

# PROTEOLYTIC ACTIVITY OF SILK PUPÆ (*BOMBYX MORI* L.) AND DEGUMMING OF SILK WASTE

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## SUMMARY

The results of an investigation designed to put to use the pupa extract for degumming silk waste have been reported. That only about 14% of the gum gets removed by steeping the silk waste in pupa extract and therefore the method offers no advantage over the one practised in the industry, has been indicated.

## INTRODUCTION

After the extraction of the oil, the possibilities of using pupa powder as animal feed has been explored by Bheemeswar (1954). He found that the biological value of pupa protein could compare favourably with that of protein from several animal sources. Pupa powder was found by him to be rich in many B-complex vitamins and as such its use in fermentations involving fastidious micro-organisms has also been suggested. Since the pupa waste from reeling basins exhibits considerable enzyme activity, an attempt has been made in this Laboratory to explore the possibility of utilising this in the degumming process, *i.e.*, process involving removal of sericin from the silk waste. The results of this investigation are presented in this paper.

## MATERIALS AND METHODS

1. *Proteolytic activity of pupa waste.*—Pupa waste was obtained from the Spun Silk Mills Ltd., Channapatna. The material was ground with water and homogenized (approximately 5 lb. of pupa waste for 2.5 l. of water) and preserved in cold.

The proteolytic activity of the homogenate was determined by using sericin as a substrate along with the appropriate buffer, the activity being measured in terms of the amino nitrogen liberated by formol titration (Wilson, 1944). Before this, the optimum pH for the enzyme activity was determined (Table I).

Sericin was prepared by boiling raw silk in water and precipitating the protein with alcohol.

2. *Degumming of silk waste by pupa extracts.*—The silk waste was also kindly supplied by the Spun Silk Mills Ltd., Channapatna. The material was separated

from the extraneous impurities before the total gum present therein was determined by the method described by Carboni (1952). However, owing to the unavailability of olive oil soap recommended in the method, textile soap was used.

Accurately weighed samples of silk waste (20 g.) were boiled for 30 minutes in 600 ml. of 7% textile soap solution. The liquid was decanted and the silk was washed 2-3 times with hot water. Subsequently the silk was boiled once more with 600 ml. of 7% salt solution for 30 minutes. The solution was strained through a piece of curtain cloth and the silk washed repeatedly with hot water and finally with cold water. The silk was dried for 24 hours at 105° C., exposed to the atmosphere for 1 hour, and then its degummed weight was recorded.

When the pupa extract was used for preliminary degumming, the extent of degumming effected was determined by finding out the residual gum in the treated silk. The effect of using different quantities of soap on degumming of the pupa extract treated silk waste was also found out with a view to bring about, if possible, economy in the use of soap.

## RESULTS AND DISCUSSION

TABLE I

*Effect of pH on proteolytic activity*

pH	4.5	7.0	8.0	9.0	10.0
Activity (in ml. of NaOH)	0.42	1.30	2.73	2.07	1.12

Table I gives the proteolytic activity of the extracts at different pH. On the basis of this, all subsequent enzyme studies were conducted at pH 8.0.

The use of the activators like cysteine, HCN, Fe<sup>++</sup>, Hg<sup>++</sup>, Mg<sup>++</sup>, Mn<sup>++</sup> and Zn<sup>++</sup> (Irwing *et al.*, 1941; Morrison and Neurath, 1953) had no stimulating effect on the degumming process.

While exploring the possibility of using pupa extract for degumming purposes, the effect of excluding buffer was also followed for obvious reasons. Table II gives the results of these studies.

It is seen from Table II that only about  $\frac{1}{3}$  of the total gum gets removed by steeping silk waste in pupa extract for 48 hours. Extending the treatment for 72 hours does not confer any appreciable advantage. Since 14% degumming is also effected in the absence of buffer, the use of buffer has been dispensed with in subsequent experiments.

It is also observed that complete degumming of the pupa-extract-treated silk occurs when it is finally boiled for 1 hour with 10% soap (10 lb. of soap for 100 lb. of silk waste). These experiments were conducted, as stated earlier, on 20 g. weights of silk waste.

TABLE II  
*Percentage degumming with pupa extract*  
(Total gum present 40%)

No.	Treatment	% Gum removed
1	Pupa extract + buffer (48 hours)	13.9
2	„ + „ (72 hours)	16.1
3	„ + water (48 hours)	14.1
4	„ + „ (72 hours)	14.0
5	„ + „ (72 hours) (and finally boiled with 10% soap for 1 hour)	39.9

With a view to determining the extent of applicability of these results on a larger scale, pilot experiments were conducted with 1 lb. quantities of silk waste and the residual gum of the differently treated samples was determined quantitatively. The data recorded are presented in Table III.

TABLE III  
*Effect of decreasing the quantity of soap on degumming*

No.	Treatment	Concn. of soap lb./ 100 lb. of silk waste (1 hour)	% Gum removed
1	Method adopted at the Spun Silk Mills	10.0	36.76
2	Pupa extract (2.5 lb./lb. of silk waste 48 hours)	10.0	31.95
3	Do.	7.5	31.39
4	Do.	5.0	30.68

It is observed that about 32% gum of the 40% present is removed by the different treatments. Decreasing the quantity of soap below 10% level would appear to bring about lowering in the extent of degumming process. In fact, in contrast to what was observed in the 20 g. samples, the pupa extracts seem to possess no effect on the degumming process when large quantities of silk waste are handled.

In conclusion, it may be stated that it is not feasible to use pupa extract as an agent for the degumming of silk as it does not effect any economy in the quantity of soap used, though it is true that a partial degumming is brought about by it. Under the conditions obtaining in the industry at the present state wherein almost complete degumming is desirable, the use of pupa waste is of only limited value.

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