

## ON FUNDAMENTAL AND APPLIED ASPECTS OF CREATING NON-TOXIC POLYMER AGRICULTURAL PREPARATIONS

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### **Abstract**

This paper is dedicated to the 80th anniversary of the outstanding Uzbek scientist, Honored Scientist of the Republic of Uzbekistan, founder of the Society of Chitinologists of Uzbekistan, Academician Sayyora Sharafovna Rashidova. This paper briefly describes her contribution to the development of chitinology in the Republic of Uzbekistan and the creation of biologically active and eco-friendly polymeric preparations for the agro-industrial complex.

**Keywords:** chitin-chitosan *Bombyx mori*, biological activity, non-toxic polymer agricultural preparations, *Society of Chitinologists of Uzbekistan*

### **Introduction**

Fundamental research conducted in the last 3 decades at the scientific school of academician Sayyora Sharafovna Rashidova is mainly devoted to extracting natural polymer - chitin from renewable sources, such as Aral shrimps, mushroom walls and silkworm pupae, pectin from local varieties of lemon according to the principles of waste-free technology, obtaining their water-soluble derivatives and creating polymer formulations of agricultural preparations based on them [1-2]. Systematic experiments in this direction have stimulated significant progress in fundamental, theoretical and innovative research at the Institute.

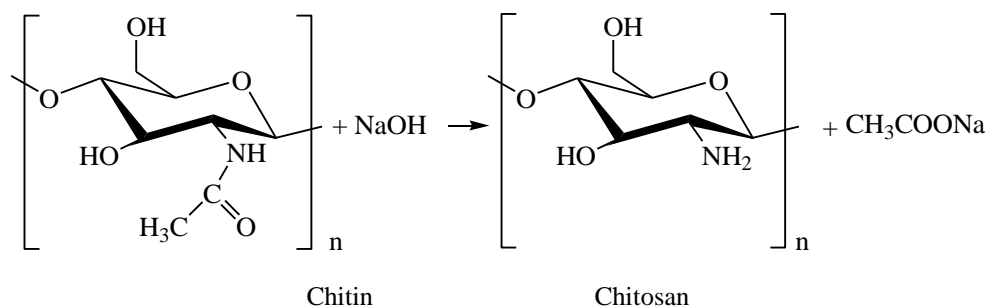
In the implementation of state priorities in the field of the economy related to food and environmental security, special attention is paid to the development of the agro-industrial complex, which is a complex system of relationships, scientifically based approaches to solving production problems of the agro-industrial sector of the economy. The creation of domestic environmentally safe biologically active drugs is relevant in the fundamental and applied aspect.

### **Results and its discussion**

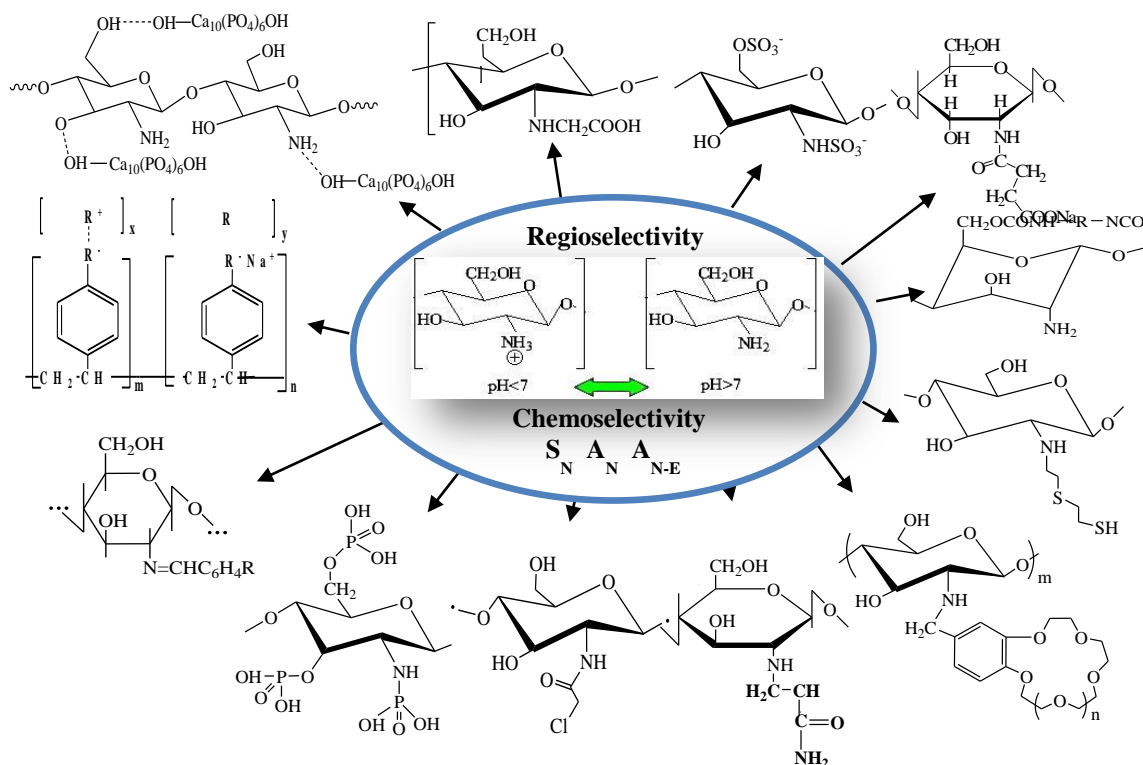
Since the 1980s, on the initiative of S.Sh. Rashidova and under her leadership, systematic studies have been carried out on the extraction of chitin from silkworm pupae, functionalization and modification of chitosan *Bombyx mori*:

It is known that the X3 molecule is chemo selective, i.e. deprotonated amino groups, as well as -OH groups on C-3 and C-6 carbon atoms, allow chitosan to undergo SN nucleophilic substitution and AN addition reactions. It should be noted that, by varying the synthesis conditions, it is possible to obtain -N and -O derivatives of chitosan (Figure 2).

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**Figure 1.** The reaction of obtaining chitosan from chitin



**Figure 2.** Possible chemical reactions in chitosan chains [3]

Natural polymer is chitin from renewable sources, such as Aral shrimps, mushroom walls and silkworm pupae, pectin extraction from local varieties of lemon according to the principles waste-free technology, obtaining their water-soluble derivatives and creating polymer formulations of agricultural preparations based on them [1-2]. Systematic experiments in this direction have stimulated significant progress in fundamental, theoretical and innovative research at the Institute.

Rashidova S.Sh. et al. studied the fundamentals of controlled synthesis-N and -O derivatives of chitosan with special properties, as well as the conditions for the interaction of the macroligand with ions of d-metals. Especially, the production of nanoderivatives of chitosan and chitosan-stabilized metal nanoparticles expands the scope of this polysaccharide. The uniqueness and unpredictability of chitin-chitosan is due to the fact that it is a rigid-chain

and compositionally heterogeneous polysaccharide, it is characterized by molecular polydispersity, pH-dependent solubility and a tendency to form H-bonds.

In accordance with the differences in the chemical composition and biological structure of silkworm pupae, a technological regulation was developed and technological regimes for the isolation of chitin and chitosan were selected.

**Table 1.**

The chemical composition of chitin-containing raw materials [4, 5]

Type of chitin containing raw materials	Humidity, %	Content, % dry matter				
		Lipids	Proteins	Mineralsubstance	Chitin	Melanin
Crab <i>Paralithodes camtschaticus</i>	12-14	1-2	25-30	34.5	30-31.5	-
<i>Gammarus lacustris</i> dry-ing	10-11	7.7-13	55-56	23-26	7.0	-
<i>Apis mellipera</i> bee dead	8-10	-	50-80	2.17-3.33	11-13.3	22-33
Dry cysts <i>Artemia sp</i>	8-10	6.5-19.2	56.5-58.0	6.1-12.6	2.5-10.5	-
Oyster mushroom <i>Pleurotus ostreatus</i> dry	7-9	5.6-7.0	13-23.6	4.8-6.3	2-5	-
*Silkworm Pupa	5-9	18-25	25-30	2-4	<2.5	undefined

\* Note: data on the chemical composition of the silkworm pupae were obtained from the Institute of Chemistry and Physics of Polymers of the Academy of Sciences of the Republic of Uzbekistan and are included in the table for comparison

The table demonstrates that in the composition of silkworm pupae, the amount of lipids is higher (up to 25%) and the content of minerals is lower (2-4%) as compared to other objects. Chitin makes up 2.5% of the total mass of the feedstock; pupae are also saturated with proteins (up to 30%). As a result of many-years research, Rashidova S.Sh. with collaborators developed a complex waste-free technology for processing silk production waste, which created the possibility of obtaining chitin, protein, oil, chitosan *Bombyx mori* (Figure 3) [6, 7].



**Figure 3.** Silkworm pupae (a) and products of complex processing: chitin (b), chitosan (c), protein (d) and pupa oil (e)

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Pilot production of chitin-chitosan *Bombyx mori*, created on the initiative of Academician Rashidova S.Sh., will contribute to the complete exclusion of its import into the Republic for foreign currency. Domestic polymeric disinfectant with a stimulating effect - UZXITAN for pre-sowing treatment of seeds of agricultural crops belongs to group IV and is a non-toxic preparation. The drug has been tested in various areas of cultivation, is included in the List of pesticides and agrochemicals (certificate No. A874), permitted for use in the agro-industrial complex of the country. In addition, preparations Kuprumchit, Askorchit, Nanoaskorchit, Carboxymethylchitosan, etc. with fungicidal, bactericidal and stimulating properties have been created and successfully introduced in various climatic conditions of the country [8-11].



**Figure 4.** Patent of the Republic of Uzbekistan "Method of encapsulation of seeds of agricultural crops"

Currently, research is underway to create innovative developments based on CS *Bombyx mori* - chitosan hydroxyapatite for the prevention and treatment of osteoporosis and osteomalacia, N-succinylchitosan with insecticidal properties, interpolyelectrolyte complexes of chitosan, which are highly effective against water and wind erosion as a soil structure former.

Unavoidably, the agro-industrial complex can be represented as interrelated areas that require a certain coordination of scientific support to transfer the results of scientific research into agricultural production. By Academician Rashidova S.Sh. a scheme of interrelated areas has been developed that require a certain coordination of scientific support for the transfer of research results in agricultural production (Figure 6).

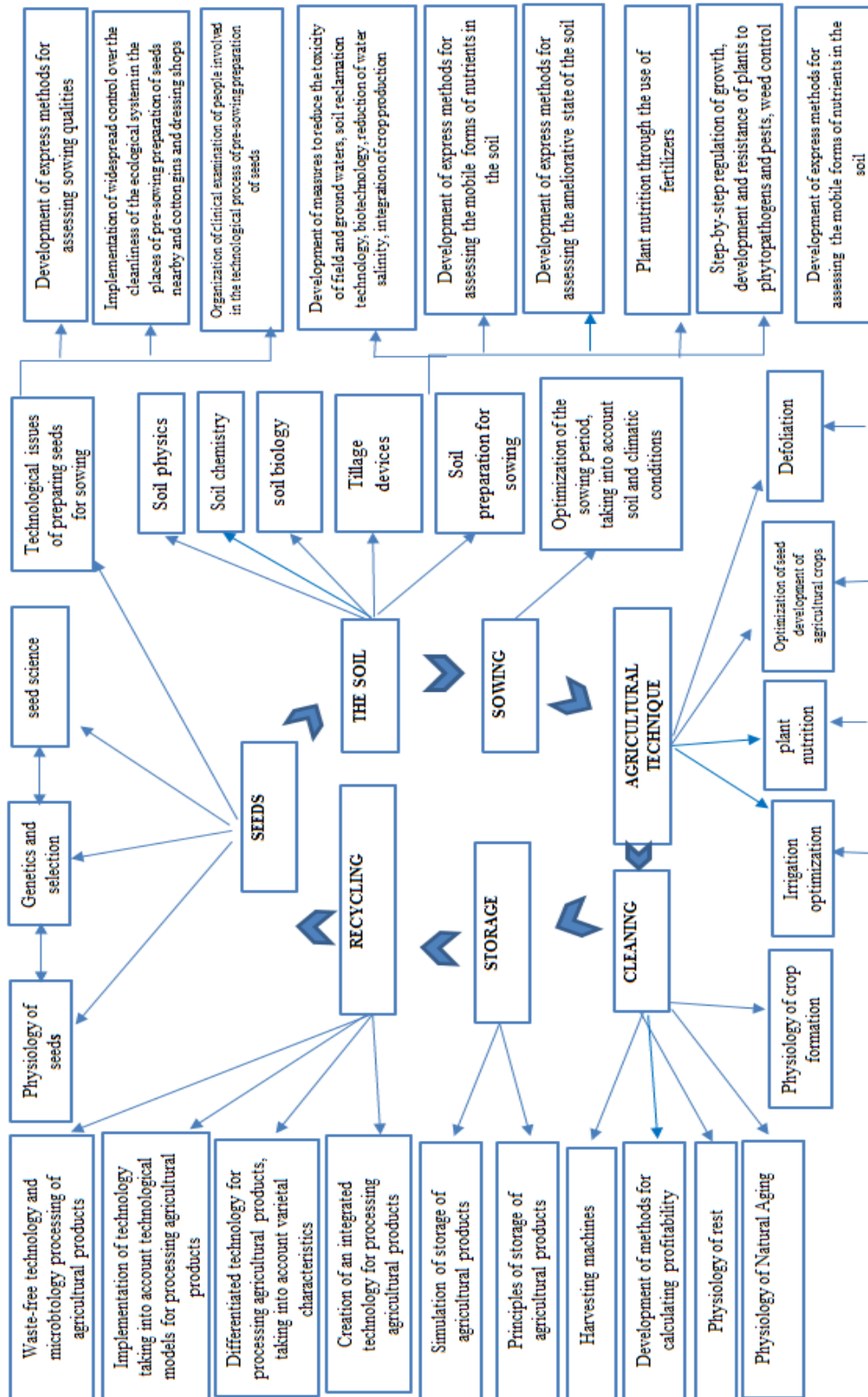


**Figure 4.** Encapsulated seeds

The development cycle of any plant begins with a seed and ends with a seed. The formation of seeds with high sowing, varietal, yielding qualities and economically valuable traits depends on the process of collecting, storing, pre-sowing preparation of seeds and agrotechnical factors. With the help of a complex of biological sciences, the development and life of seeds are studied from the moment of fertilization to the formation of a new plant.

Enormous attention is paid to the production of zoned seeds of agricultural crops, since the production of zoned seeds requires deep knowledge of seed physiology, the latest achievements in the field of genetics and selection of seeds of agricultural crops, the development of seed science, soil fertility is also of great importance. Soil fertility is crucial to ensure conditions for a rich crop harvest. In the field of soil science, sowing and agrotechnology of cultivation of seeds, including encapsulated ones, in order to obtain high yields, ensure food and environmental security, the authors carry out scientific activities that contribute to the implementation of state priorities in the field of the economy related to food and environmental security. Innovative approaches to the problem of the development of "smart agriculture" involve the unification of the efforts of specialists in various fields of knowledge, indicating the interdisciplinary nature of scientific, educational and industrial activities. To resume, the interdisciplinary nature of agricultural production is actively associated not only with research, but also with the innovative activities of specialists in the field of agriculture, agricultural processing, textile, oil and fat, food industries. Indeed, the use of chitosan and its derivatives in agriculture is aimed at improving agronomic productivity through various mechanisms of action on plants.

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**Figure 6.** Scheme of interrelated areas that require a certain coordination of scientific support for the transfer of research results in agricultural production. (This scheme was developed by Rashidova S.Sh., [13-14])

### Conclusion

Thus, the merits of Academician Rashidova S.Sh. in the creation of a new scientific direction in Uzbekistan on chemistry and technology of chitin-chitosan *Bombyx mori* are invaluable. Systematic fundamental research and identification of the "synthesis-structure-property" correlation made it possible to create science-based innovative agricultural preparations based on local raw materials. And the organization of the "Society of Chitinologists of Uzbekistan" (registered with the Ministry of Justice of the Republic of Uzbekistan dated July 25, 2021 No. 998) contributes to the deepening of fundamental research of the scientific school of academician Rashidova S.Sh. and the development of scientific integration.

### References

- [1]. Rashidova S.Sh., Milusheva R.Yu., Voropaeva N.L., Ruban I.N. Chitin and its derivatives from armored crustaceans of the Aral Sea. Receiving methods. Dokl. AN RUz, 1995, No. 8, p. 25
- [2]. Rashidova S.Sh., Milusheva R.Yu. Chitin and chitosan *Bombyx mori*. Tashkent. Fan, 2009. - 246 p.
- [3]. Vokhidova N.R., Ergashev K.H., Rashidova S.Sh. Synthesis and application of Chitosan hydroxyapatite: Review. Progress on Chemistry and Application of Chitin and its Derivatives. 2022 Volume XXVII. P. 5-34.
- [4]. Batashov E.S., Vereshchagin A.L. Comparative analysis of the physicochemical properties of chitin raw materials from the Altai Territory// Modern prospects in the study of chitin and chitosan: Proceedings of the Eighth International. conf. June 12-17, 2006. - Kazan: Russia, 2006. - P.78-82.
- [5]. Batashov E.S. Obtaining chitosan-containing preparations from substandard cysts of *Artemia* sp. and studying their effect on plants. Diss. ... cand. biol. Sciences.– Biysk (Russia), 2006. - 216 p.
- [6]. Patent of the Republic of Uzbekistan IAP 05849 dated 05/03/2019. A method for complex non-waste processing of chitin-containing raw materials. Rashidova S.Sh., Vokhidova N.R., Bekchanov I.K. and etc.
- [7]. Rashidova S.Sh., Milusheva R.Yu., Ibragimov K.S. etc. Patent RUz. Protein production method - IAP 2012 0328 dated 07/31/2012.
- [8]. List of pesticides and agrochemicals permitted for use in agriculture of the Republic of Uzbekistan. Tashkent, "Nisopoligraf". 2013, 335 pages
- [9]. Patent of the Republic of Uzbekistan IAP No. 05304 dated 07/03/2018. "Composition for pre-sowing treatment of seeds of agricultural crops and method for its production". Rashidova S.Sh., Rashidova D.K., Ruziev F.I., Vokhidova N.R. and etc.
- [10]. Patent of the Republic of Uzbekistan IAP No. 05894 dated July 30, 2019 "Method of encapsulating crop seeds". Rashidova S.Sh., Rashidova D.K., Shpilevsky V.N., Vokhidova N.R. and etc.
- [11]. Pirniyazov K.K., Rashidova S.Sh. *Bombyx mori* chitosan nanoascorbate: synthesis, structure and properties. Publishinghouse "Fanziyosi". Tashkent-2022. 177 p.
- [12]. Vokhidova N.R., Ergashev K.H., Ibragimov D., Rashidova S.Sh. "Chitosan Hydroxyapatite: Physicochemical Properties and its Effect on the Growth and Development of Broiler Chickens." Journal of the World's Poultry Research. 2023. 13(2): 233-243. DOI:<https://dx.doi.org/10.36380/jwpr.2023.26>
- [13]. Rashidova S.Sh., Vokhidova N.R., Rashidova D.K. Innovative approaches to the use of chitosan preparations in the agro-industrial complex// Science and innovative development. Chemical Sciences. 2020. No. 4 P.123-130.
- [14]. Rashidova S.Sh., Vokhidova N.R., Rashidova D.K., Iskanderov T.I., Abdurakhmanov Sh.T. Ecologically safe polymeric agricultural preparations: synthesis, properties and application. Fan Publishing House, 2021, 200 pages