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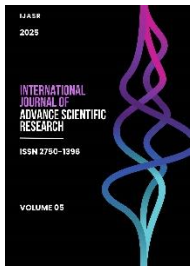

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Research Article

Study of Factors Affecting the Technological and Physicochemical Properties of Cocoons

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Abstract

In this article, local varieties of cocoons are studied for factors affecting physicochemical properties. The results of the research work on the topic are presented. Within the framework of the research, the linear density of cocoon threads and the live and dry technological indicators of cocoons were studied by single unwinding of cocoon threads on the laboratory single-opening machine of Ozttiti. According to the results of the cocoon study, the number of cocoons was determined, silkworm breeds and hybrids with large cocoon sizes and high silk yield were selected, and specific recommendations were developed for the multiplication of industrial seeds and specialization in cocoon cultivation in the regions of silkworm production and sericulture clusters, as well as the introduction of its technology.

Keywords

Breed, hybrid, mulberry silkworm, cocoon, raw silk, linear density, large calibre, production.

Introduction

" Cocoons grown in cocoon-washing plants are processed throughout the year. The moisture content of live cocoons brought to PDI bases is up to 212-233%. The main moisture content is 270-300% in the cocoon shell. The shells of such cocoons with high moisture content must first be inactivated and then dried in the same mode. As a result of the drying process of cocoons, the properties of the cocoon shell may

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deteriorate. This process mainly depends on sericin, and washing of cocoons depends on how much sericin softens and dissolves in hot water. To preserve the properties of sericin and fibroin in good condition, the technological processes of killing the cocoon shell and drying must be carried out under precise and complete control, which increases the absorbability of the cocoon shell and reduces the amount of waste. Several works have been carried out by our scientists on the cultivation and initial processing of cocoons. In these works, the methods of growing cocoons, their initial processing (killing, drying, and storage), as well as the factors affecting the technological and physicochemical properties of cocoons as a result of these processes, were analyzed.

The technological properties of cocoons grown in our republic and the properties of raw silk produced do not meet the requirements of world standards. This is due, firstly, to the technological indicators of cocoons obtained from domestically grown silkworm breeds and hybrids that lag behind those of breeds and hybrids created in foreign countries, and secondly, due to the lack of industrial cultivation of silkworms, their cultivation in buildings not intended for worm farming, and in various climatic conditions, 10-12% of the cultivated cocoons are unusable cocoons with large defects in the shell and unwashable [1].

Currently, cocoons of silkworm breeds and hybrids with high technological properties, which produce high-yielding white cocoons, are used as raw materials for cocooning enterprises. However, their hereditary productivity and technological properties are not fully manifested. There are various subjective and objective reasons for this, which are closely related to the microclimatic conditions created during the silkworm rearing process and the quality of the feed [36; 3839-b].

METHODS

Noting the sharply continental climatic conditions of our country, the territories of our republic can be conditionally divided into 2 regions. These are: the northern and southern regions. It is worth noting that the climatic conditions of the north and south differ sharply from each other. In the Surkhandarya region, the weather is sharply continental, with cold and rainy winters, scorching hot summers, and extremely low rainfall, mulberry silkworms are reared in the spring (April-May) and summer-autumn seasons (August-September). Therefore, when creating an effective technology for rearing silkworms, it is necessary to take into account the unfavourable natural and climatic conditions of the summer-autumn season and develop appropriate measures [2].

The authors state that during the storage of the cocoon, the conformational state of macromolecules on the cocoon surface deteriorates due to structural and molecular changes in protein systems under the influence of the external environment and oxygen in the air. Under production conditions, the wicking of such a cocoon shell deteriorates by 2-4%, and the quality and quantity of raw silk sharply decrease [3].

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Scientific research conducted by Professor L. Yunusov has proven that it is possible to prevent spoilage by adjusting the composition and parameters of the process water to prevent its deterioration during storage.

In Japan, silkworms of the first and second instars are kept in a centralised environment of 87%, with air temperatures of 26-28°C and humidity of 80-90%, and are fed 2-3 times a day.

According to the agrotechnology of the Uzbek Sericulture Research Institute, mulberry silkworms are reared repeatedly in the spring and autumn seasons in the cocoon farms of the republic, and satisfactory results are achieved. Based on many years of experience, up to 5 cocoons are grown annually, that is, silkworms are reared from foreign and local silkworm seeds in the spring, summer and autumn seasons. Mulberry silkworm rearing is carried out in multi-storey cocoons according to the agrotechnology developed in collaboration with the institute's specialists [5.].

The author Sh. Sulaymonov and others researched the dependence of parameters on the technological properties of cocoon varieties. In addition, experimental studies were conducted on the use and methods of application of various artificial bundles in silkworm winding. As a result, the effect of bundles on cocoon yield and their technological properties was determined by washing the grown cocoons on the KMS-10 machine. Methods for increasing cocoon yield and raw material quality are presented [6].

A comparative analysis of the cocoon productivity and main technological indicators of simple and complex hybrids created by scientists of the Sericulture Research Institute in 2018-2019, such as dry cocoon weight, raw silk yield from dry cocoons, silk product yield, cocoon worming percentage, total fibre length, continuous worming length of fibre, and metric number, was carried out. In conclusion, it was emphasized that, firstly, the correct selection of breeds in the selection process, and secondly, the environmental factors of those regions (air temperature, humidity, feed, etc.) play an important role in the manifestation of cocoon productivity and technological indicators of simple and complex hybrids of silkworms raised in different ecological regions.

The technological properties of the shell and the performance of the local Altyn Vady-2 hybrid cocoons of Chinese hybrids grown in local conditions were studied. Based on experimental studies and comparative analysis of the results of technological and quality indicators of cocoons of different breeds and their shells, it was determined that the “Altyn Vady-2” hybrids have a silk content of 10%, a thread length of 21.6%, a continuous length of 7%, and a fibre waste formation of 13.3% less than the “Chinese” hybrid cocoons grown in local conditions. It was noted that along with the cultivation of the “Altyn Vady-2” hybrid cocoons, it was possible to improve the technological performance of the local breed and hybrid cocoons, which allows the production of raw silk that meets the 2A grade requirements of the UzDSt 3313:2018 standard [7].

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A.N.Botirova noted in her work the leading technological indicators of the fibre of silkworm hybrid cocoons grown under the influence of anomalous hot temperatures and the superiority of the cocoon shell in terms of physical and mechanical properties. She noted that although a decrease in raw silk yield was observed from cocoons grown under anomalous hot conditions, it was possible to obtain high-quality silk raw materials in terms of silk fibre fineness. Agrotechnics have been developed to reduce the influence of environmental factors on the technological properties of domestic and foreign mulberry silkworm hybrids and improve the quality of raw silk.

Scientists in our country have developed a modern technology for raising silkworms under a film. According to the new technology, silkworm hybrids are raised in a microclimate created between the top and bottom of the cocoon with a polyethene film. When raising silkworms using this method, the number of feedings of young worms is sharply reduced, that is, instead of 10-12 times (with the usual method of raising), they are fed 2-3 times. As a result, feed and labour costs are reduced in cocoon production. Raising silkworms using this method allows for the productive use of the entire growing season of the mulberry tree. As a result, the technological and physicochemical properties of the cocoons change under the influence of different climatic conditions, which in turn affects the quality indicators of raw silk during production processes.

During the silkworm's cocooning period, the humidity in the cocoon house also affects the quality of the cocoon. A large amount of moisture evaporates from the leaves given to the worm at the age of 5. In addition, the silkworm produces watery faeces when it cleans its intestines before cocooning. The thickening of the cocoon also causes the humidity in the house to increase. Finally, the moisture released as a result of the drying of the cocoon shell and silk fibres also humidifies the air in the house. If the humidity of the house air increases during cocooning, the quality of the cocoons decreases, the number of inferior cocoons increases, and it is much more difficult to spin the silk from such cocoons. The relative humidity of the house air during the cocooning period should not exceed 65%. If the temperature and humidity of the house air increase, it is better to ventilate the house regularly.

If the air temperature in the silkworm house is 15 °C, the silkworm larval period will be 60 days, 37 days at 20 °C, 25 days at 25 °C, and 21 days at 30 °C. This is because when the air temperature is low, the silkworms slow down and consume fewer mulberry leaves, which in turn slows down the silkworm development process. However, these factors do not necessarily mean that silkworms should be fed at excessively hot and high temperatures. When the air temperature exceeds 28-30 °C, especially when the relative humidity is low, the metabolism of silkworms is disrupted, and the cocoon yield becomes small. When the temperature is high, the water in the silkworm body and mulberry leaf evaporates quickly. As a result, the silkworm body becomes dry and brittle, and the leaves wither and become dehydrated, and such leaves are not digested well in the silkworm's stomach.

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Air temperature also affects the weight, quality and productivity of the cocoon. This process is especially strongly affected by young silkworms. The optimal temperature for good growth and development of silkworms is 25-27 °C. When silkworms of the I-III age are fed at 26-27 °C, the quality of the cocoon is good. Exceeding the specified air temperature will lead to an increase in the number of silkworms that do not spin cocoons or spin cocoons on the cocoon.

In the cultivation of cocoons in new methods, it is very important to study the quality of cocoons. Because the higher the quality of the cocoon, the easier the technological processes for the preparation of high-quality silk products from it. One of the scientists of our country, Sh.M. Esanova, conducted research on improving the quality of live cocoons grown using biologically active substances (BFM). In industrial cocoons, the technological properties of the shell should be high. The effect of biologically active substances (BFM) on the above indicators was determined. It was found that with an increase in the amount of biologically active substances (BFM) in the feed, the cocoon thread becomes more brittle and breaks, increasing the number of cocoon threads [8].

The quality of the cocoon being grown depends on several factors, one of which is the cocoons used in the silkworm cocooning process.

The breed of the silkworm, the thread's breaking strength and elongation at break, linear density, diameter and length, which layer of the cocoon the thread is extracted from, and moisture are factors that affect the properties of the cocoon thread.

The technology of preparing cocoon raw materials - feeding silkworms depends on the following external factors: air temperature; humidity level; air exchange; quality of mulberry leaves; quantity of mulberry leaves; feeding area; and density of worms. These factors affect the processes of shortening the silkworm's larval period, shedding, transitioning from one age to another, and eating and digesting food.

The method of inactivating and drying the grown cocoons using sunlight is considered one of the earliest methods and was used by Chinese cocoons in ancient times.

We know that sunlight has a negative effect on the shells of cocoons. Inactivation in sunlight takes a long time, which leads to poor hatching of cocoons. Therefore, this method has been used in some cases. This method has been partially used in the southern regions of Uzbekistan.

To date, there are several methods for inactivating and drying cocoons: under the influence of sunlight; killing with steam and drying in the shade; using hot air; with toxic substances; by hermetic sealing; in a vacuum; with high-frequency current; using cold air for live cocoons; and methods for killing and drying cocoons using radioactive isotopes and X-rays.

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When steaming the cocoon, if the process is prolonged for too long, the sericin swells, partially dissolves, and begins to liquefy. During the drying process, the physicochemical properties of sericin change. During the steaming and washing of the cocoons, the solubility of sericin decreases sharply. This has a negative impact on the efficiency of washing and the output of raw materials.

A new generation of equipment for heat treatment of cocoons using saturated steam was developed in 1969-1991 - a laboratory-based device by A.S. Shamagdiev.

To compare different methods of drying cocoons and killing the cocoon, experiments were conducted with different chemicals. The killed cocoons were dried in shade dryers. To study the effect of the above killing method on the technological, physical-mechanical properties of the cocoon shell, as well as on the quantity and quality of the dried cocoons, they were tested in a test laboratory. It was proven that when killing cocoons with bromomethyl, the quality, quantitative characteristics and technological properties of the cocoons give better results than the currently used hot air killing method [9].

During the cocoon processing process in cocoon factories, a large amount of fibrous and non-woven waste is generated. Therefore, the main goal of the research is to synthesize a new surfactant (SFM) based on cocoon waste and develop a waste-free technology by saving raw materials. The effect of the substance obtained based on non-woven waste on the cocoon shell winding speed was studied, and the alternative winding speed of the treated cocoons was set at 149 m/min. The improvement in the shell winding speed led to a decrease in the defects of raw silk and an increase in its quality in terms of rewinding ability.

In our country, air temperature and relative humidity change frequently in spring and autumn. This sharp change in air temperature causes the air temperature and relative humidity in incubators and worm houses to exceed or decrease above the norm, which negatively affects the development of silkworm eggs and young and adult silkworms. The decrease in temperature causes the body of the worm to cool down, its movement decreases, it consumes fewer leaves, its development slows down, and it spins small and thin-shelled cocoons. The physiological process of the silkworm occurs best at a temperature of 2030 °C. When the air temperature in the cocoon house drops below 15 °C, the growth and development of silkworms slows down significantly, and when the temperature exceeds 30 0C, the physiological functions of the silkworm organism are disrupted. Environmental and metrological conditions during the feeding and cocooning processes of young and adult silkworms have a significant impact on the viability of the silkworm, its productivity, cocooning, the quality of the grown cocoons, and the technological properties of the cocoon shell.

According to the authors, when the temperature was 2021 °C and the relative humidity was 6580%, the number of silkworms that had spun cocoons was 8183%, when it was 2425 °C, it was 8990%, and when the temperature was 2829 °C, 8485% of silkworms had spun cocoons.

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According to the authors, as a result of long-term storage of the cocoon, it is also affected by various insects and rodents. The appearance of skinworms is due to the pollution of the environment of the enterprise. One of the cocoon pests that has appeared in the warehouses of the cocoon-making enterprise is the skinworm An Aremus Slavipes, which is oval in shape and has white, yellow, and black spots on its body. They pierce the cocoon, turn the cocoon into powder, and over time, repeatedly damage the cocoon shell. The authors modified the cocoon before the technological process of preliminary treatment with new surfactants (SFM) synthesized based on the waste of the Biochemical Plant - bardo residue fraction and such oil, which reduced the factors that cause defects during storage.

Sh.A. Sulaymonov synthesized surface-activating substances based on ethyl alcohol waste, residual fraction "Bardo" and "Sivush oil" and fibre-free waste from cocoon enterprises to improve the preservation and spinning properties of cocoons. The physicochemical properties of these substances were studied, a technological regime for processing cocoons was developed, and after processing with these substances, the yield of raw silk was increased by 3.13%, and the spinning properties by 7.48% [10].

Research has been conducted to develop various methods of pre-processing and preparing cocoons for spinning, but the theoretical and practical aspects of these methods for preparing cocoons grown in different climatic conditions for spinning have not been widely implemented in production. Therefore, the problem posed is one of the urgent tasks for the industry and requires the study of the chemical composition of cocoons and the technology of preparing them for spinning.

Conclusions

The ecology of the area where the cocoons are grown influences the technological and physicochemical properties of the cocoons. Our republic is one of the countries that produces and supplies textile products, namely cocoon cultivation, and competitive natural silk products, which are in great demand in the foreign market. Today, it has been determined that one of the important tasks of our country is to fully process and develop the finished product, using local raw materials efficiently.

Noting the sharply continental climatic conditions of our country, the territories of our republic can be conditionally divided into 2 regions. These are: the northern and southern regions. In the Surkhandarya region, which we selected for the study, the weather is sharply continental, with cold and rainy winters, scorching hot summers, and extremely low rainfall, mulberry silkworms are bred in the spring (April-May) and summer-autumn seasons (August-September). In the Republic of Karakalpakstan, the weather is changeable, with very cold winters, low rainfall, and lower temperatures in the summer months compared to other regions, mulberry silkworms are bred in the spring (May-June) and summer-autumn seasons (August-September). Therefore, when creating an effective technology for worm farming, it is necessary to

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take into account the unfavourable natural and climatic conditions of the summer-autumn season and develop appropriate measures. To obtain high-quality raw silk, in addition to the quality of the cocoons, the initial processing of the cocoons, preparation for washing, and washing processes also affect the quality of the cocoons.

REFERENCES

1. Ermatov Sh.Q. Surxondaryo iqlim sharoitida takroriy mavsumlarda yetishtirilgan pillalarning texnologik xususiyatlari tadqiqi Diss. phD. -Toshkent. TTESI. 2023. –B. 105
2. Islambekova N.M., Boboxonov F.O., Yunusov L.Yu. Quruq pillalardagi seritsin molekulasining holatini o‘zgarishiga ta’sir etuvchi omillarni o‘rganish. // J.To‘qimachilik Muammolari, 2004, № 1, 15-17 b.
3. Каримов Ш.И. Влияние поверхность активных вещество на смачиваемость и показатели размотки. // Ж.Проблемы текстиля, 2009, №3, с. 65-67.
4. Юнусов Л.Ю. и другие. Об исследовании теоретической основы старения коконов в процессе хранения. // Ж. Ипак, 1991, №3, с.18-19.
5. Samami R., Seidavi A., Eila N., Rubiu N.G., Cappai M.G. Production performance and economic traits of silkworms fed with mulberry tree leaves (Morus alba, var. Ichinose) significantly differ according to hybrid lines. Livestock Science. -2019. p.226. -P. 133-137.
6. Axunbabayev U.O., Zamonaviy pilla chuvish uskunalarida yuqori sifatli xom ipak olish texnologiyasini takomillashtirish mavzusidagi dissertatsiyasi avtoreferati. -2021 y. 19-20 b.
7. Сулаймонов Ш., Муминов У., Жамолдинов С. Изучение состояния использования ваты-сдира и пути повышения качества коконного сырья// Universum: Технические науки: электрон. научн. журн. -2019. -№ 7(64). -С. 124-129.
8. Batirova A.N. turli ekologik yil sharoitlarida parvarishlangan oddiy va murakkab duragaylarning pilla mahsuldorlik va texnologik ko‘rsatkichlari // To‘qimachilik muammolari. -Toshkent. -2019. -№2. -B. 66-70.
9. Турдиалиева М.М., Тургунбеков А.М. Исследование и анализ современного состояния коконопрядильных машин // Universum: технические науки: электрон. научн. журн. 2025. 2(131). URL: https://7universum.com/ru/tech/archive/item/19291 (дата обращения: 26.02.2025).
10. Ахунбабаев Улугбек Охунжонович, Тургунбеков Ахмадбек Махмудбек Ўғли, & Асроров Гапдирашид Газнаивич (2023). Элементы процесса кокономотания, влияющие на качественные характеристики шёлка-сырца. Universum: технические науки, (4-3 (109)), 65-67.