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Usage of Silkworm Pupae Waste as an Animal Feed and Textile Industry

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INTRODUCTION

Sericulture activities are highly sequential and timely in nature. By products generated from major sericultural activities play a significant role in enhancing income for the sericulturists. Appropriate technology adopted by the farmers and replicated on a commercial scale is the need of the hour which sustains the sericulture industry to stand on economically sound footage. The nutritive value of the sericultural wastes certainly boosts up the Sericulture industry which helps in elevating the socio- economic status of the rural poor rearers. Now a day application of silkworm pupae oil in paints and varnishes industries, supplementing animal feed, synthesis of surfactants and food industries etc.

SILKWORM PUPAE WASTE:

When the silkworm enters the pupal phase, it builds a protective cocoon made of raw silk. And the end of pupation, the pupa releases an enzymes that creates a hole in the cocoon and the moth emerges. In order to produce silk, the pupae are killed by boiling, drying or soaking in sodium hydroxide solution, before they produce the enzyme. The spent pupae are produced in large quantities and are a major by-product of silk production. Spent silkworm pupae are the waste material often discarded in the open environment or used as fertilizer. It can be extracted to yield valuable oil (pupa oil) used in industrial products such as paints, varnishes, pharmaceuticals, soaps, candles, plastics and bio-fuels etc. the extracted meal is sometimes used for the production of chitin, the long chain polymer of N- acetyl glucosamine which is the main component of the exoskeleton. silkworm pupae have long been part of human food in Asian silk producing countries, and are considered as a delicacy in regions of China, Japan, Thailand and India, among others. Due to its high protein content, silkworm pupae meal has been found suitable as a livestock feed, notably in monogastric species (poultry, pigs and fish), and also in ruminants.

1. SILKWORM PUPAE MEAL (SWPM):

Silkworm pupae meal (SWPM) is a protein-rich feed ingredient of animal origin with a high nutritional value. On dry matter basis its crude protein content ranges from 50% to more than 80% (defatted meal). The lysine (6-7% of the protein) and methionine (2-3% of the protein) contents are particularly high. However, the true protein in silkworms was found to correspond to only 73% of the crude protein content. The presence of chitin and insoluble protein may also explain the presence of fibre, and values of 6-12% DM of ADF have been reported. The pupae meal (undefatted) is rich in fat, typically in the range of 20-40% on dry matter basis. Defatted Silkworm meal contains less than 10% oil which is rich in polyunsaturated fatty acids, notably linolenic acid (18:3), with values ranging from 11 to 45% of the total fatty acids as reported. Silkworm pupae meal is relatively poor in minerals (3-10% dry matter) as compared to other animal by-products. The crude protein value of Silkworm litter varies extremely i.e. between 15 and 58% dry matter.

i) Silkworm pupae diet for ruminants:

Silkworm meal (SWPM) is very rich sources of protein and can supplement in ruminants diet, due to its highly undegradable protein content and favourable amino acid profile. There is a limitation of its use as ruminant feed due to high oil content. Therefore, fat extraction of silkworm pupae meal is of prime criteria when it is fed in large amounts. It is reported that Silkworm meal could safely replaced 33% of groundnut cake (GNC) in fattening diets for Jersey calves without affecting performance, resulting in a cheaper diet. They also found that the protein digestibility of the silkworm meal-based diet was higher than that of the groundnut cake diet. Effective in situ nitrogen degradability of silkworm pupae meal is relatively low. The effective degradability values (5%/h outflow rate) for undefatted silkworm pupae were 29% and 25% as reported by many researchers and only 20% for defatted meal resulting in good proportion of undegradable protein, especially from the defatted meal, richer in protein. The two major limiting amino acids for milk production, Lysine and methionine are considered to have a low in situ disappearance of 26% (24 h incubation, 5%/h outflow rate), indicating that the bypass protein fractions of silkworm pupae meal are good sources of lysine and methionine for ruminants diets .

ii) Silkworm pupa diet for pigs:

It is found that silkworm pupae meal is a good replacement for conventional protein sources. In a study carried out in Brazil, up to 100% replacement of soybean meal in diets for growing and finishing pigs with undefatted silkworm meal resulted no effect on growth performance and carcass characteristics. However, there was a negative effect on intake when the substitution rate was more than 50%, which was attributed either to the higher energy density of the diet or to a lower palatability. The lower intake was compensated by a better feed conversion rate, which may have been due to the higher lysine content of the silkworm-based diet. The Silkworm excreta or litter can be incorporated in pig diets at recommended inclusion rate are about 7% and should not exceed 10%.

iii) Silkworm pupae diet for poultry:

The conventional source of protein used in poultry diet is fishmeal and Soyabean which costly. Silkworm pupae meal is a valuable cheaper alternate protein source that can be used in poultry feeding, though it is of slightly lower quality than fish meal. High amino acid digestibilities (lysine 94%, methionine 95%) were determined in geese. Several trials have conducted in many countries of the world shown that replacing 50% of the main protein source (fish meal) in most of the experiments is usually safe, though mineral supplementation may be required. Total replacement is sometimes possible but tends to result in a lower performance. Normally inclusion rates are typically in the range of 5-10% range.

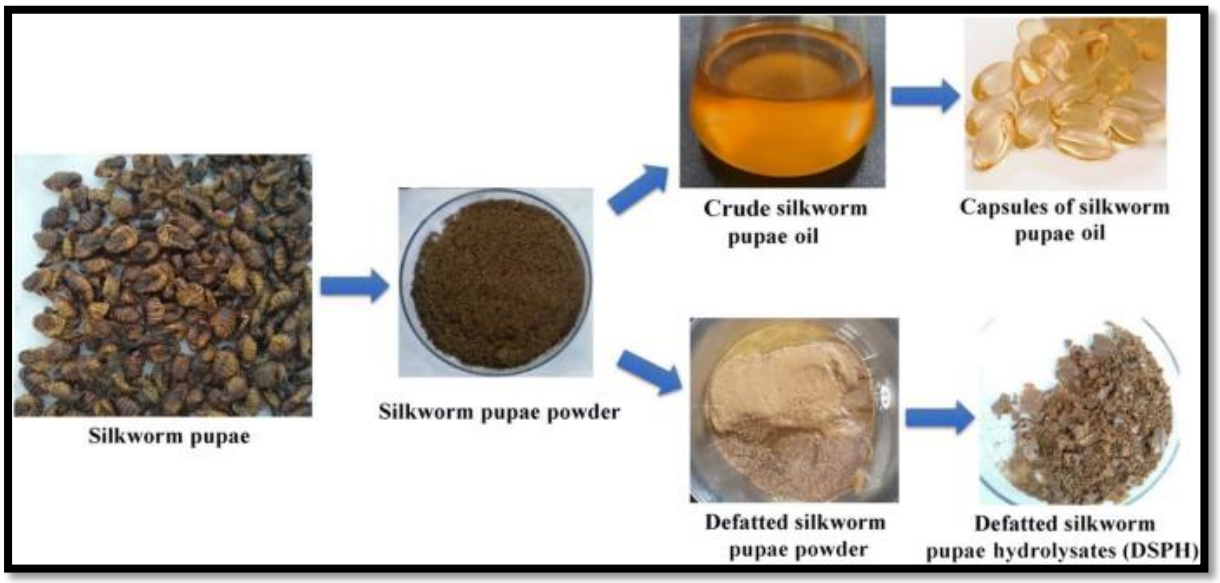
iv) Silkworm pupa diet for fish species:

Silkworm pupae meal is valuable protein source in many fish species. CYPRINIDS: high level of silkworm meal (about 30%) can be fed to cyprinids. COMMON CARP: pupae diets is fed to common carp because of its higher nutrient digestibility and nutrient retention. SILVER BARBS : in silver barbs, highest growth performances was observed in fish fed a diet replacing about 38% of total dietary protein by silkworm pupae meal.

Silkworm pupa diet for pig, poultry and fish

2. SILKWORM PUPA OIL:

Oil is extracted from dead pupae. The residues formed during the chrysalis, oil extraction is used as natural organic fertilizer and as food for poultry, pig, fish and fur bearing animals. The silkworm pupae due to their high fat content (over 30%) are used as chrysalis oil to obtain cosmetic products (cream, soap, lotion, emulsion) and as proteic powder for valuable animals fodder.



Steps involved in pupal oil production

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The extraction of mulberry silkworm pupae oil is carried out by following maceration method:

- Two different solvents – petroleum and ether is taken
- About 100g of pupal powder is added to 150ml of both the solvents separately in a reagent bottle
- The bottles are closed tightly and sealed with glycerine to avoid evaporation
- After 7 days when the colour of solvent changes to yellow the contents in the bottles are filtered using filter paper.
- The filtrate is then kept in open to evaporate all volatile solvent from which the oil is extracted

Pupa oil is used to produce paints, varnishes and dyes which are essential for textile industries.

CONCULSION

The silk industry and the by-product utilization thus play a crucial role in the the past as well as in the coming years which make the sericulture an economically viable proposition enabling it to withstand competition from other cash crops. The useful conversion of by-products through indigenously available processing techniques brings additional income lead to socio-economic advantage of rural people. Profitable conversion of wastes to high value utilities through innovative technologies can reduce the production cost, pollution, recycles resources to cater the ever growing population and their demanding wants.

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