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Influence of Silk Gland Activity on the Quality and Technological Performance of Cocoons

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Abstract: It is known that abnormal changes in the environment during the life of any living organism lead to certain changes in the physiological, biochemical and other processes that take place in the body. This law is more relevant and important to the biology of the silkworm, as it is a monophagous insect and a cold-blooded organism; so many processes in the body are inextricably linked to the amount of nutrients given and the temperature in the silkworm. Examples include the prolongation of the worm cycle, cocoon wrapping technology, biological characteristics of cocoons, cocoon yield and variety, and changes in technological properties.

Keywords: mulberry silkworm, cocoon, mulberry leaf, silk cloth, fibroin, sericin, amino acid, silk fiber, natural silk products.

Introduction: Given the urgency of the problem, we focused on the next direction of our research to determine how the biological parameters, yield and variety and technological properties of cocoons change under the influence of nutrient content, variety and temperature on the activity of the silkworm.

To do this, after the cocoons of all variants were wrapped in cocoons, the cocoons were collected separately for each variant, sorted according to the requirements of existing state standards and the number of varietal, varietal, deaf and black cocoons, biological characteristics, yield and variety and technological characteristics of varietal cocoons were determined. .

Main part: To determine the weight of the live cocoons and the weight of the silkworm cocoon, 15 female and 15 male cocoon samples were taken and weighed on each repetition. The most important economic characteristics of silkworms are the spinning of cocoons, the yield of raw silk, the continuous spinning length of the cocoon fiber and the metric number of the cocoon fiber.

In this regard, in order to determine the extent to which mulberry silkworms affect the activity of the silk gland on the basis of feeding and temperature, the cocoon samples were sampled and the most important indicators were calculated. Cocoon samples were taken from each variant, coiled in the laboratory of primary processing of cocoons of the Uzbek Silk Research Institute on the machine KMS-10 and technological features were identified. The arithmetic means of the sign and the property (□x) and its error (Sx); the coefficient of variability (CV), the degree of reliability of the difference between the experimental and comparative variant indicators was calculated according to [(Rd) P. F. Rokitsky (1964)]. The silk separating gland is the second pair of salivary glands to change shape in terms of origin. It is a pair of tubular organs, almost clear, swollen, very light amber (pale yellow), sometimes

greener. This gland is located on either side of the body cavity of the worm and slightly below the midline of the intestine. Each side of the gland begins with a silk-separating section, followed by a fluid bladder where fluid flows from the fluid bladder, and these pathways join to the silk-separating tube located in the lower lip of the oral apparatus.

Results and Discussions: Silkworm worms begin to function from the time they hatch, and as the larva's body grows, it also develops and increases in weight and size from age to age. These parameters of the silk gland are mainly due to the sharp enlargement and activation at the age of five, which synthesizes the main amount of silk fluid (Table 1).

Table 1. Increased silkworm performance over the age of 5 years of the worm

The days of the worm's fifth age	Silk cloth			
	Weight, mg		Size sm^3	
	Ipakchi-1 breed	Ipakchi-2 breed	Ipakchi-1 breed	Ipakchi-2 breed
the first day	100	102	0,102	0,104
second day	220	230	0,200	0,210
third day	430	452	0,360	0,400
fourth day	500	550	0,630	0,670
fifth day	730	735	0,970	1,010
sixth day	810	845	1,135	1,180
seventh day	1040	1080	1,220	1,260
Before wrapping the cocoon	1450	1500	1,470	1,520

In these experiments, the worms were fed under the same conditions, i. e. , factors such as air temperature, humidity, nutrition, and light were normal. After the worms reached the age of five, 10 worms were taken from each breed, and a silk cloth was removed from its body to determine its weight and volume.

The data in Table 1 show that the silk gland weight and size of 5-year-old worms increase day by day. In particular, on the first day of 5 years the weight of the silk gland was 100-102 mg, the volume was 0. 102-0. 104 cm3, on the 3rd day it weighed 430-452 mg, the volume was 0. 360-0. 400 cm3, on the 5th day it weighed 730-765 mg. 0. 970-1. 010 cm3 and finally 1450-1500 mg weight before cocoon wrapping, volume 1,470-1,520 cm3, weight 1350-1400 mg compared to the first day, volume increased by 1,368-1,416 cm3. In other words, the silk gland has the highest pre-cocoon performance (full of silk liquid), ie its weight is 14. 5-14. 7 times larger than the first day of the fifth year, and its volume is 14. 4-14. 6 times larger.

As mentioned above, the silk gland grows and enlarges at the age of 5 with each leaf eaten. This is due to the fact that the worm's body grows larger day by day, and at the age of five, the worms are given fresh and nutritious leaves. The number of times the weight and volume of the silk cloth increased every day during the 5-year period compared to the first day is given in Table 2 below.

Table 2. Enlargement (many times) of silk gland indicators at 5 years of age compared to the first day

Indications for silk	Days of the fifth age						
	Second day	third day	fourth day	fifth day	sixth day	seventh day	Before wrapping the cocoon
Ipakchi-1 breed							

Weight	2,20	4,30	5,10	7,30	8,10	10,40	14,50
Size	1,96	3,53	6,18	9,51	11,13	11,96	14,41
Ipakchi-2 breed							
Weight	2,30	4,40	5,40	7,50	8,20	10,60	14,70
Size	2,02	3,85	6,44	9,71	11,35	12,12	14,62

In fact, silkworm worms have been found to develop extremely rapidly during the fifth age. Compared to the first day of the fifth age, the second day compared to the day of the silkworm, the weight of the silk cloth on the second day is 2. 20-2. 30 times, the volume is 1. 96-2. 02 times, the third day is 4. 30-4. 40 times the volume, the volume is 3. 53 -4. 40 times, weight on the fourth day 5. 10-5. 40, volume 6. 18-6. 44 times, weight on the fifth day 7. 30-7. 50, volume 9. 51-9. 71 times, sixth day weight 8,10-8,20, size 11,13-11,35 times Seventh day weight 10,40-10,60 times, size 11,96-12,12 times and weight before lifting the pole 14,50-14, 70, and the volume increased by 14. 41-14. 62 times

To study the dynamics of silkworm size during the fifth age, which days of worm growth and development is to detect changes in this important organ and to take into account the feeding area of the worms as well as the feeding area.

From Table 2, it was found that the maximum enlargement (one-day growth) of the silk gland occurs in the middle of the worm's fifth age, i. e. , days 4 and 5. This biological feature is due to the fact that the worms enter the "Daha" or eat the most leaves. Therefore, we believe that it is advisable to feed the worms with more quality and nutritious leaves by the middle of the fifth year to ensure the rapid growth of the silk glands and the production of more silk in it.

The study of the ratio of silkworm size to worm size is important for silkworm physiology. Therefore, in different breeds, systems and breeding families, it is important to conduct a selection process on the percentage of silkworm volume in the body of the worm, or to create certain environmental conditions to change this ratio in favor of silkworms.

The body size of the silkworms Ipakchi-1 and Ipakchi-2 and the size of the silk gland in them were determined on the first day of the fifth year and before cocoon wrapping. The data obtained are used to compile Table 3.

Table 3. The proportion of silkworms in the body volume of worms changes at the beginning of the fifth year and before cocoon wrapping

Time to measure worm body and silk gland size	Worm body size, sm^3		Silk cloth size, sm^3		The share of silkworms in the volume of worms,%	
	Ipakchi-1 breed	Ipakchi-2 breed	Ipakchi-1 breed	Ipakchi-2 breed	Ipakchi-1 breed	Ipakchi-2 breed
At the beginning of the 5th year	0,945	0,950	0,102	0,104	10,8	11,0
Before wrapping the cocoon	4,250	4,260	1,470	1,520	34,6	35,7

The figures in this table show that on the first day of the fifth year, the most productive breeds of silkworms, Ipakchi-1, accounted for 10. 8% of the silkworm body, and 34. 6% before cocooning, respectively. 11. 0% and 35. 7%, respectively. This means that in both species, the growth and development of the silk gland takes place in rapid images.

The length of the silk-separating gland grows very rapidly at the age of five. Especially in fertile breeds, the length of this gland was observed to be almost five times longer than that of the silkworm. The length of each section of the silk separating gland (silk separator, fluid bladder and double and single excretory ducts) is on average 6: 2, 5: 1.

As the worms grow, the silk-secreting gland also enlarges, but in the first four years the growth rate is normal, and by the fifth year there is a sudden change in the development of the glandular sections, as can be seen from Table 4 below.

Table 4. Growth of silkworm glands by age (in mm)

Silk separating cloth pieces	The age of the worm					
	first	second	third	fourth	Fifth	
					at the beginning	at the end
Single and double silk paths	1,92	3,75	5,80	20,10	29,20	31,40
Fluid bladder (reservoir)	1,55	2,40	4,10	10,30	22,80	70,50
Silk separating section	2,15	3,80	9,15	20,40	66,50	180,10
Total = 282. 0 mm.						

As can be seen from Table 4, the size of the silk separating section is greatly enlarged. The silk separating section is 2. 15 mm at the first age, reaching 180. 10 mm by the end of the fifth age and growing to almost 178 mm. In other words, the length of the silk-separating section increased 1. 8 times in the second year compared to the first year, 4. 3 times in the third year, 9. 5 times in the fourth year, 30. 9 times at the beginning of the fifth year and 83. 8 times at the end of the fifth year. All this indicates that at the end of the silkworm's life, the body's activity is focused on accumulating the large amount of silk needed for cocoon wrapping, and the enlargement of the silk separating section allows the silkworm's body to produce abundant silk due to protein compounds. This feature is also the information needed to predict the performance of newly created breeds and hybrids.

The formation of silk and its separation is a very large part of the process of protein metabolism in mulberry silkworms. In order for silk to form, silkworms need to expend a lot of protein and a lot of energy in their bodies. Silk production is a special separation activity that occurs during the development of the silkworm and creates favorable conditions for the unprotected mushroom stage. This activity consists in the extreme adaptation of the organism to the external environment, as a result of which the metabolism intended for this pre-stage takes place at this stage.

Silk is a thick, elongated fluid that is secreted by a special gland. This fluid solidifies as the worm exits the body and takes the form of a fiber. The silk glands that make up this fluid are a pair in the body of the worm, and the silk of the cocoon, which is formed from the fluid extracted from them, consists of two fibers, which are evenly and very tightly connected to each other. Each silk fiber is made of pure silk fibroin and a series of adhesive (adhesive) substance that surrounds it with a thin film on the outside. 70-80% of this fluid in the silk gland is fibroin and 20-30% is sericin. So far, there is almost no data on how much of the silk liquid is made up of febroin and sericin by worm breeds or hybrids.

In this regard, the literature only mentions which elements contain more fibroin and sericin. With this in mind, we planned to conduct research in silkworm biology to collect new data on silkworm fluid and its composition, and in the first year we obtained some data. The

following are the results of research on the composition of silk fluid.

Fibroin is a natural high-molecular-weight protein compound that mainly contains the following chemical elements (in the example of the new Ipakchi-1 breed):

Carbon-49-50%;

Oxygen-27-29%;

Nitrogen-18-19%;

Hydrogen-7-8%;

Fibroin is one of the non-sulfur-containing (not uncommon) protein bodies. Its molecular structure is very complex and consists of amino acid residues. The content of fibroin, sericin and other substances in Ipakchi-1 and Ipakchi-2 breeds is as follows:

Ipakchi-1

Fibroin-73-74%

Seritsin-22-23%

Waxy poison

substances-2. 4-2. 5%

Minerals-1. 2-1. 3%

Pigment and other substances-0. 2-0. 4% Silk-2

Fibroin-74-75%

Seritsin-21-22%

Waxy poison

substances-2. 5-2. 6%

Minerals -1. 1-1. 2%

Pigments and other substances - 0. 2-0. 4%

The most important amino acids in the structure of the fibroin molecule are natural proteins:

1. Glycol, 2. Alanine, 3. Tyrosine, 4. Leucine, 5. Serine, 6. Proline.

Fibroin is not broken, tough and elastic, insoluble in alcohol, ether and other solvents, resistant to alkalis and acids, as well as indestructible. It is insoluble in water, but bends without changing its structure. The physical and chemical properties of fibroin make textiles made of silk, as well as technical products extremely durable, elastic, hydroscopic, durable, shiny, beautiful, and many other useful qualities.

Although sericin is also a protein composed of amino acids, its composition is very different from that of fibroin. It is mainly composed of: 1-Sericin, 2-Aspiragin, 3-Glutamine, 4-Glycine, 5-Alanin, 6-Leucine.

Sericin is an unstable compound that changes its physical and chemical properties, especially as a result of evaporation and drying of cocoons and evaporation of cocoons before spinning. Sericin is a colorless, odorless, tasteless substance and is insoluble in alcohol, ether, acetone and other similar solutions. Water is the only neutral solvent for sericin. The melting point of sericin (in warm water) is 70-800.

Sericin mulberry plays a very important role in the biology of silkworms, both in the

technological processes of obtaining raw silk fiber, and in the manufacture of textiles and technical products. Due to the presence of sericin, the cocoon shell not only mechanically protects the silkworm, but also regulates the conditions and humidity inside the cocoon. The state of sericin is also important for subsequent processes in the production of silk products from cocoons: including the tight wrapping of silk yarns, the process of weaving fabrics, the tendency to flower, etc. , all depend on the state of sericin.

Conclusion: Given the importance of the above processes, we determined the main amino acid types in silkworms and their quantitative parameters before the 5th, third, fifth days of silkworm larvae and before cocoon wrapping (day 8). The determination of the composition of the silk liquid was performed at the Scientific Research Institute of Plant Chemistry. For this purpose, on days 3,5,8 of the 5th year, the silkworms were taken to the institute's laboratory, where the silk glands were surgically removed and examined.

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