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PHYSICO - CHEMICAL STUDIES ON *ANTHERAEA MYLITTA* DRURY COCOON SHELL (SATURNIIDAE : LEPIDOPTERA)

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The dissolution of cocoon shell of different ecoraces measured using distilled water, ethyl alcohol, acetone and methyl alcohol. The thickness of the cocoon shell based on melting and the time required for saturation among the different ecoraces were found in the order of Andhra local having maximum thickness of the shell followed by Resham, Modal and the least was Ampatia.

INTRODUCTION

Softening of tasar cocoons of *Antheraea mylitta* Drury is necessary to extract silk with maximum fibre realization without effecting its natural and desirable properties. Among the various chemicals along with soaps have been found not most suitable for its performance in optimum cooking. Reeling and also post reeling which has been confirmed through the field trials. But it differs in various ecoraces particularly the cocoon which are thick and hard.

Li Zheng *et al.* (1992) have reported the solubility properties of sericin experimenting on *Antheraea yamami* cocoons under different temperatures and the treatment timings they have observed some similarity between the sericin of *A. yamamai* and *Bombyx mori* cocoons. Such studies to determine the dissolution performance of the cocoons in relation to time and temperature were not seen enough for tasar cocoons. A few solvents have been tested in relation to shell dissolution and temperature during the course of present experiment.

MATERIALS AND METHODS

Determination of cocoon shell dissolution (Li Zheng *et al.*, 1992) : To examine the solubility of cocoon shell in water, alcohol, acetone and methanol at different treatment times and analysed dissolution properties of shell to provide data to develop a better cooking method for various tasar cocoons.

To estimate the dissolution of shell at various temperature and treatment time, dried and chopped cocoon were put in water, alcohol, acetone and methanol, the weight ratio between the sample and the test chemicals were 1 : 100 heated them a series of temperature one after another and kept it at each temperature from 10 min. to one hour. Afterwards the shell amount dissolved at each temperature was determined after drying the sample were put in electric oven at 100^0C for 24 hours.

RESULTS

Physico-chemical studies on tasar cocoon shell : The cocoon shell of tasar ecoraces subjected to dilution with certain aromatic solvent samples such as water, alcohol (ethanol), methanol and acetone by taking definite quantity of the shell material.

Water as solvent : The ecorace Modal collected from Bihar shows in the first 10 minutes a moderate of 12.67% and a significant rate of 62.16% dissolution after boiling for 400 minutes. However, the rate of dissolution has come down even after 460, 580 and 1060 minutes of boiling which are in order of 12. 12, 10 and 20%.

In the ecorace Raily, the percent dissolved after 10 minutes of boiling was moderate, after 60 minutes percent dissolved was higher (30%). However, the shell of this ecorace was found hard even after 400, 760, 880 and 1180 minutes of boiling. It is evident from the rate of dissolution which was between 14 - 25%.

In Daba Chaibasa (Bihar) after 10 minutes, the rate of dissolution is similar to Modal, a significant percent of dissolution of the shell in the rate of 36.53% was found, after 40 minutes of boiling. Unlike Modal, after 400 minutes of boiling the rate of dissolution was only 25% after 520 minutes, the percent of dissolution was 33.33 which is insignificant after 640 minutes of boiling the percentage change was a meager 7.14%.

In Bihar ecorace of Daba within 10 minutes 73.91% dissolution was recorded, however, upto 520 minutes of boiling the shell rate of change was limited again at the point 75% dissolution of sericin was found. Similarly after 1180 minutes, the shell dissolution was found to the extent of 60%.

In Andhra local ecorace, the initial rate of dissolution of 80% was found at 400 minutes of boiling. Again only at 1000 minutes 33.33% dissolution was found.

In the ecorace Resham, the initial boiling time was yielded limited percent of dissolution even after 460 minutes of boiling, the percent dissolved was only 15.38 but after 520 minutes the rate of dissolution was reached to 100%. However, no change was found upto 1120 minutes, at this point further change of 30% was noticed.

In the ecorace Daba M.P. maximum percent dissolution was found after 10 minutes (45.45%) followed by again after 460 minutes 33.33% dissolution was found.

The Daba ecorace which is originally brought from Bihar to Andhra Pradesh, to substitute the low yield of Andhra local and also reported in the recent years (1992) that it is found to loose certain of its basic racial features and loss heterosis as seen from the present data. The cocoon dissolution shows variability between the Daba of Bihar and the Daba cocoon collected in Warangal district of Andhra Pradesh.

The ecorace Sarihan cocoons were experimented for its shell dissolution and found at 40 minutes of boiling about 68% of decrease similarly after 280 hours of boiling the present dissolution was 30.43%. Beyond this, the rate of dissolution was limited even at 1060 minutes of boiling.

The ecorace Ampatia shows maximum rate of dissolution after 500 minutes of boiling and after 520, 580, 640 and 700 minutes of boiling the rate of dissolution was in order of 78.57, 40.00, 33.33 and 36.36% respectively.

Above results are based on systematic boiling and drying of the cocoon shell. Calculation of the total boiling period in relation to change in the weight of boiled cocoons shell at regular intervals (Table I).

Acetone as solvent : The ecorace Modal in the initial boiling time 20 minutes have yielded limited percent of dissolution 14.28%. The maximum dissolution was found at 120 minutes, the dissolution percentage have increased gradually from 20, 60, and 120 minutes, the rate of dissolution recorded were in order of 14.28, 40.00 and 66.66%, again the rate of dissolution 33.33% decreased at 630 minutes beyond which no further dissolution of shell was recorded.

The ecorace Raily, the initial boiling time have yielded 33.33% of shell dissolution. Same dissolution has recorded at 270 minutes and 560 minutes but the significant dissolution 50% was found at 510 minutes. But in 120 and 330 minutes of boiling the dissolution 20% similarly 25% of dissolution were recorded at 180 and 360 minutes of boiling.

In Daba Chaibasa (Bihar) the rate of dissolution recorded were 0.60, 10.00, 12.50, 14.28, 16.66, 20.00, 56.25 and 60% at 10, 40, 60, 120, 200, 300, 390 and 480 minutes of boiling respectively.

Daba (Bihar) ecorace after initial time of boiling the percentage of shell dissolution was 45.45% and threshold of shell dissolution 66.66% was found after boiling 450 minutes, as minimum percentage of dissolution 8.57 after 180 minutes of boiling at 20, 60, 240 and 300 minutes of boiling, the rate of dissolution was in order of 30.95, 10.52, 16.66 and 20%.

In the ecorace Andhra local the rate of dissolution found minimum after 90 minutes of boiling at 450 and 570 minutes of boiling the rate of dissolution is same 33.33%, at 270, 330 and 390 minutes after boiling the dissolution of shell was recorded 25, 20 and 25% respectively.

In the ecorace Resham the initial boiling time 10 minutes the rate of dissolution was found 23.07%, minimum dissolution 20% was found at 270 minutes, at 120 minutes the percentage of dissolution was 30. However, at 390 and 510 minutes the rate of dissolution found equal 33.3% beyond which there is no further dissolution of shell was recorded.

In the ecorace Daba M.P. the minimum dissolution 6.66% was found at initial time 10 minutes followed by 60 minutes the maximum percentage of dissolution 50% was recorded. At 40 minutes, 120, 330, 390, 450 and 600 minutes after boiling the rate of dissolution was in the order of 25, 33.33, 0.50, 33.33, 15.38 and 44.44%.

In Daba collected from Warangal area initial time of boiling 20 minutes and 630 minutes after boiling maximum percent of dissolution was recorded, beyond which, no further dissolution of shell was recorded. Minimum shell dissolution 9.09% was found at 90 minutes after boiling, at 150, 210, 300, 450, 540 and 570 minutes after boiling the percent of shell dissolution were in order of 22.22, 12.50, 14.28, 16.60, 20 and 25%.

In the ecorace Sarihan after the initial time of boiling 20 minutes 60% of the shell dissolution was recorded, at 570 minutes after boiling dissolution of shell was maximum 66.66% beyond which no further dissolution of shell was recorded at 40, 60, 180, 240 and 480 minutes after boiling the percentage of dissolution was 25, 33.33, 50, 33.33 and 50 respectively.

In the ecorace Ampatia 10 minutes of boiling the dissolution of shell was found minimum 17.64% and maximum 80% after boiling 330 minutes. After 90, 180, 480 and 570 minutes of boiling the shell dissolution percentage was in order of 23.63, 22.22, 33.33 and 50% respectively beyong which no further dissolution of shell was found (Table I).

Table 1 : Time required for saturation point in shell dissolution using water and several organic solvents.

Name of the ecorace	Tickness of cocoon shell Av. of head tail side I & II (mm)	Water at 100°C		Acetone at 55°C		Ethanol at 78°C		Methanol at 78°C	
		% of cocoon shell at saturation point	Time (mts) required to reach saturation point	% of cocoon shell at saturation point	Time (mts) required to reach saturation point	% of cocoon shell at saturation point	Time (mts) required to reach saturation point	% of cocoon shell at saturation point	Time (mts) required to reach saturation point
Modal	0.81	31.25	1060	12.50	630	31.25	600	25.00	540
Daba Chaibasa*	0.59	35.00	640	12.50	480	18.75	480	18.75	980
Raily	0.72	25.00	1180	12.50	570	25.00	450	37.50	600
Resham	0.87	25.00	1000	18.75	510	25.00	450	18.75	660
Daba M.P.	0.56	25.00	1180	11.25	600	12.50	540	12.50	540
Daba Bihar	0.60	12.50	1000	18.75	450	13.75	570	7.50	600
Andhra local	0.98	18.75	700	18.75	570	18.75	420	25.00	630
Daba form**	0.34	18.75	1060	18.75	630	12.50	680	12.50	480
Sarihan	0.52	18.75	700	7.50	570	18.75	480	7.50	600
Ampatia	0.27	13.75	1180	12.50	570	13.75	570	12.50	540

* = Daba Chaibasa (Bihar); ** = Daba form of Warangal (A.P.).

Ethanol as solvent : The ecorace Modal has no effect in the initial stage but at 150 minutes of boiling the percent dissolution was 25 and 50 percent of dissolution was noted at 450 minutes, the threshold limit of the dissolution was found at 600 hours of boiling, beyond which no further dissolution of shell was recorded.

The ecorace Raily showed about 23.07% dissolution after 10 minutes, 33.33% at 60 minutes 40% at 210 minutes and lastly 25% at 450 minutes.

In Daba Chaibase (Bihar) within 10 minutes of boiling the cocoon shell has shown a dissolution of about 78% later again 390 minutes of boiling 50% of dissolution was noted. It has reached the saturation point at 480 minutes beyond which no change was found in the shell.

In Daba (Bihar) ecorace 23 and 25% of the cocoon shell dissolution was found in the initial 10 - 15 minutes of boiling at 450, 480 and 570 minutes the ratio of dissolution was 16.66, 100 and 36.36% respectively.

The ecorace Andhra local cocoon shell has dissolved 100% in 20 minutes and within 120 minutes 33%, 270 minutes 50% and 420 minutes 33.33%.

Resham another ecorace of Bihar has 60% of dissolution in 20 minutes, 25% dissolution in 60 minutes, 33.33% at 180 minutes and finally at 450 minutes there is about 25% of dissolution was recorded.

In Daba M.P. ecorace within 10 minutes of boiling 33.33% of cocoon dissolution was recorded however did not increased much even upto 450 minutes, again at 480 minutes 50% dissolution of cocoon shell was recorded.

In Daba collected from Warangal region didi not show much rate of dissolution upto 60 minutes. At 60 minutes it was 30%, again at 480, 540 and 680 minutes of boiling significant percent of dissolution was noted (25, 33.33 and 50% respectively).

In Sarihan ecorace at 10 minutes 33%, at 40 minutes 50%, at 90 minutes 33%, at 390 minutes 50% dissolution of shell and at 480 minutes only 33.33% were recorded.

The ecorace Ampatia within 20 minutes of boiling 60% and again after 480 and 570 minutes of boiling the percentage was 33.3 and 36.36% respectively (Table I).

Methanol as solvent : The ecorace Modal collected from Bihar shows in the first 10 minutes a moderate rate of dissolution was found 14.28% and the significant rate of dissolution was found after boiling time of 540 minutes. However, the rate of dissolution increased after 60, 120, 210, 270 and 330 minutes of boiling which are in the order of 7.69, 8.33, 20, 25 and 33.33%.

In ecorace Raily the maximum percent of shell dissolution 23.07 was found after initial time (10 minutes) of boiling and minimum rate dissolution 10% was found at 450 minutes of boiling. However, the moderate rate of dissolution 18.18, 25, 14.28 and 16.66% after 390, 480, 540 and 600 minutes of boiling.

In Daba Chaibasa (Bihar) shows in the first 10 minutes of boiling a moderate rate of dissolution 33.33% was found, the minimum rate of dissolution 11.11% was recorded after 210 minutes of boiling and maximum rate of dissolution 66.66% was found after 980 minutes of

boiling. The rate of dissolution was 20, 40.62 and 28% after 20, 360, 920 minutes of boiling respectively.

In Bihar ecorace of Daba after initial time (10 minutes) of boiling the dissolution rate was 33.33%, after 60 minutes of boiling of the shell dissolution was 9.09%. Further after 360 minutes of boiling a maximum rate of dissolution 72.41% was recorded and then 66.66% of dissolution was found after 600 minutes of boiling. However, the rate of dissolution 16, 20, 33.33 and 50% was recorded after 390, 480, 510 and 540 minutes of boiling respectively.

In the ecorace Andhra local a minimum percent of dissolution was found (8.33%) after 120 minutes of boiling, a maximum percent of dissolution was recorded (33.33%) after 510 minutes of boiling. However, the moderate percent of dissolution 14.28 was recorded after 10 minutes of boiling. The dissolution rate found 7.69, 20, 11.11, 12.50, 20 and 25% were in order of 60, 210, 330, 450, 570 and 630 minutes of boiling.

In the ecorace Resham the percent dissolved after 10 minutes of boiling was moderate 33.33. There is a decrease in the rate of dissolution 20% after 150 minutes of boiling. The shell dissolution found maximum 66.66% after 360 minutes of boiling. After 390 and 600 minutes of boiling the shell dissolution decreased gradually drawn 50 - 33.33% respectively.

In the ecorace Daba M.P. the maximum rate of dissolution 100% was recorded after 360 and 540 minutes respectively. After 10, 60, 330, 390 and 420 minutes of boiling the rate of shell dissolution were in order of 14.28, 7.69, 8.33, 20 and 25% respectively.

In Daba collected from Warangal region the dissolution after initial time of boiling 10 minutes was found 14.28% shell dissolution. 16.66% of shell dissolution found at 60 minutes after boiling, at 300 minutes after boiling the dissolution was found 37.50%, at 390 minutes after boiling dissolution was 33.33%, at 420 minutes after boiling the dissolution was 50%. However, the maximum percent dissolution 100% was recorded after 480 minutes of boiling, beyond which no change was found in the shell.

In the ecorace Sarihan belongs to Bihar the sell dissolution was found 33.33% after 20 minutes boiling followed by the minimum percent of dissolution 9.09 was recorded after 40 minutes of boiling. There was an increased rate of dissolution found 22.22% after 120 minutes of boiling, at 270 minutes of boiling again decrease of dissolution 18.42% was recorded followed by a maximum percent of dissolution 90% was found after 330 minutes of boiling, again there is a decrease in the rate of dissolution 53.84% after boiling 360 minutes followed by decrease percent of dissolution 30% at 450 minutes of boiling and after 600 minutes of boiling the rate of dissolution was 66.66% recorded.

In ecorace Ampatia shows in the first 10 minutes moderate rate of dissolution found 23.07% and a significant rate of dissolution (100%) was found after a boiling time of 270 minutes. However, the rate of dissolution was 8.33% at 90 minutes, 20% at 360, 25% at 420 minutes 33.33% at 490 minutes and 50% at 540 minutes after boiling was recorded (Table I).

DISCUSSION

A set of experiments were done using distilled water and organic solvents such as ethyl alcohol, acetone and methyl alcohol. The saturation point in melting the cocoon shell were measured in terms of time and percentage saturation. These experiments were designed to find out

the thickness of the cocoon shell from different ecoraces which is an important commercial character. Literature shows that the wild silk differs from ordinary silk both in physical and chemical properties. Tasar silk is considerably tough and coarse. It is difficult to bleach and dye, it requires a more severe treatment for degumming than the other silk fibers. X - ray diffraction studies show polyalanian as the main constituent of tasar cocoons. Further it is also reported that fibers of wild silk are nearly three times thicker than mulberry silk and are useful in making firm fabrics and carpets (wealth of India, 1972). The thickness of cocoon shell based on these experiments is found in order of Andhra of Andhra local > Resham > Modal > Raily >Daba Bihar > Daba M.P. > Sarihan > Daba form Warangal > Ampata. This classification showing Andhra local filament as the best among the ecoraces tested in similar with the reports of Central Silk Board (C.T.R. & T.I., Quarterly News Bulletin, 1993).

REFERENCES

ANONYMOUS. 1972. *Wealth of India*. C.S.I.R., New Delhi.

ANONYMOUS. 1993. *Quarterly News Bulletin*. C.T.R. & T.I.. Ranchi.

ZHENG, LI, YUANPING, SHAO. & MEIGUI, LI. 1992. Studies of physical-chemical properties of *Antherea yamamai* cocoon : sericin solubility. *Wild silkmoths*. pp. 144 - 150.