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The Economic Implications of Feeding Fingerlings During Outbreaks of Enteric Septicemia in Catfish

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KEY POINTS

- **Enteric septicemia of catfish (ESC) accounts for 30% of all mortality among fry and fingerlings.**
- **Current non-medicated approaches to managing ESC involve feeding fish during an outbreak and accepting high losses or withdrawing feed, which results in poor growth.**
- **Managing ESC outbreaks with feed medicated with AQUAFLOR® (florfenicol) resulted in over double the revenue per acre compared to conventional nonmedicated management.**

Introduction

Outbreaks of enteric septicemia of catfish (ESC) are temperature dependent and coincide with the production cycle of *Ictalurus punctatus*, or channel catfish. In the major catfish-producing regions of the United States, the incidence of ESC outbreaks is highest when water temperatures are in the 70° to 85°F range, which is usually during July through September and May through June.[1] Fingerling growth decreases when temperatures cool in the fall and winter, but final size at the end of the first fall is economically important and depends on how ESC disease outbreaks are managed.[2]

ESC is caused by the bacterium *Edwardsiella ictaluri*. Catfish of all sizes are susceptible, but fry and fingerlings are especially affected and ESC accounts for 30% of their mortality.[3, 4] Affected catfish do not feed well; fingerlings suffer from acute infections that spread quickly through the population. Prompt treatment and maintaining good water quality are critical to successful ESC control.

Two traditional methods of managing ESC are feeding throughout an outbreak, which results in high losses, and restricting feed, which can dramatically reduce losses but does not prevent outbreaks and results in poor growth. Surveys show 54% percent of fingerling producers withhold feed as their primary treatment for ESC. Another method of controlling ESC is the use of antibiotic medicated feed, which is used by 18% of catfish fingerling producers.[5]

Producers should determine if the additional income from an increased number and longer length of surviving fingerlings will be more than the increased cost of medicated feed. If the benefits outweigh the costs, then the producer will have an overall larger return with medicated feed versus traditional non-medicated approaches to ESC control.

Production background and pricing

Catfish fingerling production begins with egg collection from broodstock ponds. Egg masses are taken to a hatchery, placed in a trough and hatched in mid-May to early July. At 10 days post hatch, fry are transported to ponds where they grow to 5- or 6-inch fingerlings by mid-September to early November.

A 6-inch fingerling weighs approximately 0.0588 lb and typically sells for $0.015 per inch or $0.09 per fingerling, while a 5-inch fingerling weighs approximately 0.0355 lb and typically sells for $0.010/inch or $0.050 per fingerling. This 66% increase in weight between a 5- and 6-inch fingerling presents a price premium opportunity for the producer.

Fingerlings that are 5 inches can be produced using non-aggressive management methods

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that are readily available, while 6-inch fingerling production requires more aggressive management methods and not as many are produced in the industry. Foodfish producers would buy larger fingerlings if they were available because they have a head start in growth, a lower mortality and less time until harvest compared to 5-inch or smaller fingerlings.

Current ESC management

Fingerling production methods are dictated by how ESC outbreaks are managed. They include varying stocking rates, feeding schedules and choice of regular or medicated feed.

Producers who feed throughout an ESC outbreak generally stock a greater number of fry initially, accept high losses and are able to produce 6-inch fingerlings by fall. Losses are part of the business plan, but wide swings in survival from year to year can occur, leading to inefficiency and uncertainty of output.

Cessation of feed during an ESC outbreak is an approach used by other producers because it is thought that the disease is spread among fish during feeding time, since fish congregate and some exchange of water occurs. The consequence of this approach is that fish have nothing to eat and do not grow. The non-feeding days during an ESC disease outbreak are "lost" and cannot be recovered during the remainder of the peak growing season. Therefore, 5-inch fingerlings are the largest size producers can hope to grow in a typical year. This strategy is the most common one used to manage ESC outbreaks because no additional expenses are incurred.

Using a vaccine and/or medicated feed may be considered for managing ESC in fingerlings. These approaches allow for continuous feeding and growth of fingerlings during the outbreak.

AQUAVAC-ESC® is the only vaccine available for managing ESC in catfish. FDA has licensed two in-feed antibiotics, AQUAFLOR® (florfenicol) and ROMET® (a potentiated sulfonamide containing sulfadimethoxine and ormetoprim), for control of catfish mortality due to ESC associated with *Edwardsiella ictaluri*. For best results, medicated feeds should be used early in the ESC outbreak and be fed for the full treatment cycle indicated on the product's label.

Economic analysis of ESC management practices

The production and price assumptions used in the economic analysis of non-feed, non-medicated feed and medicated feed approaches to controlling ESC in the production of catfish fingerlings are presented in Table 1. Three ESC-management regimens have been developed and are compared: 1) Medicated feed (AQUAFLOR); 2) no medicated feed but feeding through ESC outbreaks and 3) no medicated feed and no feed during ESC outbreaks.

Each regimen's parameters are based upon industry expert opinion[6] as well as surveys[7, 8] and research findings.[9,10, 11, 12] ESC vaccination is not included in this analysis, but could be effectively used in conjunction with medicated AQUAFLOR feed or non-medicated feed regimens.

TABLE ONE

ECONOMIC ANALYSIS OF PRODUCING CATFISH FINGERLINGS WITH THREE ESC-MANAGEMENT APPROACHES AND ASSUMPTIONS FOR INPUT VARIABLES.

Fingerling Information	AQUAFLOR (*) & Feeding During ESC	Non-Medicated Feed During ESC	No Feeding During ESC
Fingerling Production Parameters**			
Fingerling harvest size, inch	6.00	6.00	5.00
Fingerling price, $/inch	0.0150	0.0150	0.0100
Feed conversion ratio	1.80	2.40	2.00
Fry stocking rate, #/acre	100,000	100,000	100,000
Fry-to-fingerling survival, %	70	40	60
Fingerling feed cost			
Non-medicated feed cost, $/ton	240	240	240
Medicated feed (AQUAFLOR), $/ton	800		
Other cost items			
Fry cost, $/1,000,000	5,000	5,000	5,000
Fixed cost of fingerling operation, $/acre	500	500	500
Farm characteristics and ESC outbreak frequency			
Fingerling water acres	250	250	250
Fingerling pond size	10	10	10
Number of ponds on farm	25	25	25
Ponds with ESC outbreaks per year, %***	28%	28%	28%

* *Medicated feed (AQUAFLOR) fed at 2% body weight per day for 10 days, 12-day withdrawal time and an average of 1.5 treatments per ESC season.*

** *Production parameters are based upon industry knowledge (USDA:APHIS:VS:CEAH Parts I and II, 2003), expert opinion (research and extension personnel in the Delta region of Mississippi) and laboratory research investigating the effectiveness of AQUAFLOR for controlling mortality due to ESC in exposed catfish fingerlings (Schering-Plough Animal Health; Patricia Gaunt, DVM, Ph.D., Mississippi State University).*

*** *Source USDA:APHIS:VS:CEAH, Part I, 2003.*

TABLE TWO

PRE-ACRE RECEIPTS, COST AND NET RETURN FROM THREE ESC-MANAGEMENT STRATEGIES FOR A CHANNEL CATFISH HATCHERY OPERATION, FRY TO FINGERLING STAGES.

Fingerling Information	AQUAFLOR Feeding During ESC	Non-Medicated Feed During ESC	No Feeding During ESC
I. Fingerling receipts			
Stocking rate, #/acre	100,000	100,000	100,000
Survival rate, %	70	40	60
Surviving fingerlings, #/acre	70,000	40,000	60,000
Average fingerling size, inches	6	6	5
Total fingerling inches for sale	420,000	240,000	300,000
Fingerling selling price, $/inch	0.0150	0.0150	0.0100
Total fingerling receipts, $/acre	**6,300**	**3,600**	**3,000**
II. Fingerling production costs			
Fingerling feed costs			
• *Fingerling weight, lb/1,000 fish*	58.8	58.8	35.5
• *Total fingerling weight produced, lb/acre*	4,116	2,352	2,130
• *FCR*	1.80	2.40	2.00
• *Non-medicated feed fed, lb/acre*	6,174	5,645	4,260
• *Medicated feed (AQUAFLOR), lb/acre*	1,235		
• *Total feed fed, lb/acre*	7,409	5,645	4,260
• *Fingerling feed cost*			
Non-medicated feed, $/ton	240	240	240
Medicated feed (AQUAFLOR), $/ton	800		
• *Non-medicated feed cost, $/acre*	741	677	511
*Medicated feed (AQUAFLOR), $/acre**	494		
Total fingerling feed, $/acre	**1,235**	**677**	**511**
• *Fry purchase cost, $/acre*	500	500	500
• *Other variable costs, $/acre***	445	339	256
Total variable costs, $/acre	**2,179**	**1,516**	**1,267**
III. Income above variable costs, $/acre	4,121	2,084	1,733
IV. Fixed cost, $/acre	500	500	500
V. Total fingerling cost, $/acre	2,679	2,016	1,767
• *Cost of production, $/fingerling*	**0.038**	**0.050**	**0.029**
VI. Net return, $/acre	**3,621**	**1,584**	**1,233**
• *Net return, $/fingerling*	**0.052**	**0.040**	**0.021**

* *Medicated feed (AQUAFLOR) fed at 2% body weight per day for 10 days, 12-day withdrawal time and an average of 1.5 treatments per ESC season.*

** *Other variable costs are estimated to be equal to feed costs, as feed costs represent approximately 50% of all variable costs (calculated as total feed fed at the non-medicated feed price).*

A comparative, enterprise budget approach was used to look at the benefits and costs of growing 5- or 6-inch fingerlings by the end of the summer or early fall season under each ESC management regimen. Base parameters used in the analysis include final fingerling size, feed conversion ratio, fry stocking rate, survival rate, medicated feed information and fry cost. Differences in sales and variable costs between the three approaches are reported, with fixed costs assumed to be the same for each system.

Economic results

Using feed medicated with AQUAFLOR yielded much higher receipts from fingerling sales compared to the two non-medicated feed treatments (Table 2). Treating with AQUAFLOR resulted in increased survival, more efficient production through a lower feed conversion ratio (FCR) and the 6-inch fish netted a higher price per fish.

Total fingerling receipts were $6,300 for the group treated with AQUAFLOR, compared to $3,600 for the non-medicated fish that were fed and $3,000 for the fish that were not medicated or fed during an ESC outbreak. The receipts per acre were higher for the non-medicated fed group than for the non-medicated, non-fed group, although survival was 20% less than for the group that was not fed. The compensating factor was the extra inch in growth and associated premium price, i.e., the $0.015/inch price for the 6-inch fingerling or $0.09 each versus $0.01/inch paid for the 5-inch fingerling or $0.05 each (Table 2).

Table 2 also presents the fingerling feed-cost calculations for the medicated and non-medicated feed treatments, as well as costs for fry purchases and other variable costs. Total per-acre variable cost to produce 6-inch fingerlings with feed medicated with AQUAFLOR was $2,179 and fixed costs were $500 per acre. Total production costs were $2,679 per acre or $0.038 per fingerling. Subtracting total costs from receipts produces a net return of $3,621 per acre or $0.052 return per fingerling produced.

For the non-medicated feed and feeding through ESC treatment, the total per acre variable cost to produce 6-inch fingerlings was $1,516 and fixed costs were $500 per acre. Total production costs were $2,016 per acre or $0.050 per fingerling. Subtracting total costs from receipts produces a net return of $1,584 per acre or $0.040 return per fingerling produced.

In the group that received no feed during ESC, the total per acre variable cost to produce 5-inch fingerlings was $1,267 and fixed costs were $500 per acre. Total production costs were $1,767 per acre or $0.029 per fingerling. Subtracting total costs from receipts produced a net return of $1,233 per acre or $0.021 return per fingerling produced.

The cost of feed with AQUAFLOR ($1,235*/acre) is greater than the two non-medicated feed alternatives. The overall feed cost is also increased due to a higher survival rate and larger size of the treated fingerlings, yet treated fish also have a more efficient feed conversion. The additional feed costs are also offset by the higher sales receipts of over

**Total medicated feed cost based on an average of 1.5 treatments per ESC season.*

Foodfish producers would buy larger fingerlings if they were available because they have a head start in growth, a lower mortality and less time until harvest compared to 5-inch or smaller fingerlings.

TABLE THREE

PER-FARM RECEIPTS, COST AND NET RETURN FROM THREE ESC-MANAGEMENT STRATEGIES FOR A TYPICAL 250-ACRE CATFISH FARM PRODUCING FINGERLINGS FROM FRY.

Fingerling Information	AQUAFLOR Feeding During ESC	Non-Medicated Feed During ESC	No Feeding During ESC
Farm Characteristics			
Ponds on farm, number	25	25	25
Typical pond size, acre	10	10	10
Operation ponds with ESC, %*	28	28	28
Ponds with ESC, number	7	7	7
I. Revenue $	**1,575,000**	**900,000**	**750,000**
II. Cost of fingerling production			
Fingerling feed cost			
• *Regular feed cost, $*	211,892	169,344	127,800
• *Feed with AQUAFLOR, $***	34,574		
Total feed cost, $/farm	**246,466**	**169,344**	**127,800**
Fry purchase costs, $/farm	125,000	125,000	125,000
Other variable costs, $***	111,132	84,672	63,900
Total variable costs, $	**482,598**	**379,016**	**316,700**
III. Income above variable costs, $	**1,092,402**	**520,984**	**433,300**
IV. Fixed cost, $/farm	**125,000**	**125,000**	**125,000**
V. Total costs, $/farm	**607,598**	**504,016**	**441,700**
Total cost per fingerling, $	0.035	0.050	0.029
VI. Net return, $/farm	**967,402**	**395,984**	**308,300**
Net return, $/acre	**3,870**	**1,584**	**1,233**
• *Net return, $/fingerling*	0.055	0.040	0.021

* *Source: USDA:APHIS:VS:CEAH, Part I, 2003.*

** *Medicated feed (AQUAFLOR) fed at 2% body weight per day for 10 days, 12-day withdrawal time and an average of 1.5 treatments per ESC season.*

*** *Other variable costs are estimated to be equal to feed costs, as feed costs represent approximately 50% of all variable costs (calculated as total feed fed at the non-medicated feed price).*

TABLE FOUR

FINGERLING FEED COST AS A PERCENTAGE OF TOTAL FEED COST, TOTAL VARIABLE COSTS, TOTAL COSTS AND FINGERLING RECEIPTS FOR THREE ESC-MANAGEMENT STRATEGIES.

FINGERLING FEED COST AS A PERCENT OF:	AQUAFLOR Feeding During ESC		Non-Medicated Feed During ESC	No Feeding During ESC
	MEDICATED FEED	REGULAR FEED		
Total fingerling feed costs, %	14	86	100	100
Total variable cost, %	7	44	45	40
Total variable and fixed costs, %	6	35	34	29
Fingerling receipts, %	2	13	19	17

For best results, medicated feeds should be used early in the ESC outbreak and be fed for the full treatment cycle indicated on the product's label.

$6,000 per acre. The non-medicated feed treatments are affected by weight differences between the 5- and 6-inch fingerlings, survival rates and different feed conversion ratios. Total feed fed, cost of feed and overall production costs are higher for the treatment that fed non-medicated feed during ESC than for the treatment that stopped feeding during ESC (Table 2).

The overall quantity of feed medicated with AQUAFLOR is relatively small compared to the overall feed quantity (and cost) and other production and fixed costs used in producing fingerlings. According to USDA surveys, the average reported percentage of ESC outbreaks at any given time is 28%.[13, 14] To look at the economics of ESC management at the farm level, this percentage of ESC outbreaks is combined with an average size catfish fingerling farm in the Delta region of Mississippi and the results are provided in Table 3. For the typical 250-acre fingerling operation with 28% of their ponds experiencing an ESC outbreak, 86,436 pounds of AQUAFLOR-medicated feed was used compared to the entire farm's regular fingerling feed usage of 1,852,200. Feed medicated with AQUAFLOR represented only 4.7% of all fingerling feed fed. Feed with AQUAFLOR represented 14% of all fingerling feed costs, 7% of all variable costs, 6% of all costs (variable plus fixed) and 2% of fingerling receipts (Table 4).

Feed medicated with AQUAFLOR may cost the fingerling producer more money up front to produce 6-inch fingerlings ($0.035 cost per fingerling), but the producer is rewarded with higher survival (70%), higher production

Using feed medicated with AQUAFLOR yielded much higher receipts from fingerling sales compared to the two non-medicated feed treatments.

(17.5 million 6-inch fingerlings) and higher sales revenue ($1,575,000) compared to non-medicated feed during ESC treatment ($0.050 cost per fingerling, 40% survival, 10.0 million 6-inch fingerlings and $900,000 in sales, respectively) and the treatment that stopped feeding during ESC ($0.029 cost per fingerling, 60% survival, 15.0 million 5-inch fingerlings and $750,000 in sales, respectively). In addition to these obvious economic advantages, medicated feeds for ESC outbreaks can be directed only to affected fish ponds, allowing cash to be spent when and where it is most needed.

Conclusions

During ESC outbreaks, feed medicated with AQUAFLOR provides greater receipts and net returns compared to the use of non-medicated feed or not feeding at all. Treating with AQUAFLOR resulted in over double the revenue per acre compared to the other two treatments and represented only 13% of total fingerling feed costs.

[1] National Warmwater Aquaculture Diagnostic Center's Annual Reports, 2002-2004, Stoneville, MS.

[2] Hanson, T. "Why Reduce Catfish Mortality?" Presented at the annual convention for the Catfish Farmers of America, New Orleans, LA, Feb. 25, 2005.

[3] Tucker, C., J. Avery, C. Engle and A. Goodwin. Industry Profile: Pond-Raised Channel Catfish. Industry review report developed for the National Risk Management Feasibility Program for Aquaculture, Department of Agricultural Economics, Mississippi State University, 2004. http://www.agecon.msstate.edu/Aquaculture/pubs/Catfish_Industry_Profile.pdf.

[4] USDA. Part I: Reference of Fingerling Catfish Health and Production Practices in the United States, 2003 USDA:APHIS:VS:CEAH, National Animal Health Monitoring System, Fort Collins, CO, 2003;#N406.1103.

[5] USDA. Part II. Reference of Foodsize Catfish Health and Production Practices in the United States, 2003 USDA:APHIS:VS:CEAH, National Animal Health Monitoring System, Fort Collins, CO 2003;#N407.1103.

[6] Steeby, J., Ph.D., MSU Extension Service, personal communication.

[7] USDA. Part I: Reference of Fingerling Catfish Health and Production Practices in the United States, 2003 USDA:APHIS:VS:CEAH, National Animal Health Monitoring System, Fort Collins, CO, 2003;#N406.1103.

[8] USDA. Part II. Reference of Foodsize Catfish Health and Production Practices in the United States, 2003 USDA:APHIS:VS:CEAH, National Animal Health Monitoring System, Fort Collins, CO 2003;#N407.1103.

[9] Gaunt, P., Ph.D., MAFES, personal communication.

[10] Heikes, D.L, C.R. Engle, and P.J. Kouka. Catfish Yield Verification Trials, Final Report, May 1993-December 1996. University of Arkansas Cooperative Extension Program, University of Arkansas at Pine Bluff, United States Department of Agriculture and County Governments Cooperating. http://www.uaex.edu/aquaculture/verification/catfish_verification/1993_1996/final_report.htm.

[11] Pomerleau, S. and J. Trimpey. Catfish Research Verification Program Update. Arkansas Aquafarming, Cooperative Extension Program, University of Arkansas at Pine Bluff 2005;22(1)Winter. http://www.uaex.edu/aquaculture/ArkansasAquafarming/pdf-files/v22-1_Aquafarming-Winter-2005.pdf.

[12] Klesius, P., C. Lim and C. Shoemaker. Effect of feed deprivation on innate resistance and antibody response to *Flavobacterium columnare* in Channel Catfish, *Ictalurus punctatus*. Bulletin of the European Association of Fish Pathology 1999:19(4),156-158.

[13] USDA. Part I: Reference of Fingerling Catfish Health and Production Practices in the United States, 2003 USDA:APHIS:VS:CEAH, National Animal Health Monitoring System, Fort Collins, CO, 2003;#N406.1103.

[14] USDA. Part II. Reference of Foodsize Catfish Health and Production Practices in the United States, 2003 USDA:APHIS:VS:CEAH, National Animal Health Monitoring System, Fort Collins, CO, 2003;#N407.1103.

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