

Effects of *Sargassum ilicifolium* (Sargassaceae, Phaeophyceae) Meal on Physico- Chemical Formulated Shrimp (*Litopenaeus vannamei*) Feed

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Abstract

Almost 309 species and infraspecific taxa of macroalgae including 78 Chlorophyta (within 15 families), 70 Ochrophyta (Phaeophyceae; within 7 families) and 161 Rhodophyta (within 30 families) listed in coastal line of the Persian Gulf and Iranian water of Oman Sea. Among them, *Sargassum ilicifolium*, a dominant brown seaweed, which was used as a part of aquatic animal feed in order to investigate its effect on physico chemical formulated feed. Two isocaloric diets (336 kcal metabolizable energy /100g diet) containing 33% crude protein, with and without inclusion of brown seaweed *S. ilicifolium* (0 and 15, replaced on protein resources of shrimp diet) were used. Seaweed supplement in formulated feed not only improved the humidity absorbance ($110.20\% \pm 5.00\%$) and stability of pellet feed in seawater ($98.11 \pm 3.23\%$) compared to the control but also acted as the best binder and increased the periods of leaching pellet (5.20 ± 0.50) when they were dropped in seawater. It can be replaced instead of vitamin and mineral premixes when the feed is enriched by vitamin pyridoxine (6.4

mg.100⁻¹ seaweed DW) and minerals cobalt (0.06 mg.100⁻¹ seaweed DW) and zinc (1.1 mg.100⁻¹ seaweed DW).

Keywords: Physico- Chemical Characteristic Feed, Western White Leg Shrimp, *Sargassum ilicifolium*.

Introduction

In recent decades, aquaculture activities affected by using algae as a part of aquatic animal diet not only change the physico-chemical properties of formulated feed, but also improve the quality and quantity of fish or shrimp fed with. Effect of dietary algae and adequate levels will probably vary with the species of both algae and fish or shrimp. During 1990 to 2010, more than 309 macroalgae species were described in Oman Sea and the Persian Gulf, IRAN (Gharanjic et al., 2010). Micro and macro algae, seaweed and aquatic plants with relatively high nutritional value and high production rate, act as a new dietary resources for cultured aquatic animals, specifically fish and shrimp (Nakagawa and Montgomery, 2007). Substitution of protein resources in fish and shrimp diets by algae has additional benefits for feed

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such as taste and binder improvement, flesh consistency, additional Omega 3 fatty acid content, growth rate promoting due to better digestibility caused on high mineral and vitamin consist (Hafezieh et al., 2017). Aquaculture seaweeds productivity in 2005 was more than 16.09 million tons (wet weight), (FAO, 2009) and because of their bioactive compounds, they produced different secondary metabolites which had biological activities even against aquatic animal pathogens and even human pathogens (Mahasneh et al., 1995; De Val et al., 2001; Liao et al., 2003). Nakagawa (1985) reported that the addition of small amounts of algae to fish and shrimp diet not only evaluated growth and survival rates, but also produced physiological improvement, vitality, disease resistance, desired body composition and carcass quality of fish and shrimp (Hamauzu and Yamanaka, 1997). Different algae composition reports revealed that algae and seaweed contain all essential amino acids (Hafezieh et al., 2017; Behairy and EL-Sayed, 1983; Qasim, 1991; FAO/WIIO, 1991), nevertheless, Wong and Cheung (2000) reported that *Ulva lactuca* L. has not tryptophan amino acid. Fujiwara-Arasaki et al. (1984) analyzed 10–30% of amino acid in dry weight and showed they are rich in vitamins A, B1, B2, B6, B12, C and niacin. Fleurence (1999) measured 10-26% crude protein content in dry weight *Ulva* sp. and 47% in red seaweed, in order to be used as functional food and accelerator of nutrient absorption. They can also be replaced by animal protein and plant resources in fish and shrimp diet easily (Yone et al.,

1986; Wong and Cheung, 2000). Moreover, Mustafa et al. (1994; 1995a, b) showed significant growth and feed utilization increase in fish *Pagrus major* when they were fed only by small amount of algal powder in diets. Nakagawa et al. (1993) revealed optimum feed and protein in *Aconthopagrus schlegelii* (Bleeker) when they were supplemented by *Ulva* sp. Also, Mabcau and Fleurence (1993) reported higher content of the important minerals, calcium and iron in some seaweeds compared with vegetables and fruits. On the other hand, Basemir et al. (2004) and Nakagawa and Montgomery (2007) showed wide variety of EFA in lipids of different algae and seaweeds such as HUFA, PUFA specifically DHA and EPA which are the most important nutrients for neural function and health. Therefore, the objective of this work was to study the effect of seaweed (*S. ilicifolium*) supplemented to shrimp diet on physico-chemical properties of the pellet.

Materials and Methods

This experiment was carried out at Off-Shore Research Center- Chabahar, IRAN. The prepared seaweed (*Sargassum ilicifolium* (Turner) (C.Agardh) was collected from nature along the coastal line of Tis, a village near Chabahar, Sistan and Baluchistan province, IRAN (25°21'36", 60°36'26"). Rinsed, dried and powdered seaweed was measured for nutritional values in laboratory, based on standard method for statistical survey and was replaced by protein resources (fish, bone and meat meals) of shrimp

Table 1. Composition (gram per 100g DW feed) and proximate analysis of diets without (control) and with (treatment) seaweed *S. ilicifolium* used in this experiment.

	Control	Treatment
<i>Sargassum</i> sp. meal	0	15
Fish meal	40	21
Fish Oil	10	10
Bone and meat meal	7	7
Soybean meal	7	20
Seaweed powder (<i>S. ilicifolium</i>)	0	15
Yellow corn	8	7
Wheat flour	20	12
Starch powder	7	7
Vitamins and minerals mixture	0.3	0
Iodized Salt	0.5	0
Moisture	7.08	7.09
Crude protein	33.22	32.02
M.E. [*] (kcal. kg)	3555	3564
NFE	20.57	21.21
Ash	8.11	8.82

Fish meal (CP=54.06%, DM=92.89, EE=15.3, Fiber= 1.51, Ash= 22.92, M. E= 3335 kcal/kg); Bone and meat meals (CP=40.6%, DM=91.00, EE=16, Fiber= 1.51, Ash= 36.6, M. E= 2920 kcal/kg); Soybean meal (CP=44.84%, DM=88.22, EE=1.74, Fiber= 5.57, Ash= 5.73, M. E= 3005 kcal/kg); Seaweed (CP=9.18%, DM=82.89, EE=1.2, Fiber= 33.11, Ash= 11.11, M. E= 2301 kcal/kg); Yellow corn (CP=8.67%, DM=87.45, EE=3.84, Fiber= 2.17, Ash= 1.18, M. E= 3110 kcal/kg); Wheat flour (CP=16.67%, DM=87.74, EE=3.13, Fiber= 8.12, Ash= 4.57, M. E= 2930kcal/kg); Powdered Starch (CP=5.84%, DM=85.84, EE=0.55, Fiber= 13.83, Ash= 1.55, M. E= 2771 kcal/kg); Vitamin A, 4.8 MIU; Vitamin D, 0.8 MIU; Vitamin E, 4.0 g; Vitamin K, 0.8 g; Vitamin B1 , 0.4 g; Vitamin B2 , 1.6 g; Vitamin B6 , 0.6 g; Vitamin B7 , 20.0mg; Vitamin B12, 4.0g; Folic acid, 0.4 g; Nicotinic acid, 8.0g; Pantothenic acid, 4.0 g; Colin chloride, 200 g; Zinc, 22 g; Cooper, 4.0 g; Iodine, 0.4 g; Iron, 12.0 g; Manganese, 22.0 g; Selenium, 0.04 g.

*M.E= Metabolizable Energy

(*Litopenaeus vannamei*). Control diets were formulated from commercial ingredients of fish meal (wheat flour, wheat bran, soybean meal, yellow corn, bone meal, chemical binder, vitamins and minerals premixes) to achieve 33% dietary crude protein level with 336 kcal/100g. Metabolizable energy level of the diet (on dry basis) was based on feed-

stuff values reported by NRC (1993) (Table 1), and the treatment diet included 15% of dried seaweed meal without using chemical binder and vitamins and mineral premixes. Dry ingredients were passed through a sieve (2mm diameter) before being mixed into the diets. Mixtures were homogenized in a food mixer. Boiling water (80°C) was then blend-

ed into the mixture at the ratio of 40% for pelleting. The diets were pelleted using meat grinder with a 2mm diameter.

Analytical Measurements

Analytical measurement of dried pellet diet was done using methods of AOAC (1990) to compare vitamin and mineral deficiencies of treatment diet and control. After preparing the treatment feed, samples of pellet feed were chosen for humidity absorbance, stability test and leaching time in seawater compared to control feed which was used in chemical binder (Sodium bentonite). The Student T-Test was done to compare samples.

Results

The results of the present study have shown that there are some deficiencies between vitamins (Pyridoxine) and minerals (Cobalt and Zinc) in the diet containing seaweed and control, which was prepared based on the amount required for shrimp (*L. vannamei*) diet. These deficiencies need to be enriched by adding to them the pure form (Table 2). Also, the physical characteristics of control and treatment pellet is shown in Table 3.

Discussion

several recent studies used seaweed as part of diet to improve growth performance, body composition, feed utilization and other quantitative traits of fish, such as Tilapia and western white leg shrimp which have become objects of interest for culturists and researchers throughout the world (Watanabe

et al., 1990; El-Zacem et al., 2009; El. Tawil and Amer, 2010).

Results of the work indicate that maximum percentage of *Sargassum ilicifolium* that can be replaced by protein ingredient in shrimp feed is 15%, which can act as binder agent, vitamin and mineral premixes when the final diet is enriched by pyridoxine vitamin and minerals, cobalt and zinc, based on vitamins and mineral requirements of shrimp juvenile (Ahamad Ali, 2001; Catacutan and De la Cruz, 1989; Mustafa and Nakagawa, 1995; Mustafa et al., 1994; Mustafa et al., 1995 a,b; Valente et al., 2006; Xu et al., 1993).

On the other hand, using seaweed in shrimp (*L. vannamei*) pellet diet can improve humidity absorbance (%), stability (%) and leaching time of pellet in seawater.

Previous scientists had confirmed this fact as they used different seaweed powders for shrimp and fish feed (Diler et al., 2007; Elmorshedy, 2010; Ergun et al., 2008; Fleurence, 1999; Guroy et al., 2007; Mabeau and Fleurence, 1993; Nakagawa, 1984, 2004).

It could be concluded that seaweeds (*S. ilicifolium*) can be used to enrich western white leg shrimp (*L. vannamei*) diet at optimum level of 15% to improve physico-chemical characteristics of formulated pellet. It also can be enriched by some minerals and vitamins.

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Table 2. Required level of vitamins and minerals in shrimp diet and enrichment amount of some deficiencies in treatment diet. (3 replication mean±sd).

	Vitamins : mg.100 ⁻¹ g feed DW (shrimp required)	Amount in treatment pellet	Required enrichment	Minerals: mg.100 ⁻¹ g feed (shrimp required)	Amount in treatment pellet	Required enrichment
Vitamin A	150-200	170.90±11.11	negative	Fe >40	58.90±9.11	negative
Vitamin E	30-40	32.66±2.86	negative	K >80	82.66±2.81	negative
Vitamin C	100-800	890.20±98.04	negative	Mn 1-2	1.22±0.04	negative
Thiamin	40-50	45.37±6.03	negative	Mg >60	81.37±6.03	negative
Riboflavin	1-2	1.38±0.01	negative	Zn 3-4	2.38±0.1	positive
Niacin	10-15	12.04±0.09	negative	Co >0.1	0.04±0.01	positive
Pyrodoxin	>10	0.61±0.03	positive	Cu >500 (µg in 100 g DW)	700.04±11.01	negative
				I >100 (µg in 100 g DW)	140.14±12.01	negative

positive= needs enrichment

Table 3. Means ± standard error (SE) of humidity absorbance (%) and seawater stability (%) of pelleted feed

Treatments	Humidity absorbance (%)	Seawaters stability (%)	Leaching time in seawater (h)
control	95.20±4.03 ^a	95.20±2.73 ^a	3.12±0.33 ^a
15%	110% 20±5.00 ^b	98.11±3.23 ^b	5.20±0.50 ^b

Means in each column followed by different letters are significantly different (p< 0.05)

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