Testing Pacific oyster for resistance to OsHV-1

GERMANY:

- Studying the toxicity/effectiveness of peracetic acid to fish and the effectiveness of this compound to control, *Ichthyophthirius multifiliis*, *Ichthyobodo necator*, *Flavobacterium columnare* and *Saprolegni*a spp. on fish.

ITALY:

- Evaluating and discovering natural compounds with toxicity towards common disease-producing bacteria of pond-raised channel catfish.

NORWAY:

- Determining the feasibility of selectively breeding Nile tilapia for resistance to *Streptococcus* species other tilapia pathogens.
- Working to make closed-containment aquaculture systems a reliable and economically viable technology and identify biological solutions for producing Atlantic salmon.

SPAIN:

- Identifying genotypes and determining the population structure of *Saprolegnia parasitica* world-wide.

Personnel in NP 106

***New additions to the NP 106 team in 2018*:**

Dr. Johnny Shelley, Veterinary Medical Officer, Aquatic Animal Health Research Unit, Auburn, Alabama.

***The following scientists retired from the ranks in NP 106*:**

Dr. Peter Bechtel, Food Processing and Sensory Quality Research, New Orleans, Louisiana.

The distinguished record of Dr. Bechtel is recognized world-wide and he will be missed at NP 106.

The following scientists in NP 106 received prominent awards in 2018:

Dr. Craig Tucker, Stoneville, Mississippi received the 2018 Distinguished Alumnus Award from Humboldt State University.

Dr. Benjamin Beck, Auburn, Alabama, was awarded the Outstanding Alumni Award from the College of Agriculture, Auburn University.

The **National Cold-Water Marine Aquaculture Center,** Franklin, Maine, received the 2018 Mid-Atlantic Regional Excellence in Technology Transfer Award at the Federal Laboratory Consortium Mid-Atlantic Meeting in Rockville, Maryland, on November 14, 2018.

RESEARCH RESULTS

The following section summarizes the specific research results addressing objectives in the current National Program Action Plan.

Component 1: Selective Breeding, Directed Reproduction, and Development of Genomic Tools

Problem Statement 1A: Genomic Tools and Genotype to Phenotype

Rainbow Trout

Gene editing in rainbow trout. Advancements in gene editing technologies have enabled the induction of targeted mutations in genes of interest, allowing for precise manipulation of the genome. ARS researchers at Leetown, West Virginia, have provided the first proof-of-concept for rainbow trout by demonstrating that this technology can produce fish that exhibit a desired trait and that these genetic modifications are transmitted to the next generation via typical reproduction. Gene editing provides a new opportunity to understand gene function and an alternative strategy that can complement other approaches to genetic improvement.

Catfish

Genomic selection for growth and carcass yield in the Delta Select strain of channel catfish. Determining the relative value of an individual fish for breeding has depended on traditional methods that use parentage information and trait measurements. ARS scientists in Stoneville, Mississippi, collaborated with University of Georgia scientists to develop a technology that uses genome information to improve the accuracy of breeding value estimates. This approach led to 30 percent improvement in breeding value accuracy for growth and carcass yield in 2,000 Delta Select strain catfish. The improved breeding value accuracy will result in more rapid genetic gain for growth and carcass yield in the Delta Selects, which will be released to U.S. catfish farmers to improve their production efficiency.

Problem Statement 1B: Define Phenotypes and Develop Genetic Improvement Programs

Catfish

Evaluation of growth and processing yield of blue catfish strains. Blue and channel catfish hybrids now comprise approximately 75 percent of annual U.S. catfish production. As a result, evaluating blue catfish strains for growth and carcass yield has become an important aspect of the breeding program conducted by ARS scientists in Stoneville, Mississippi. In their research, they evaluated six strains of blue catfish and then used the three strains with the best growth and carcass yield in further evaluations. Their results indicated the Rio Grande blue catfish strain was superior to the D&B and Mississippi River strains of blue catfish for growth and carcass yield. The release of a superior blue catfish strain will improve production efficiency of U.S. catfish farmers and processors.

Rainbow Trout

Incubation temperature impacts rainbow trout embryo survival. Incubation temperature is commonly manipulated to control and predict hatch date in salmonids so that suppliers can consistently provide their customers with eyed eggs across the spawning season. However, there is little information on how temperature changes affect embryo survival. ARS scientists in Leetown, West Virginia, found that incubation at 5 degrees Celsius within the first day of fertilization reduced embryo survival around 5 percent compared to incubation at 10 degrees Celsius, and that rapidly transferring embryos between 10 degrees Celsius and 5

degrees Celsius after 100-degree days of incubation did not affect survival. This information suggests that stakeholders should end the practice of initially incubating fertilized eggs at 5 degrees Celsius.

Component 2: Nutrient Requirements and Alternative Protein and Lipid Ingredients

Problem Statement 2A: Determine Nutrient Requirements and Evaluate the Nutritional Value of Alternative Sources of Protein and Lipid

Catfish

Assessment of phytase "super-dosing" in catfish diets. ARS scientists at Stoneville, Mississippi, collaborated with Mississippi State University scientists to conduct two experiments to evaluate responses of hybrid catfish (female *Ictalurus punctatus* × male *Ictalurus furcatus*) to "super-dosing" of phytase added to existing commercial catfish feeds. They found that phytase super-dosing in catfish does not appear to have additional benefits beyond the standard dose, at least for promoting growth and preventing anemia, and also did not improve water quality. Ongoing technology transfer efforts recommend 500 phytase units [FTU/kg] phytase, not "super-dosing," to replace inorganic phosphorus in catfish feeds.

Reducing feed cost for catfish fingerling production. Catfish producers are interested in reducing feed expenses because commercial fingerling feeds that are 35 percent protein can cost up to $600-700 per ton. Reducing protein levels or using less expensive alternative feed ingredients can both reduce feed costs. ARS scientists in Stoneville, Mississippi, and their collaborators conducted a feeding trial in pond-raised hybrid catfish fingerlings to evaluate diets containing different levels of protein and protein sourced from either fish meal or pork meat, bone, and blood meal (PMBB). They found no significant production differences associated with the different feeds. However, they determined that using a feed enhanced with 32 percent fish meal could save producers $20/ton; using a feed enhanced with 35 percent PMBB could save producers $69/ton; and using a feed enhanced with 32 percent PMBB could save producers $89/ton. These savings are equivalent to annual savings of $120, $414, and $532 per acre, respectively, assuming a total use of 6 tons of feed per acre in a growing season. The researchers also noted that some savings can be realized using feed enhanced with 32 percent PMBB, because fish meal is much more expensive than PMBB.

Reducing feed cost for catfish fry production. Although catfish fry initially feed on natural foods available in pond ecosystems such as zooplankton, they typically begin consuming commercial feeds as soon as they are transferred to stocking ponds. Pond studies were conducted on both channel catfish and hybrid fry to determine if transferring them to feeding/stocking ponds could be delayed to save on feed costs without compromising production. Results indicated that delaying channel catfish fry feeding for 5 weeks can save $236/acre in feed costs without compromising production. However, hybrid catfish fry production starts to become affected only 2 weeks after feeding is delayed and saves only $15.69/acre

Tilapia

Phytase enzyme substitutes for inorganic phosphorus in diet for tilapia biofloc production. Fish feed typically is supplemented with inorganic phosphorus to ensure adequate dietary phosphorus availability, especially in diets that contain high percentages of plant feedstuffs. Phosphorus is present in plant feedstuffs as phytate, which is not bioavailable to fish because their digestive system lacks sufficient phytase enzyme. As a result, phytate is excreted unmetabolized and high concentrations subsequently accumulate in biofloc technology production systems because of the high quantities of feed fed daily to fish. In a study conducted in an outdoor biofloc production system, ARS researchers at Stuttgart, Arkansas, found that phytase enzyme can substitute

completely for inorganic phosphorus in fish feed without negatively affecting tilapia growth and that this substitution reduces phosphorus excretion by tilapia by about 50 percent, resulting in improved water quality. Reducing potential phosphorus excretion will help fish farmers meet National Pollutant Discharge Elimination System permit requirements.

Rainbow Trout

Adding value to broken rice. Broken rice is used worldwide to produce significant amounts of high protein rice flour (HPRF). To increase the value of broken rice and to expand its end uses, ARS scientists in Aberdeen, Idaho, assessed the feasibility of using physical (dry) and chemical (wet) methods to increase the protein enrichment of commercial HPRF used in fish feed. Results showed that these processes increased HPRF protein levels more than seven-fold and also increased levels of oil, ash, and phytate. However, when the enriched HPRF is fed to animals (such as farmed fish) in large amounts, the high phytate levels resulted in the unwanted excretion of excess phosphorus. Several options were tested to enrich protein and remove phytate, and results indicated an aqueous medium having mild acidic to mild alkaline pH was the most effective.

Rainbow Trout

Benefits of extruded feeds for trout production. While commercial fish feed produced via steam-compressed pelleting has largely been replaced since the late 1980s by dry extruded feeds, most rainbow trout grown in the United States are still fed steam-compressed pellets. ARS scientists in Hagerman, Idaho, determined how feed pellet processing (extrusion versus expansion-steam pelleting) affected feed quality, water quality, fecal durability, and growth in rainbow trout. All feeds had similar chemical compositions, but extruded feeds had a significantly higher degree of starch gelatinization than the expansion-steam pelleted feeds, which led to extruded feeds having much higher water stability, fecal durability, and lower phosphorus discharge. This research is the first to show that extruded feed pellets are more stable in water than pellets made by expansion-steam pelleting, and that they reduce fecal contributions to waste through improved fecal size and durability in water. The use of extruded feeds in commercial rainbow trout culture could improve waste collection and removal and reduce pollution in downstream receiving waters.

Component 3: Health of Aquatic Animals

Problem Statement 3A: Improve Understanding of Host Immunity, Immune System Evasion by Pathogens, and Disease-Resistant Phenotypes

Catfish

Identification of four distinct groups in *Flavobacterium columnare* with fish host associations. Columnaris disease, which is caused by the bacterium *F. columnare*, is one of the most prevalent fish diseases worldwide. An exceptionally high level of genetic diversity among bacterial isolates has long been recognized, but there has been little systematic work on quantifying or characterizing this diversity. ARS researchers at Auburn, Alabama, and collaborators used high resolution methods to characterize the genetic diversity in *F. columnare,* and their results established the existence of four distinct genetic groups within the species and indicated that different bacterial genetic types were associated with different fish species and geographic regions. This research highlights the importance of understanding the genetic diversity in *F. columnare* and has facilitated a standard nomenclature for these groups. The new knowledge gained from this research will aid in identifying which genetic type(s) of *F. columnare* are prevalent in different regions and/or aquaculture industries and will support the development of more targeted control and treatment measures for columnaris disease.

Stress responses in juvenile catfish influence susceptibility to enteric septicemia. Disease is the leading cause of reduced productivity in aquaculture production systems, and intensification of these systems has exacerbated disease susceptibility. Low dissolved oxygen stressors invariably increase the susceptibility of farmed fish to diseases, and concentrations of cortisol, the principal corticosteroid in ray-finned fish, increase rapidly following a stressful event. ARS scientists at Stoneville, Mississippi, classified juvenile catfish based on their cortisol stress response as either as 'high' or 'low' responders to stress. High- and low-responding channel catfish were then exposed to virulent *Edwardsiella ictaluri* bacteria, and the scientists found that catfish mortality rates increased with higher cortisol responsiveness when healthy fish were stressed prior to infection. These results indicate that mitigating stress or stress response may help reduce catfish mortality in aquaculture production systems.

Tilapia

Capsular typing of *Streptococcus agalactiae* from fish. *Streptococcus species*, including *Streptococcus agalactiae* (Lancefield group B streptococci) are emerging Gram-positive bacterial pathogens and are responsible for approximately $1 billion in annual losses to the global tilapia industry. The capsule on the surface of these bacteria contains sugar that support bacterial virulence and antigenicity, and there is an urgent need to identify different capsular types of *S. agalactiae* from farmed and wild fish to combat streptococcal disease. ARS researchers at Auburn, Alabama, surveyed and identified forty *S. agalactiae* isolates, and found that most isolates from North, Central, and South America were capsular type Ib, among the most common types in animals. The assay in this study can be used to identify the capsular type of *S. agalactiae* on farms and/or regions and has been used to support disease management strategies, including selective breeding and vaccines.

Problem Statement 3B: Control of Pathogens and Prevention of Disease

Catfish

Testing of a recombinant protein vaccine to protect catfish against columnaris disease. *Flavobacterium columnare* is a bacterium that causes columnaris disease, which severely affects channel catfish production in the United States. ARS researchers at Stuttgart, Arkansas, had previously identified *F. columnare* proteins that activate the adaptive immune response. They followed up this work with the development of a new recombinant protein vaccine that in laboratory tests provides excellent immune protection against columnaris disease.

Channel catfish have little genetic resistance to enteric septicemia of catfish. Enteric septicemia of catfish (ESC) is a major microbially-induced disease that significantly reduces production. ARS scientists at Stoneville, Mississippi, exposed more than 10,000 individual catfish from pedigreed families of the Delta Select catfish line to virulent *Edwardsiella ictaluri* bacteria and found few indications that genetic traits offer promise for breeding robust catfish lines with improved disease resistance. These results indicate that controlling ESC in farmed catfish will more likely be achieved through management rather than selective breeding.

A novel vaccine against enteric septicemia of catfish. Enteric septicemia of catfish (ESC) is the one of the most problematic bacterial diseases affecting the production of channel catfish fingerlings. Mississippi State University scientists worked with ARS scientists at Stoneville, Mississippi, to develop an effective ESC oral vaccine. To date, approximately 500 million stocked catfish have been vaccinated in field trials or on commercial farms. The net economic benefits at the fingerling production stage for channels and hybrids were determined to be $3,868 and $7,063/hectare (ha), respectively. Results from whole farm mathematical

programming models showed additional economic benefits in the range of $397 to $473/ha on farms that integrate fingerling production to their food fish operations.

Immune responses of channel catfish after vaccination with *Ichthyophthirius multifiliis*. *Ichthyophthirius multifiliis* (Ich) is a parasite of fish and causes severe losses to aquaculture industries worldwide. Treating Ich with chemicals is costly and often ineffective after the parasite penetrates the fish host skin and gill tissue. More information is urgently needed about protective immune responses in fish to develop effective vaccines against the parasite. ARS researchers at Auburn, Alabama, investigated the expression of innate and adaptive immune-related genes in surface and internal tissues of channel catfish following vaccination with live forms of Ich. The research demonstrated significantly higher antibody levels and 95 percent survival in vaccinated fish than non-vaccinated fish. These results reveal new insights into the molecular responses that may govern protective immunity of catfish against Ich infection.

Virulent *Flavobacterium columnare* degrades catfish mucus. *Flavobacterium columnare* is a bacterium that causes columnaris disease in farmed fish and is a concern for U.S. and international aquaculture producers. Skin mucus is an important defense protecting fish health, but some pathogens have developed adaptions for penetrating this protective layer. ARS researchers at Auburn, Alabama, collaborated with Auburn University scientists and identified the components of catfish mucus that are vulnerable to bacterial damage from the pathogen. They also found that a highly virulent *F. columnare* isolate growing in catfish mucus showed significantly elevated enzyme activity compared to a moderately virulent isolate. This activity may promote greater bacterial virulence by increasing the pathogen's ability to break down the protective mucus layer, which in turns enhances bacterial colonization and disease that may kill that fish host. The data provide new insights on the pathogenic mechanisms of *F. columnare* in columnaris disease that researchers can use in developing strategies for mitigating the disease.

Component 4: Sustainable Production Systems

Problem Statement 4A: Improve Technologies for Recirculating and Flow-through Production Systems

Catfish

Dissolved oxygen requirements for separated hybrid catfish eggs incubated in vertical tubes. ARS scientists at Stoneville, Mississippi, previously determined that channel catfish eggs incubated as intact egg masses require water with dissolved oxygen at over 95 percent air saturation during the last day of incubation for optimum development. Recent research by the same scientists determined that the maximum dissolved oxygen requirement for separated hybrid catfish eggs during the last days of incubation was only 79 percent. ARS scientists at Stoneville, Mississippi, have begun recommending that farmers maintain the dissolved oxygen in vertical tubes at or above 80 percent air saturation during the last two days of incubation to maximize egg development.

Reducing variability of hybrid catfish growth during year-round pond harvests. Hybrid catfish, which make up 75 percent of U.S. farmed catfish products, exhibit superior growth, better feed conversion, higher survival, availability, and are better suited for intensive production systems. However, their rapid growth, physical characteristics, and behavior have presented some unique production problems, including highly variable fish growth, oversized fish, and increased difficulties with year-round harvests. An ARS scientist at Stoneville, Mississippi, collaborated with Auburn University researchers and catfish producers to conduct extensive field samplings and assess how a number of factors affect size variability at harvest and effective year-round harvest schedules. These factors included culture systems, harvest technology, fingerling size and variability, grading,

genetics, stocking rates and schedules, and feeding rates. Their results indicated links between the genetic profiles of purebred parents, stocking fingerlings of different sizes together in production ponds, and variability in hybrid catfish performance. They also found that increasing aeration in production ponds and bar-grading fingerlings before stocking improved the subsequent size uniformity of harvested fish. Models based on economic analyses for specific sets of farm conditions were developed to help catfish farmers improve management practices and increase the profitability of their hybrid catfish production.

Rainbow Trout

Growth and fillet quality in commercially available rainbow trout. Determining if commercially available rainbow trout raised in recirculating aquaculture systems (RAS) exhibit variable growth performance and fillet quality is critical to identifying genetic lines that maximize profitability. ARS extramural researchers in Shepherdstown, West Virginia, determined rainbow trout lines contain considerable genetic variation in growth performance; the fastest growing line reached 3 kg while the slowest line lagged 30 percent behind. These findings indicate that farmers interested in maximizing product yields should familiarize themselves with the growth potential of available stocks before purchasing eggs or fish for their systems. In contrast, fillet quality indices, such as nutrient profile, texture, and color, did not differ among commercial genetic lines. These results indicate a producer or processor who values optimal fillet quality above growth-related traits can be more flexible in their genetic stock selection. Researchers also defined changes in processing yields and indices of fillet quality at different harvest weights throughout the production cycle and gathered valuable data that RAS producers can use to predict growth trajectories and fillet characteristics.

Use of woodchip bioreactors to improve water quality in fish farm effluents. As with all intensive agricultural systems, fish farms produce waste that has the potential to impact the surrounding environment. ARS extramural researchers in Shepherdstown, West Virginia, determined that woodchip bioreactors can capture nitrate nitrogen and suspended solids from aquaculture effluent streams to minimize nutrient discharge into surrounding waterways. A cost and engineering assessment demonstrated that the woodchip bioreactor is an affordable, low maintenance technology to treat aquaculture effluent, reduce environmental impacts, and reduce wastewater treatment costs.

Problem Statement 4B: Enhance Control of Pond-Based Ecosystems to Maximize Production and Product Quality

Catfish

Management practices minimize size variation in hybrid catfish food fish ponds. Two management practices to reduce food fish size variation and resulting weigh backs have been developed by ARS scientists at Stoneville, Mississippi, and collaborating Mississippi State University scientists. While in some cases economic benefits increase from mid-season partial harvests of larger fish, most farmers have adopted the use of graded fingerlings (recommended by ARS scientists) when processors penalize farmers for out-of-size food fish.

Tilapia

Intensive production of stocker size tilapia in biofloc systems. Market-size fish can be harvested from grow out ponds sooner if larger advanced fingerlings or stockers are stocked, but optimizing the overall production cycle requires the efficient production of stockers. Stocking rate is one factor that affects fish growth and can be manipulated to obtain stocker size fish. Much greater numbers of fish are stocked in biofloc technology production systems because microorganisms in the pond water consume fish waste quickly and help maintain suitable water quality. ARS researchers at Stuttgart, Arkansas, quantified the relationship between tilapia

stocking rate and growth and yield of stocker-size fish in an outdoor biofloc production system. They found yields of stocker-size tilapia increased linearly with stocking rate, while mean individual weight decreased linearly, but that stocker-size fish was produced at all stocking rates. Farmers can use these findings to optimize their annual production of stocker-size tilapia by manipulating stocking rates and the length of production cycles.

Component 5: Product Quality and New Products

Problem Statement 5A: Product Quality and New Products

Catfish

A new method for measuring catfish fillet texture. Catfish texture is important to consumers, especially if textures do not meet consumer expectations for uniform product hardness and other sensory characteristics. ARS scientists in New Orleans, Louisiana, developed a mechanical texture measurement method for sensory characteristics that can be used to quickly evaluate fillet texture. This will support the development of methods catfish processors can use to quickly and conveniently monitor texture quality and evaluate factors that affect fillet texture characteristics, information that in turn can be used to create more marketable catfish products to meet consumer demands.

Managing preharvest off-flavors in catfish raised in split ponds. While conventional earthen ponds have been used in the southeastern United States catfish farming industry for decades, producers are increasingly interested in using partitioned aquaculture systems (PAS). Split-pond systems, one type of PAS, are designed to improve the management of dissolved oxygen levels and fish waste products (e.g., ammonia). Producers have assumed that fish off-flavor incidence will be reduced in split-pond systems because previous research showed that off-flavors were rare in fish grown in PAS, but there have been no studies on the frequency and intensity of common “off-flavor” episodes in split-pond systems. ARS researchers at Oxford and Stoneville, Mississippi, evaluated water and catfish fillet samples collected from commercial and research split pond facilities in west Mississippi and west Alabama for intensities of earthy and musty off-flavor compounds; phytoplankton ecology of the split ponds were also studied. Levels of earthy and musty compounds in fillets and their sensory characteristics were similar to those reported previously for off-flavor catfish from conventional ponds. In addition, the types of phytoplankton and community structures observed in the split ponds were similar to those commonly observed in conventional catfish ponds. These results demonstrate that catfish farmers using split ponds can use the same management approaches and preharvest sampling to monitor for the presence of off-flavors as the strategies used in conventional catfish ponds for dealing with earthy and musty off-flavor problems (e.g., applications of algicides). These determinations are of critical importance to commercial culturists who are considering the benefits and constraints of adopting split-pond technology.