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Development of Diets for Gilthead Bream *Sparus aurata* L. Cultured in Egypt.

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ABSTRACT. Two novel raw materials, dry germinated soyabean meal and fish silage, were used as the major protein sources in *Sparus aurata* feeds. Amino acid analyses of both materials, on one hand and the experimental fish on the other hand, proved that they meet or exceed the requirements of the species.

Three balanced diets were formulated on the basic idea of replacement of fish meal either partially, by defatted soyabean meal/dried germinated soyameal, or completely by a mixture of both soyabean meal and fish silage. Preliminary observations, under aquarium conditions, indicated that these artificial feeds are appropriate for the species.

Introduction

There is ample potential in Egypt, both in environment and in the favorable climate, for the development of fish farming utilizing new technology already in use in Europe. Recent interest in marine fish farming in Egypt stems from 1976, when culture of gilthead bream *Sparus aurata* L. was initiated. Trials of weaning the species in brackish water ponds or cages were successful (Eisawy and Wassef, 1984 and Wassef and Abu El Wafaa 1985). As part of the ongoing program to develop commercial production techniques and to maximize the yield per unit area, a low cost diet is required. In many countries, high quality fish meal is the primary protein source of the feed in intensive culture systems. However, alternative sources of good quality, but

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2. *Preparation of Fish Silage*

Acid preserved silage was produced in the laboratory, from freshly caught pelagic trash fish (other species available could also be used as well) adopting the method of Jackson *et al.* (1984). Nutritional characteristics of silage were also determined (Table 1).

TABLE 1. Composition (% dry weight) of raw materials.

Ingredients		Crude protein	Ether extract	Carbohydrates*	Metabolic energy	Calcium	Phosphorus
Fish silage	(FS)	73.4	17.1	1.2	14.7**	1.0	1.5
Soyabean meal, defatted	(SBM)	44.0	1.0	39.3	9.4	0.3	0.6
Fish meal	(FM)	65.0	4.0	5.0	11.8	6.0	3.0
Dried germinated soya	(DGS)	43.9	16.7	28.2	15.4**	0.2	0.6
Cod liver-oil	(CLO)	–	100	–	35.0	–	–
Soyabean oil	(SBO)	–	100	–	37.0	–	–
Wheat starch	(WHST)	–	–	100	13.0	–	–
Calcium carbonate	($CaCO_3$)	–	–	–	–	38.0	–

*Includes nitrogen free extract and crude fiber.
**Estimated.

3. *Other Ingredients*

3.1 *Fish Meal*

Fish meal available in Egypt, is of variable quality and prices. Imported fish meal is the highest quality and is correspondingly expensive (£E 1200-1400 per tonne). Typical composition would be 70% protein and 9% fat. Indigenous fish meal are produced from a number of sources. In present work, fish meal (composition listed in Table 1) was provided from the principal fish meal factory at Aswan at a price of £E 800 per tonne.

3.2 *Vitamin Premix*

There is a lack of suitable vitamin or mineral premix for fish diets in local markets. At present, poultry premixes are used, often at very low levels. But, due to the differing requirements of poultry and fish, the vitamins are incorrectly balanced. In view of the high prices (£E 15 per kilogram) and inadequate inclusion of premixes, they are considered in the present work as unnecessary expense particularly when the fish are farmed in semi-intensive systems.

3.3 *Treatment*

Other ingredients were obtained from normal commercial sources at reasonable prices except for cod liver oil which was relatively expensive (£E 30/kg).

All dry feed ingredients were milled and sieved, as described for soybeans, to get the requisite particle size before inclusion.

fish silage) meet or exceed the essential amino acid pattern for sea bream. The first limiting amino acid is methionine, then tryptophan (Table 2).

TABLE 2. Amino acid profiles for soyabean meal, fish silage and sea bream muscles.

Amino acid	Dry germinated soyabeans (g/100 g)	Fish* silage	Sea bream muscles (g/100 g protein)	Requirements***
Arginine	5.59	4.97	4.14	1.7/34**
Histidine	4.30	3.24	1.97	–
Threonine	2.97	3.58	5.63	–
Isoleucine	3.64	3.65	2.18	–
Leucine	6.09	6.08	6.06	–
Valine	3.86	4.13	3.60	–
Lysine (LYS)	4.49	7.23	6.49	1.7/34
Methionine	1.25	2.48	1.88	1.4/34
Tryptophan	–	0.87	–	0.2/34
Phenyl alanine	4.30	3.24	1.75	–
Aspartic acid	15.20	8.19	8.85	–
Serine	4.15	3.60	6.63	–
Glutamic acid	13.03	12.09	11.54	–
Glycine	3.14	4.80	17.45	–
Alanine	3.54	5.13	14.57	–
Tyrosine	4.03	2.80	1.22	–
Proline	4.46	3.57	3.71	–
Cystine	1.13	0.67	–	–
Availability LYS	4.31	–	–	–
% availability	96%	100%	–	–
% recovery	83%	79%	–	–

*Wassef, 1990.
**Percent of protein in the diet.
***After Sabaut and Luquet, 1974 (Loc. cited Wilson, 1985).

Yone (1975) measured the requirement for the Japanese red sea bream *Chrysophrys major* for 10 essential amino acids. However, the relation between gilthead bream and red sea bream is still uncertain.

1.3 Carbohydrates

Not more than 10% of diet, since species has low capability of carbohydrate assimilation (Marias and Kissil 1979).

1.4 Lipids and Essential Fatty Acids

The use of vegetable oil alone and an excessive amount of oil in the diet is undesirable for sea bream. The superior performance of fish oil over soyabean oil is supported by evidence, in the literature, indicating better growth of certain fish, especially marine species, when a source of marine oil is used in the diet (Kissil *et al.* 1982).

3. Preliminary Feeding Trial

Prior to the start of feeding experiment, young sea breams underwent a 3-week conditioning period during which they readily adjusted to diets and standardized environmental conditions. Unfortunately, the feeding trial lasted only for 20 days further, and terminated after the electricity cut-off the system and the consequent death of all experimental fish. However, preliminary results obtained so far (Table 5) indicated a satisfactory growth rate as compared to that obtained for wild young fish (Eisawy and Wassef 1984). Percentage mortality ranged from 5 to 7% throughout the whole experimental period. But these results are not sufficient to elucidate a precise comparison between the three diets. Next paper will overcome this problem.

TABLE 5. Growth characteristics of *Sparus aurata* on the three diets.

Diet	Mean Fish Weight (g)				
	Initial day (0)	Final day (21)	% gain / day	day (41)	% gain / day
Diet I	0.65 ± 0.4*	1.63 ± 0.6	0.05	8.39 ± 0.5	0.34
Diet II	0.65 ± 0.4	2.00 ± 0.5	0.06	11.15 ± 0.4	0.46
Diet III	0.65 ± 0.4	1.85 ± 0.4	0.06	10.10 ± 0.7	0.41

Standard deviation.

The present work's experimental facilities (closed system) failed to prove convenient for sea breams, instead, they can be kept for about 8 months in an open circulation system (constant water flow) with no mortality at all (Kraljevic 1984).

Numerous workers have studied the effects of artificial diets on the growth of gilthead bream, (Marias and Kissil 1979, Ramos and Kobayashi 1981, Kissil *et al.* 1981, 82, Kraljevic 1984, and Divanach *et al.* 1986). However, their data were mainly based on either purified or semi-purified test diets. Although their results provided a significant ground for studies of sea bream nutrition, this problem requires further investigations particularly under local situations in Egypt.

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إعـداد عـلائق صناعيـة لتغـذيـة أسماك الدنيس المستـزرعـة في مصر

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المستخلص . يعتبر مجال التغذية الصناعية لأسماك المزارع (وخاصة الأنواع البحرية منها) من المجـالات الهامة والحديثة للبحث العلمي في مصر . ويهدف إلى التوصل إلى إعداد وجبات صناعية متزنة لتغذية الأسماك المرباة ، وذلك لزيادة معدلات النمو وبالتالي الحصول على محصول سمكي أوفر . ويراعي عند اختيار المواد الخام المستخدمة في هذه العلائق أن تكـون متوافرة في السوق المحلي وبسعر رخيص حتى تنخفض تكاليف التصنيع وبالتالي يسهل توافرها على المستوى التجاري فيما بعد .

وفي هذا البحث تم اختيار كل من مسحوق فول الصويا بعد إنباته (Germinated Soyabean Meal) وسيلاج الأسماك (Fish Silage) كمصدرين رئيسين للمواد البروتينية في إعـداد علائق لتغذية صغار أسماك الدنيس البحرية . حيث أثبتت التحاليل الكمية للأحماض الأمينية لكل من هاتين المـادتين صلاحيتهما لهذا الغرض وذلك لاحتوائهما على الكميات (من الأحماض الأمينية الأساسية) التي تفي بالمتطلبات الغذائية للأسماك التي تحت الاختبار .

وقد تم إعداد ثلاث وجبات صناعية متزنة على هيئة كبسولات غذائية (Pellets) يتم بوساطتها إحلال كل من مسحوق فول الصويا أو سيلاج الأسماك إحلالاً جزئيًا أو كليًا محل دقيق السمـك (Fish Meal) المـرتفع الثمن نسبيًا ، والتي يجري حاليا استخدامه لمعظم الأسماك المستزرعة .

وقد أثبتت التجارب المبدئية لتغذية صغار أسماك الدنيس (في أحواض زجاجية معملية) على تلك الكبسولات معدلات نمو لا بأس بها مقارنة بمعدلات النمو لمثيلاتها في البيئة الطبيعية .

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