Utilization of different types of fish silage on the growth of juvenile sea cucumber (*Holothuria scabra*) (sandfish)

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Abstract

Aquaculture has the potential of meeting the increasing demand for *Holothuria scabra*. Unfortunately, culture of sea cucumber has faced to a major problem of feed supply, as the nutrient requirement of sea cucumber is yet to be established. According to literature, Sri Lankan reservoirs contain substantial stocks of minor cyprinids and it is suggested that minor cyprinid resource remain much underutilized level. Records also show that millions tons of fish waste are dumped to the sea in many parts of the world. Regularly techniques have been developed to make silage by fish waste as a substitute for expensive protein ingredients in rations of aquatic organisms. In this study the effects of four different types of fish silage based diets were observed on growth performance of juvenile sea cucumber (*Holothuria scabra*) for 8 weeks. A total of 120 juvenile sea cucumbers averaging 5.51 ± 0.27g (mean ± SD) were randomly distributed in 12 round fibreglass tanks of 150 L, and each tank was randomly assigned to one of three replicates of four isonitrogenous (CP- 24.65±0.5%) (Mean ± SD) diets containing 100% fish meal (FM) (T_1); 50% FM: 50% Freshwater fish Silage (FWFS) (T_2); 50% Fish Waste Silage (FWS): 50% FM (T_3) and 50% FWFS: 50% FWS (T_4). At the end of feeding trial, highest final body weight (FW), weight gain (WG), specific growth rate (SGR) and protein efficiency ratio (PER) showed the fish fed T_3 diet. However there were no significant differences in WG, SGR, PER and FW among fish fed four diets. The results indicate that the use of fish waste to make fish silage for replacing expensive fish meal varieties in sea cucumber (sand fish) diets would be efficient and feasible.

Keywords: Fish silage, growth, juvenile sea cucumber, *H. scabra*

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Introduction

Holothuria scabra is important for several reasons: (1) it is abundant and widely distributed in shallow soft-bottom habitats throughout the Indo-Pacific; (2) it has a high value on the Asian markets, where it is mainly sold as beche-de-mer; and (3) it is the only tropical holothurian species that can currently be mass produced in hatcheries. The demand for sea cucumber has been increased because of commercial exploitation; wild stocks are declining. Aquaculture has the potential of meeting the increasing demand for this species. Unfortunately, culture of sea cucumber has faced a major problem of feed supply, as the nutritional requirements of sea cucumber are yet to be established.

Sri Lankan reservoirs contain substantial stocks of minor cyprinids and it is suggested that this resource is underutilized and subsidiary gill net fishery could be introduced for this resource (Amarasinghe, 1990; De Silva, 1983; De Silva and Sirisena, 1987; Sirisena and De Silva, 1989). This resource can be used to prepare feeds in aquaculture and livestock industry (Amarasinghe, et al., 2003).

Millions tons of fish waste are dumped to the sea in many parts of the world. Furthermore food industry wastes are an important environmental contamination source. Probably, more than 50% of the remaining material from the total fish catch is not used as food and involves almost 32 million tonnes of waste (Kristinsson and Rasco, 2000; Ioannis and Aikaterini, 2008). The use of fish silage as a substitute for protein ingredients in feed for aquatic organisms is an alternative to solve sanitary and environmental problems caused by the lack of adequate disposal of the waste from the fish industry. Besides, it is also a way of decreasing feeding costs, and, consequently, fish production costs, since feeding corresponds to about 60% of the overall expenses of production (Ferraz de Arruda, L. et al, 2007).

Therefore this study was aimed to evaluatefish silage produced from minor cyprinid species and fish waste as a feed ingredient on growth of juvenile sea cucumber.

Materials and Methods

Diets and Experimental design

Fish waste was collected from Peliyagoda Central fish market and minor cyprinids were caught from Chandrika wewa, Embilipitiya. Fish waste was minced and mixed with 98% formic acid at 4% of weight and stirred until the pH was around 3.5-4. Same procedure was followed to make fresh water fish (minor cyprinids) silage. Four experimental diets were formulated containing fish meal (FM):100% (T_1); 50% FM: 50% Freshwater fish Silage (FWFS) (T_2); 50% Fish Waste Silage (FWS): 50% FM (T_3) and 50% FWFS: 50% FWS (T_4), and each diet was randomly assigned to triplicate groups.

Fish and feeding trial

A feeding trial was conducted at Regional Research Center (RRC), National Aquatic Resources Research and Development Agency (NARA), Kalpitiya. Sea cucumber juveniles were supplied from the sea cucumber hatchery of RRC, NARA, and Kalpitiya. Feeding trial was performed in an indoor, refilling salt water tank system for 8 weeks. Initial average weight of 5.51 ± 0.27g (mean ± SD) juvenile sea cucumber were randomly allocated to 12 conical fiberglass tanks of 150 L. Triplicate tanks per

each diet group were used by 120 sandfish per tank. Each tank was arranged with a sand bottom. Sandfish were acclimatized for the culture system and feeds for a week after allocation. Initially, the fish were fed at 7% of biomass per day and divided in to 3 meals (09:00, 12:00, and 17:00). But later it was adjusted according to body weight as 5 %. Water temperature, pH and dissolved oxygen level of the system was maintained at 26.2 ± 0.4 °C, 8.1 ± 0.33, 4.6 ± 0.5 $mg \cdot L^{-1}$, respectively.

Data collection and sample analysis

Every two weeks a sample of ten individuals was taken from each tank and the individuals weighed. Fish were starved 12 hours before weighing. Percent weight gain (WG), specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER) and protein retention (PPV) were calculated. Proximate composition analysis of experimental diets was performed according to a standard method of AOAC (2000).

Statistical analysis

One-way analysis of variance tests (ANOVA) were used to analyze the calculated WG, FE, PER, SGR and Survival Rate data. Least significant difference (LSD) was used to find the treatment effect at $P<0.05$ level of significance using Statistical Analysis System (SAS Institute Inc. 2000).

Results

During feeding trial, all the experimental diets were well accepted by sea cucumber. After eight weeks of feeding trial, there were no significant differences in weight gain (WG), feed conversion ratio (FCR), protein retention (PPV), specific growth rate (SGR) and protein efficiency ratio (PER) among fish fed four different diets. Growth performance values are shown in Table 1. Nevertheless fish fed T_3 (made from fish meal and fish waste silage) showed highest WG, SGR, PER and PPV as well as lowest FCR.

Table1: Growth performances of juvenile sea cucumber fed four experimental diets for 8 weeks[1]

		Diets[2]			Pooled SEM[10]
	T_1	T_2	T_3	T_4	
IW[3]	5.46	5.33	5.47	5.72	0.08
FW[4]	8.58	6.99	10	8.93	0.53
WG[5]	57.34	31.03	81.93	56.24	8.47

SGR[6]	0.68	0.41	0.90	0.68	0.07
FCR[7]	9.34	13.85	6.03	8.38	1.25
PER[8]	0.54	0.32	0.72	0.47	0.07
PPV[9]	71.84	43.34	88.23	79.99	9.58

[1]Values are mean from triplicate groups of fish where the values in each row with different superscripts are significantly different ($P<0.05$).

[2]See diets and Experimental design in methodology section

[3]IW: Initial weight (g/fish).

[4]FW: Final weight (g/fish).

[5]WG: Weight Gain (%) = (final weight - initial weight) × 100 / initial weight.

[6]SGR: Specific Growth Rate (% day^{-1}) = (log_e final wt.-log_e initial wt.)/days

[7]FCR: Feed Conversion Ratio = feed intake (dry) (g)/ weight gain (wet) (g) × 100 /

[8]PER: Protein Efficiency Ratio = weight gain (wet) / protein intake.

[9]PPV (%): Protein Retention = ((Final body protein –initial body protein)/ Protein intake) x100

[10]Pooled SEM: Pooled Standard Error of Means: SD/√n.

Discussion

The present study showed the potential of using fish waste silage as a protein source in juvenile sea cucumber diets. Even though no significant difference in WG, SGR, PER, PPV and FCR was found among the four different treatments. Nevertheless fish fed diet 3 showed highest WG, SGR, PER and PPV as well as lowest FCR. Fagbenro et al. (1994) and Fagbenro and Jauncey (1998) studied the nutritional value of diets containing microbial fish silage partially dehydrated by the addition of soy meal, poultry by-products, or bone and meat powder and these diets, especially the ones including silage and soy meal, could be used to feed tilapias, *Oreochromis niloticus* (omnivorous), and the North African catfish, *Clarias gariepinus* (carnivorous), with no changes in its performance, use of protein and carcass composition. Viana et al. (1999) evaluated the use of silage as an alternative feed. The authors concluded that fish silage was very attractive, but not very palatable. They recommended that it should be used with a more tasteful ingredient, such as corn meal. However, further studies are necessary on lipid oxidation reactions and the possible unavailability of amino acids.

Conclusion

The study revealed that silage made by fish waste could be utilized cost effectively as a protein supplement in juvenile sea cucumber feeds to replace high cost fish meals.

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