



Locust Meal – An Alternative Protein Source in the diet of fish

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Introduction

The term locust refers to insect species which can aggregate into migratory swarms that causes wide scale destruction of crops and posture and contributes significant effect to food security. They are rich in industrial product like chitin, oil and bioactive proteins. It is already used for pets and zoo animal and has been investigated for livestock feeding. India has recently (May 2020) witnessed the attack of the Desert locust (*Schistocerca gregaria*). It is considered to be the deadliest threat to aquaculture. Considering this emergency situation and to turn the adverse situation into a potential opportunistic one a study was planned to explore the nutritional potency of locust as a novel ingredient in aquafeed.

Introduction about Locust

The word 'Locust' is derived from the Latin word which means Grasshoppers. Locust belongs to the grasshopper family Acrididae insect of the order Orthoptera which contain 6,787 known species. Among 21 known Locust 10 species have been traditionally consumed by humans or fed to animals in 65 countries. Locust looks like ordinary grasshopper most notably; they have big hind legs that help them hop or jump. They

sometimes share the solitary lifestyle of a grasshopper too. However, locust behavior can be something else entirely. Locust exhibit two interconvertible behavioral phases, solitaries and gregarious. While solitaries' individuals are repelled from other locust, gregarious insects are attracted to conspecifics and can form large aggregative such as marching hopper band. They are highly nutritious. They are rich in industrial products like Chitin, Oil and bioactive protein. They are powerful, long-distance flyers. So, they can easily go a hundred plus kilometers in a 24 hours period. When environmental conditions are right, usually when there is a lot of rainfall and moisture they increase in numbers.

Life cycle of locust:

- Stage 1 - The egg
- Stage 2 - The Nymph
- Stage 3 - The fledglings
- Stage 4 - The Adults

STAGE 1:

After fertilization, the female locust usually lays their eggs inside the holes made in warm, damp soil or sand known as Pod. The female locust produces a froth liquid that encloses the eggs which ensure a hydration and protection from predators. After this, the eggs undergo further development and enter the Nymph stage.

STAGE 2:

After 10 days to two weeks of egg laying, the eggs hatches and Nymphs emerges out. These newly hatched locust are called hoppers or Nymphs. Gradually as the Nymphs grow they shed their skin or mould five times. These moulting phases are known as Instars. After the fifth instar, the Nymphs develops wings and reproductive organs.

STAGE 3:

After the fifth moulting even through the Nymphs has fully grown wings but they are soft and fragile. Due to this, the exoskeleton of fledgling locust becomes harder. Fledglings also consume large number of plants in order to conserve energy for reproduction and development.

STAGE 4:

After about two weeks, the fledglings become sexually mature. During this stage, the adult



locust is mostly migrating and constantly feeding. Adult locusts tend to gather in large groups and invade the given plants or crops fields. After eight to ten weeks, the male and female locust mate, the female locust lays eggs and the entire cycle begins again.

Table 1 Nutritional Composition of body parts of locust

Sl.No.	Locust body part/Nutrient	Adult fledging	Whole body	Legs	Wings
1.	Crude protein	51.63	51.69	79.79	71.28
2.	Crude fat	16.42	20.31	4.04	5.46
3.	Total ash	4.95	5.31	4.31	5.71

Table 2 Nutritional composition of locust

Sl. No.	Nutrients	Composition
1.	Energy (kcal/100g)	106-353
2.	Calcium (mg/100g)	4-28
3.	Iron (mg/100g)	1-6
4.	Zinc (mg/100g)	2.4-12.5
5.	Vitamin D3 (µg/kg)	0.8-2.4
6.	Vitamin A (µg/g)	0.6
7.	Vitamin E (µg/g)	267.5
8.	Vitamin B12 (µg/100g)	10-20
9.	Cholesterol (mg/100g)	56

Locust as human food:

Locust has been widely collected during outbreaks and consumed in 65 countries especially in Africa, Asia for millennia. It is prepared for eating in different ways, which includes boiling, Toasting, Roasting, Frying and sun drying or even raw usually with wings and legs plucked off in different countries. People consume and trade in at least one of the 5 locusts namely Migratory, Desert, Red, Brown and Sahelian locust. The swarming behaviour makes locusts relatively easy to harvest for food.

Culture of locust:

Locust will be hold in metal cages, each one will be equipped with a sixty-volt light bulb with wire mash fence wrapped around it, to provide another source of heat for the locust. Temperature around 36° C has to be maintained in the metal cages. Water-soaked cotton wool balls are placed in each cage to provide hydration. The locust egg will be introduced to each cage and allow it to hatch. About 220-330 nymphs were obtained after hatching. Different feed materials such as Soya extracts, Cornmeals, Dried cowpea

leave, Corn stover and Dried carrot powder supplement with vitamins are used for feeding locust.

Harvesting of cultured locust:

Harvesting can be done after 29 days from the hatching or as soon as the last moulting from 5th instar to pre-adult stage. The locust will be weighed and stocked in airtight Ziploc bags. It will be killed by freezing at -20°C. The dead insects will be stocked in brown colour paper bags and it will be dried in an air-circulation oven. Finally, it will be allowed to reach the room temperature. Subsequently, the insects were weighed, counted and ground into fine powder (particle size below 2mm) using a laboratory blender.

Harvesting of Non-culture Locusts:

Most locust swarms are diurnal; therefore, they can be mass harvested at night when the temperature is cooler and the swarming makes locust relatively easy to harvest. Current technique used for harvesting locust swarm such as sweeping with brooms, hand collecting and large sweeping nets.

Locust Meal as a Novel Ingredient in Aquafeed:

Fish meal is the most expensive protein source for aquaculture diets as it is having a higher amount of protein, balanced amino acid and fatty acid profile, more digestibility and is more price of fish meal and low accessibility makes it difficult to be used in most of the aquafeed. The large number of locusts that have died as a result, since 2000 the development of aquaculture in Africa and Asia searches the alternative source of protein have led to trails on the feeding value of locust for catfish and tilapia. Locust is an excellent source of protein, amino acid and fatty acid. Some species differ in their protein content (i.e.) from 50 to 60% of dry weight. It also contains sufficient amount of Iodine, Phosphorus, iron, Thiamine, Riboflavine and low level of carbohydrate. The locust is prepared for feeding of fishes in different ways; it includes dried and ground form. Sometimes they are boiled before drying. Desert and Migratory locust can replace 25% of dietary protein in fish feed. Preliminary studies on analysis of the adult locust revealed that it is a very good source of Protein and Fat.



Considering the nutritive richness, it would be an ideal ingredient in Fish and Shrimp feed as a fish meal replacer. In *Oreochromis niloticus* the optimum replacement level was found to be 29.8% which would be useful in formulating cost-effective commercial feeds for the intensive culture of this fish. It is, therefore, recommended that locust meal can be incorporated up to 30% as a replacement for fish meal without compromising the growth of fish. There are a variety of protein sources that can be used in aquaculture without affecting growth function, feed performance and body composition, given the need for amino acids, locust meal can be used as another protein ingredient in fish food.

Shelf life of locust meal

Packaging and storage technique improves the shelf life of locust. Shelf life of fresh grasshopper is 1-2 days. However, processing this grasshopper by dry-pan frying, drying, vacuum packaging and opaque storage at room temperature increase its shelf life to 12 weeks. While chilled storage and vacuum-packed storage of the processed insect at ambient temperature almost double the shelf life to 22 weeks.

Conclusion:

Locust meal is a potential ingredient for aquaculture system because it increases the growth rate of cultured fishes, reduce the fish feed cost and increase the productivity of the aquaculture sector and also help for agriculture by reducing the destruction of crop during swarming phases of locust. 30% inclusion level of locust meal produced the best result in terms of growth. It is therefore, recommended that locust meal can be incorporated up to 30% as a replacement for fish meal without compromising the growth of fish. There are a variety of protein sources that can be used in aquaculture without affecting growth fertilizes, feed performance and body composition gives the need for amino acid. Locust meal can be used as another profit ingredient in fish feed. Locust could be harvested physically or without any pesticides, then it can be effectively used in shrimp feed

Reference:

1. Makkar, H., Heuzé, V. and Tran, G., 2022. Locusts and grasshoppers: nutritional value, harvesting and rearing for animal feed, and other applications. *CABI Reviews*, (2022)
2. A Yousif, R., Zehra, S. and A Mohamed, F., 2022. Use of Locust Meal as Alternative Protein Source to Fish Meal in Practical Diets for Fingerling *Oreochromis niloticus*.



a) Mature locust



b) Locust attack in fields



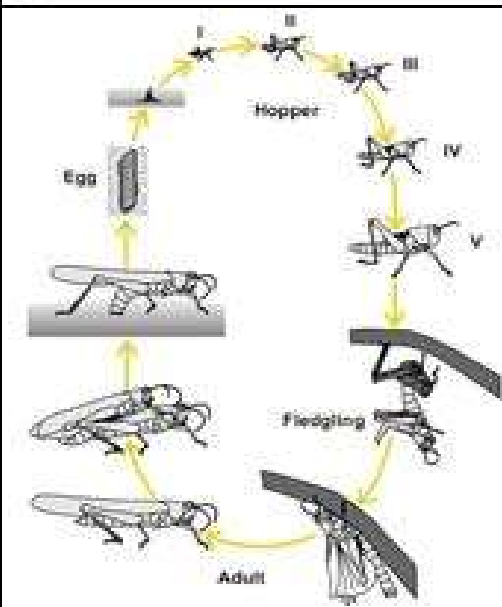
c) Sweep net collection of locust



d) Grained locust



e) Locust meal give to catfish



f) Life cycle of locust