Modification of nutritional properties of microalgae for Artemia breeding

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Abstract

Artemia (brine shrimp) is used as a live-feed stuff for seed fish in fish hatcheries and aquarium fisheries. Nutritional properties of Artemia are in close relationship with the nutritional facts of the microalgae it is fed by. In this study, 20 different microalgae and cyanobacteria (indigenous strains from Dunaliella, Isochrysis, Phaeodactylum, Tetraselmis, Nannochloropsis, Spirulina, Synechocystis, Synechococcus, Chlamydomonas, Chlorella, and Scenedesmus genus) were supplied to A. franciscana as food source and growth characteristics of A. franciscana and were followed during 10 days of growth. Seven microalgae strains were selected for Artemia breeding and dry weight, total protein, starch and lipid contents of microalgae and A. franciscana were recorded. Then, microalgae were exposed to N-, S-, P-deprivation and high salt stress for 5 days of incubation. Total lipid, protein and carbohydrate contents of those strains were recorded and 5-days stress exposed microalgae were supplied to A. franciscana as only food source. Lastly total lipid, protein and carbohydrate content of A. franciscana was followed during 10 days of growth. In most cases, feeding A. franciscana with D. tertiolecta was superior to other strains studied.

Portunid crabs stand out as highly valued resources for fisheries and aquaculture because of their export potential and high nutritional value. Due to their size, meat content and unique flavor, their products are highly priced in domestic and international markets. Since global portunid product demands exceed expectations each year, world fisheries captures have grown steadily, surpassing 1 million tons by 2016, leading to the local overexploitation of some species. At the same time, unsatisfied market demands have been increasingly sustained by restocking and aquaculture production in excess of 0.38 million tons by 2016, 96% of which were produced in East Asia. At present, portunid aquaculture is restricted to meat production of Scylla serrata, Portunus pelagicus, Portunus trituberculatus, Portunus sanguinolentus and Charybdis feriata and to restocking of Callinectes sapidus. Still, the culture potential for many other large-sized species from the taxon is virtually unexplored. Indeed, reported production out of the west coast of Asia is still negligible, representing both a challenge and an opportunity for the industry sector elsewhere. The southern surf crab Ovalipes trimaculatus (de Haan, 1833), one of the species with high potential for aquaculture, is widely distributed in coastal areas of the South Atlantic, Indian and Pacific Oceans, being present along the mid-latitude (25°–45° S) Argentinean coast, where populations have been targeted by artisanal fisheries over the last 10 years providing products with good acceptance in the local shellfish markets. Although several studies have been conducted on the structure of its populations, reproduction, growth and some behavioral and anatomical aspects information available on the biology of its early life stages is still scarce and insufficient to allow encouraging their breeding in aquaculture facilities.

Larval stages of decapod crustaceans may be lecithotrophic or planktotrophic depending on the reproductive strategy of each species. While the former cover their food requirements by consuming abundant yolk reserves stored in the oocytes, the later start feeding on different plankton components soon after hatching. Thus, breeding planktotrophic decapod larvae requires assessing the quality and frequency of food consumption to optimize survival, growth and physiological condition. However, this involves the simultaneous maintenance of larvae and auxiliary food cultures, representing the bottleneck for the aquaculture of many decapods, including portunid crabs.

Research on dietary quantity and quality requirements has contributed to minimize mortality and to enhance growth and fitness of zoeae from several portunids including Scylla serrata, Portunus sanguinolentus, P. pelagicus and Callinectes sapidus. Among other live feeds, brine shrimps (Artemia spp.) are widely used due to their food carrying capacity and good acceptance. At low temperatures (i.e., 12°), like those experienced by O. trimaculatus during the reproductive season, Artemia persimilis, a brine shrimp species native from Argentina and Chile, shows higher survival rates compared to its native congener A. franciscana, probably resulting from its adaptation to Patagonian climate conditions. Its cysts have nutritional properties comparable to those of other commercial species traded in international markets, displaying high hatching efficiencies and producing small-sized nauplii with

elevated fatty acid unsaturation, highly desirable for use as live food in aquaculture. Still, up to date the species has been rarely used to feed larval stages of fishes or marine invertebrates.

Artemia is an incomplete food source itself because of the paucity of some essential elements in its composition, as for example the n3 and n6 polyunsaturated fatty acids (PUFAs) frequently required for successful development of crustacean larvae. Although nutritive commercial emulsions have been used to complement its composition, fulfilling the dietary requirements of larvae preying on it, their autoxidation with synthesis of toxic compounds along with relatively high commercial cost have discouraged this practice. Alternatively, feeding Artemia with various types of food in suspension culture systems has allowed its enrichment with higher fatty acid content and to use it as carrier of other nutrients (e.g., vitamins), antimicrobial substances, vaccines and probiotics.

Microalgae can be incorporated as a food additive to supply basic nutrients into a wide variety of food, and represent an alternative to replace feedstuff and ensure sustainability standards in aquaculture. Their positive effect on the growth rate and physiological condition of aquatic species are related to their increased triglyceride and protein deposition in muscle, improved resistance to diseases, decreased nitrogen output into the environment,

and augmented omega-3 fatty acid content, physiological activity and carcass quality.

Typically, microalgae can provide up to 30–40% protein, 10–20% lipid and 5–15% carbohydrate contains if feed to Artemia during the exponential phase of culture growth representing an energy source with a high benefit to cost ratio Thus, finding an optimal dietary combination of microalgae and an appropriate schedule for feeding them to Artemia are critical to guarantee their nutritional value at low production cost

Taking into consideration all of the above mentioned, this study has two main objectives: testing alternative microalgae dietary compositions and different feeding schedules to enrich Artemia persimilis so as to optimize its nutritional value as live food, and enhancing survival, growth and physiological condition of Ovalipes trimaculatus zoeae I by feeding them with Artemia persimilis nauplii enriched on different microalgal diets.

Biography:

Numan has started his PhD at Karamalu Mehmetbey University, Turkey and still continues. Also, he is working as a Research Assistant at Bioengineering Department of the same university. He is the part of Tubitak and British Council Newton Katip Celebi Fund bilateral cooperation program with collaborate Newcastle University and Karamanolu Mehmetbey University.

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