RUFORUM Working Document Series (ISSN 1607-9345) No. 14 (2) : 907 - 911.
Available from *http://repository.ruforum.org*

Research Application Summary

Effects of polychaete based diets on growth and survival of Tiger shrimp juveniles

Muli, B. M.,[1, 2]* Kihia, C.,[3] Fulanda, B, M.,[2] Munguti, J.[4] & Muthumbi, A.[5]
[1]Mariculture Department, Kwetu Training Centre for Sustainable Development, P.O Box 685-80109, Mtwapa, Kenya
[2]Department of Biological Sciences, Pwani University, P.O Box 195-80108, Kilifi, Kenya
[3]Department of Biological Sciences, Egerton University, P.O Box 536, Njoro, Kenya
[4]Aquaculture Research Division, Kenya Marine and Fisheries Research Institute, P.O Box 451, Sagana, Kenya
[5]Department of Biological Sciences, University of Nairobi, P.O. Box 30197-00100, Nairobi, Kenya
Corresponding author: brendanmutuamuli@gmail.com

Abstract

This study is designed to assess viability of Polychaete worms (*Marphysa mossambica*) species as potential alternative animal protein ingredients in formulation of juvenile tiger prawn (*Peneaus monodon*) feeds in Kenya. Specifically the study seeks to determine the effects of *M. mossambica* based diets on growth and survival of juvenile *P. monodon.* Fresh water shrimps (*Caradina nilotica*), used as animal protein ingredient in formulation of feeds for juveniles of *P. monodon* will be substituted with varying levels of *M. mossambica*. Four diets will be formulated with 25%, 50%, 75% and 100% replacement of *C. nilotic*a with *M. mossambicca*. A control diet with no *M. Mossambica* content will be prepared. Also, 15 hapa nets of $2m^3$ each will be used as the culture units in a tidal pond. Equal number of prawns will be stocked per unit. Prepared diets will be administered in triplicates. Sampling will be done after every 14 days coinciding with spring tide for three months to determine growth and survival rate. Key water quality parameters including Dissolved oxygen, PH, salinity and temperature will be monitored every sampling. The data obtained will be analyzed using Minitab statistical package in order to determine potential of cultured *M. mossambica* species as alternative animal protein ingredients in formulation of *P. monodon* juvenile feeds. It is expected that the study will provide information for improving growth and survival of juveniles of *P. monodon* through polychaete based diets.

Key words: Brackish water, feeds, mariculture, polychaetes, tiger prawns

Résumé

Cette étude est conçue pour évaluer la viabilité des espèces des vers polychètes *(Marphysa de mossambica*) comme potentiels ingrédients alternatifs de protéines animales dans la formulation des aliments pour les crevettes tigrées (*Penaeus monodon*) juvéniles au Kenya. Plus précisément l'étude vise à déterminer les effets des régimes à base de *M. mossambica* sur la croissance et la survie des P. monodon juvéniles. Les crevettes d'eau douce (*Caradina nilotica*), utilisées comme ingrédient de protéine animale

dans la formulation des aliments pour les juvéniles de *P. monodon* seront substituées avec différents niveaux de *M. mossambica.* Quatre régimes seront formulés avec 25%, 50%, 75% et 100% de remplacement de C. nilotica avec *M. mossambicca*. Un régime de contrôle qui ne contient pas *M. mossambica* sera préparé. En outre, 15 filets hapa de $2m^3$ chacun seront utilisés comme unités de culture dans un étang de marée. Le même nombre de crevettes sera stocké par unité. Les rations préparées seront administrées en triple repetitions. L'échantillonnage sera effectué après tous les 14 jours qui coïncident avec la marée de printemps pour trois mois afin de déterminer la croissance et le taux de survie. Les principaux paramètres de qualité de l'eau, y compris l'oxygène dissous, le pH, la salinité et la température seront contrôlés à chaque échantillonnage. Les données obtenues seront analysées en utilisant Minitab package statistique afin de déterminer le potentiel des espèces *M. mossambica* cultivées comme ingrédients alternatifs de protéines animales dans la formulation d'aliments pour *P. monodon* juvénile. Il est prévu que l'étude fournira des informations pour améliorer la croissance et la survie des juvéniles de *P. monodon* grâce à des régimes à base de polychètes.

Mots clés: l'eau saumâtre, les aliments pour animaux, la mariculture, les polychètes, les crevettes tigrées

Background

Adult *Peneaus monodon* migrate into open water to spawn. Fertilized eggs are shed free into the water where they settle at the bottom and hatch into nauplius then to protozoea and mysis. There are five nauplius stages and three protozoea stages. Both nauplius and protozoea stages are found in oceanic waters and primarily feed on phytoplankton. During Mysis stage they change their feeding from primarily herbivores to primarily carnivorous feeding on Zooplanktons, detritus and small macro-invertebrates. The Mysis larvae develop into post larvae which appear as miniature shrimps with fully developed walking and swimming legs. The post larvae develop into juveniles where growth is rapid and they soon resemble adults. The shrimp-like post larvae and juvenile reach inshore waters about two weeks after hatching Both post larvae and juveniles are primary carnivores feed on phytoplanktons, zooplanktons, detritus and small macro-invertebrates (Dall *et al.,* 1990).The post larvae settle in the upper parts of the tidal creeks whereas the juvenile remain in the marsh creeks and move to the deeper rivers where they become sub adults. The adult shrimps are totally mature to produce sperm and eggs and are usually found in the ocean.

Among marine invertebrates, polychaete worms have been used as feed in aquaculture (Olive, 1999). Polychaetes are also used to induce spawning among several fish and crustacean species, and are able to supply spawners with essential nutrients such as fatty acids and amino acids. The potential use of polychaete worms as a dietary source of protein, lipid, amino acids and vitamins for current Mariculture species including Tiger pawn is huge, especially at a time when there is interest in the use of alternatives to fish meal and fish oils.

The aim of this study is to assess viability of local polychaete worms (*Marphysa mossambica*) in addressing growth and survival of juvenile tiger prawns.

Literature summary

Aquaculture producing countries put emphasis to maximize the use of locally available feed grade ingredients sources and nutritionally sound and safe feed ingredients that can be sustainably produced and grown within the sector (FAO, 2011). In shrimp farming, quality and quantity of available food affects growth and survival of cultured shrimp and inadequate nutrition is one of the main limitations (Vogt *et al.,* 1985). Dietary requirements of prawns has been obtained from food intake studies in the natural habitat, since available food in ponds is limited and differs from food in the wild. Marte (1980) reported that polychaetes composed portion of the ingested food of wild *P. monodon* in Asia. Chuntapa *et al.* (1999) found that shrimp fed with a feed containing 35 percent protein, an energy content of 330 kcal/100 g, and a lipid:carbohydrate ratio of 1:4.6 had highest growth and survival rates. Alava and Lim (1983) recorded an improvement in the growth, feed conversion ratio (FCR), protein efficiency ratio (PER) and survival rate of *P. monodon* juveniles fed with a 40 % protein diet.

Techprempreecha *et al.* (2011) determined the nutritional composition of both cultured and wild sandworms and found out that while the protein content of dried cultured worm was 51.2% wild worm contained 52.8%. In an early study Meunpol *et al.* (2005) reported that cultured wet mud worm (*Marphysa* sp.) contained 50.9% protein. In addition, *P. monodon* juveniles require polyunsaturated fatty acids (PUFA) such as linoleic acid and linolenic acid and highly unsaturated fatty acids (HUFA) such as eicosapentanoic acid and docosahexanoic acid for high quality and faster growth (Kanazawa *et al.,* 1979). Polychaete lipid contents provide a source of these essential fatty acids (Meunpol *et al.,*2005). There is need to search for alternatives to fish meal ingredients for juveniles that is not only locally available but also ecologically efficient.

Research Approach

Cultured polychaetes from Kwetu training Centre, Mtwapa in Kenya will be dried at 45^0C to constant weight and grounded. The dried and grounded polychaetes and other feed ingredients will be mixed and stored for subsequent feeding. Proximate analysis will be done to determine the protein content of polychaetes, fish meal and artemia. Feed formulated using either protein ingredients will be administered to the prawns.

For polychaete based feeds four diets will be made containing different percentages of polychaete that is; 0%, 25%, 50%, 75% and 100%. The performance of the shrimps in the different formulated diets will be established by observing growth performance (final body weight, weight gain (%) and specific growth rate (%) and protein survival rate (%). A sample of 10 shrimps will be obtained at random every 14 days for three months using scoop net from each Hapa net. Their weights and length will be measured individually before being returned to their respective hapas. To determine survival rates census will be done at every sampling period. The growth and survival indices will be calculated

using (Busacker *et al.,* 1990) formula:

SR%=Nt/No*100 while SGR%=In(BWt)-In(BW0)/T*100

where SR is survival rate (%), N is number of prawns collected at a time, No is number of prawns initially stocked; SGR is the specific growth rate (% BW day-1); BWt is the final body weight (g); BW0 is the initial body weight (g); and T is duration of the experiment (days).

Based on the resuts the best high quality and nutritive and economical prawn diet will be established. The benefit of incoporating *Marphysa mossambica* in prawn diet formulation will be subsquently established.

Research Application

The rationale for this study is to contribute to knowledge on the potential of local marine invertebrates specifically polychaete worms (*M. mossambica*) in addressing the challenge of low Prawn production by using locally produced but nutritious dietary sources. This is anticipated to improve the livelihoods of local Mariculture communities through increased incomes and improved food and nutrition from improved production. Through polychaete study, pressure from overreliance on fishmeal which is expensive due to its competing usage as human food and in the formulation of animal feeds will be reduced. Successful culture of *P. monodon* on polychaete based diets will ultimately ensure economic sustainability of Mariculture venture through improved production. With Prawn hatchery establishment underway in Kilifi County, cultured polychaetes based diets will find demand in the hatchery. Also prawn seed availability from the hatchery could increase Mariculture uptake thus increasing demand for polychaete-based diet.

Acknowledgement

This project was funded by the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) Grant Number: GRG-111 2015. This paper is a contribution to the 2016 Fifth African Higher Education Week and the RUFORUM Biennial Conference.

References

Alava, V. R. and Lim, C. 1983. The quantitative dietary protein requirements of *Penaeus monodon* juveniles in a controlled environment. *Aquaculture* 30 : 53-61.

Chuntapa, B., Piyatiratitivorakul, S., Nitithamyong, C., Viyakarn, V. and Menasveta, P. 1999. Optimal lipid: carbohydrate and protein:energy ratios in semi–purified diets for juvenile black tiger prawn *Penaeus monodon* Fabricius. *Aquaculture Research* 30: 825–830.

Dall, W., Hill, B.J., Rothlisberg, P.C. and Staples, D. J. 1990. The biology of the Penaeidae. *Adv. Mar. Biol.* 27: 489.

Food and Agricullture Organisation (FAO), 2011. Demand and supply of fish feed ingredients for farmed fish and crustaceans: trends and prospects. FAO Fisheries and Aquaculture Technical Paper No.564, November 2011. 87pp. Rome

Kanazawa, A., Teshima, S., Ono, K. and Chalayondeja, K. 1979. Biosynthesis of fatty acids from acetate in the prawn, *Penaeus monodon* and *P. merguiensis*. *Memoirs of the Faculty of Fisheries, Kagoshima University* 28 : 21-26.

Lim, C. and Akiyama, D.M. 1995. Nutrient requirements of penaeid shrimp. In: Lim, C. and Sessa, D. J. (Eds.). Nutrition and utilization technology in aquaculture Champaign, AOCS Press.

Marte, C. L. 1980. The food and feeding habit of *Penaeus monodon* Fabricius collected from Makato River, Aklan, Philippines (Decapoda:Natantia). *Crustaceana* 38 (3): 225- 236.

Meunpol, O., Meijing, P. and Piyatiratitivorakul, S. 2005. Maturation diet based on fatty acid content for male *Penaeus monodon* (Fabricius) broodstock. *Aquac. Res.* 36: 1216-1225.

Olive, P. J.W.1999. Polychaete aquaculture and polychaete science: a mutual synergism. *Hydrobiologia* 402: 175–183.

Shiau, S.Y. 1998. Nutrient requirements of penaeid shrimps. *Aquaculture* 164 (1): 77–93.

Subasinghe, R., Soto, D. and Jia, J. 2009. Global aquaculture and its role in sustainable development. *Review in Aquaculture* 1:29.

Techaprempreecha, S., Khongcharemonporn, N., Chaicharoen- pong, C., Aranyakananda, P., Chunhabundit, S. and Petsom, A. 2011. Nutritional composition of farmed and wild sandworms, *Perinereis nuntia*. *Animal Feed Science and Technology* 169: 265-269.

Vogt, G., Starch, V., Quinitio, E.T. and Pascual, F. P. 1985. Midgut glad as monitor organ for the nutritional value of diets in *Penaeus monodon* (Decapoda). *Aquaculture* 48: 1-12.