A PRELIMINARY EVALUATION OF A FISH DIET BASED ON ROASTED SOYBEANS AND FRESH FISH

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ABSTRACT

Two experimental fish diets, one consisting of 50% roasted soybeans and 50% fresh fish, and another consisting of 30% soybeans, 20% corn meal, and 50% fresh fish, both with vitamin and mineral supplements, were compared to Oregon pellets in a 6 week feeding trial using yearling channel catfish (*Ictalurus punctatus).* The experimental diets were ground, blended and pelletized by passing the ingredients through a food chopper four times. Both mixtures proved highly attractive to the fish. Fish fed either experimental diet grew as well as fish fed the Orgon pellets. The experimental diets are suggested for use in parts of the world where commercially prepared fish feeds are not available. The diets also present the possibility of using non-commercial fishes as feed for more valuable fishes. It was observed that the fish exhibited fighting when the vitamin mix was omitted.

A variety of pelleted feeds for fish are now available in the United States. Included are both complete diets for raceway and cage feeding, and less complete diets that are used for feeding fish in open pond culture, where some natural food is available. These feeds are available in various sizes of dry pellets of either a floating or sinking type. In addition to these feeds, manufactured by several different companies, there is a preparation known as the Oregon pellet (Hublou, 1963; Crawford and Law, 1972). The Oregon pellet is a moist feed which requires refrigeration. It has proven highly successful in feeding trout and salmon.

All of these feeds are satisfactory when they are properly used, but prepared fish feeds are not available worldwide. Further, there may be a potential for incorporating locally availablenon-commercial, non-game fishes into fish feeds. There is also a possibility of using fish viscera or scraps in locally processed feeds.

The basic approach in preparing the diets suggested here is the same as that used in preparing the Oregon pellet, to the extent that the moisture from the fresh fish is incorporated into the pellet. It differs, however, in that the formula is much simpler and the facilities required to prepare it are less sophisticated.

The suggestion for formulation of this pellet came from the Fish Feeds and Nutrition Workshop held September 26-28, 1972, in Rapid City, South Dakota. It was suggested at this workshop that soybeans roasted at 218 C for 15 minutes, supplemented with fish meal, would approach a nutritionally complete and palatable diet for fish. We modified this suggestion by combining 50% (by weight) fresh whole ground fish and 50% roasted soybeans. In a second formulation we used 50% ground fish, 30% roasted soybeans, and 20% corn meal. Both formulations were fortified with a salt mixture and a vitamin mix (Tables 1 and 2).

METHODS

Whole soybeans were roasted for 15 minutes at 218 C and then passed through a food chopper using a 3 mm plate. We used a 1-horsepower Toledo Chopper, manufactured by Toledo Scale Company, Toledo, Ohio. After being preground, the soybeans were passed through the chopper with whole (12 to 18 cm) frozen gizzard shad (*Dorosoma cepedianum*), 1% vitamin mix and 2% salt mix-

ture. The preparation was then ground three more times to insure complete mixing. The chopper extruded a 3 mm strand of material, which, when placed in a plastic bag and shaken, produced a pellet 0.5 to 1.0 cm long and 3 mm in diameter. This preparation was frozen until it was to be fed.

Nine different tanks, each containing 200 liters of water, and each aerated and maintained under 24 hours of light, were stocked with 20 channel catfish (*Ictalurus punctatus*), weighing approximately 20 g each. Three of the tanks were fed Oregon pellets, three were fed the mixture of soybeans and shad, and three were fed the soybean/shad/corn meal mixture. On basis of calculated dry weight, all the feeds were fed at the same rate: approximately 3% of body weight per day for the first two weeks; the amount of feed was increased by 50% for the third and fourth weeks, and doubled for the fifth and sixth weeks. At the end of 6 weeks the fish were harvested. The calculated feeding rate at the time of harvest was 2.3%. Performance of the two experimental feeds in comparison to Oregon pellets was evaluated in terms of weight gain of fish and feed conversion.

Miscellaneous observations included substitution of the carp (*Cyprinus carpio),* the green sunfish (*Lepomis cyanellus*), and the fathead minnow (*Pimephales promelas*), for gizzard shad in some experimental lots of feed. Evaluation of these diets was limited to the physical state of the feed produced and acceptance of the feed by the fish. In a separate short-term study, the shad/soybean diet was evaluated without the addition of the vitamin mix. This evaluation was limited to observing the fish for evidence of vitamin deficiency.

RESULTS

The process of grinding the roasted soybeans in a food chopper and then regrinding them with the fresh or frozen fish produced a pellet of excellent physical characteristics, which was readily accepted by channel catfish. Feeding response to the experimental feeds was similar to the response to the Oregon pellet. At the end of 6 weeks there was no difference in weight gain of fish fed the two experimental diets (shad/soybeans, and shad/soybeans/corn meal), and the Oregon pellet (level = .10, resulting P = .115). Among the three types of feed (two experimental and one control), there was no significant difference in the feed conversions (level = .10, resulting P = .107) (Table 3). The fish commenced to fight within 2 weeks when the vitamin mix was omitted from the shad/soybean diet. Substituting the different fishes for shad did not alter the physical state of the pellet nor the feeding response of the catfish.

DISCUSSION

It appears that either of the experimental diets will be satisfactory for some purposes. Catfish readily accept the feeds, and, on basis of preliminary examination, the diets are nutritionally complete. The substitution of corn meal for part of the soybeans reduces the cost of the feed. However, actual cost is somewhat difficult to assess in view of the difficulty of assigning a value to the fish and the labor involved. In the United States the diet should be particularly attractive for certain types of experimental work where a moist pellet is needed. More important, however, is the already mentioned possibility of using less valuable fishes to prepare feeds for fishes that are of greater importance for recreational or commercial purposes.

The most attractive possibility for this feed is that it may be used in countries where commercial fish feeds are not readily available. Assuming the availability of soybeans, or a legume of similar amino acid profile, the feed can be produced locally using inexpensive equipment.

The occurrence of fighting when the fish were fed the diet without the vitamin mix was tentatively interpreted as a symptom of vitamin B_6 deficiency. It will be interesting to further evaluate this phenomenon, since fighting is a particularly serious problem in cage culture.

LITERATURE CITED

Crawford, David L., and Duncan K. Law. 1972. Mineral composition of Oregon pellet production formulations. Prog. Fish-Cult. 34(3):126-130.

Hublou, Wallace F. 1963. Oregon pellets. Prog. Fish-Cult. 25(4):175-180.

Table 1. --Composition of two experimental fish feeds based on roasted soybeans and fresh or frozen fish

Ingredient	Wet weight (g)	Percent of total (wet weight)	Dry weight[1]/ (g)	Percent of total[2]/ (dry weight)
		Experimental feed 1		
Ground roasted soybeans	725	48.5	698.90	79.5
Fresh or frozen shad	725	48.5	142.68	16.0
Vitamin mix	15	1.0	14.10	1.5
Salt mixture U.S.P. XIV	30	2.0	28.74	3.0
	1495	100.0	884.42	100.0
		Experimental feed 2		
Ground roasted soybeans	483	32.3	466.00	52.5
Corn meal	242	16.2	224.01	27.0
Fresh or frozen shad	725	48.5	142.68	16.0
Vitamin mix	15	1.0	14.10	1.5
Salt mixture U.S.P. XIV	30	2.0	28.74	3.0
	1495	100.0	875.53	100.0

[1]/Dry weight established by oven drying samples of roasted soybeans for 24 hours at 105° C, and samples of shad for 48 hours at 105° C.

[2]/Values have been rounded for simplification.

Table 2. --Composition of vitamin mix and amount (mg/kg wet feed) of each vitamin in the feed[1]/

Vitamin A (200,000 units/gram)	90.45
Vitamin D (400,000 units/gram)	5.025
Alpha topopherol	100.5
Ascorbic acid	904.5
Inositol	100.5
Choline chloride	1507.5
Menadione	45.225
p Aminobenzoic acid	100.5
Niacin	90.45
Riboflavin	20.1
Pyridoxine hydrochloride	20.1
Thiamine hydrochloride	20.1
Calcium pantothenate	60.3
Biotin	0.402
Folic acid	1.809
Vitamin B12	0.0271

[1]/Mix obtained from Nutritional Biochemicals, Cleveland, Ohio.

Table 3. --Evaluation of two experimental fish feeds based on roasted soybeans and fresh or frozen fish

Diet[1]/	Tank number	Total weight of fish (g)[2]/ Initial	Final	Percent gain	Weight of feed (g) Wet	Dry	Feed conversion[3]/
OP	1	408	1068	162	784	549	.832
OP	2	398	1064	167	784	549	.824
OP	3	384	1084	182	784	549	.784
SS	4	400	1010	153	920	552	.905
SS	5	422	1066	153	920	552	.857
SS	8	404	982	143	920	552	.955
SSC	9	402	1014	152	920	552	.902
SSC	10	386	1038	169	920	552	.847
SSC	11	394	1024	160	920	552	.876
x OP		397	1072	170		549	.81
x SS		409	1019	149		552	.90
x SSC		394	1025	160		552	.87

[1]/OP - Oregon Pellet, 55 percent protein
SS - Shad/soybean, 31 percent protein
SSC - Shad/soybean/corn meal, 18 percent protein.

[2]/ All tanks contained 20 fish except tank 5, which by error contained 22.

[3]/ Dry weight of feed fed divided by gain of fish (wet weight).