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EFFECT OF MOISTURE IN DETERMINING THE SILKNESS OF SILKWORM COCOONS

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ANNOTATION: *This article is devoted to improving the process of receiving cocoon products based on quality indicators, which is an important part of the silkworm breeding industry (Bombyx mori). The main goal is to control the quality of products by increasing the standards used in the acceptance of grown cocoons, including the development and improvement of methods for determining the mass and silk content of the cocoon shell. The article examines in detail the quality indicators of the received batches of cocoons, in particular, the mass of the cocoon, the thickness of the shell, the quality of the silk, and other parameters. In addition, the issue of determining the influence of cocoon moisture (W) on silk content is being studied in depth, since the level of moisture is an important factor in the silk support process, and an incorrect assessment can lead to low-quality products. The results of the experiments conducted in the study were analyzed using methods of mathematical statistics (including correlation calculations). The values of corrections based on moisture content when determining silk content in samples taken from batches of silkworm cocoons are given:*

KEY WORDS: *Cocoon, silk content, cocoon moisture content, cocoon mass, cocoon shell mass, cocoon quality indicators.*

INTRODUCTION

Currently, special attention is paid to the accelerated development of the silk industry in the Republic of Uzbekistan, as well as the production of raw silk and silk products with high quality indicators and competitive on the world market. In this regard, research has been conducted for several years to determine cocoon quality indicators, including silk content, using accurate and rapid methods, and to improve its quality [1,2]. The silk content of cocoons depends on several external factors, one of which is moisture. Humidity affects the geometric dimensions of the live cocoon and, most

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www.lajoe.org

importantly, leads to a change in the volume of the cocoon. The cocoon shell and pupa differ significantly in origin and physical properties. According to the results of the conducted research, the quality indicators of cocoons depend on environmental humidity. Changes in ambient humidity lead to changes in the quality indicators of cocoons [3,4].

Methods

This study is aimed at assessing the quality indicators of silkworm cocoons, in particular, the degree of silk content, and was conducted under laboratory conditions of the Scientific Research Institute of Sericulture of the Republic of Uzbekistan. The main goal of the research is to determine the influence of cocoon moisture (W) on silk content (Sh) using mathematical statistical methods and to develop practical recommendations. As a sample, 5 batches (1000 cocoons in each) were selected, which were sorted according to the following criteria: cocoon mass in the range of 0.8-1.2 g, humidity up to 10-20%, growing conditions (temperature 25-28°C, humidity 70-80%) were standardized. The batches were taken from different regions (Fergana, Andijan and Tashkent regions), which was done to ensure geographical diversity.

Method for determining moisture content:

Cocoon moisture was measured by the gravimetric method, which complies with international standards (ISO 7211-2:1984) and the State Standard of the Republic of Uzbekistan (O'zDSt 2.3.1.06:2014). 50 cocoons were selected from each batch, and their total mass (m_1) was measured on analytical scales (0.001 g, Mettler Toledo model). Then the cocoons were dried at a temperature of 105°C for 2 hours (in a laboratory oven, with a thermostat), and the dried mass (m_2) was measured again. The formula for humidity is:

$$W = \frac{m_1 - m_2}{m_2} \cdot 100\% \quad (1)$$

The accuracy of this method is higher than 0.5%, and the reproducibility is 95%.

Method for determining silk content:

At the time of delivery of grown cocoons to receiving points, under natural conditions or subjective factors, the cocoons may have different moisture content. Therefore, determining the quality parameters of cocoons is one of the important tasks, since the silk content, determined by cutting cocoons with different moisture content in one batch, can change significantly. Due to the high moisture content of the delivered cocoons, this can lead to excessive savings for cocoon producers at receiving points [5-8].

Therefore, when determining the actual silk content in live cocoons, it is necessary to consider the influence of moisture. The dependence of silk content on the moisture content of cocoons is determined by the following expressions:

$$M_{qob.} = a \cdot W + b \quad (2)$$

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$$M_{pil.} = a \cdot W + b \quad (3)$$

$$Sh = \frac{M_{qob.}}{M_{pil}} \cdot 100\% + b \quad (4)$$

where M_{shell}- mass of cocoon shell [g]; M_{pil} - cocoon mass [g]; Sh - silk content of cocoons [%]; W - moisture content of cocoons [%]; a - correction coefficient, which depends on the size of the cocoon, the mass of the shell, the geometric dimensions of the measuring container, and is determined experimentally in each cocoon season; b - free term.

To determine the dependence of silk content of live cocoons, cocoon mass, and cocoon shell mass on moisture, 250 g cocoon samples from the submitted batch are selected [9-11] and experiments are conducted until the cocoon moisture reaches conditional moisture, i.e., 11% [12].

Cocoon moisture content is determined by the following expression:

$$W = \frac{m_1 - m_2}{m_2} \cdot 100\% \quad (5)$$

where: m_1 - mass of cocoon samples, g; m_2 - mass of cocoon samples after drying, g.

Results

The research results confirmed the inverse dependence of cocoon moisture on the original silk content: with an increase in moisture content, silk content decreased, and the shell mass decreased by 10-20%. In addition, the combined influence of temperature and humidity is also significant, and at a temperature of 28°C, when humidity reached 11%, silk content decreased from 25% to 22%. Based on the conducted experiments, the results of determining the mass of cocoon samples, the mass of the cocoon shell, and the dependence of silk content on moisture are presented in Table 1.

Table 1. Relationship between humidity and silk content (average values, n=1000)

W, %	11	20	30	40	60	80	100
M_{cocoon}, g	26.67	44.44	66.67	88.89	133.33	200.00	250.00
ΔM_{cocoon}, g	0	17.77	40.00	62.22	106.66	173.33	223.33
$M_{pack.}$, g	5.87	9.86	14.97	20.43	31.59	49.01	62.50
$\Delta M_{cap.}$, g	0	3.99	9.1	14.56	25.72	43.14	56.63
Sh, %	22.00	22.18	22.45	22.98	23.69	24.50	25.00
ΔSh,%	0	0.18	0.45	0.98	1.69	2.50	3.00

W - moisture content of cocoon samples, [%];

M_{cocoon} - mass of cocoon samples, [g];

ΔM_{cocoon} -difference in the mass of cocoons by the percentage of moisture content of the cocoon samples, [g];

$M_{shell.}$- mass of the shell of the cocoon samples, [g];

Latin American Journal of Education
www.lajoe.org

$\Delta M_{shell.}$-difference in the mass of the shell of cocoons by the percentage of shell moisture content of the cocoon samples, [g].

y=ax+b We determine the coefficients "a<7" and "b<9" in the expression by the least squares method using the following expressions [5-7]:

$$a = \frac{n \cdot \sum W \cdot M_{qob.} - \sum W \cdot \sum M_{qob.}}{n \cdot \sum W^2 - (\sum W)^2} \quad (6)$$

$$b = \frac{\sum W^2 \cdot \sum M_{qob.} - \sum W \cdot M_{qob.} \cdot \sum W}{n \cdot \sum W^2 - \sum W \cdot \sum W} \quad (7)$$

here, n - number of measurements (n=7), x=W - moisture content in cocoons (%), y=Sh - value of silk content of cocoon samples (%), $y=M_{cocoon}$ - value of mass of cocoon samples (g), $y=M_{pack.}$ - value of the shell mass of the cocoon samples (g).

Based on the results presented in Table 1, the expressions for the dependence of the mass of cocoon samples, the mass of the cocoon shell of the cocoon samples, and the silk content of the cocoon samples on moisture, determined by the least squares method, are as follows:

$$M_{pil} = 2.401 \cdot W + 3.516 \quad (8)$$

$$M_{qob} = 0.610 \cdot W - 0.754 \quad (9)$$

$$Sh = 0.034 \cdot W + 21.66 \quad (10)$$

Based on the results presented in Table 1, the graphs of the dependence of the mass of the cocoon samples, the mass of the cocoon shell of the cocoon samples, and the silk content of the cocoon samples on moisture content are presented in Figure 1.

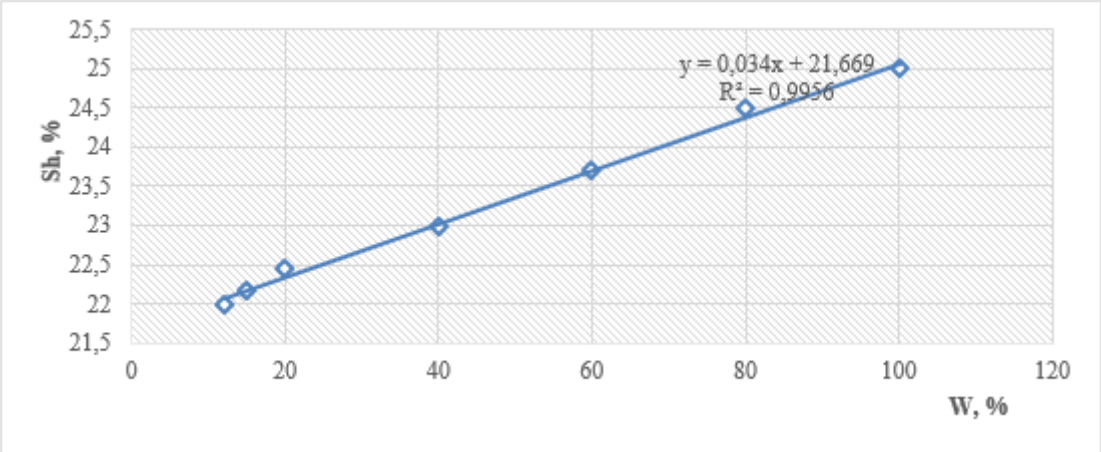

Figure 1. Dependence of cocoon silk content on moisture content.

As expected, the mass of the cocoon samples, the mass of the shell of the cocoon samples, and the silk content of the live cocoon samples are directly proportional to the amount of moisture in it.

DISCUSSION

According to the results of the conducted research, with a change in the moisture content of the delivered cocoons from 11% to 100%, the mass of the cocoons changed from 26.67 g to 250 g, the mass of the cocoon shell from 5.87 g

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to 62.5 g, and the silk content of the cocoons from 22% to 25%. From this it can be seen that at 100% moisture content, the silk content was 25%, and at 11% moisture content, the silk content was 22%.

For the delivered batches of cocoons, the calculated values of the corrections for determining the mass of cocoons, the mass of the cocoon shell, and the silk content of cocoons based on the cocoon moisture content (W) are entered into the computer and determined by adjusting the actual values of the mass of cocoons, the mass of the cocoon shell, and the silk content of cocoons.

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