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Growth Response of Nile Tilapia, *Oreochromis niloticus* (L.), Fed Date Palm Leaf Silage

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ABSTRACT. Date palm leaf silage was used as an alternative fish feed, and was fed to *Oreochromis niloticus* of two weight groups. The growth rates and food conversion ratios were compared with fishes of similar weight groups but fed on commercial fish feed; other treatments being the same. The growth performance and feed utilization was less efficient for the silage and this difference was more apparent for smaller weight fishes (mean weight 9.1 g) than for larger fishes (mean weight 125.0 g). Although the water quality with respect to dissolved oxygen content, pH and ammonia levels was not affected, yet considerable amount of fiber accumulated in tanks receiving silage and it required considerable efforts to flush it off. The date palm leaf silage appears to be suitable for larger fishes but unsuitable for small size fishes in tank culture system. However, it could be used as a supplemental feed in pond culture systems where dependence is on natural food.

In Saudi Arabia the major constraints for fish farming are, (1) high costs of establishment of aquaculture facility, (2) water scarcity, and (3) cost of fish feed. No commercial fish feed was available until 1980, and when it became available it was expensive, about SR 3.0/kg (about US$ 800.00/ton). Since 1985 fish feed prices have been subsidized and it now costs SR 1,068.00/ton. However, there is still a need to develop fish feeds prepared from local ingredients, possibly cheaper and meeting basic fish nutrition requirements. King Faisal University, in collaboration with scientists from South Korea, developed a feed for livestocks under a KACST-KAIST research project on "Utilization of date palm leaves and poultry manure as feed stuffs for farm livestocks in Saudi Arabia", and satisfactory results were obtained (M. Sohail 1988, personal communication). As this feed was mainly

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prepared from local ingredients, it was decided to test the feed in tilapia culture and find out its suitability as tilapia feed.

Materials and Methods

The date palm leaf (DPL) silage was obtained from the KACST-KAIST Research Project. The following method was used for its preparation (M. Sohail, personal communication). Dried date palm leaves were washed with tap water and dried in the sun. They were then cut into small pieces by a cutting machine and ground by a hammer crusher fitted with 14 mm seive. Poultry manure was cleaned and dried in oven at 80°C for 24 h, and then ground in a hammer mill fitted with 40 mesh screen. The crushed DPL were sprayed with 7% sodium hydroxide and kept at room temperature for 3 days. Following that poultry manure, broken wheat, wheat bran and water were added to the chopped leaves and mixed. The final moisture was adjusted to 45%. The product was tightly packed in double layered polythene bags and allowed to ferment for 30 days at room temperature. Routine analysis of volatile fatty acids, pH and moisture levels indicated that 20-30 days were required to complete fermentation. The ingredients used for the preparation of the silage and its proximate analysis as made per procedures outlined by AOAC (1980) are given in Table 1. The DPL silage was also analysed for alfatoxins and coliform Salmonella and was found to be free (M. Sohail, personal communication).

For this study 6 small tanks (2.5 × 1.5 × 1.1 m; volume 3.75 m^3) and two large tnks (8 × 5 × 1 m) with water volume of 20 m^3 each were used to test the performance of DPL silage in comparison to a commercial fish feed with a dietary protein level of 34.23% (Table 2). Two size groups of fish were used. The experiment was conducted for 90 days, from 1.8.1985 to 30.10.1985. Each treatment was duplicated and different treatments are given below:

1. Tank 1 (3.75 m^3); 59 fish, mean weight 120.0 g; commercial fish feed, feeding rate 3% (1.8-24.9.85) and 2% (25.9-30.10.85) of body weight daily.
2. Tank 2 (3.75 m^3); 60 fish, mean weight 127.5 g; feed and feeding rates same as in tank 1.
3. Tank 3 (3.75 m^3); 59 fish, mean weight 125.7 g; feed DPL silage, feeding rate 6% (1.8-24.9.85) and 4% (25.9-30.10.85) of body weight daily.
4. Tank 4 (3.75 m^3); 59 fish, mean weight 126.5 g; feed and feeding rates same as in tank 3.
5. Tank 5 (3.75 m^3); 150 fish, mean weight 9.1 g; feed DPL silage, feeding rate

10% (1.8-10.9.85) and 6% (11.9-30.10.85) of body weight daily.

6. Tank 6 (3.75 m^3); 150 fish, mean weight 9.1 g; feed and feeding rates same as in tank 5.
7. Tank 7 (20 m^3); 800 fish, mean weight 9.17 g; commercial fish feed, feeding rate 5% (1.8-10.9.85) and 3% (11.9-30.10.85) of body weight daily.
8. Tank 8 (20 m^3); 800 fish, mean weight 9.5 g; feed and feeding rates same as in tank 7.

DPL silage contained 45% moisture and commercial feed had about 6% moisture, therefore the silage was fed at twice the amount of the commercial fish feed. The feeding rate was adjusted after every two weeks to the new biomass determined from a sample weighing of about 30 fish from each tank. The feeding rate was reduced as the fish grew in weight. The food was offered in equal amounts in the mornings and evenings.

Table 1. Proximate analysis of date palm leaf silage and its ingredients

A. Proximate Analysis	**(%)**
Moisture	45.80
Crude protein	13.30
Crude fiber	14.66
Ether extract	2.70
Ash	13.30
ME (Kcal/kg) 1303	
Nitrogen free extract (NFE)	56.03
Lignin	6.76
Acid detergent fiber (ADP)	6.76
B. Ingredients for DPL silage	**(% on dry weight basis)**
Date palm leaf	40.0
Wheat bran	30.0
Broken wheat	15.0
Poultry manure	15.0

1. This data was provided by Dr. M. Sohail, Principal Investigator of KACST-KAIST Research Project on "Utilization of date palm leaves and poultry manure as feed stuffs for farm livestocks in Saudi Arabia".
2. All details about the DPL silage are available with King Abdulaziz City for Science & Technology, Riyadh.

Table 2. Proximate composition of commercial fish feed as provided by the manufacturer

Proximate Analysis	(%)
Crude protein	34.23
Crude fat	3.39
Crude fiber	3.00
Calcium	1.20
Phosphorus	1.00
ME (Kcal/kg) 2580	

Ingredients

Yellow corn, wheat mill feed, soybean meal, fish meal, dry yeast, dicalcium phosphate, manganese, iron, copper, iodine, zinc, vitamins D3, E, K, A, thiamine, riboflavin, niacin, pentothenic acid, folic acid, biotin, choline chloride, B12, fermentation products.

Manufacturer

Grain Silos and Flour Mills Organization, Dammam Plant, Dammam.

A flow-through water circulation system was maintained in all experimental tanks throughout the experimental period and a flow rate of about 1 L/min/kg biomass was maintained. In tanks 7 and 8, the water was almost completely changed in the morning and evening in August, but in September and October a flow-through system was maintained with a flow rate of 1 L/min/kg biomass.

The water quality parameters (maximum-minimum temperatures, dissolved oxygen, BOD, pH, alkalinity, ammonia and salinity were regularly monitored in tanks 1 and 3 and standard methods were followed (APHA, 1975).

Results and Discussion

The DPL silage was stored at room temperature and no spoilage was noted. It was dark brown in colour with pungent smell and a pH of about 5.5. It was in moist crumble from with leaf fibers measuring upto 20 mm. Crude fiber content was 14.66%. Usually large leaf fibers were not eaten by the fish, particularly by small fishes, and in all four tanks receiving silage feed large quantities of fiber accumulated. Daily efforts were made to flush off the left over feed (fiber). It appeared that the fish were mostly feeding on the wheat bran, broken wheat and poultry manure proportions and avoiding the fibrous part. On the other hand the commercial fish feed was palatable and very well accepted by the fish.

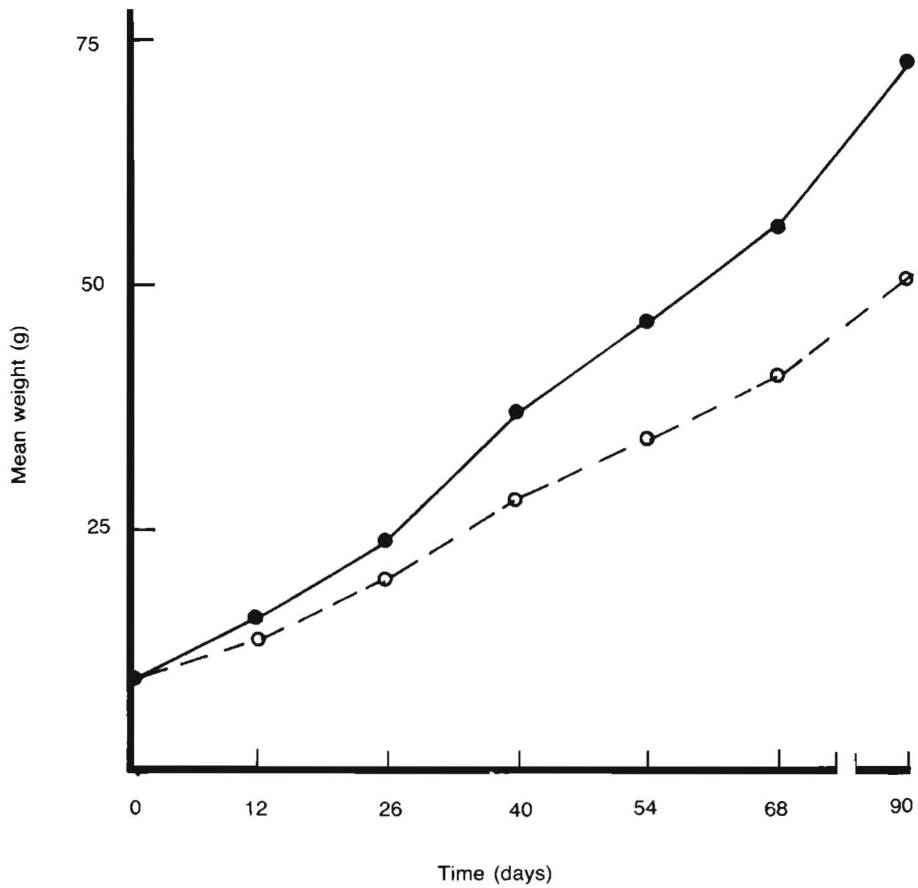

Fig. 1. Growth of *O. niloticus* with starting average weight of 9.1 g and fed on commercial fish feed (● —— ●) and date palm leaf silage (○ – – – ○).

Data on stocking rate, growth and food conversion ratio are given in Tables 3 and 4, and the growth curves are shown in Figures 1 and 2.

In larger fishes (initial weight about 125 g) reasonable weight gains were maintained (1.84 g/fish/day) with silage, though the final weight (average weight 291.4 g) was lower than that obtained with the commercial fish feed (average weight 337.6 g; average daily growth 2.37 g/fish/day). The food conversion ratio on the basis of the silage as it was fed (with 45% moisture) was 4.73 in tank 3 and 4.44 in tank 4, higher than the food conversion ratios obtained for the commercial fish feed (1.92).

Table 3. Growth and food conversion of *O. niloticus* (av. wt. 125.0 g) fed on commercial fish feed and date palm leaf silage

Duration of experiment (days)	Tank No.	Number and weight of fish						Weight increase			Feed fed (g)	FCR (g)
		At start			At end			Total (g)	%	Average daily growth (g/f/day)		
		No. of fish	Weight Total (g)	Weight Mean (g)	No. of fish	Weight Total (g)	Weight Mean (g)					
Commercial fish feed												
90	1	59	7080	120.000	59	19863	336.666	12783	180.55	2.407	24450	1.913
90	2	60	7650	127.510	60	20310	338.500	12660	165.49	2.344	24307	1.920
Date palm leaf silage												
90	3	59	7419	125.750	58	17078	294.450	9659	130.19	1.850	45666	4.727
90	4	59	7463	126.500	59	17010	288.320	9547	127.92	1.789	42630	4.444

FCR = g dry weight fed/g live weight gain.

Table 4. Growth and food conversion of *O. niloticus* (av. wt. 9.16 g) fed on commercial fish feed and date palm leaf silage

Duration of experiment (days)	Tank No.	Number and weight of fish						Weight increase			Feed fed (g)	FCR (g)
		At start			At end			Total (g)	%	Average daily growth (g/f/day)		
		No. of fish	Weight		No. of fish	Weight						
			Total (g)	Mean (g)		Total (g)	Mean (g)					
Commercial fish feed												
90	7	800	7336	9.17	798	55509	69.56	48173	656.7	0.671	74711	1.551
90	8	800 (40/m^3)	7600	9.50	800	62120	77.65	54520	717.4	0.757	75616	1.395
Date palm leaf silage												
90	5	150	1374	9.16	146	7563	51.80	6188	450.4	0.471	22429	3.524
90	6	150 (40/m^3)	1374	9.16	148	7317	49.44	5943	432.5	0.446	21579	3.630

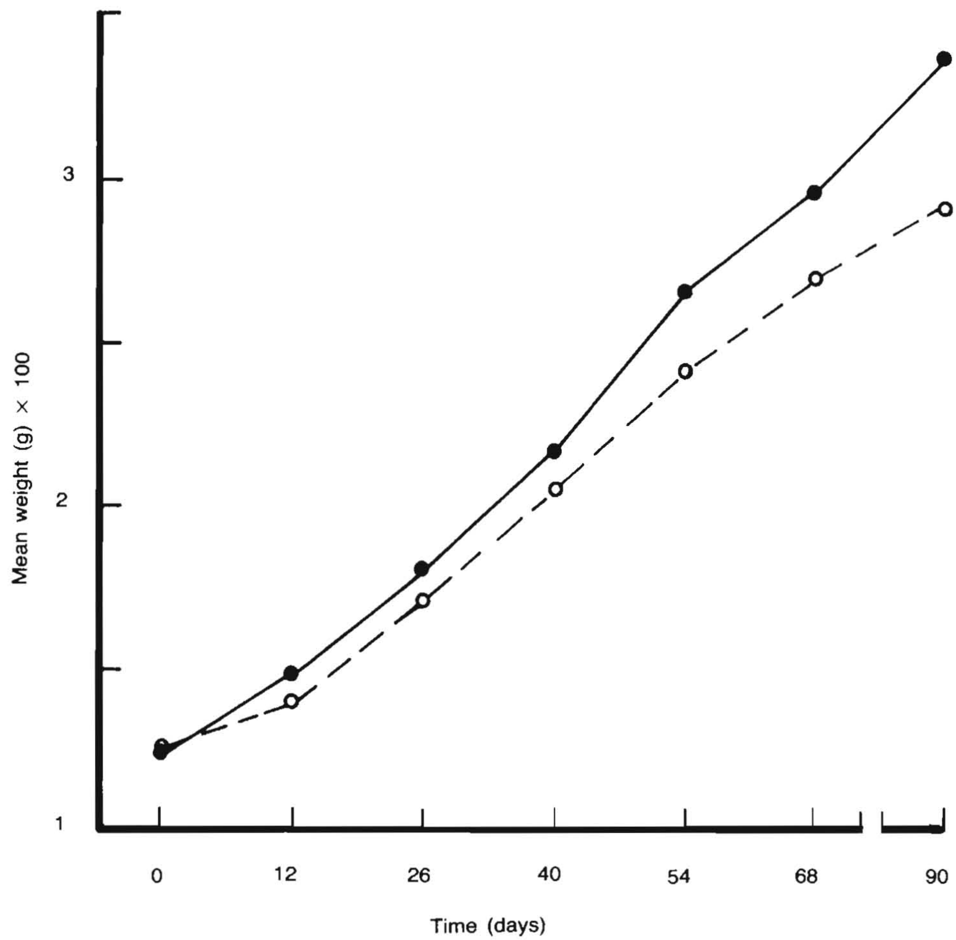

Fig. 2. Growth of *O. niloticus* with starting average weight of 125 g and fed on commercial fish feed (● —— ●) and date palm leaf silage (○ – – – ○).

Differences in growth rates of smaller fishes (initial average weight about 9.1 g) for the two types of feed were more apparent. The average daily growth in the tanks receiving silage was 0.46 g/fish/day and for the commercial fish feed 0.62 g/fish/day. The average food conversion ratio for silage was 3.58 and for the commercial fish feed 1.46.

The poor growth performance of both size groups of fish with DPL silage is understandable. The crude protein content of the silage was 13.3% with a considerable amount of crude fiber. The high fiber content makes the silage less ingestible, and if ingested it is not digested well by the fish. Therefore a considerable amount of fiber accumulated in the tanks. The protein content of the silage was low, as the dietary protein requirement of small size tilapia is 35% and above (Cruz and Laudencia, 1976; Davis and Stickney 1978; Jauncey 1982; Jauncey and Ross 1982; Siddiqui *et al.* 1988) and for larger fish about 30% (Ofojekwu and Ejike 1984; DeSilva and Perera, 1985; Wang *et al.* 1985; Siddiqui *et al.* 1988). Besides, the source of protein is wheat bran and poultry manure, and obviously the protein quality is poorer than that of animal protein.

In intensive fish culture DPL silage appears to be of less value as food because there is 100% dependence on artificial feed from outside, and therefore, a well balanced diet is required to provide all the essential elements necessary for healthy development and growth. Besides, the accumulation of fiber was a great nuisance and it required considerable effort to eliminate it.

However, in pond fish culture the DPL silage could be used as a fish food. In such environments, besides providing supplemental food, it can enhance natural food production, as the leftover food will decompose and release nutrients for phytoplankton production. But the natural food production will depend upon the input of nitrogen through the protein present in the diet as demonstrated by Edwards *et al.* (1985) using feed prepared from decomposed and dried hyacinth together with fish feed by a simple displacement procedure.

The water quality parameters were regularly monitored and are reported in Table 5. During the period of this study the water temperatures were optimum for tilapia growth as the maximum temperature ranged between 28.0 and 31.8°C. The dissolved oxygen contents in different tanks varied between 4.1 and 6.1 mg/L. There was not much dissolved organic matter in the water as the BOD levels were low. The water was almost neutral (pH 6.9-7.4) with methyl orange alkalinity about 250 mg/L. All these ranges in environmental parameters are within tolerable limits of tilapia (Bardach *et al.* 1972; Huet 1972; Stickney 1979).

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Table 5. Water quality parameters in tanks receiving commercial fish feed and date palm leaf (DPL) silage (Mean ± SD)

Month	Max. water temperature °C	Min. water temperature °C	Dissolved oxygen mg/L	pH	Total Alkalinity as $CaCO_3$ mg/L	Total Ammonia-N Mg/L	Salinity ppt.	B.O.D. mg/L
Tank 1 (receiving commercial feed) 1985								
August	31.8 ± 2.2	26.5 ± 1.0	4.4 ± 0.2	7.4 ± 0.2	243 ± 20	0.75 ± 0.10	3.90 ± 0.2	1.7 ± 0.12
September	29.6 ± 1.7	26.1 ± 1.7	4.8 ± 0.5	7.0 ± 0.3	260 ± 14	0.78 ± 0.20	3.66 ± 0.4	1.6 ± 0.12
October	28.5 ± 1.3	20.3 ± 4.9	6.1 ± 0.6	7.1 ± 0.3	260 ± 18	0.70 ± 0.10	3.95 ± 0.2	1.9 ± 0.16
Tank 3 (receiving DPL silage) 1985								
August	31.8 ± 2.2	26.5 ± 1.0	4.4 ± 0.2	6.9 ± 0.1	240 ± 25	0.70 ± 0.20	3.90 ± 0.2	1.8 ± 0.2
September	29.7 ± 1.7	26.1 ± 1.7	4.9 ± 0.4	7.1 ± 0.2	250 ± 20	0.76 ± 0.26	3.70 ± 0.3	1.7 ± 0.2
October	28.5 ± 1.3	20.3 ± 4.9	5.5 ± 0.4	7.0 ± 0.3	260 ± 16	0.71 ± 0.10	3.86 ± 0.2	1.8 ± 0.2

References

American Public Health Association (1975) *Standard Methods*, 14th Edition. American Public Health Association, Washington, D.C., 1193 p.

AOAC (1980) *Official methods of analysis of the Association of Analytical Chemists. 13th Edition. Association of Analytical Chemists.*, Washington, D.C., 956 p.

Bardach, J.E., Ryther, J.H. and **McLarney, W.O.** (1972) *Aquaculture:* The farming and husbandry of freshwater and marine organisms. Wiley Inter-Science, New York, 868 p.

Cruz, E.M. and **Laudencia, I.L.** (1977) Protein requirements of *Tilapia mossambica* fingerlings. *Kalikasan Phillip. J. Biol.* **6:** 177-182.

Davis, A.T. and **Stickney, R.R.** (1979) Growth response of *Tilapia aurea* to dietary protein quality and quantity. *Tans. Amer. Fish Soc.* **107:** 479-483.

DeSilva, S.S. and **Perera, M.K.** (1985) Effects of dietary protein levels on growth, food conversion and protein use in young *Tilapia nilotica* at four salinities. *Trans. Amer. Fish Soc.* **114:** 584-589.

Edwards, P., Kamal, M. and **Wee, K.L.** (1985) Incorporation of composted and dried water hyacinth in pelleted feed for the tilapia, *Oreochromis niloticus* (Peters). *Aquaculture and Fisheries Management* **1:** 233-248.

Huet, M. (1972) *Textbook of fish culture:* Breeding and cultivation of fish. Fishing News (Books) Ltd., Farnham, Surrey, 436 p.

Jauncey, K. (1982) The effects of varying dietary protein level on growth, food conversion, protein utilization and body composition of juvenile tilapia *(Sarotherodon mossambicus). Acquaculture* **27:** 43-54.

Jauncey, K. and **Ross, B.** (1982) A guide to tilapia feeds and feeding. University of Stirling, Institute of Aquaculture, Stirling, 111 p..

Ofojekwu, P.C. and **Ejike, C.** (1984) Growth response and feed utilization in the tropical cichlid *Oreochromis niloticus niloticus* (Linn.) fed on cottonseed-based artificial diets. *Aquaculture* **42:** 27-36.

Siddiqui, A.Q., Howlader, M.S. and **Adam, A.A.** (1988) Effects of dietary protein levels on grov h, feed conversion and protein utilization in fry and young tilapia, *Oreochromis niloticus. Aquaculture* **70:** 63-73.

Stickney, R.R. (1979) Principles of warmwater aquaculture. John Wiley and Sons, New York, 395 p.

Wang, Ki-Wei, Takeuchi, T. and **Watanabe, T.** (1985) Effects of dietary protein levels on growth of *Tilapia nilotica. Bull. Jpn. Soc. Fish.* **51:** 133-140 (English summary).

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استجابة سمك البلطي النيلي للنمو بالتغذية على علف سعف النخيل

عبدالقيوم صديقي[1] و محمد شاهجهان هولادر[2] و أحمد البدوي آدم[3]

[1]مدينة الملك عبدالعزيز للعلوم والتقنية ـ ص. ب ٦٠٨٦ ـ الرياض ١١٤٤٢

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استخدم علف سعف النخيل كغذاء بديل للأسماك وتمت به تغذية مجموعتين ذات أوزان مختلفة من سمك البلطي النيلي. وتمت مقارنة معدل النمو وكفاءة تحويل الغذاء إلى لحم في هذه الأسماك وأسماك أخرى لها نفس مجموعتي الأوزان ولكنها مغذاة على غذاء صناعي.

إتضح من الدراسة أن نمو الأسماك واستقلال الغذاء كان أقل كفاءة بالنسبة لعلف سعف النخيل وظهر هذا الاختلاف أكثر وضوحاً في الأسماك الصغيرة (متوسط الوزن ٩,١٥ جرام) منها في الأسماك الكبيرة (متوسط الوزن ١٢٥ جرام).

وعلى الرغم من أن نوعية الماء فيما يختص بمحتوى الأكسجين المذاب ودرجة التأين ومستوى الأمونيا لم تتأثر إلا أن كميات كبيرة من الألياف قد تراكمت في الأحواض مما تتطلب بذل مجهودات كبيرة لغسلها وإزالتها من الأحواض.

وعليه يمكن الإستنتاج بأن علف سعف النخيل ملائم كغذاء للأسماك الكبيرة الحجم (متوسط الوزن أكثر من ١٠٠ جرام) ولكنه غير مناسب للأسماك الصغيرة الحجم (متوسط الوزن أقل من ١٠ جرام) في نظام التربية في الأحواض الاسمنتية.

ومن ناحية أخرى يمكن استخدامه كغذاء اضافي في أنظمة التربية في البرك المائية حيث يتم الاعتماد في التغذية على الغذاء الطبيعي.