Put catfish offal to work for you

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Roughly 40 percent of the weight of catfish which enter a processing plant turn up as waste at the end of the processing line. To date the industry has not used that waste very profitably because of a scattered, erratic supply and lack of information on how to utilize the waste economically. The situation now may be changing. Auburn University research shows that catfish is a valuable source of animal protein which might be used economically in livestock and fish feeds. Here's the story.

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WATER STABILITY of moist fish feeds containing nondried catfish processing waste is tested by placing the feed in dishes of water for prescribed lengths of time.

WASTE comprises about 40 percent of the weight of the product which enters catfish processing plants. Moreover, it represents a potential source of nutrients which have considerable value in fish and livestock feeds, especially with fish meal at record prices and practically non-available.

To date, the catfish industry has not made highly profitable use of catfish waste, partly because of the scattered and erratic supply and a lack of technical information on methods for utilizing the waste. At present catfish processing waste probably could be used economically in livestock and fish feeds, fed either in dried or moist form.

Studies are being conducted at Auburn University to evaluate the nutritional value of catfish waste, fed in dry and moist feeds, for catfish and swine, and effects of the waste on flavor and composition of the flesh of the fed animals.

A study has been completed in which catfish waste was fed in dry and in moist catfish feeds. The feeds contained one third catfish waste, on a dry matter basis, and two thirds dry ingredients to produce 32 percent protein, nutritionally complete feeds. One preparation was dried and pelleted, another contained the wet waste, uncooked, and another contained the wet waste, pasteurized. A dry-pellet diet of similar composition except the animal protein came from marine fish meal, also was fed.

Table 2 shows that fish on the fish meal diet gained most with greatest feed conversion efficiency. The catfish waste fed in dry-pellet form was about equal to the pasteurized waste fed in moist form. The non-pasteurized waste was inferior to preheated waste, probably because of anitinutritional enzymes in the raw waste, specifically antithiaminase.

The slight superiority of fish meal over catfish waste is due in part to the lower quality protein in the head, cartilage and skin of catfish waste. Laboratory studies show that two hours heating at 240° F. under steam significantly

increased the *in vitro* digestibility of catfish waste protein. Therefore, hydrolysis of catfish waste protein by heat processing, such as is done in the manufacture of hydrolyzed feather meal, may improve the nutritional value of the waste somewhat. The added cost may not be economical, however.

Catfish waste, if fed in moist form, must be heat treated to some degree before feeding to food animals to comply with government regulations and also to destroy possible antinutritional enzymes.

Moist fish feeds are less convenient than dried, pelleted feeds because they must be fed daily or expensive preservation measures provided. They cannot be handled with automated equipment as with hard pellets. Good quality, water-stable moist pellets can be made, however, by using low-fibre, finely ground ingredients, an adequate binding ingredient, a minimum amount of moisture to bind the ingredients together (approximately 33 to 36 percent) and a small amount of drying on the surface of the extruded particles.

The large amount of fat in catfish waste presented a question regarding the effect of catfish fats on flavor of fish consuming feeds containing large amounts of the fat. It has been demonstrated at the Southeastern Fish Cultural Laboratory at Marion, Ala., that when marine fish oils are used in catfish feeds, a fishy flavor in the fed fish results.

A study was conducted at Auburn University in which 7.3 percent of catfish fat, menhaden oil or soybean oil was added to experimental catfish diets. Table 3 shows that catfish or soybean fat produced fish with a highly acceptable flavor, whereas the feed with marine fish oil produced fish with a distinct fishy off-flavor. After several months in frozen storage, the fish fed marine fish oil had undergone considerable oxidative rancidity, as indicated by chemical analysis (higher TBA values), while those fed the catfish fat or vegetable oil diets showed relatively little oxidation. Thus, fish feeds may contain high amounts of catfish fat, which is an excellent source of energy for fish, without detrimental effects on fish flavor.

To quantitatively evalute catfish waste meal against commercial fishmeal, a cooperative study between Auburn University and the Southeastern Fish Cultural Laboratory is being conducted. Catfish waste meal is being fed at 8.8, 17.6 and 26.4 percent in catfish feeds and compared with feeds containing equal amounts of marine fish protein. To make sure that sources of fat do not interfere with comparison of the two sources of protein, salmon oil was added to all of the experimental feeds.

One of the most practical uses

Table 1. NUTRIENT COMPOSITION OF CATFISH PROCESSING WASTE

Product	Component	Range	Average
Dried Waste	Protein	27-49 %	42 %
Dried Waste	Fat	30-60 %	35 %
Dried Waste	Ash	14-23 %	16 %
Dried Waste	Calcium	5- 7 %	5.4%
Dried Waste	Phosphorus	2.4-3.4%	2.8%
Wet Waste	Water	60-70 %	67 %

THESE VALUES represent samples of waste collected from a number of sources during all seasons of the year. The fat content of catfish changes with season. In the fall when the fish have been on heavy feeding, the fat content of the waste is high and the moisture, protein and ash contents are correspondingly low. The generally high fat content makes the waste impossible to dry without extracting the fat or adding a fat absorbent prior to drying. The frequently large amount of bone ash probably will limit the amount of waste which can be used in fish or animal feeds; it will provide an excellent source of calcium and phosphate, however. Most of the fat can be added to animal or fish feeds without deleterious effects. Although the quality of the protein does not appear to equal that of marine fishmeal, it is a valuable source of animal protein.

Table 2. NUTRITIONAL VALUE OF CATFISH WASTE IN CATFISH FEEDS

	Production per Acre	Pounds of Feed per Pound of Gain
Fishmeal, pelleted feed	5,930 lb.	1.1
Catfish waste, pelleted feed	4,700 lb.	1.5
Catfish waste — cooked, moist feed	4,680 lb.	1.6
Catfish waste — noncooked, moist feed	3,940 lb.	2.1

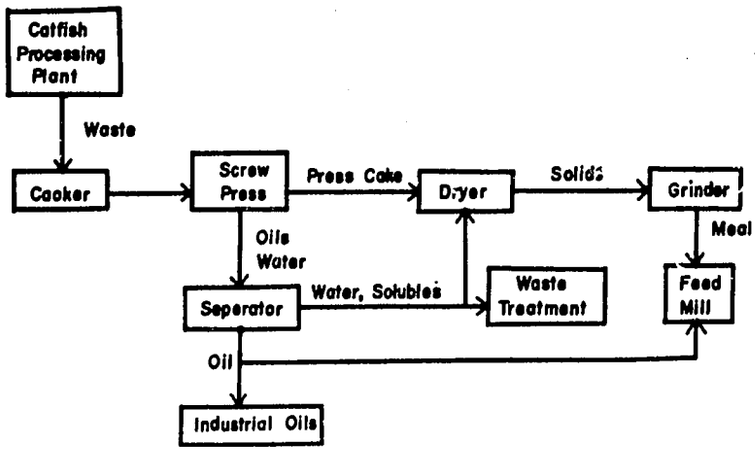
Table 3. EFFECTS OF HIGH LEVELS OF CATFISH, VEGETABLE OR MARINE FISH FAT IN THE DIET ON CATFISH FLAVOR

	Fresh		6 mos.		12 mos.	
Diet	Flavor[1]	TBA[2]	Flavor	TBA	Flavor	TBA
*CFWM with 7.3% catfish fat	8.0	.23	7.6	1.03	6.2	.52
CFWM with 7.3% marine fish fat	6.3	.20	4.8	2.26	5.1	3.16
CFWM with 7.3% vegetable fat	8.4	.21	7.6	.68	7.3	.32

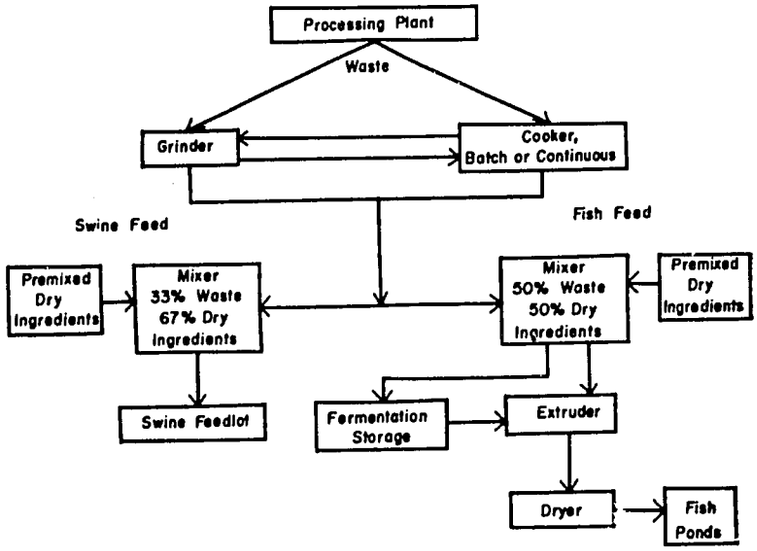
[1]Flavor evaluation scale: 9 = Like extremely well
7 = Like moderately
5 = Neither like nor dislike
3 = Dislike moderately
1 = Dislike extremely

[2]TBA means thiobarbituric acid titration value; the higher the value the greater the amount of fat oxidation.

*Catfish waste material.



FLOW DIAGRAM showing the optimum drying process for catfish processing waste wherein the oil is separated prior to drying, the soluble protein is recovered and the water may be evaporated instead of being discharged in plant effluent. The system includes a precooker and screwpress for removing the oil prior to drying. The water which initially is separated with oil can be added back in the dryer and reduce plant waste water treatment and also allow for recovery of soluble protein. The catfish oil can be added back in the manufacture of fish feeds and probably animal feeds.



CATFISH PROCESSING PLANT WASTE may be used in swine or catfish feeds without prior drying by preparing moist feeds from the pasteurized waste and dry ingredients. This diagram shows processing sequences for using catfish plant waste in moist swine or fish feeds. Swine feed requires less processing than catfish feed and could be fed conveniently by automated equipment. The labor requirement of either process would be about one man per day.

of catfish waste, without the use of a drying plant, appears to be in moist swine feeds. That would involve close association between a catfish processing plant and a swine feedlot. The processing waste would be pasteurized, ground and mixed with dry ingredients (mostly corn with perhaps a small amount of oil seed meal) to yield a 14 to 17 percent protein feed of excellent nutritional quality. This would provide a year-around outlet for the processing waste. Feed needed by the swine feedlot during slack periods of plant operation could be supplemented from a commercial source.

Moist swine feed containing pasteurized catfish waste was evaluated with laboratory rats. The rats were fed a diet made only from catfish waste and corn, plus vitamins, which contained 16 percent protein (dry matter basis) and 36 percent moisture. That diet was compared with a standard swine production ration used at the Auburn University swine research unit. Weight gains for a five-week period were 108 grams for the swine ration and 106 for the catfish waste diet. Although growth was essentially the same for both feeds, the gain per gram of protein fed was greater from the catfish waste (2.6) than from the swine feed (2.3).

Previously, catfish processing waste was not considered valuable enough or in large enough supply to warrant drying it for feed purposes. With the present cost of animal protein feeds, a supply of four or more tons of plant waste per day for most of the year would probably justify a drying operation. Economics of drying is greatly dependent on the volume of product dried per year and cost of energy for operation. An average cost for drying industrial marine fish with equipment as illustrated in Figure 2 and current energy costs is approximately ½ cent per pound of wet material. Processing plant catfish waste probably could be economically processed into meal and oil at one or two of the larger catfish plants now; or possibly by pooling the waste from plants located within a 100-or-so mile radius.

Assuming that the protein, fat and minerals in catfish waste can be used to a nutritional advantage by fish and other food animals, a value of $7.50 per protein unit may be assigned to a ton of the processed waste solids. That is somewhat lower than the current value of marine fishmeal but would amount to about $315 per ton of dry solids. That price should justify processing the waste from catfish processing plants.