Valorization of fish wastes using Green bottle fly pupae, *Lucilia sericata*

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Globally, most fish processing industries are discarding huge quantities of fish trimmings which consist of head, viscera, flesh and bone. Fish trimmings accounts for nearly 20-30% of the total fish yield and is species specific. Often the disposal of these wastes create lot of environmental issues and commonly are sun dried or processed as fishmeal for the poultry feed industry. However, these products did not find a place in aquafeed industry as the protein content of the fishmeal made from fish trimmings is very low (25-35% of DM) compared to regular fishmeal

(60-70% of DM) and the ash content is also very high (30-35% of DM) according to the composition of the trimmings. In this context, the unutilized fish waste/ trimmings can be utilized for insect meal production. The insect production system is one where insects can valorize the waste food and convert them into biomass rich in protein and lipids. The nutrient profile of insect pupae grossly depends on the nutrient composition of the waste fed to them. In general, the omega-3 fatty acid composition of insect meal is significantly lower than the fishmeal as the insects do not convert the 18C:2 n-3 fatty acids into Eicosapentaenoic Acid (EPA) and Docosahexaenoic Acid (DHA). But, it can bio-accumulate the available EPA and DHA from the feed source and hence food wastes with comparatively lower nutritive profile can also be blended with fish trimmings to enhance the nutritive composition of insect pupae as well as utilization of low quality food wastes.

An attempt to produce insect meal from unutilized fish trimmings using green bottle fly, *Lucilia sericata* larvae as the bioconversion agent is described below. A simple low cost device to produce insect pupae in a protected condition and self-harvesting mode of insect pupae collection was designed (Fig. 1). The device consists of a 20l capacity polyethylene terephthalate (PET) carboy as decomposing bin, fly entry point and two numbers of pupae collection bins which are connected to the decomposing bin through 1" diameter PVC pipe. The device is intended to prevent the escape of the pupae. The fish trimmings maintained in the decomposing bin attracts adult green bottle fly, *L. sericata* and the female fly lays eggs on the same day. The eggs hatched at about 9 hours and pass three larval instars in 4 days at ambient temperature (28-30 °C). Thereafter they attain pupae stage and crawl onto soil/sawdust kept in the collection bin which usually lasts from 6 to 8 days in the prevailing (28-30 °C) temperature. At this stage the pupae were harvested from the collection bin. The yield of green bottle fly larvae was about 20% of original fish biomass used for decomposition. After harvesting the green bottle fly pupae (GFP) were washed with freshwater and dried in hot air oven for 6 h at 80 °C. The dried pupae were ground and the nutritive profile of GFP was assessed (Table 1). As the nutritive profile of GFP grown on the fish waste indicates higher level of EPA and DHA, the insect oil can also be extracted from the GFP meal and can be used to replace fish oil. Further, it can also be used as a good feed attractant in carnivorous marine food fish diets. The nutritive profile of greenbottle fly pupae meal (GFPM) clearly indicated that it is a potential alternative ingredient in replacing fishmeal in the diet of marine ornamental and food fish fishes.

Fig. 1. The unit fabricated for insect culture

Table 1. Nutritive profile of green bottle fly pupae

Proximate composition	(%)
Moisture	4.3
Crude protein	49.65
Crude fibre	8.38
Ether extract	26.77-29.89
Total ash	4.46
Gross energy(Kcal/g)	6.098
Fatty acid profile	
Myristic acid	4.03
Palmitic acid	29.55
Stearic acid	3.85
Oleic acid	24.34
Linolenic acid	0.79
Linoleic acid	0.41
Arachidic acid	1.83
Behenic acid	4.04
Eicosapentanoic acid (EPA)	8.75
Docosahexaenoic acid (DHA)	10.64
Palmitoleic acid	11.72