Key Words: Soy protein concentrate, grass carp, fingerling feed, China

**Soy Protein Concentrate as a Replacement for**

**Fishmeal in the Fingerling Diet for**

 **Grass Carp Fingerling Production**

**Results of ASA-IM Feeding Demonstration U-35-10-517**

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**Introduction**

A feeding demonstration was conducted in 2010 by the American Soybean Association International Marketing (ASA-IM) program in cooperation with the Wujiang Aquaculture Co. Ltd., Jiangsu Province to demonstrate the feasibility of replacing fishmeal with soy protein concentrate (SPC) in the ASA-IM 36/7[[1]](#footnote-1) fingerling feed for grass carp. The demonstration was conducted to demonstrate to fish farmers and feed millers in the Yangtze River Delta that an all-plant protein fingerling feed would yield the equivalent tilapia production and performance as a high fishmeal inclusion feed. The ability to use all-plant protein feeds at the fingerling stage provides feed millers with an option to formulate without fishmeal, which is limited in availability with increasing price, as well as a means to improve industry sustainability by providing a fingerling feed in which the majority of protein is supplied from renewable plant sources.

**Protocols**

The grass carp pond feeding demonstration was conducted at the Demonstration Farm of the Wujiang Aquaculture Co. Ltd., Jiangsu Province, China. Grass carp fry of size 0.95-g were stocked in three 6.0-mu (0.4 ha) earthen ponds. Grass carp were first fed the locally available high protein feed from stocking size to an average fish size of 3 g, at which time the fish were weaned to the ASA-IM formulated 36/7 SPC fingerling diets. The 36/7 SPC feed was formulated to replace the standard 20% fishmeal with low antigen, animal grade SPC having a crude protein content of 65%. The animal grade SPC was produced by Archer Daniels Midland Company (ADM), Qinhuangdao Goldensea Foodstuff Co.,Ltd and Yihai (Fangchenggang) Soybeans Industries Co., Ltd, Yihai Group in China under the trade name Soycomil (Table 1-3).

The ASA-IM 36/7 SPC feed was fed in extruded, floating pellet form, with an initial feed pellet size of 1.5-mm. Grass carp in all ponds were fed to satiation three times daily using the ASA-IM 90% average satiation feeding technique. Fish in the three replicate ponds of each feed treatment received an identical amount of feed each day and at each feeding. The test feed was produced by the Ningbo Techbank Feed Company, Zhejiang Province, China using ASA-IM feed formulation and with ASA-IM technical guidance.

**Results**

Grass carp fingerlings on the Wujiang Aquaculture Co. Ltd. Demo Farm were fed with the 36/7 SPC feed for 101 days between 11 July and 19 October 2010. The grass carp fed the 36/7 SPC feed grew from 0.95 g to an average weight of 34.5 g, (Table 4, Figure 1). The average FCR of the three demonstration ponds was 1.30:1 .

Fish production at harvest averaged 116 kg/mu (1,740 kg/ha) for grass carp and 52 kg/mu (780 kg/ha) for silver carp. The average survival rate for grass carp and silver carp was 69.5% and 53% respectively.

The grass carp fingerling demonstration with 36/7 SPC feed yielded an average net economic return of RMB 160.1 per mu ($363.8/ha) at market prices of RMB 10/kg ($1.51/kg) for grass carp and RMB 5.0/kg ($0.75/kg) for silver carp (Table 4). Return on investment (ROI) for the three demonstration ponds averaged 12.7%**.**

**SUMMARY AND CONCLUSIONS**

The grass carp fingerlings in this demonstration grew smaller than the target size because of cold temperature and short production cycle this year. However, the demonstration results indicate that soy protein concentrate can be substituted for fishmeal in the fingerling diet for grass carp. The ASA-IM has conducted a series of feeding demonstrations with the 36/7 SPC feed on different freshwater fish species in China in the past years. The collective results show that SPC supplemented with methionine can be used as a substitute for fishmeal in the ASA-IM 36/7 feed to formulate a soy protein feed for most of the freshwater fish species cultured in ponds and cages. The feed millers are encouraged to incorporate animal grade SPC 65% in their fingerling feed formulations to reduce demand of the limited fishmeal supply and feed price for fish producers in China.

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**Chinese Currency and Production Unit Conversions:**

RMB 6.50 = US$1.00
15 mu = 1.0 hectare (ha)
kg/mu x 15 = kg/ha
1.0 kg = 2.2 lb
6 mu = 1.0 acre (ac)
kg/mu x 13.2 = lb/ac

Table 1. Formula for the ASA-IM 36/7 SPC feed used in the 2010 grass carp fingerling 80:20 pond feeding demonstration in Wujiang Municipal Aquaculture Co., Ltd., Jiangsu Province, China.

 Ingredient Percent of total

|  |  |
| --- | --- |
| Soybean Meal | 30.00 |
| Soy Protein Concentrate (SPC) | 12.00 |
| Soy Hulls | 0.00 |
| Wheat Flour8 | 12.50 |
| Wheat Midds8  | 23.50 |
| Corn Gluten Meal | 7.00 |
| Blood Meal, spray dried | 5.25 |
| Calcium phosphate mono - 21%P | 2.26 |
| Fish, Anchovy  | 0.00 |
| Fish Oil | 1.00 |
| Soy Oil | 3.90 |
| Soy Lecithin | 1.50 |
| Vitamin Premix-F2 | 0.50 |
| Mineral Premix F-1 | 0.25 |
| DL-Methionine 99% | 0.15 |
| Choline Chloride 50% | 0.12 |
| Stay C - 35% | 0.03 |
| Antioxidant4 | 0.02 |
| Mycotoxin Binder5 | 0.01 |
| Mold Inhibitor6 | 0.01 |
| Total | 100.00 |
|  |  |

Table 2. Calculated nutritional profiles of the ASA-IM 36/7 SPC fingerling diets tested in the 2010 grass carp pond feeding demonstration conducted in Wujiang Municipal Aquaculture Co., Ltd. Demo Farm, Jiangsu Province, China.

 Nutrient As fed Unit

|  |  |  |
| --- | --- | --- |
| DE Fish | 2852.85 | kcal/kg |
| NFE | 35.56 | % |
| Starch | 18.53 | % |
| \*Protein | 36.00 | % |
| Protein, dig. | 34.06 | % |
| Fish Protein | 0.00 | % |
| Soy Protein | 21.60 | % |
| \*Fat | 7.64 | % |
| W 3 | 0.69 | % |
| W 6 | 3.33 | % |
| Fiber | 3.99 | % |
| \*Ash | 6.31 | % |
| Calcium | 0.53 | % |
| Phos Avail | 0.61 | % |
| Iron | 596.89 | % |
| Copper | 27.53 | % |
| Zinc | 122.95 | ppm |
| Selenium | 0.79 | ppm |
| Moisture | 8.34 | ppm |
| Vitamin C | 105.00 | ppm |
| Choline | 2491.08 | % |
| Ethoxyquin | 134.50 | mg/kg |
| Arginine | 2.20 | mg/kg |
| Lysine | 2.08 | mg/kg |
| Methionine | 0.68 | % |
| Meth+Cyst | 1.20 | % |
| Threonine | 1.42 | % |
| Tryptophan | 0.41 | % |

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Table 3. Vitamin and mineral premix formulations for the ASA-IM 36/7 SPC feed used in the 2010 grass carp fingerling pond demonstration at Wujiang Aquaculture Co., Ltd. Demo Farm, Jiangsu Province, China. Quantities of vitamins and minerals are per kilogram of premix. Both premixes were produced at the Phoenix Feed Mill premix plant in Chengdu, Sichuan Province.

 Ingredient Unit Amount

 Vitamin Premix F-2

 Vitamin A IU/kg 1,200,000

 Vitamin D3 IU/kg 200,000

 Vitamin E IU/kg 20,000

 Vitamin K mg/kg 0

 Vitamin C mg/kg 0

 Biotin mg/kg 40

 Choline mg/kg 0

 Folic Acid mg/kg 1,800

 Inositol mg/kg 0

 Niacin mg/kg 40,000

 Pantothenate mg/kg 20,000

 Pyridoxine (B6) mg/kg 5,000

 Riboflavin (B2) mg/kg 8,000

 Thiamin (B1) mg/kg 8,000

 Vitamin B12 mcg/kg 2,000

 Ethoxyquin mg/kg 500

 Mineral Premix F-1

 Iron ppm 40,000

 Manganese ppm 10,000

 Copper ppm 4,000

 Zinc ppm 40,000

 Iodine ppm 1,800

 Cobalt ppm 20

 Selenium ppm 200

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**Figure 1.** Growth curve for grass carp fingerlings fed 36/7 SPC feeds at Wujiang Municipal Aquaculture Co. Ltd. Demo Farm, Jiangsu Province. The 36/7 FM feed contained 20% fishmeal, while the 36/7 SPC feed replaced all fishmeal with low antigen soy protein concentrate (SPC).

Table 4. Results of the 2010 grass carp fingerling feeding demonstration with 36/7 soy protein concentrate (36/7 SPC) feeds at the Demo Farm of the Wujiang Aquaculture Co. Ltd, Jiangsu Province, China. A 20% fishmeal inclusion in the 36/7 FM feed was replaced with low antigen, animal grade soy protein concentrate in the 36/7 SPC feed.

Pond GrC1 stocking Stocking rate No. days Harvest wt. (g) PG3 (kg/mu) Survival (%) FCR Net income ROI

 No. size (g) (fish/mu) fed GrCSiC2 GrC SiC GrC SiC (RMB/mu) (%)

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 1 0.9 5,000 101 43.8 168 120.5 68 55.0 40 1.25 829.2 22.8

 2 0.9 5,000 101 28.5 85 111.2 46 78.0 54 1.35 752.2 6.6

 3 0.9 5,00 101 31.1 73 115.7 43 75.4 58 1.31 284.2 8.8

Mean 0.9 5,000 101 34.5 108.6 115.8 52.3 69.5 50.7 1.30 622 12.7

1GrC = Grass Carp

2PG  = Gross Production

1. 1The numerical component of the feed description refers to the percentage of protein and fat, respectively, in the ration, i.e. 36/7 indicates 36% crude protein and 7% crude fat. [↑](#footnote-ref-1)