european chitin society

newsletter

August 2015. Nº 35

Presentation

"Unoccupied readers" (as Cervantes termed in the Foreword of Don Quixote his possible readers), it is my pleasure to present a new issue of our Newsletter once we have been able to solve other, more urgent affairs of our Society.

It was in Oporto during our last meeting where we agreed to carry out surveys on the situation of our discipline along member countries and our Russian colleagues have made the first of these surveys on their country that we offer now in this Newsletter. May other similar surveys follow so we can have in the next future a general overview of our studies!

I hope this survey interest you as much as it did to me. After reading it one gets undoubtedly a better idea of what is going on presently in Russia in Chitin science and technology.

We will meet very soon in the ICCC/EUCHIS2015, in Münster, and there I hope we will have time enough to comment this and other matters and also to renew what we want for next issues of our Newsletters.

Ángeles Heras, President

european chitin society newsletter

Russian Government Awards for Chitosan Research & Development

In December 2014 a group of Russian chitinologists received a prestigious Prize of Government of Russian Federation in the field of Science and Technology for the work "DEVELOPMENT AND PRODUCTION OF CHITIN DERVATIVES AND PRODUCTS ON THEIR BASIS FOR APPLICATION IN AGRICULTURE, VETERINARY, MEDICINE, FOOD INDUSTRY AND BIOTECHNOLOGY".

This award was a logical continuation of decades of research in the field of chitin and chitosan in Russia, initiated in 1934 by Academician Pavel Shorygin. These years were also marked by the first attempts to acclimate Kamchatka crab, one of the important chitin sources, in the Norwegian see. In 1960s thanks to the enthusiasm of Russian scientists under the supervision of Yuri Orlov (Research Institute of Fishing and Oceanography) crab females, fry and roe were brought to Barents Sea. Although the very possibility of acclimation was disputable for a long time, Kamchatka crab acclimated well. Its population is now multiplying and exploited by Norway and Russia not only as a delicious food but as a row material for chitin and chitosan production.

In 2014 ten laureates representing six organizations with geography from St. Petersburg to Vladivostok under the leadership of Academician Igor

Tikhonovich were awarded for the achievements in research and development of chitosan-based products for versatile applications.

Laureates of Prize of Government of Russian Federation in the field of Science and Technology

As a main achievement in **chitin and chitosan production**, a problem of biosynthesis of chitin oligomers, which are of great interest in a variety of important applications in medicine, biotechnology, agriculture and other fields, has been solved. The suggested new method to produce chitin oligomers was based on the use of nodule bacteria enzyme (*Rhizobium* -N-acetyl-glucosaminyltransferase) participating in chitin oligomers biosynthesis. Efficiency of enzymes from different *Rhizobium* strains and the quantitative output of the synthesized chitin oligomers of different structures have been investigated, and N-acetyl-glucosaminyltransferase enzyme from two strains of nodule bacteria (*Mesorhizobium loti* and *Rhizobium* sp. GRH2) was used. Application of recombinant technologies to produce enzymes allowed an efficient solution of the synthesis problem. The *nodC* gene of these two nodule bacterial species were implanted as plasmid into *E.coli* bacteria for production of large amounts of target oligomers.

In the process of controlled synthesis, oligomers containing five and six N-acetyl-glucosamine units were obtained, and their properties were studied in detail. Conditions for production of chitin oligomers of some specific structure in quantities sufficient for application have been determined. Among the synthesized compounds, strong elicitors inducing resistance in plants have been revealed.

european chitin society newsletter

Inducing plant resistance using elicitors or inductors is one of the promising ways of plant protection, which complies with "green technologies" principles unlike approach of plant pathogens suppression using pesticides. The highest elicitor activity is related to the low-molecular chitosan (MW 5-20 kDa), whose production technology was developed at the Center of Bioengineering RAS, Moscow and implemented at the facilities of All-Russia Research and Technology Institute of Biological Industry, Shchelkovo, Moscow region, where a number of other chitosan derivatives (low-molecular derivatives, glucosamine, succinoyl-chitosan) are also produced.

Chitosan-based growth regulator 'Narcissus"

At present chitosan-containing preparations 'Narcissus' and 'Agro-Chit' (based on low-molecular chitosan), which are growth regulators and disease-resistance inductors for potato, grain and garden and greenhouse plants, are commercially available. In 2008-2012 more than 200 tons of these products with of total output of about 60 million RUR were manufactured.

A complex of investigations on introduction of chitosan to veterinary practice as an enterosorbent and immunomodulator used in treatment of gastrointestinal diseases of young agricultural animals (calves and piglets) has been carried out during periods of mass calving and farrows at farms

of Moscow, Kursk and Tula regions. Medical and preventive (prophylaxis) doses and frequency of chitosan application were optimized, including combination schemes with antibiotic treatment. In 70-80% cases the synergetic prolonged effect was obtained.

Production of chitosan-based **biologically active formulations and food additives for humans** (more than 20 products) was organized. The biologically active additive 'ChitAN' comprises high-purity poly-fraction chitosan manifesting enterosorbent, lipotropic, anti-inflammatory, and hypotensive properties, which were validated by comprehensive clinical tests over many years of application.

The 'PolyChit' preparation contains, aside from food-grade chitosan, fibers of the iodine-containing laminaria seaweed, which provides a complex effect for the organism. The products in the series of biologically active food additives under the 'PhytoChitoDez' trademarks contain water-soluble forms of chitosan and extracts of mixed medicinal herbs of different prescriptions. More than 60 variants of mixed herbs sorbed on chitosan and, thereafter, freeze-dried have been prepared and examined. Recently, an additive based on chitosan glutamate and gum of the sorbed *ferula assafoetida grass was developed. 'FerulaChit' is a highly active preparation applied at some metabolic disorders in the organism.*

european chitin society newsletter

Chitosan based products: left - ChitAN, PhytoChitoDez, PolyChit; in the middle - food grade chitosan (powder and gel forms); right - chitosan-based products of Tentorium Company

The annual **food-grade chitosan production** and sales is in the range 700-1200 kg at a price of 1700-2200 RUR/kg. The product is sold as the substantial component to manufacture of biologically active food additives, the base for wound-healing coatings ('CollaChit', 'CollaTex'), and the component of apiculture products (chitosan of the 'ApiChit' type). Within the recent 5 years, total price of sold food-grade chitosan was more than 5 million RUR.

Apiculture (bee-keeping dead matter) is another important source of chitin and chitosan, whose high potential is implemented by Tentorium Company (Perm, Ural region). In 2012 at the facilities of the Tentorium Company chitosan-containing food additives ('ApiChit', 'Milk cocktail with chitosan', 'Salt with chitosan') were produced with total output of 6.6 million RUR.

Production of chitosan-based products in Tentorium Company

For **application of chitosan in drinking water treatment** a number of flocculants based on water-soluble ionic chitosan forms under general trademark ‘ChitoFloc’ and flocculation compositions based on chitosan and inorganic coagulant (aluminum oxychloride) differing in component ratio under general trademark ‘InstaFloc’ were developed and certified. Tests of flocculants safety performed at the A.N. Sysin Institute of Human Ecology and Environmental Hygiene corroborated the absence of acute and chronic toxicity of ‘ChitoFloc’ flocculants. The same flocculants were successfully tested for removal of transuranic elements from liquid radioactive wastes at the ‘Shelter’ object (Chernobyl Nuclear Power Plant, Ukraine).

The technology of manufacturing **hypoallergenic dairy products** based on selective binding of chitosan and β-lactoglobulin was developed within the frames of the State Contract ‘Development of the technology of manufacture of hypoallergenic functional dairy products’. Removal of this protein from lactoserum allows extension of the latter fields of application and development of new products for prophylaxis and medicine. The State Contract stipulates for organizing the manufacture of 4 dairy products of reduced allergenic capacity with the productivity of 100 tons/month at a dairy plant in Voronezh.

european chitin society newsletter

Pilot facility for protein biosorption by chitosan from lactoserum (Dairy plant, Voronezh)

Significant progress was made in production of a new class of **biomedical materials** – high-efficiency fluid-based biodegradable implants capable to promote regeneration of human and animal organism tissues at inflammatory and degenerative processes. Different chitosan-based medical devises (wound dressings, dental pastes, female care products, drug delivery formulations) have been developed and produced at pilot plant facilities with output in 2012 of about 20 million Rubles.

Sponge-type chitosan-collagen wound dressings containing β-carotene ('Chitoskin-beta') and superoxide dismutase ('Chitoskin super') demonstrated high efficiency in reduction of burn surface area with no sign of toxicity, local irritant or allergic effects. Chitosan-collagen materials accelerated the healing of burn wounds and were suitable for use in clinical practice for ulcers treatment. Compared to traditional methods of treatment the time of closing post-burn and traumatic injuries was reduced by 4-5 days, in the treatment of trophic ulcers their depth was reduced by 50% 10-15 days earlier than in conventional treatment schemes.

Developments in the field of chitin/chitosan in Russia are not limited to these innovations, more than 100 federal patents cover new products and materials, which have already found application and which will bring benefits to the society in the future.

Svetlana Bratskaya

european chitin society newsletter

Valery Varlamov,

Russian Chitin Society