Effects of cocoon shell properties and breeding success on the quality of raw silk

Khalima Khabibullaevna Umurzakova
umurzaqova_h@mail.ru
Jakhongir Adkhamovich Akhmedov
Tashkent Institute of Textile and Light Industry
Ulugbek Yakhshilik-ugli Gulbaev
Jizzakh Polytechnic Institute

Abstract: This research examines how the physical and mechanical traits of cocoon shells influence the final quality of raw silk, with a focus on the role of selective breeding. A comparative study was conducted on two silkworm hybrids, "Xitoy" and "Ipakchi-1xIpakchi-2", alongside a control group. The evaluation centered on four key shell parameters: firmness, wall thickness, compactness, and pore structure. The outcomes indicate that properly bred cocoons are capable of delivering raw silk that reaches the 4A quality level. Such material is well-suited for demanding applications in the textile field, as well as in aerospace and healthcare industries.

Keywords: silkworm, raw silk, porosity, hybrid, silkworm, cocoon shell, technological indicators

The strength and hardness of silkworm cocoons tend to increase with a decrease in diameter, a decrease in sericin content, or an increase in the lamellar composition.

Our scientists have conducted several studies on the cultivation of natural raw silk, the technological indicators of cocoons, the production of high-quality raw silk, the improvement of the reeling process, and the state and prospects of reeling enterprises. In addition to being sorted at the enterprise, the cocoons brought for the study underwent re-sorting once more. Cocoons that underwent re-sorting were designated as the experimental variant, while cocoons obtained without sorting were designated as the control variant.

Quality indicators such as cocoon shell hardness, thickness, density, and porosity were determined using existing tools and equipment at the "Silk and Spinning Technology" department.

To determine the hardness of the cocoon shell, 300 g of samples were taken from the "Xitoy" and "Ipakchi-1xIpakchi-2" hybrid cocoons, and the experiment was conducted on a VK equipment. The research results showed that the cocoon shell hardness was higher in the experimental variant compared to the control (Table 1).

Table 1

Cocoon shell hardness

Silkworm hybrid	Deformation of the cocoon shell, mm	
	Experiment	Control
Xitoy	0,83±0,05	0,90±0,05
Ipakchi-1xIpakchi-2	0,84±0,05	0,92±0,05

The cocoon shell thickness was determined using the "Tolstomer" instrument. The thickness of the shell varies across different parts of the cocoon. To increase the cocoon shell thickness and ensure an even distribution of the shell thickness across the parts, the silkworm must wrap the cocoon horizontally during the cocoon winding period. The cocoon shell thickness was higher in the experimental variant compared to the control (Table 2). This reduces premature breakage during the cocoon unwinding process and allows for the production of high-quality raw silk. The results obtained for determining the cocoon shell thickness are presented in Table 2. The average cocoon shell thickness in the "China" hybrid was 0,87 mm, and in the "Ipakchi-1x Ipakchi-2" hybrid, it was 0,92 mm. The unevenness decreases by 5,5% in the "China" hybrid and by 11,5% in the "Ipakchi-1xIpakchi-2" hybrid compared to the control.

Table 2.

Analysis of cocoon shell thickness

Hybrids	Average cocoon shell thickness, mm		
	Average shell thickness, *mm*	Average quadratic deviation, *mm*	Quadratic unevenness, %
Xitoy Experiment	0,87±0,025	0,129	20,97
Control	0,78±0,025	0,131	23,52
Ipakchi-1xIpakchi-2 Experiment	0,92±0,020	0,081	21,24
Control	0,84±0,032	0,150	23,14

The capacity of the cocoon shell (*M*) is defined as the ratio of the cocoon shell mass ((m_q) to the surface area (*f*) and is calculated using the following formula:

$$M = \frac{m_к}{f} \quad (1)$$

The strength of the cocoon shell, as well as its thickness, varies in different parts of the cocoon: the largest value is in the shortened lumbar part of the cocoon, the smallest value is in the upper part of the main hemispheres, and the average values are in the lateral parts of the hemispheres. The cocoon thickness of the "Chinese" hybrid cocoons decreased by 9,33% compared to the control, while the "Chinese" silkworm hybrid cocoons decreased by 9,05%. The density of the cocoon shell is an indicator expressing the weight of the cocoon shell per specific volume, calculated using the following formula:

$$\delta = \frac{m_{\kappa}}{f\,t} \quad (2)$$

where, δ- is the shell density, mg/mm^3; f- is the disk area, mm^2; t- is the shell thickness, mm.

The research results were calculated using formula (2), and the indicators of cocoon shell density and density irregularities are presented in Table 3.

Table 3.

Unevenness of cocoon shell density

Silkworm hybrid	Average cocoon shell density, mg/mm^3		
	Average shell density, mg/mm^3	Average quadratic deviation, mg/mm^3	Quadratic unevenness, %
Xitoy Experiment	0,350±0,005	0,026	7,32
Control	0,375±0,007	0,041	10,96
Ipakchi-1xIpakchi-2 Experiment	0,305±0,004	0,023	7,55
Control	0,337±0,005	0,029	8,8

During the silkworm's cocoon winding process, the arrangement of rings and ring packets along the layers of the cocoon, as well as the adhesion of individual short-length cocoon threads, gives the cocoon a porous structure, which is calculated using the following formula:

$$П = \left(1 - \frac{M}{1{,}37 \cdot t}\right) \cdot 100 \quad (3)$$

where P- is the porosity, %, and 1,37- is the density of the silk, *mg/mm^3*.

The porosity of the "China" hybrid cocoon in the experimental variant varied within the range of 76,86-78,37% in the shell parts, while in the control variant, it was 77,08-78,91%. The porosity of the cocoons of the "Ipakchi-1x Ipakchi-2" hybrid increased by 2,82% compared to the control, and by 2,34% for the "China" hybrid.

The conducted research showed that the technological properties of the hybrid cocoons in the experimental variant are higher than in the control variant.

The cocoon shell strength of the "China" hybrid was 25% higher than the control, its thickness was 34%, and its porosity was 2,8% (abs), while in the "Ipakchi-1xIpakchi-2" hybrid, it was 7%, 18,5%, and 2,3% higher, respectively, and it was proven that the unevenness of the cocoon shell sections decreased according to these indicators.

From the results of the above research, it can be seen that raw silk of class 4A can be obtained from selected cocoons. Such raw silk is widely used not only for clothing, aviation, and special purposes, but also in the field of medicine.

References

1. Alimova K. et al. New assortiment of natural silk products //International Journal of Advanced Research in Science, Engineering and Technology. – 2019. – Т. 6. – №. 3. – С. 8568-71.

2. Alimova K. et al. The basis for sustainable development of the agro-Industrial cluster "silk" //AIP Conference Proceedings. – AIP Publishing LLC, 2024. – Т. 3045. – №. 1. – С. 040024.

3. Alimova K. et al. Implementation of primary processing technology for repeatedly grown cocoon //International Journal of Innovative Technology and Exploring Engineering. – 2020. – Т. 8. – №. 5. – С. 5118-22.

4. Kh A. et al. Bastamkulova Kh //D., Umurzakova Kh. Kh., Abdullaev OS Ustroystvo morki kukolki tutovogo shelkopryada/№ FAP. – 2019. – Т. 20190145. – №. 26.07.

5. Умурзакова Х. Х. и др. Определение закона движения центра-масс кокона и натяжения нити при переменной скорости мотовила //Проблемы текстиля. – 2018. – №. 3. – С. 91-98.

6. Исламбекова Н. М., Умурзакова Х. Х. Улучшение свойств и совершенствование размотки дефектных коконов //SCIENCE AND WORLD. – 2013. – С. 42.

7. Alimova K. et al. Method for using natural silk fibers for producing valuable grade paper //AIP Conference Proceedings. – AIP Publishing LLC, 2024. – Т. 2969. – №. 1. – С. 030022.

8. Kh U., Kh A., Holdarova S. The law of motion in determining the tension of the cocoon thread //International journal on orange technology. – 2022. – Т. 4. – №. 7. – С. 33-41.

9. Храмова Н. В. и др. Разработка тканеинженерной конструкции из шелковой отваренной марли и аллофибробластов для лечения поверхностных дефектов кожи //Гены и клетки. – 2022. – Т. 17. – №. 3. – С. 248-248.

10. Умурзакова Х. Х. Янги турдаги тиббиёт бинтлари учун хом ашё хусусиятларини тадқиқи //Ж. Илм-фан ва инновацион ривожланиш. – 2021. – Т. 6. – С. 69-78.

11. Kh U. K. Development of technology for the preparation of raw materials for medical silk gauze. Author. diss… doctoral philosophy (PhD) in tech //sciences. Tashkent. – 2020.

12. Islambekova N. M., Umurzakova X. X. Improving the properties and improving the unwinding of defective cocoons //SCENKE AND WORLD". Science and Peace is an international scientific journal.-Volgograd. – 2014. – Т. 10. – С. 42-44.

13. Алимова Х. А. и др. Структура и свойства некоторых видов шелкового волокна //Ж. Композиционные материалы. – 2013. – №. 2. – С. 4-7.

14. Алимова Х. А. и др. Технология производства поли компонентной пряжи //Илм-фан ва инновацион ривожланиш/Наука и инновационное развитие. – 2024. – Т. 7. – №. 2. – С. 83-90.

15. Умурзакова Х. Х. ТЕХНОЛОГИЯ ПОДГОТОВКИ СЫРЬЯ ДЛЯ ПОЛУЧЕНИЯ МЕДИЦИНСКИХ ИЗДЕЛИЙ ИЗ ШЕЛКА //Сборник научных трудов по итогам Международной научной конференции, посвященной 135-летию со дня рождения профессора ВЕ Зотикова. – 2022. – С. 96-99.

16. Umurzakova H. H. et al. BIRINCHI VA TO'RTINCHI MAVSUMDA YETISHTIRILGAN PILLALAR QOBIG 'INING XUSUSIYATLARI //Oriental renaissance: Innovative, educational, natural and social sciences. – 2021. – Т. 1. – №. 9. – С. 291-300.

17. Umurzakova X. X., Muratova Z. A. NOTO'QIMA MATERIAL TO'SHAMASINI SHAKLLANISHIDA TOLALARGA TA'SIR QILUVCHI OMILLARNI NAZARIY TAHLILI //Results of National Scientific Research. – 2025. – Т. 4. – №. 8. – С. 5-17.

18. Kh U. K. et al. TECHNOLOGY OF PRODUCTION OF WOOL-SILK YARN //AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN. – 2025. – Т. 3. – №. 6. – С. 306-312.

19. Umurzakova X. ВЫБОР СЫРЬЯ ДЛЯ ФАСОННЫХ НИТЕЙ ИЗ ХИМИЧЕСКИХ НИТЕЙ МЕТОДОМ ТЕРМИЧЕСКОЙ ОБРАБОТКИ //AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN. – 2025. – Т. 3. – №. 5.

20. Алимова Х. А. и др. ШЕРСТЯНОЕ ВОЛОКНО КАК СЫРЬЁ ДЛЯ СМЕШАННОЙ ПРЯЖИ //Илм-фан ва инновацион ривожланиш/Наука и инновационное развитие. – 2025. – Т. 8. – №. 4. – С. 103-113.

21. Алимова Х. А. и др. ПОЛИКОМПОНЕНТЛИ ЙИГИРИЛГАН ИПЛАР ИШЛАБ ЧИҚАРИШ ТЕХНОЛОГИЯСИ //ILM-FAN VA INNOVATSION RIVOJLANISH. – 2024. – Т. 7. – №. 2. – С. 83-90.

22. Khalima U. et al. XOM IPAKNI STANDART KALAVAGA O 'RASHDA QO 'LLANILADIGAN EMULSIYANI TAYYORLASH //SCIENCE AND INNOVATIVE DEVELOPMENT. – 2023. – Т. 6. – №. 5. – С. 83-91.

23. Alimova K. et al. TAKRORIY YETISHTIRILGAN PILLA IPLARINI TADQIQ QILISH //SCIENCE AND INNOVATIVE DEVELOPMENT. – 2023. – Т. 6. – №. 3. – С. 83-90.

24. Алимова Х. А. и др. ИЗМЕНЕНИЯ ДЛИНЫ ШЕЛКОВОЙ НИТИ В ЗАВИСИМОСТИ ОТ ПОВТОРНОЙ ВЫКОРМКИ //Results of National Scientific Research. – 2023. – С. 4.

25. Алимова Х. А. и др. Такрорий етиштирилган пилла ипларини тадқиқ қилиш //Илм-фан ва инновацион ривожланиш/Наука и инновационное развитие. – 2023. – Т. 6. – №. 3. – С. 83-90.

26. Khramova N. V. et al. Razrabotka tkaneinzhenernoy konstruktsii iz shelkovoy otvarennoy marli i allofibroblastov dlya lecheniya poverkhnostnykh defektov kozhi //Genes & Cells. – 2022. – Т. 17. – №. 3. – С. 248-248.

27. Alimova K. et al. The formation of defects during the reeling of raw silk //Journal of Physics: Conference Series. – IOP Publishing, 2021. – Т. 1889. – №. 4. – С. 042049.

28. Khabibullaev D. A. et al. Raw materials for production of polycomponent yarn with silky effect //Design Engineering. – 2021. – Т. 4. – С. 458-464.

29. Adkhamovich A. Z. et al. Ways and technologies for making natural silk //European science review. – 2016. – №. 9-10. – С. 179-181.

30. Islambekova N. M. et al. Investigation of unwinding speed based on the process of separating the thread from the surface of the cocoons //International journal of advanced research in science engineering and technology. – 2019. – Т. 6. – №. 5. – С. 9136-9141.

31. Tulanov S., Ahmedov J., Prozorova O. Causes and methods for determining the pilling ability of knitted fabrics depending on the fibrous composition //AIP Conference Proceedings. – AIP Publishing LLC, 2024. – Т. 2969. – №. 1. – С. 030023.

32. Ахмедов Ж. А., Бастамкулова Х. Д., Алимова Х. А. Технология подготовки сырья для производства нового ассортимента шелковых тканей //Естественные и технические науки: опыт, проблемы, перспективы. – 2016. – №. 2. – С. 50-53.

33. Akhmedov J. A. et al. Properties and development of a textile thread model //Composite Materials. – 2015. – Т. 4. – С. 96-99.

34. Kulmatovich E. S. et al. Exploration of the belly characteristics of living cocoons grown in repeated seasons //Annals of the Romanian Society for Cell Biology. – 2021. – Т. 25. – №. 1. – С. 4275-4282.

35. Чарышникова О. С. и др. Генетика, геномика ва биотехнологиянинг замонавий муаммолари //Республика илмий анжумани. – 2021. – Т. 18. – С. 189.

36. Akhmedov J. et al. Technology of Production of Cocoon Raw Materials and Study of Its Impact on Raw Silk Quality //International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET). – 2021. – Т. 10. – №. 12. – С. 15036-15041.

37. Nabidjanova N. N. Alimova Kh. A., Umurzakova Kh. Kh., Usmanova Sh. A., Akhmedov JA Dependence of the diameter of the thread on the parameters of the body structure andthe deformability of the knitwear //Proceedings of the II

International Conference on Advances in Materials, Systems and Technologies AIP Conf. Proc. 2467. – С. 060048-1.

38. Khabibullaev D. et al. Raw material composition and technology for producing polycomponent yarn //AIP Conference Proceedings. – AIP Publishing LLC, 2022. – Т. 2467. – №. 1. – С. 020066.

39. Nabidjanova N. N. et al. Dependence of the diameter of the thread on the parameters of the body structure and the deformability of the knitwear //AIP Conference Proceedings. – AIP Publishing LLC, 2022. – Т. 2467. – №. 1. – С. 060048.

40. Kh A. et al. New range of raw silk twisted threads //J. The American journal of engineering and technology (TAJET). AMERIKA. – 2020. – Т. 2. – №. 11. – С. 166-173.

41. Tulanov S. et al. Evaluation of insulation materials for winter clothing: A study on warmth retention properties //AIP Conference Proceedings. – AIP Publishing LLC, 2025. – Т. 3304. – №. 1. – С. 030003.

42. Umurzakova K. et al. Studying the properties of twisted threads for silk medical bandage //AIP Conference Proceedings. – AIP Publishing LLC, 2024. – Т. 3045. – №. 1. – С. 030023.

43. Anvarjonovich K. D. et al. Raw Materials for Production of Polycomponent Yarn with Silky Effect //Design Engineering. – 2021. – С. 458-464.

44. Ахмедов Ж. А. и др. Технология подготовки сырья для получения качественного шелка-сырца //Academic research in educational sciences. – 2021. – Т. 2. – №. 9. – С. 370-381.

45. Ахмедов Ж. А. Янги структурали тикув ва кашта ипларини ишлаб чиқариш технологиясини яратиш //Тошкент. ТТЕСИ.-2018.-Б. – 2018. – С. 47-53.

46. Умурзакова Х. Х., Ахмедов Ж. А. Табиий ипак хом ашёсини етиштириш ҳолатлари ва истиқболлари. – 2016.

47. Akhmedov J. A., Bastamkulova K. D., Alimova H. A. Technology of preparation of raw materials for the production of a new range of silk fabrics //Natural and technical sciences: experience, problems, prospects, Center for Scientific Knowledge" Logos". – 2016. – С. 50-53.

48. Алимова Х. А., Бастамкулова Х. Д., Ахмедов Ж. А. Связь крутки с линейной плотностью шелковой нити //Проблемы текстиля.-Ташкент. – 2016. – №. 3. – С. 32.

49. Алимова Х. А. и др. Мировое производство и потребление текстильного сырья //Ж. Композиционные материалы. – 2013. – №. 4. – С. 71-74.

50. Akhmedov J. et al. Preparation of raw materials for knitted products from natural silk //International journal on orange technology. e-ISSN. – С. 2615-8140.

51. Kh U. K. et al. Characteristics of New Sample Medical Gauze //International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET) Volume. – Т. 10. – С. 14330-14335.

52. Umurzakova H. H. et al. BIRINCHI VA TO'RTINCHI MAVSUMDA YETISHTIRILGAN PILLALAR QOBIG 'INING XUSUSIYATLARI //Oriental renaissance: Innovative, educational, natural and social sciences. – 2021. – Т. 1. – №. 9. – С. 291-300.

53. Alimova K. et al. Technology for preparing silk string for staplement //AIP Conference Proceedings. – AIP Publishing LLC, 2025. – Т. 3304. – №. 1. – С. 030004.

54. Shukhratov S., Axmedov J. The choice of raw materials for the production of bicomponent yarn //AIP Conference Proceedings. – AIP Publishing LLC, 2024. – Т. 3045. – №. 1. – С. 030036.

55. Хожиматов М. и др. ҒЎЗАНИНГ ЯНГИ "АНДИЖОН-ЗИЁ" НАВИ ТАВСИФИ ВА ПАРВАРИШЛАШ АГРОТЕХНОЛОГИЯСИ //Science and innovation. – 2024. – Т. 3. – №. Special Issue 21. – С. 180-182.

56. Ахмедов Ж. А. и др. Нуқсонли пиллаларни чувиш ва хом ипак хусусиятларини ўрганиш //Илм-фан ва инновацион ривожланиш/Наука и инновационное развитие. – 2023. – Т. 6. – №. 5. – С. 72-82.

57. Adkhamovich A. J., Alimovna A. K. qizi OEZ. Effectiveness of microwave killing live cocoon //J Textile Eng Fashion Technol. – 2022. – Т. 8. – №. 6. – С. 191-1925.

58. Халимахон А. А., Ахмедов Ж. А., Ортиқова Э. З. Қ. ПИЛЛАЛАРГА ДАСТЛАБКИ ИШЛОВ БЕРИШНИНГ ЯНГИ УСУЛИ //Academic research in educational sciences. – 2022. – Т. 3. – №. 9. – С. 14-23.

59. Алимова Х., Ахмедов Ж. А., Собиров Қ. Э. ЮҚОРИ СИФАТЛИ ХОМ ИПАК ИШЛАБ ЧИҚАРИШНИНГ ТЕХНОЛОГИК ПАРАМЕТРЛАРИНИ НАЗАРИЙ АСОСЛАШ //Academic research in educational sciences. – 2022. – Т. 3. – №. 7. – С. 204-217.

60. Собиров Қ. Э., Ахмедов Ж. А., Холдарова С. Ш. Қ. ПИЛЛАНИНГ ПИШГАНЛИК ДАРАЖАСИ КЎРСАТКИЧЛАРИГА СТАТИСТИК ИШЛОВ БЕРИШ //Oriental renaissance: Innovative, educational, natural and social sciences. – 2022. – Т. 2. – №. 9. – С. 483-487.

61. Ахмедов Ж. А. и др. СУРХОНДАРЁ ВИЛОЯТИДА ЕТИШТИРИЛГАН ХИТОЙ ДУРАГАЙ ПИЛЛАРИНИ ҚОБИҚ ХУСУСИЯТЛАРИ //Academic research in educational sciences. – 2022. – Т. 3. – №. 4. – С. 1197-1209.

62. Alimova H. et al. XOM IPAKNI QAYTA ISHLASHNING YANGI USULI //SCIENCE AND INNOVATIVE DEVELOPMENT. – 2021. – №. 5. – С. 93-101.

63. Алимова Х. А. и др. Новый способ обработки шелка-сырца //Илм-фан ва инновацион ривожланиш/Наука и инновационное развитие. – 2021. – Т. 4. – №. 5. – С. 93-101.

64. Axmedov J. A. et al. TABIIY IPAKDAN TIKUV IPLARINI ISHLAB CHIQARISH //Oriental renaissance: Innovative, educational, natural and social sciences. – 2021. – Т. 1. – №. 11. – С. 476-486.

65. Ахмедов Ж. А. и др. СУЩЕСТВУЮЩИЕ И НОВЫЕ ТЕХНОЛОГИИ ПОДГОТОВКИ ШЕЛКА СЫРЦА К КРУЧЕНИЮ //ПРОБЛЕМЫ ТЕКСТИЛЬНОЙ ОТРАСЛИ И ПУТИ ИХ РЕШЕНИЯ. – 2021. – С. 25-30.

66. Ахмедов Ж. А. и др. КАШТА ТИКИШДА ҚЎЛЛАНИЛАДИГАН ИПЛАРНИ ИШЛАБ ЧИҚАРИШ УСУЛЛАРИ //Academic research in educational sciences. – 2021. – Т. 2. – №. 12. – С. 86-97.

67. Ахмедов Ж. А., Эркинович С. Қ., Исмоилов Д. А. ИССЛЕДОВАНИЕ ПРОЦЕССА СЪЕМА НИТИ С ПОВЕРХНОСТИ КОКОНА В ВОДНОЙ СРЕДЕ //Oriental renaissance: Innovative, educational, natural and social sciences. – 2021. – Т. 1. – №. 5. – С. 613-621.

68. Ахмедов Ж. А., Бастамкулова Х. Д., Эрматов Ш. К. НОВЫЙ СПОСОБ ПОДГОТОВКИ ШЕЛКА-СЫРЦА К КРУЧЕНИЮ //ББК 1 А28. – 2020. – С. 66.

69. Ахмедов Ж. А. и др. ИЗМЕНЕНИЯ МАССЫ КОКОНА ОТ ДЛИНЫ РАЗМОТКИ //Advances in Science and Technology. – 2020. – С. 69-71.

70. Kushimov A. A., Gadaev N. E., Gulbaev U. Y. O. Changes in the amount of contamination in the combed sliver and yarn during the spinning process //Science and Education. – 2021. – Т. 2. – №. 1. – С. 158-162.

71. Gulbayev U. Y. O., Ruzmatov B. S., Yuldashev K. X. Creation and introduction of innovative education cluster in the leather and fur industry //Science and Education. – 2021. – Т. 2. – №. 1. – С. 289-292.

72. Xoliyarov M. S. et al. To'qimachilik sanoat chiqindilarini qayta ishlash muammolari va istiqbollari //Science and Education. – 2021. – Т. 2. – №. 11. – С. 384-391.

73. Yusupalieva U. N. et al. Efficient use of raw materials in textile enterprises and ensuring product quality //Science and Education. – 2021. – Т. 2. – №. 11. – С. 337-341.

74. Аббазов И. З., Гулбаев У. Я. Ў., Шаропов Б. технологик жараёнлардан чиқаётган чанг заррачаларининг фракцион таркиби //science and education. – 2021. – Т. 2. – №. 3. – С. 129-135.

75. Jumaniyazov Q. J. et al. YIGIRISH JARAYONI O'TIMLARI BO'YICHA ARALASHMA TARKIBIGA ASOSAN CHIQINDI VA IP MIQDORINING O'ZGARISHI //Science and Education. – 2021. – Т. 2. – №. 1. – С. 179-186.

76. Jumaniyazov Q. J. et al. Korxonalarda paxta tolasidan saralanmalar tuzish tartibi //Science and Education. – 2021. – Т. 2. – №. 5. – С. 327-334.

77. Jumaniyazov Q. J. et al. PAXTA TOLASIDAN SIFATLI SARALANMA TUZISH TARTIBI //Science and Education. – 2020. – Т. 1. – №. 8. – С. 65-68.

78. Jumaniyazov Q. J. et al. YIGIRISH KORXONASIDA TOLANING MEXANIK SHIKASTLANISHINING ARALASHMA TARKIBI BO'YICHA O'ZGARISHI //Science and Education. – 2021. – Т. 2. – №. 1. – С. 163-169.

79. Turatbekova A. et al. Study on isolation methods of natural polysaccharides //E3S Web of Conferences. – EDP Sciences, 2024. – Т. 497. – С. 03016.

80. Jumaniyazov K. et al. PREDICTING THE RELATIONSHIP BETWEEN FIBER PROPERTIES AND YARN PROPERTIES //Universum: технические науки. – 2023. – №. 9-5 (114). – С. 27-30.

81. Xolmominov A., Gulbaev U., Karimov S. Properties of polypropylene yarn production //Science and Education. – 2024. – Т. 5. – №. 9. – С. 172-176.

82. Jumaniyazovich J. Q. et al. CHANGES IN THE MECHANICAL DAMAGE OF THE FIBER ACCORDING TO THE COMPOSITION OF THE MIXTURE IN SPINNING MILLS //BOSHQARUV VA ETIKA QOIDALARI ONLAYN ILMIY JURNALI. – 2023. – Т. 3. – №. 2. – С. 170-172.

83. Gulbayev U. Y. O., Ro'zmatov B. S. Yuldashev CREATING AND LOCATING AN INNOVATIVE TEACHING CLUSTER IN THE KX LEATHER AND FUR INDUSTRY vain ta'lim. – 2021.

84. Gulbayev U. Y. O., Ro'zmatov B. S. Yuldashev CREATING AND LOCATING AN INNOVATIVE TEACHING CLUSTER IN THE KX LEATHER AND FUR INDUSTRY vain ta'lim.-2021//T //T. – Т. 2. – С. 289-292.

85. Gulbaev U. Change in fiber length during the spinning process //Science and Education. – 2025. – Т. 6. – №. 7. – С. 82-86.

86. Gulbaev U. Comparison of yarn breaking strength in spinning processes based on fisher and student's criteria //Science and Education. – 2025. – Т. 6. – №. 7. – С. 92-96.

87. Gulbaev U. Changes in product unevenness during different spinning process stages //Science and Education. – 2025. – Т. 6. – №. 7. – С. 87-91.

88. Umarova G. A. et al. Xom ipakni standart kalavaga qayta o 'rash jarayonida emulsiyani mahalliylashtirish //Science and Education. – 2026. – Т. 7. – №. 4. – С. 114-122.

89. Umurzakova X. X. et al. Ipak qurti duragaylarida pilla qobig ‘ining fizik-mexanik xossalari va saralash samaradorligining xom ipak sifatiga ta’siri //Science and Education. – 2026. – Т. 7. – №. 5. – С. 92-103.

90. Сабиров К. Э., Ахмедов Ж. А. ПОЛУЧЕНИЕ ВЫСОКОКАЧЕСТВЕННОГО ШЕЛКА СЫРЦА ВЫРАЩЕННЫХ ВО ВТОРОМ ПОВТОРНОМ СЕЗОНЕ OBTAINING HIGH-QUALITY RAW SILK GROWN IN THE SECOND REPEAT SEASON //II Всероссийская научная конференция с международным участием «Актуаль-ные направления развития текстильной и легкой промышленности в современ-ных условиях»: Сборник научных трудов (27 мая 2025 г.).–М.: РГУ им. АН Косыгина, 2025.–255 с. – 2025. – С. 207.

91. Xiao Q. et al. Enhanced electrochemical and thermoelectric performance of bacterial cellulose-based composite aerogels via multi-component reinforcement //RSC advances. – 2026. – Т. 16. – №. 23. – С. 21307-21319.

92. Гулбаев Я. И., Тиркашева Х. О. СИНТЕЗ СЕМИКОРБАЗОНА ПАРАОКСИБЕНЗОАЛЬДЕГИДА С МОЛИБДЕНОМ //Интернаука. – 2020. – №. 26-2. – С. 35-36.

93. Гулбаев Я. И., Исамиддинов Ж. К., Нореков У. Д. СИНТЕЗ И ЭЛЕМЕНТНОГО АНАЛИЗА КОМПЛЕКСНЫХ СОЕДИНЕНИЙ ТИОСЕМИКАРБАЗОНА МЕТИЛЭТИЛКЕТОНА С МОЛИБДЕНОМ //Science and Education. – 2021. – Т. 2. – №. 1. – С. 117-122.

94. Гулбоев Я. И., Исомиддинов Ж. ЎСИМЛИКЛАРНИ ХИМОЯ ҚИЛИШДА КИМЁВИЙ ТАДБИРЛАРНИ ҚЎЛЛАШ //Журнал естественных наук. – 2020. – №. 1.

95. Abdullaev A. A. et al. MOLIBDEN SANOATI CHIQINDILARINING INSON VA ATROF–MUHITGA TA’SIRI //Журнал естественных наук. – 2021. – Т. 1. – №. 4.

96. Гулбоев Я. И., Исомиддинов Ж. КРИСТАЛЛИЧЕСКАЯ И МОЛЕКУЛЯРНАЯ СТРУКТУРА ДИМЕРА УРАНА //Журнал естественных наук. – 2021. – Т. 1. – №. 2.

97. Гулбаев Я. И., Каримова Ф. С. Муллажонова ЗСК Координационное соединение тиосемикарбазона параоксибензоальдегида с молибденом //Universum: химия и биология. – 2021. – №. 4. – С. 82.

98. Dilmuxammad K., Otabek G., Yakhshilik G. Inheritance of the quantity of grains in first generation durum wheat hybrids //Universum: химия и биология. – 2022. – №. 10-3 (100). – С. 15-17.

99. Gulbayev Y. I., Abdullayev A. A., Xolmo’Minova D. A. Benzoilgidrozon solitsiloviy aldegidni infraqizil spektroskopiya yordamida aniqlash //Science and Education. – 2022. – Т. 3. – №. 1. – С. 163-168.

100. Гулбаев Я. И., Каримова Ф. С., Муллажонова З. С. К. Координационное соединение тиосемикарбазона параоксибензоальдегида с молибденом //Universum: химия и биология. – 2021. – №. 4 (82). – С. 64-68.

101. Гулбаев Я. И. Жавохирмирзо Камаридинович Исамиддинов, & Умид Дониёрович Нореков (2021). Синтез и элементного анализа комплексных соединений тиосемикарбазона метилэтилкетона с молибденом //Science and Education. – Т. 2. – №. 1. – С. 117-122.

102. Gulbayev Y. I. et al. Olma kislotasi va uning xususiyatlari //Science and Education. – 2022. – Т. 3. – №. 1. – С. 44-52.

103. Гулбаев Я. И., Холмуминова Д. А. Синтез и свойства комплексных соединений тиосемикарбазона метилэтилкетона с молибденом //Universum: химия и биология. – 2021. – №. 6-1 (84). – С. 73-78.

104. Гулбаев Я. И., Холмуминова Д. А. Дерватограмма комплексных соединений тиосемикарбазона метилэтилкетона с молибденом //Science and Education. – 2021. – Т. 2. – №. 1. – С. 123-127.

105. Гулбаев Я. И., Рашидова Н. Т. Рентгенограмма молекулы семикарбазона параоксибензоальдегида с молибденом //Science and Education. – 2020. – Т. 1. – №. 2. – С. 142-146.

106. Abdullaev A. A. et al. MOLIBDEN SANOATI CHIQINDILARINING INSON VA ATROF–MUHITGA TA'SIRI //Журнал естественных наук. – 2021. – Т. 1. – №. 4.

107. Гулбоев Я. И., Исомиддинов Ж. КРИСТАЛЛИЧЕСКАЯ И МОЛЕКУЛЯРНАЯ СТРУКТУРА ДИМЕРА УРАНА //Журнал естественных наук. – 2021. – Т. 1. – №. 2.

108. Гулбоев Я. И., Исомиддинов Ж. ЎСИМЛИКЛАРНИ ХИМОЯ ҚИЛИШДА КИМЁВИЙ ТАДБИРЛАРНИ ҚЎЛЛАШ //Журнал естественных наук. – 2020. – №. 1.

109. Эгамбердиев Ф. О. и др. ТАКОМИЛЛАШТИРИЛГАН ИККИ БАРАБАНЛИ ТЎҒРИ ОҚИМЛИ ТОЛА ТОЗАЛАГИЧ УСКУНАСИНИНГ ТОЗАЛАШ САМАРАДОРЛИГИНИ ОШИРИШ //ТЕХНИКА ФАНЛАРИ. – 2020. – Т. 5. – №. 3. – С. 71.

110. Doniyorova M. A., Shamiyev D. B., Doniyorov B. B. PAXTA TOLALI TO'QUVCHILIK IPLARINING TEXNOLOGIK XOSSALARINI TADQIQ QILISH //Экономика и социум. – 2022. – №. 7 (98). – С. 45-51.

111. Shamiyev D. B. To'quv dastgohlari assortimentlik imkoniyatlari asosida yo'l-yo'l naqshli to'qimalarni loyihalash //Avtoref. dis. PhD-Jizzax-2024 yil.

112. Doniyorova M. A. et al. Piltali to'qimalarni ishlab chiqarish va tadqiqot qilish //Science and Education. – 2022. – Т. 3. – №. 12. – С. 357-364.

113. Shamiyev D. B. O. G. L. et al. Bazalt tolasi va uning tarkibiy tuzilmasi //Science and Education. – 2023. – Т. 4. – №. 4. – С. 379-388.

114. Шамиев Д. ПИЛТАЛИ ТУКДМАНИ ИШЛАБ ЧИКАРИШДАН КУТИЛАДИГАН ЩТИСОДИЙ САМАРАДОРЛИК //Образование наука и инновационные идеи в мире. – 2023. – Т. 18. – №. 7. – С. 187-190.

115. Doniyorova M., Doniyorov B., Shamiyev D. Research of the structure of new stripe ribbed fabrics and assessing the design of the surface //PROBLEMS IN THE TEXTILE AND LIGHT INDUSTRY IN THE CONTEXT OF INTEGRATION OF SCIENCE AND INDUSTRY AND WAYS TO SOLVE THEM:(PTLICISIWS-2022). – 2023. – Т. 2789. – №. 1. – С. 040116.

116. Шамиев Д. ПИЛТАЛИ ТУ^ ИМАЛАРНИ ИШЛАБ ЧИКДРИШ ВА ТАДКДКОТ КДЛИШ //ОБРАЗОВАНИЕ НАУКА И ИННОВАЦИОННЫЕ ИДЕИ В МИРЕ. – 2023. – Т. 18. – №. 7. – С. 190-193.