I. INTRODUCTION

Poultry farming in India has achieved a tremendous growth rate in four and half decades from an age old backyard farming to most sophisticated agro based Industry. India occupies fifth place in poultry meat production in the world, but in consumption aspect India has to go a long way. According to the National Nutrition Council, each individual requires 11 kg of poultry meat per annum but currently India’s, per capita consumption of poultry meat is around 1.5kg (Anon., 2005).

Since the major expenditure on poultry industry is towards the feed constituting about 60-70per cent of the total recurring expenditure, one of the major approaches of research in poultry nutrition should involve in producing both economical and quality rations. This may be based on the substitution of locally available feed ingredients both conventional as well as nonconventional. In order to make it economical, the feedstuffs included in poultry feeding should be of noncompetitive in nature.

Energy and protein are the two major nutrients which cost anywhere between 80-90per cent of the total expenditure of broiler and layer diets. As per the present need of poultry industry in India, the availability of good quality protein feed ingredients is the biggest problem and the situation is very much alarming. Almost all the conventional and non conventional vegetable protein sources available are deficient in one or more essential amino acids. The availability of animal protein source especially fish meal, both of quality and quantity at a reasonable price is a major constraint. Many a times, fishmeal is adulterated with urea and salt, depending upon processing conditions it may be contaminated with bacteria and because of fishy odour its use is limited.

Since four decades, considerable work has been done to tap new and cheaper agricultural/ industrial byproducts to replace conventional soybean meal and fishmeal as a source of protein in poultry diets. Poultry nutritionists are making concrete efforts in the direction of searching a suitable substitute for fishmeal.
Among the various avenues tried for the purpose, the silkworm pupae meal is one such byproduct of sericulture industry (Panda, 1968). Pupae are waste product of silk industry. A great deal of work has been done on silk waste, but no appreciable volume of work has been done on pupae waste. Silkworm pupae meal (swpm) is the dried residue of Bombyx mori pupae is an immediate byproduct of reeling industry, obtained after removal of the silk thread. There are however, some reports on the use of pupae waste in poultry feed, in manure and in feeding of monogastric and ruminant species for many years in Asian countries. Early studies revealed that silkworm pupae meal was an excellent source of protein and fat and can substitute fishmeal in livestock rations at considerable percentage. According to Jayachandra 1976, the meal contains the exoskeleton and the contents of the body cavity, Chitin which is a component of the exoskeleton, contains approximately 25 per cent of the crude protein which is not composed of amino acids and is not digestible. When fat content is reduced, higher amounts of silkworm pupae meal can be fed at higher levels to carp fish and layer chickens.

The full fat silkworm pupae collected after reeling operation contains 70-75 per cent moisture and is usually subjected to sun drying. The dried pupae contain on average 10 per cent moisture, 55 per cent protein, 25-27 per cent fat, 3 per cent crude fiber (Panda 1970). Sujatha (1979) reported that digestibility of the crude protein in silkworm meal was found to be similar to fish meal when fed to Fishes. Jain (1985) reported 68-76 per cent protein in deoiled silkworm pupae. Compared to plant protein source, it was superior when fed to carp and shrimp growth weight trials showed that digestive efficiency was reduced when silkworm meal was used to replace fishmeal. Swamy et al., (1994) and Sheik et al., (2005) reported that there were no adverse effects on various carcass qualities when fish meal was completely replaced with silkworm pupae meal.

Numerous investigations have been under taken on biological evaluation of protein quality of silkworm pupae meal, the majority of them using layer chicks or the rats. In most of the studies, feed for poultry was formulated on the basis of total amino acid content, which does not take into account the utilization of amino acids by the
animal during digestion and absorption. Formulating feed on their amino acid digestibility basis is more reliable and efficient. Though information on amino acid digestibility in broilers is available for many ingredients there are no such reports on amino acid digestibility of silkworm pupae meal in broilers.

Very few published reports are available on the studies of utilization of silkworm pupae meal in broiler diets. Bora and Sharma (1961) successfully utilized silkworm pupae meal as a replacement for fish meal in chick rations and found that no significant difference in body weight between silkworm pupae and fishmeal fed chicks. Panda (1970) reported biological value of Silkworm pupae meal is 134 per cent and pepsin digestibility was 89.5 per cent. Lodhi and Ichhponani (1974) studied the apparent digestibility of silkworm pupae meal in 12 weeks birds and reported the protein digestibility of 70 per cent, when 50 per cent of total nitrogen was replaced by groundnut cake. Joshi et al, (1979) substituted 25, 50, 75 and 100 per cent fishmeal with silkworm pupae meal and observed progressive decline in body weight and feed efficiency in broilers as the level of silkworm pupae meal increased. Virk et al., (1980) concluded that untreated silkworm pupae meal can replace from 50 per cent to 75 per cent in starter broiler diets. Lin et al., (1983) obtained digestibility, biological value, Protein efficiency ratio and Net protein utilization value of 88.9, 84.7, 92.3 and 75 per cent respectively in rat studies for raw silkworm protein. Depression in growth weight rate at higher level of inclusion was reported by Jain (1988). This suggests some confusion regarding the optimal level at which it could replace fishmeal in poultry rations.

Perusal of the literature revealed that most previous research on nutritive value of silkworm pupae meal has been conducted using deoiled meal after spraying with insecticide like DDT and replacing fishmeal in the poultry rations. The dried and pulverized Silkworm pupae meal is now available and has been successfully included upto five per cent in broiler rations, replacing soybean meal without any detrimental effect. However no systemic studies have been done about the raw material and processing conditions that affect protein quality of animal meal. It has been well documented that the addition of proteolytic enzymes in the diet can have
beneficial effects on amino acid digestibility. It is of interest to assess the extent to which proteolytic enzymes improves protein quality of silkworm pupae meal. No information is available on the effect of supplementation of enzymes in Silkworm pupae meal based broiler diets. One of the major pre-requisite of this industrial waste in feed formulation is information on the digestibility of feed ingredients and knowledge of nutrients availability from Silkworm pupae meal for broilers is desirable, so that effective substitution of one ingredient to another may be achieved.

In view of the above facts, the present study is undertaken to evaluate the biological usefulness of powdered Silkworm pupae meal and Deoiled silkworm pupae meal as alternative protein source, replacing soybean meal in broiler diets.

**Objectives of the Investigation:**

- Comparative chemical evaluation of deoiled and powdered silkworm pupae meal.
- To determine optimum level of inclusion of deoiled and powdered silkworm pupae meal in broiler rations as reflected by various performance criteria.
- To study the influence or effect of proteolytic enzyme in deoiled and powdered silkworm pupae meal based broiler diets.
- To work out cost benefit ratio of inclusion of deoiled and powdered silkworm pupae meal to replace soybean meal.