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Yildiz M., Sener E.

in

Tacon A.G.J. (ed.), Basurco B. (ed.).
Feeding tomorrow's fish

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 22

1997
pages 225-233

Effect of dietary supplementation with soybean oil, sunflower oil or fish oil on the growth of seabass *(Dicentrarchus labrax* L. 1758*)*

M. YILDIZ
E. SENER
UNIVERSITY OF ISTANBUL
FACULTY OF AQUATIC PRODUCTS
ORDU CADDESI, NO: 200
34580 LALELI, ISTANBUL
TURKEY

SUMMARY - A 98 day feeding trial was carried out at the HATKO Anafartalar Fish Farm, Eceabat, (Çanakkale, Turkey), concerning the effect of dietary addition of soybean oil, sunflower oil, or fish oil on the growth of sea bass. Fish of initial mean weight 58.79 g, were housed within experimental net cages (25-50 fish / cage) and fed either a control commercial seabass ration, or the same ration supplemented with either 5% fish oil (Experimental group III), 5% soybean oil (Experimental group I), or 5% sunflower oil (Experimental group II). At the end of the feeding trial, the live weight gain of experimental fish was found to be 79.53 g, 85.70 g, 86,31 g and 93.93 g for fish fed the control diet, soybean oil, sunflower oil or fish oil supplemented diet, respectively. Food conversion ratio was found to be highest level in experimental group II (2.25) and the lowest level within experimental group III (2.03). However, on the basis of analyses of variance, there was no significant differences between treatments on the basis of live weight gain and food conversion ratio. Carcass analysis showed no real differences among experimental groups by the end of the 98 - day rearing period, other than a slightly elevated carcass lipid content and decreased carcass moisture content of fish fed the sunflower oil supplemented diet. On the basis of these results the use of 5 % supplemental plant lipid over the use of fish oil had no adverse effect on the live weight gain, food conversion ratio, and viscerosomatic and hepatosomatic index fish. However, all experimental groups supplemented with dietary lipids had elevated carcass lipid levels compared with control fish fed the non - supplemented rations.

Key words: Sea bass, feeds, fish oil, soybean oil, sunflower oil.

RESUME - *"Effet de la supplémentation du régime avec de l'huile de soja, de l'huile de tournesol ou de l'huile de poisson, sur la croissance du bar (Dicentrarchus labrax L. 1758)". Un essai d'alimentation sur 98 jours a été mené à la ferme piscicole de HATKO à Anafartalar, Eceabat (Çanakkale, Turquie), pour voir l'effet de l'addition dans le régime d'huile de soja, de tournesol et de poisson, sur la croissance du bar. Des poissons d'un poids moyen initial de 58,79 g ont été placés dans des cages expérimentales en maille (25-50 poissons / cage) et alimentés soit avec une ration commerciale pour bar comme témoin, ou cette même ration supplémentée par 5% d'huile de poisson (groupe expérimental III), 5% d'huile de soja (groupe expérimental I), ou 5% d'huile de tournesol (groupe expérimental II). A la fin de cet essai d'alimentation, le gain de poids vif des poissons sous expérimentation a été de 79,53 g, 85,70 g, 86,31 g et 93,93 g pour les poissons du régime témoin, et des régimes supplémentés avec de l'huile de soja, de tournesol et de poisson, respectivement. L'indice de conversion alimentaire présentait le niveau le plus élevé chez le groupe expérimental II (2,25) et le niveau le plus faible chez le groupe expérimental III (2,03). Cependant, sur la base des analyses de variance, il n'y avait pas de différences significatives entre les traitements en ce qui concerne le gain de poids vif et l'indice de conversion alimentaire. L'analyse de la carcasse a montré qu'il n'y avait pas de différences réelles entre les groupes expérimentaux à la fin de la période d'élevage de 98 jours, à part une teneur en lipides dans la carcasse légèrement plus élevée, et une teneur en humidité dans la carcasse un peu moindre chez les poissons du régime supplémenté avec de l'huile de tournesol. Au vu de ces résultats, l'utilisation de 5% de lipides supplémentaires d'origine végétale par rapport à l'utilisation d'huile de poisson, n'a pas d'effet adverse sur le gain de poids vif,* *l'indice de conversion alimentaire, et l'indice viscérosomatique et hépatosomatique des poissons. Néanmoins, tous les groupes expérimentaux supplémentés avec des lipides dans le régime avaient des niveaux élevés de lipides dans la carcasse comparés aux poissons du régime témoin non supplémenté.*

***Mots-clés** : Bar, aliment composé, huiele de possion, huile de soya, huile de tournesol.*

INTRODUCTION

Marine fish farming plays an important role in aquaculture; the increase in demand of aquatic products and difficulties in fishing encouraging the development of marine fish farming. As in the other Mediterranean countries, sea bass and sea bream farming constitutes an important part of marine aquaculture in Turkey (Hossucu et al., 1991; Uçal and Benli, 1993).

Marine fish farming first developed in Turkey in 1987, and according to recent data sea bass production in Turkey has increased from 5 mt in 1987, 808 mt in 1992, to 500 mt in 1993. Although sea bass can grow from 2 g to 330 g (market size) in 18-20 months in Mediterranean countries such as Greece, Italy, Spain and Turkey, the growth period is longer in the Northern Aegean Sea due to lower water temperatures (Jones, 1988; FAO, 1993; DIE, 1993; and Chamberlain, 1993). At present valli culture systems are used by the HATKO corporation to produce sea bass and sea bream located near Çanakkale (Dardanelles). In the main sea bream and sea bass farming has been developed primarily on the Aegean coasts and in the Mediterranean and Marmara regions of Turkey (Atay, 1985; Çakir, 1993).

Feeds play an important role within intensive culture systems, and should contain all essential nutrients, including all the proteins, lipids, carbohydrates, vitamins, and minerals required the farmed by fish species. Of these nutrients, dietary lipids play an important role as a source of energy and essential fatty acids (EFA) which all required by fish for optimum growth. Lipids are also important carriers and play a role in the absorption of fat soluble vitamins. Moreover, phospholipids are lipids and play an essential role in cellular structure and for the maintenance of membrane flexibility and permeability. Studies on lipid metabolism have shown that fish lack the ability to synthesize linoleic acid (18: 2n-6) and linolenic acid (18: 3n-3) de novo, and that these fatty acids are dietary essential for fish. The EFA requirements of fish have been well studied, and one of the major differences in the EFA requirements between species appears to be between freshwater and marine fish; freshwater fish species generally requiring 18: 2n-6 or 18: 3n-3 or both, whereas marine fish require eicosapentaeonic acid (EPA; 20:5n-3) and/or docosahexaenoic acid (DHA; 22: 6n-3) (NRC, 1983; Watanabe, 1988; Barnabe, 1990; Hardy and Toshiro, 1991; Kalogeropoulos et al, 1991; Di Bella et al, 1993; Tacon, 1993).

The effects of lipids and EFA on the growth of sea bas using different lipid sources and environmental conditions has been investigated by earlier researchers (Mohr, 1987; Boonyaratpalin, 1989; Kalogeropoulos et al, 1991; Di Bella et al, 1993). Fish oil is an excellent source of n-3 fatty acid series and oilseed oils such as soybean and sunflower are also rich in n-6 fatty acid series as wal having but have n-3 fatty acid series at low concentrations levels (NRC, 1983; Pigot and Tucker, 1990). Water have also been shown to effect the beneficial effect of adding plant oils to fish feeds on fish performance has been shown by numerous authors (NRC, 1977; Lovell, 1988; Amerio et al, 1989; Lovell, 1989), and soybeans and sunflowers are widely cultivated in Turkey as a source of lipids for human consumption. The aim of the present investigation was therefore to determine the effect of dietary lipid additions, including soybean oil sunflower oil, or fish oil, on the growth performance and body composition of juvenile cage-reared sea bass. Due to decrease in production of fish meal has also reduced fish oil in recent years, and plant oils play important role in feed industry.

MATERIALS AND METHODS

Experimental design

The feeding trial was conducted over a 98 - day period from 18 May, 1995 to 26 August, 1995 at a private sea bass farm (HATKO company), located near the Dardanelles, Çanakkale.

Juvenile sea bass of 55-60 g mean initial weight were stocked into experimental cages, namely a control group and three experimental groups I, II and III. 25 Randomly chosen sea bass were assigned to the control group (housed within 1m x 1m x 1m cage), and 50 fish allotted to each experimental group (housed within 2m x 2m x 2 m cages). Prior to the start of the feeding trial, all experimental fish were acclimatized over a 10 day adaptation period.

Feeds and feeding trials

Fish within the control group were fed with PINAR sea bass feed (P 3; 3.2 mm) containing 49% crude protein, 11% crude fat, 13.50% ash, 3% crude fibre, 13.50% NFE, and 3007 kcal/kg metabolizable energy (Table 1).

Table 1. Proximate composition of the feed

Nutrients	% on dry feed basis
Dry matter	90.00
Crude protein (N x 6.25)	49.00
Crude fat (ether extraction)	11.00
Ash	13.50
Crude fibre	3.00
NFE [(1)]	13.50
M.E. (kcal/kg)[(2)]	3007

[(1)] : Nitrogen free extractives determined by differences

[(2)] : Metabolizable energy calculated using calorific values of 3.9 kcal/g for crude protein, 8.0 kcal/g for fat, and 1.6 kcal/g for carbohydrate.

Fish with the three experimental test groups were fed with the same commercial feed to which was added either 5% soybean oil (group I), 5 % sunflower oil (group II), or 5 % fish oil (group III), on a dry weight basis. All the lipids used was added to the pelleted feeds by spraying onto the outside of the pellets.

All fish were fed depending upon body size and water temperature at a fixed rate of 2 % body weight per day for the first three 14 day growth periods, and then at 3 % body weight for the remainder of the experiment; with fish being fed by hand twice daily. Water temperature have been measured between 16.4 ^{0}C - 27.2 ^{0}C over experimental period. (Di Bella et al. 1993; Alpbaz, 1990; Barnabe, 1990).

Chemical analyses and growth performance determination

The commercial and experimental feeds used were analyzed for dry matter, crude protein, crude fat, cellulose, ash, and NFE using the Weende analysis system on a percent dry matter basis (AOAC, 1984). The metabolizable energy content of the feeds was determined as reported by Halver (1972). Five fish were randomly selected from each group at the start, after 52 days and end of the experiment for proximate analysis of body constituents (ie . water, crude protein, crude fat, ash) and liver lipid analysis. The total body weight of experimental fish was measured at 14 - day intervals by anaesthetizing fish with quinaldine.

The live weight gain was calculated by difference, and food conversion ratio calculated by dividing the weight of feed consumed by the mean weight gain of fish (Ricker, 1979; Schreck and Moyle, 1990). Data on body weight gain and food conversion ratio were statistically analyzed using the analysis of variance (Kutsal and Muluk, 1975), and fish condition factor calculated using the formula; $K = 100 \times W/L^3$ where W is the fish weight (g) and L is "fork length" (cm). Finally, random fish samples were taken for the estimation of viscerosomatic index (VSI) and hepatosomatic index (HSI) as described by Ricker, (1979), and Schreck and Moyle, (1990).

RESULTS AND DISCUSSION

The growth performance of fish fed the experimental diets is shown in the Table 2 and Figure 1. No fish mortality was observed over the rearing period within any of the experimental cages.

Table 2. Growth performance of fish over the 98 day feeding period.

	Experimental Groups			
	Control	I	II	III
Mean initial body weight(g)	55.15	60.03	60.10	59.10
Mean final body weight (g)	134.68	145.73	146.41	152.95
Weight gain (g)[(1)]	79.53	85.70	86.31	93.33
Feed consumption (g)	197.00	187.74	194.66	190.76
Food conversion ratio[(1)]	2.16	2.19	2.25	2.03
Condition factor	1.01	1.04	1.05	1.08

[(1)] : $P \geq 0.05$

There was no significant difference between treatments on the basis of live weight gain and food conversion ratio. Despite this, fish fed the fish oil, supplemented diet (III) displayed the highest mean final body weight and lowest food conversion ratio over the 98 - day rearing period. These results are consistent with those obtained by other, including, Amerio et al, (1989); Barnabe (1990), and Di Bella et al (1993). A similar food conversions who was reported by Uçal and Benli (1993) for sea bass on the Mediterranean coast of Turkey.

Unfortunately, due to difficulties encountered during the process of anesthètizing fish prior to weighing, fish weight and growth was negatively affected during the first three 14 - day rearing periods. Table 3 shows the results of the body composition, viscerosomatic index, and hepatosomatic index of fish at the start, after 52 days and at the end of the 98 - day feeding trial. No major trend emerged from the data presented other than a slightly evaluated carcass lipid and decreased moirhus catent of fish fed the sunflower oil supplemented diet (II).

Table 3. Body composition, viscerosomatic index (VSI), hepatosomatic index (HSI), and liver lipid content of fish over the feeding trial.

	Body composition (% in dressed out carcass)						
	Moisture	Crude protein	Crude fat	Ash	VSI	HSI	Crude fat (liver)
Control group							
Start	72.02	19.30	4.80	3.86	15.38	1.59	32.57
Day 52	72.85	18.20	5.00	3.60	15.26	2.03	12.22
End	71.31	20.65	4.80	3.16	13.98	2.41	20.20
Experimental group I							
Start	72.02	19.30	4.80	3.86	15.38	1.59	32.57
Day 52	71.58	18.70	5.90	3.84	15.30	1.83	17.72
End	70.30	20.02	5.50	3.76	14.28	2.49	25.24
Experimental group II							
Start	72.02	19.30	4.80	3.86	15.38	1.59	32.57
Day 52	71.95	18.00	4.80	3.82	15.11	2.01	15.53
End	69.86	20.83	6.00	3.83	14.09	2.20	25.32
Experimental group III							
Start	72.02	19.30	4.80	3.86	15.38	1.59	32.57
Day 52	71.68	18.70	5.90	3.45	15.38	2.26	17.75
End	71.03	19.93	3.19	3.50	14.04	2.05	22.42

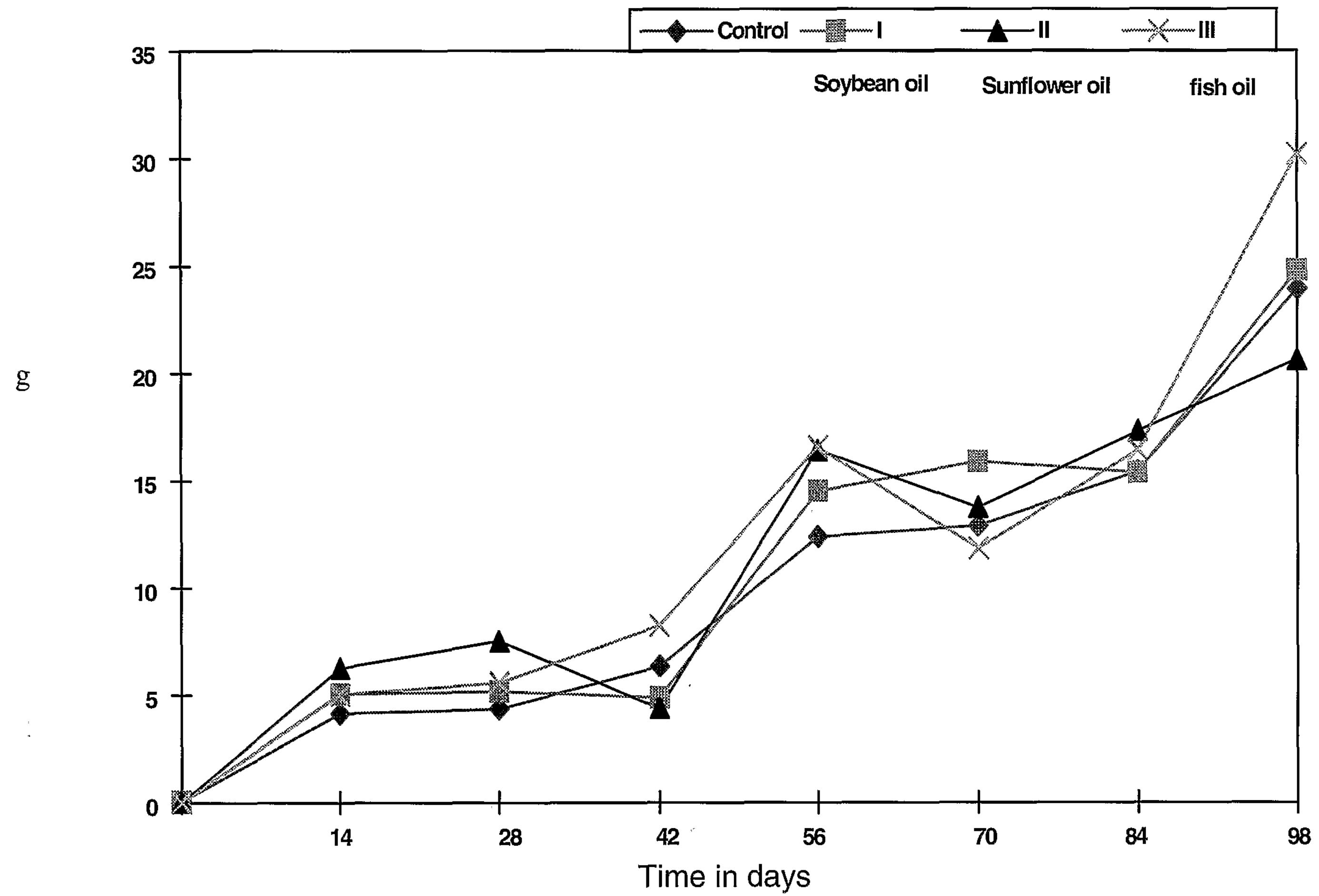

Fig. 1. Growth response of fish over the experimental test period.

In summary, the results show that there was no adverse effect of supplementary practical diets for seabass with plant oils as compared with fish oil; fish fed lipid supplemented rations display a better growth performance and feed utilization efficiency than fish fed unsupplemented rations.

ACKNOWLEDGMENTS

We are thankful to HATKO Anafartalar Fish Culture Corporation for allowing us to conduct this research at their facilities, and to the staff of the Food Control Laboratory of the Çanakkale Province for their assistance at the laboratory, and to Mr.Murat Gönül for his contributions.

REFERENCES

Akiyama, D.M. (1991) Future considerations for the aquaculture feed industry. Proceedings of the aquaculture feed processing and nutrition workshop. Thailand and Indonesia, September 19-25, 1991. Edited by Dean M. Akiyama and Ronnie, K.H. Tan. pp: 5-10

Alpbaz, A.G. (1990) Deniz baliklari yetistiriciligi. Ege Üniversitesi Su Ürünleri Yüksekokulu yayinlari, no: 20:291 - 323, Izmir.

Amerio, M, Costa. M: Mazolla, A; and Crisafi, E. (1989) Use of extracted soybean meal in diets for sea bass. Aquaculture a biotechnology in progress. De Pauw, N., Ackefors, H.; Wilkins, N. (Eds.) European Aquaculture Society, Bredene, Belgium, pp: 603-608.

AOAC, (1968) Official methods of analysis (9 th ed.) Association of Official Analyhical Chemists, Washington, DC.

Atay, D. (1985) Deniz baliklari üretim teknigi. Ankara Üniversitesi Ziraat Fakültesi No, 943: 20-21, Ankara

Barnabe, G. (1990) Rearing seabass and gilthead bream. Aquaculture, vol II, pp. 647-683 Ellis Horward Limited, England.

Boonyaratpalin, M. (1989) Sea bass culture and nutrition. Prooceedings of the Peoples Repubic of China, Aquaculture and Feed Workshop, American Soybean Association, Singapore. 43- 77.

Chambarlain G. W (1993) Aquaculture trends and feed projection. World Aquaculture, 24 (1): 19-29.

Çakir, H. (1993) Türkiyedeki kiyi alanlarinda su ürünleri yetistiriciligine uygun yerlerin tespiti. Tarim ve Köyisleri Bakanligi Tarimsal ,Üretim ve Gelistirme Genel Müdürlügü. Cilt I,II.

Di Bella, G: Genoverse; L; Dugo, G; Amerio, M.(1993). Fatty acid composition of the liver of the reared european sea bass (Dicentrarchus labrax, L.) in relation to three different diets and to the temperature. Instituto Sperimentale Talassografico C.N.R. Spianata S. Raineri 86-98122 - Messina, Italy.

D.I.E. (1995) T.C. Basbakanlik Devlet Istatistik Enstitüsü, Su Ürünleri Istatistikleri, 1-30.

F.A.O. (1993) Food and Agriculture Organization of the United Nations. Statistical bulletin for the fishery committee for the Eastern Central Atlantic (CECAF) No:7, nominal catches 1979-1991, Bulletin of Fisheries Statistics, Roma, 1993.

Frentzoz, T. (1995) Fish farming of Mediterranean species. 2-6 Ekim 1995. I.Ü. açilis etkinlikleri. Su Ürünleri Fakültesi Seminerleri, Istanbul.

Genari, L; Melotti, P; Amerio, M; Novelli, A; Garella, E., and Roncarati, A. (1991) Essais de sevrage du loup avec different aliments equilibres. IV. International Symposium on Fish Nutrition and Feeding, 24-27 June 1991, pp 79-92, Biartz, France.

Halver, J.E. (1972) Fish Nutrition. Academic Press, XII + 713. London.

Hardy, R. W and Toshiro, M. (1991) Specification for marine by - products for aquaculture. Proceedings of the aquaculture feed processing and nutrition workshop. Editted by, Akiyama, D. M. and Tan, R.K.H. American Soybean Association, Singapore. pp. 99-115.

Hossucu, H: Özden, O; Korkut, A.Y; ve Diler,I. (1991) Levrek (Dicentrarchus labrax, L.1758) yetistirme ve larva üretimi üzerinde arastirmalar. E.Ü. Su Ürünleri Yüksek Okulu. 1988 / 001 sayili proje, Izmir.

Jones, A. (1988) The development of marine fish farming in Europe, Recent developments and future potential. I.Ü. Su Ürünleri Yüksekokulu Su Ürünleri Dergisi: 2 (1) : 11-25.

Kalogerpoulos, N: Alexis, M.N; and Henderson, R.J. (1991) Effects of dietary soybean and cod liver oil levels on growth and body composition of gilthead bream (Sparus aurata), Aquaculture, 104: 293-308.

Koch, H; Siedentop, W; Straub, J. (1967) Aligemeine Biologie, 11. Verbesserte Auflage, Quelle Meyer Heidelberg

Kutsal, A; Muluk, Z. (1975) Uygulamali Temel Istatistik (2. Baski) Hacettepe Üniversitesi Yayinlari, No: A 2.

Lees, R. (1968) Laboratoy Handbook of Methods of Food Analyses. Leonard Hill Books, London.

Lovell, R.T. (1988) Use of soybean products in diets for aquaculture species. I.Ü. Su Ürünleri Yüksekokulu, Su Ürünleri Dergisi, 2(1) ; 26-49.

Lovell, R.T. (1989) Use of soybean products in diets for aquaculture species (Revised). Proceedings of the Peoples Republic of China Aquaculture and Feed Workshop American Soybean Association, Singapore, pp 335-356.

Mohr, V. (1987) Control of nutrition and sensory quality of cultured fish. Procceding of the International Symposium on Seefood Quality Determination, coordinated by the University of Alaska Sea Grand College Programme, Anchor, Alaska, U.S.A. November, 1986, Edited by Kramer, D.E; Liston, J. pp: 486 - 496.

NRC, (1977) Nutrient requirements of warmwater fishes. Nutrient requirements of domestic animals.National Academy of Science, Washington D.C. pp. 13-16.

NRC, (1983) Nutrient requiremets of warmwater fishes and shellfishes (Revised ed.) National Academy Press, Washington D.C. pp. 1-38.

Pigot, G.M; Tucker, B.W. (1990) Seafood effects of technology on nutrition. Aquaculture, Commercial farming of fish and shellfish, Appendix A.pp:318-325.

Ricker, W.E. (1979) Growth rates and models in fish physiology (W. S.Hoar; D.J. Randall; and J. R. Brett, editors) Volume 8. Academic Press. New York. pp. 678-738.

Schreck, C. B, Moyle, P. B (1990) Methods For Fish Biology. Oregon Fishery Research Unit. U. S. Fish and Wildife Service, Oregon State University. American Fisheries Society, Maryland U.S.A.

Tacon, A.G.J. (1993) Standard Methods for the Nutrition and Feeding of Farmed Fish and Shrimp. Kuwait Institute for Scientific Research. Safat, Kuwait, Volume I.

Uçal, U: Benli, H.A. (1993) Levrek baligi ve yetistiriciligi, T.C. Tarim ve Köyisleri Bakanligi Su Ürünleri Arastirma Enstitüsü Müdürlügü, Bodrum Seri A, Yayin no:9

Watanabe, T. (1988) Nutrition and Growth. In Intensive Fish farming, (Edited by Sheaherd, C.J, and Bromage, N.R.) BSP Professional Books. Oxford. pp. 154-198

Wheaton, F.W; Lawson, T.B. (1985) Processing Aquatic Food Products, A Wiley Interscience Publication, John Wiley, and Sons, Singapore.