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STUDY OF THE PHYSICO-CHEMICAL PROPERTIES OF SERICIN OF THE COCOON SHELL

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Abstract:

The swelling and solubility of the cocoon shell were studied depending on the water temperature and on the concentration of sericin. Various surfactants were used to increase the swelling of the cocoon shell. It has been established that the solubility and swelling of cocoon shell sericin for 3-5 minutes, temperatures above 50°C and a concentration of 0.4-0.5% corresponds to the lowest solubility and better swelling.

Keywords: Swelling, Solubility, Silk Thread, Sericin, Softening, Sheath, Temperature

INTRODUCTION.

The purpose of cocoon winding is to develop a smooth monolithic, continuous in length and uniform in thickness, tensile strength and other properties of a complex silk thread of a given linear density by adding together several cocoon threads wound from the sheath.The developed complex thread from several cocoon threads is called raw silk. As you know, the cocoon thread, laid in packets in eight-shaped loops, is glued in the sheath not along the entire length, but only at separate points. Therefore, in general, the unwinding of a cocoon is a process of successive separation of the cocoon thread from the shell by small sections of the force necessary to overcome the adhesion force of sericin in the shell or to glue the thread in the shell. In practice, swelling and softening of sericin is achieved by treating the cocoon with steam and water at a high temperature.

MATERIAL AND METHODS.

Swelling and dissolution of cocoon sericin are due to the presence of hydrophilic amino acids in the protein, which create favorable conditions for the penetration of water into the interfibrillar space. The good swelling of sericin in the process of steaming and unwinding is also explained by the fact that the large size of the protein macromolecule leads to their not very dense packing, due to which the intermolecular interaction manifests itself relatively weakly in the layers of sericin. The specificity of the structure of the sericin molecule facilitates the penetration of the solvent into the interior of the shell. Water, penetrating inside sericin, causes its swelling, separation and dissolution of particles [1-3]. In this regard, the swelling and dissolution of the shell of the cocoons of the Navruz-2, Navruz-3 and Chinese hybrids were studied depending on the temperature and duration of the lock in water (Table 1).

RESULTS.

The swelling and dissolution of the substances contained in the cocoon shell begin at lower temperatures. In all hybrids, up to a temperature of 90°C, with an increase in the duration of the lock, swelling and dissolution shells increase.

Table 1.

Swelling and dissolution of cocoon shell sericin depending on temperature and duration of soaking in water

Cocoon hybrids	Duration of shell locking in water, min.	Water temperature, ^{0}C							
		45		65		90		When boiling	
		swelling	dissolution	swelling	dissolution	swelling	dissolution	swelling	dissolution
Navruz-2	1 3 5 10	- 40,1 42,4 46,7	- 0,59 0,73 1,20	- 46,4 49,6 58,4	- 2,06 2,55 2,12	86,7 86,9 96,6 107,2 96,6	2,29 3,15 4,23 4,20 3,15	123,9 107,2 102,9 105,9 95,5	4,77 5,97 5,35 7,78 8,95

Navruz-3	1 3 5 10	- 41,1 43,9 48,9	- 0,69 0,93 1,30	- 47,4 49,7 59,8	- 2,16 2,65 2,18	87,1 87,6 96,6 106,2 95,8	2,24 3,05 4,23 4,12 3,09	123,9 107,9 102,9 105,9 95,5	4,77 5,97 5,35 7,78 8,95
Chinese	1 3 5 10	- 43,1 45,4 48,7	- 0,72 0,83 1,19	- 46,4 49,6 58,4	- 2,06 2,55 2,12	86,7 86,9 96,6 107,2 96,6	2,29 3,15 4,23 4,20 3,15	123,9 107,2 102,9 105,9 95,5	4,77 5,97 5,35 7,78 8,95

In boiling water, the highest swelling of the shell is noticed in the first minute, in the Chinese hybrid 119.3-114%, and then it remains almost at the same level, and the dissolution increases from 4.83 to 8.02%.

The degree of solubility of the layers of the cocoon shell varies at a certain temperature, time and amount of water used. The dependence of cocoon shell sericin solubility on cocoon treatment temperature before and after steaming was studied. Before steaming, the cocoons were placed in hot water for a short time, then they were taken out, left in the air, and then subjected to steaming for a certain time (Table 2).

Table 2.

The degree of solubility of the shell of cocoons on the dependence of temperature before and after processing

Cocoon hybrids	Temperature before processing, ^{0}C	Processing temperature, ^{0}C	The degree of solubility of the cocoon shell,%
Navruz-2	100 96 100 97 93 89	100 100 97 97 97 97	6,09 4,25 4,15 2,95 2,03 1,87
Navruz-3	100 96 100 97 93 89	100 100 97 97 97 97	6,72 5,45 5,14 3,55 2,07 1,97
Chinese	100 96 100 97 93 89	100 100 97 97 97 97	6,80 5,54 5,20 3,65 2,27 1,99

The cocoon solubility is influenced to a certain extent by the cocoon processing temperature prior to their steaming. Pretreatment at different temperatures was carried out for 25 seconds, the time spent in air was 12 seconds, the duration of treatment was 25 minutes. From Table 2, it was determined that at a high treatment temperature, the degree of solubility increases, and lowering the temperature before treatment and increasing it during treatment reduces the solubility of cocoon shell sericin.

The effect of sericin concentration on the solubility of the shell was studied. The cocoon shell was boiled for 10 min in 200 ml of water. For all hybrids that were tested, the dependence of the degree of solution is almost the same.

Table 3 shows the obtained average values of the relationship between the concentration of sericin and the degree of solubility of the cocoon shell

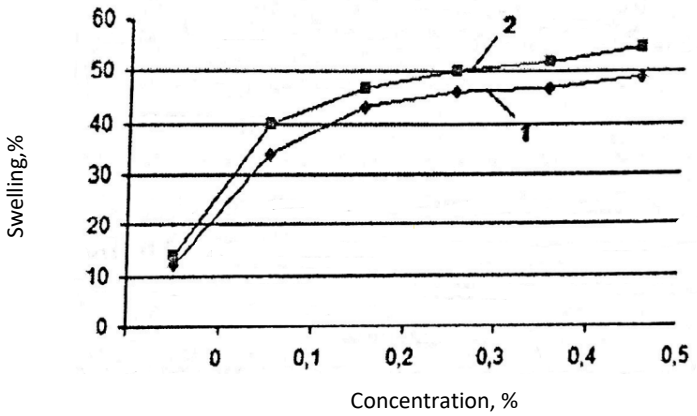
Table 3

Dependences between the concentration of sericin and the degree of solubility of the cocoon shell

Sericin concentration,%	Solubility of the cocoon shell,%
0,138	0,55
0,077	3,56
0,037	6,03

As can be seen from Table 3, with an increase in the concentration of sericin, the solubility of sericin decreases, i.e. the concentration of sericin and the degree of solubility of the cocoon shell are mutually opposite. This significantly affects the park and unwinding of cocoons. In all technological processes associated with the processing of cocoons, the structure of sericin undergoes various changes, and the task is to find the optimal conditions that provide a fairly rapid and uniform swelling of sericin. Without significant changes in the ordering structure of the remaining part of the silk thread protein, the high quality of raw silk can only be ensured if the native properties of sericin are preserved in the processes of processing and preparation for unwinding.

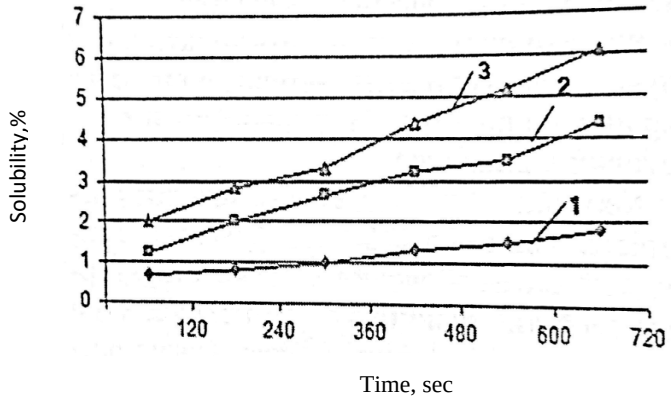
Good unwinding of cocoons is achieved with uniform swelling of sericin over the layers of the shell. However, the structural properties of sericin and its amount in the outer and deep layers may differ in connection with which the extraction rate from different layers may be different. The solubility of sericin decreases with the depth of the shell. In order to improve the swelling of the cocoon shell in all zones, various SAS were used in experimental studies (A-SAS anionic surface-active substance, N-SAS nonionic surface-active substance) (Fig. 1), as can be seen, with increasing concentration of the drug, the swelling of the cocoon shell also increases



1-A-SAS; 2- N-SAS

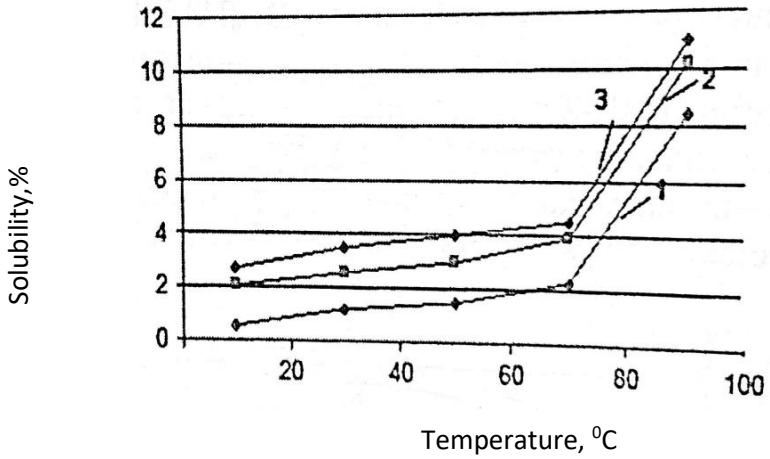
Rice. Fig. 2. Dependence of sericin solubility on time at drug concentrations of 0.1% and a temperature of 25^{0}C. temperature at a drug concentration of 0.1%.

There was also a study of the dependence of the solubility of sericin on time and on the charge of surfactants. With the addition of A-SAS, N-SAS (Fig. 2.3), the solubility of sericin improves. An increase in the solubility of sericin in the surfactant approximation can be explained by the interaction of charged groups in sericin molecules with suitable surfactant ions, leading to a general decrease in the activity of sericin and facilitating its solubility.



1- water; 2-A-SAS;3-N-SAS

Fig. 2. Dependence of sericin solubility on time at drug concentrations of 0.1% and a temperature of 25^{0}C. temperature at a drug concentration of 0.1%.



1-Water; 2-A-SAS; 3- N-SAS

Fig. 3. Dependence of sericin solubility on temperature at a drug concentration of 0.1%.

Experimental data show that by changing the composition of the concentration and type of SAS, temperature and duration of the process, it is possible to regulate to some extent the processes of softening and extraction of sericin from the shells cocoons. The ultimate goal is to limit the degree of dissolution of sericin for thinner areas, and create favorable conditions for a more uniform swelling of the shells in all areas. When choosing such conditions, it is necessary to proceed from data on the effect of various SAS on the swelling of all sections of the cocoon shell and the solubility of sericin.

The given data on the solubility and swelling of cocoon shell sericin for 3-5 minutes at a temperature of 50°C and a concentration of 0.4-0.5% show that this mode corresponds to the lowest sericin solubility and better swelling.

On this basis, it can be assumed that the presence of certain amounts of surfactants contributes to the minimum dissolution of sericin and its uniform swelling, which will be favorable for the process of unwinding cocoons.

CONCLUSION.

When studying the swelling and solubility of the sericin of the cocoon shell, it was determined that in boiling water the largest swelling of the shell is noticed in the first minute, and then it remains almost at the same level, and the dissolution of sericin in layers increases. It was found that at a high processing temperature, the degree of solubility increases, and a lower temperature before processing and an increased temperature during processing decreases the solubility of the cocoon shell. It has been established that the presence of certain amounts of SAS contributes to the minimum dissolution of sericin and its uniform swelling.

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