Utilization of Marine Trash Fish Discards for Organic Nitrogen Enriched Fertilizer Production

Aranganathan Lakshmi Narayanan*
Sathyabama Institute of Science and Technology, Chennai
Email: l.aranganathansai@gmail.com

Marine fisheries in Indian coasts disposeslargequantity of trash fishes of no commercial value, brought ashore by fishing crafts in harbours and landing centers all over the country. These trash fishes and processing wastes of the seafood industry are discarded in natural open water bodies and dumped in landfills as heaps affecting the coastal sanitation. According to the FAO's report (2017), it was estimated that 20-80% wastes are generated by small -scale fisheries. In a country like India where marine fishery is of multispecies composition and the occurrence of by-catch consisting of several species of trash fishes is quite common. Itis estimated that the quantity of by-catch which has been discarded by the trawlers operating along East-Coast was high as 100,000-130,000 lakh tones. In urban fish markets, trash fishes and non-edible portions such as head, skin, intestine, gills, bones and blood.of the commercial fishes are segregated by the sellers after cleaning and dumped in municipal garbage bins creating environmental issues. Rotting proteinaceous waste affects sanitation in several ways: producing unpleasant odour, emission of noxious gases - hydrogen sulphide, attracting diseasing, spreading vectors such as flies and ants. This leads to the growth of epidemic infectious microbial pathogens and contamination of soil due to the leakage of organic matter from the decaying wastes. I addressed this disposal issue in fish processing sites of eastcoast, Chennai and urban fish selling shops under the guidance of my research mentor Dr. Radhika Rajasree. S.R., marine scientist working in the Centre for Ocean Research. We initiated this work to study the problem of the disposal sites and developed a biotechnological solution to clean up the site.

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* Mr. Aranganathan Lakshmi Narayanan, Ph.D. Scholar from Sathyabama Institute of Science and Technology, Chennai, is pursuing his research on "Development of Slow Release Fertilizer using Industrial Fish Processing Waste." His popular science story entitled "Utilization of Marine Fish Processing Bio-Waste for Organic Fertilizer Preparation" has been selected for AWSAR Award.

The wastes were collected from local fish market and brought to our Marine Biotechnology lab. Fermentation process was assisted by protease producing bacteria- *Bacillus subtilis* in fermenters to convert the wastes into organic fish emulsion with less fishy odour. The emulsion had good levels of Nitrogen (1%) and organic Carbon (56.31%) along with high concentration of Iron: 50 mg/kg. We approached farmers in suburban Chennai who faced problems related to low productivity due to lack of sufficient organic nutrients in soil. We treated those lands with our fish emulsion at regular intervals and also attempted foliar spraying onleaves of tomato plants. The effect of the emulsion treatment was analyzed by soil testing method -"Alternative Analytical Technology" (AAT), an image processing technology developed by Sri AMM Murugappa Chettiar Research Centre and Indian Institute of Technology (IIT-M), Chennai, supported by DST. The analysis report confirmed the increase in organic carbon levels as evident by the development of spike-shaped circular disc in the chromatogram. We also found that foliar application of the emulsion promoted leaf growth with increased foliage count and fruit yield. Besides, regular sprayingof the emulsion also prevented the leaves from pesticide attack. Our experimental results showed satisfactory performance under field conditions. It was shortlisted as innovative product in National Bio Entrepreneurship Competition, 2017 under "**Soil health theme**" by Biotechnology Industry Research Assistance Council.

We also developed "Trash fish compost" through co-composting method using mixed varieties of small fishes and Bagasse-Sugarcane processing leftover as rapid composting substrate. This is a cost- effective method for large-scale production of organic soil inputs with balanced major soil nutrients-Nitrogen; Phosphorus and Potassium (N:P:K) required for plant growth stimulation. This process provides complete degradation of the fish body parts including scales with final product having good earthly aroma. We checked the maturity level of the compost as per the protocols of the Fertilizer control order 1985 and found that the compost had good maturation degree as reflected by its C:N ratio. Phytotoxicity assays also confirmed its growth promotion activity in Fenugreek (*Trigonellafoenum-graecum)* and Greengram (*Vincaradiata)* seeds confirming its positive influence especially in root and shoot development. Few characteristics of the fish compost had the appearance of brownish texture; fine particle size with good aromatic smell. It hasgood N:P:K ratio (2:2:1) with good amount of micronutrients: Manganese- 30.84 mg/kg,Zinc-29.44 mg/kg for supporting soil health. Trash fish co-compost was selected in Top 20 innovative products under **"Waste management theme"** by *Biotechnology Entrepreneurship Student Teams* by Association of Biotechnology Led Enterprises (ABLE), 2015.

We also produced an organic acid - "Humic acids" from Tuna fish waste compost. This colloidal preparation was specifically formulated for soils suffering from high acidity and lacking sufficient biological functions. This organic acid could act as a "soil conditioner" to reduce acidic levels for supporting the development of microbial flora to promote organic vegetable production. It contains good amount of elemental carbon-53% and Nitrogen-6%. This liquid could be a helpful booster to improve acidic soils suffering from low productivity and completely deprived of vital nutrients. We characterized this preparation by spectroscopic instruments and confirmed that the presence of "aromatic carbon" responsible for its biological function. The colloidal solution is

available in potassium humate formto improve soil cation exchange capacity. This liquid product could be also beneficial ~~to~~ for urban terrace gardeners interested in hydroponic culture system to grow organic vegetables. It was selected in "Top 30 innovative idea" under **University Challenge** in *Indian Innovation Growth Programme* (IIGP 2.00) by DST-Lockheed Martin, 2017.

Our Fish waste based fertilizers

Our research was by funded by Department of Science and Technology (DST) under Science for Equity Empowerment and Development (SEED) scheme for the project"Stabilization and utilization of trash fish and fishprocessing waste as a slow release nitrogenous fertilizer for increased production in vegetable farming". The work motivated us towards identifying biotechnological solutions to develop organic fertilizer products from fish processing wastes for effective utilization in organic agriculture. We express our sincere gratitude to DST for supporting this project to ideate novel biotechnological solutions to reduce the disposal activity related to fisheries industry for improving sanitation. We are also planning to disseminate the technology to educate workers to adopt effective disposal measures towards marine biowaste management.

Fish Emulsion