Using our new method of purposeful modification of natural molecules by alkylation, it is possible to enhance the resistance of living organisms to unfavourable environmental factors, to prevent mass viral and bacterial diseases, including the tumour growth, immunoaggressive and immune deficiency conditions. A possible regulatory effect of such substances upon the inherited disorders and radioactive poisoning is to be especially noted.

The approach for obtaining a large group of antitumor products from alkylation of isoquinoline alkaloids of triethyphoms, elaborated in collaboration with M. Turkevich, M. Oliyovskaya and V. Ya. Novitsky in 1969, was patented in 16 countries.

Altogether there were over 60 preparations registered as biologically active substances of this new type in the public register of the former USSR. They were created by the author in collaboration with the team of scientists in Lviv and Kyiv, and protected by 40 author's certificates, 5 patents of Ukraine and 14 international patents.

The first substance of this type, together with its analogues able to stop the destructive actions, was anti-tumour preparation thiophosphoamide (ThioTEPA) (A. I. Potopalsky, 1961) [1-4]. Here is the scheme 1 of the amitozyn synthesis.

For over fifty years this preparation has been used independently and in many complexes for malignant and benign tumours, immune aggressive and viral formed treatment. The clinical test of amitozyn, conducted in 1967-1968 in the former USSR, proved its high medicinal properties in the treatment of tumours of larynx, cervix uteri, prostate, ovaries, pancreas and mammary gland.
Malaria caused by Plasmodium falciparum is the most virulent form of malaria, leading to approximately half a million deaths per year. Chemotherapy continues to be a key approach in malaria prevention and treatment. Due to widespread drug resistance of the parasite, identification and development of new anti-malarial compounds remains an important task of malarial parasitology.

The anti-malarial effects of amitozyn alone and in combination with chloroquine, pyrimethamine and artemisinin on the blood stages of P. falciparum demonstrate that amitozyn effectively inhibits the growth of blood-stage parasites with IC 50 9.6 ± 2, 11.3 ± 2.8 and 10.8 ± 1.8 μg/mL using CS2, 3G8 and NF54 parasite lines, respectively. Treatment of uninfected red blood cells with a high dose of amitozyn (500 μg/mL) did not change the cell morphology, demonstrating its non-toxicity for erythrocytes. The synergistic impact of the amitozyn/chloroquine combination was observed at growth inhibition levels of 10–80 %, while demonstrating a nearly additive effect at a growth inhibition level of 90 %. The combination of amitozyn with pyrimethamine has a synergistic effect at growth inhibition levels of 10–70 % and a nearly additive effect at a growth inhibition level of 90 %. The synergistic anti-malarial effect of the amitozyn/artemisinin combination was observed at growth inhibition levels of 10–40 % and a nearly additive effect at growth inhibition levels of 50–90 %.

Another unique preparation - "Izatizon", which is ratified and successfully used for prevention and treatment of viral and bacterial-viral infections and tumours in veterinary medicine, medicine, crop production (and also - as an effective immune modulator) was developed in collaboration with L.V. Lozyuk in the year of 1973 [7, 8]. I.A. Zaika and O.I. Bolsunova discovered and interpreted the immunomodulatory properties of izatizon. In close cooperation with D.M. Hovorun, in particular it was found out that a wide range of izatizon biological activities is based on the conformationally-labile structure of the molecule of metysazon - the main active component of the drug, and depends on the properties of the solvent and micro environment [9, 10].

Izatizon is a new generation drug that combines the antiviral activity and immunotropic action, and in addition has anticancer properties, especially in relation to melanoblastoma. It has been experimentally proved that izatizon affects both viruses and cellular mechanisms of the immune system. In model systems of herpes virus and adenovirus we detected that izatizon has the ability to stimulate the activity of reparative DNA synthesis. [11]

We discovered the ability of the drug to inhibit the thymidine kinase activity of the herpes virus and the adenovirus, which leads to the inhibition of the virus in the early stages of infection. We discovered the curative effect of izatizon under the herpes virus infection and adenoviral infection, and its availability at AIDS, tuberculosis and viral hepatitis C. Our data shows the convincing significance of this drug, especially nowadays, when all the continents of the Earth face the dramatic increase of the number of viral and immune aggressive diseases, that were considered to have disappeared, as well as emergence of new ones, among which the virus diseases occupy an important place. Izatizon is active against DNA-and RNA-containing viruses. It also has pronounced immunomodulatory properties [12].

Izatizon is an activator of nonspecific resistance factors through its stimulating effect on the expression of metabolic and phagocytic function of macrophages, and its influence on natural killer cells activity and synthesis of lysozyme.

Altogether there are over 60 new preparations with anti-tumour, antiviral and immune modulating action patented; 15 original phyto teas are elaborated on the basis of celandine; over 20 new forms, varieties and types of medical and agricultural plants are created, 6 of which are approved by the State
Inspection of Plant Varieties of Ukraine and recommended for wide use as new varieties with high yield and high content of active substances. Eleven from the indicated phyto teas with celadine and dozens of other plants are produced by Zhitomir closed company "Medherbs" under the brand of "Doctor A.I. Poto-palsky" (Certificate on a trademark No. 109425): Angiotumorosan, Artrourosan, Ghastrosan, Dermosan, Enterosan, Imunosan, Pneumosan, Tumorosan, Urosan, Kholeurosan, Cardiosan. They recover an organism, treat benign and malignant tumours, polyarthritis, multiple sclerosis. Plants of own selection: Purple Echinacea of "Beauty of Polissya", "Blueness of Polissya" viper's bugloss, molecular hybrid of pumpkin and watermelon "Zdorovyaya" kavbuz - are used for production of such recommended food supplements as "Spokiy" (Calmness), "Badioryst" (Vivacity), "Bud’no zdrovi" (Be healthy), "Kavbuzol", "Kavbuzosorb", kavbusorb anhelminetic, kavbusorb rejuvenating.

A number of the newest biotechnologies were elaborated: targeted improvement of genetic information of biological objects; environmental cleansing by application of plants able to assimilate atmospheric nitrogen instead of expensive fertilizers; obtaining of good crop capacity of plants on highly saline soils; increase of productivity of beneficial insects, fishes, birds, animals; a method to control agrobacterial cancer of plants. In 1979 on the territory of 40 hectares of the "Ukrainian Salt Tolerant" variety in Zhytomyr closed company "Medherbs" a pilot study of alkaloids of the "Ukrainian Salt Tolerant" variety in Zhytomyr closed company "Medherbs". A technology aimed at obtaining the new forms of plants with the desired economic properties is created using the approach of structural modification of molecules-carriers of hereditary information (DNA and RNA).

Wide application of these achievements has a considerable economic and social effect, in particular, for environmental recovery, obtaining heavy yields on highly saline and nitrogen-depleted soils, and also during the hydroponic growing with the use of seawater without its desalination. The created hybrids impress even professional selectionists: kvagista (molecular hybrid of haricot and cabbage) is an unique edible and feed culture that is up to three meters high with large protein content; kavbuz (molecular hybrid of pumpkin and watermelon) is the world largest berry of more than 60 kilos of weight promoting the removal of heavy metals and radionuclides from the organism; Kiziris (molecular hybrid of cornel and barberry); Alycos (molecular hybrid of cherry-plum and apricot). The high viral and immune-modelling effect of amitozyn and izatizion were proved in 1992-1994 by the program of the National AIDS Committee, established by the President of Ukraine. However these developments have not been implemented.

We offer finished scientific elaborations, complex methods of recovery of humans and environment to interested collectives for collaborative implementation:

- Having no analogues in the world practice antiviral, antimicrobial and anti-tumour preparations "Izatizion", "Izatitonyi", "Amitozyn", "Amitozynoberamid" with high economic effect when using in medicinal care, veterinary medicine and crop production;
- New varieties of cereals with high productivity on nitrogen-depleted and highly saline soils (wheat, rye, oat, millet, barley, corn, sorghum, rice), resistant to drought, bacterial and mycotic infections;
- New types of pumpkin for introduction to farming (kavbuz, kavbudek, enriched in sugars, fructose in particular, carotene and oil);
- New varieties and forms of medicinal plants, which have the immunomodulating, bactericidal and anti-inflammatory effects (Echinacea, viper's bugloss, elecampane, thermopsis, phytolacca);
- Salt-resistant and drought-resistant forms of plants, tomatoes of the "Ukrainian Salt Tolerant" variety in particular;
- Technologies of processing of seeds of cereals and vegetable cultures, and treatment of mushrooms, which increase the productivity by 20-40%;
- Technology of beneficial insects’ productivity improvement in beekeeping, production of oakworm and silkworm, etc.; proposed biopreparations are not harmful and provide the growth of productivity of beneficial insects by 1.5-2 times;
- Technology of creation of new forms of plants with modified properties (creation of frost-resistant, salt-resistant, drought-resisting forms, transformation of winter forms of crops into the spring crops);
- Technology of fishery and sea-farming productivity improvement by 20-40%;
- Technology of diagnostics, prevention and treatment of bacterial cancer of plants (fruit cultures, grapes, vegetable cultures) by using original, ecologically harmless preparations.

In 2005 the International scientific-practical forum "Bases of molecular-genetic health improvement of both human and environment" took place at the Institute of Molecular Biology and Genetics. It was dedicated to a new scientific direction of modification of the molecular structure of biologically active substances, which were extremely highly appreciated at home and abroad. Materials of this forum are presented on the web-site http://www.potopalsky.kiev.ua/ua/forum.html. Number of visitors from more than 50 countries is still growing.
References:

1. Potopalsky A.I, Petlychnaya L.I, S.V. Yvasyvka "Modification of berberin alkaloids". - Kiev, "Naukova Dumka"., 1980. - 109 p.
2. A.I. Potopalsky "Amitozyn action on experimental malignant tumors in rats" – Oncology Questions - Proceedings of Scientific Medical Students Societies of Medical Institutions of RSFSR. – Moscow., 9-12 April., 1963.
3. A.I. Potopalsky "Some data about the treatment of malignant tumors in the experiment"., XXXI Conference of Student Scientific Society., 14-15 December, 1961., Stanislav’s State Medical Institute., pp. 36 -37.
4. Potopalsky A.I. "Celandine preparations in biology and medicine" – Kiev., "Naukova Dumka"., 1992. - 200 p.
5. Bastien Herman1., Aldrian Gudrun., Anatoly I. Potopalsky, Jadwiga Chroboczek, Sergey O. Tcherniuk «Amitozyn Impairs Chromosome Segregation and Induces Apoptosis via Mitotic Checkpoint Activation», PLOS ONE., Access mode: www.plosone.org (14 March 2013., Vol. 8., Issue 3 – e 5746) http://dx.doi.org/10.1371/journal.pone.0057461
6. Sergey O. Tcherniuk, Olga Chesnokova, Irina V. Oleinikov, Anatoly I. Potopalsky, Andrew., V. Oleinikov, Anti-malarial effect of semi-synthetic drug amitozyn., Access mode: http://www.malariajournal.com/content/14/1/425 http://dx.doi.org/10.1186/s12936-015-0952-4
7. Potopalsky A.I., Lozyuk L.V., Mirolyubova A.N., Bessarabov B.F. "The antiviral, anticancer and antileukemia drug izatizon". – Kiev., "Naukova Dumka" -1991. - 191 p.
8. Lozyuk L.V., Potopalsky A.I., Lozyuk R.M. "Medical treatment and prevention of viral diseases". - Lviv., Publishing "Norma", 2003. - 208 p.
9. Potyahaylo A.L., Bolsunova O.I., Zaika L.A., Potopalsky A.I., D.M. Hovorun “Conformational analysis of metysazon molecule: results of semi-empirical quantum-chemical calculations”, Biopolymers and cell. - 2003., Vol. 19, No. 3., pp. 292-294 http://dx.doi.org/10.7124/bc.00065f
10. Potyahaylo A.L., Bolsunova O.I., Zaika L.A., Potopalsky A.I. “Prototropic tautomerism and proton-donor- proton-acceptor properties of izatin according to semi-empirical quantum-chemical calculations”, Biopolymers and cell. - 2003., Vol. 19, No. 2., pp. 202-204. http://dx.doi.org/10.7124/bc.00064f
11. Zaika L.A., Bolsunova O.I., Patskovsky Y.V., Rubashevsky E.L., Dyadyun S.T., Rubalko S.L., Potopalsky A.I. “Antiviral drug izatizon has no mutagenic effect and stimulates the proliferation of immune system cells.”, Biopolymers and cell. - 1995., Vol. 11, No. 6., pp. 89-95 http://dx.doi.org/10.7124/bc.000409
12. L.A. Zaika, O.I. Bolsunova, A.I. Potopalsky "Antiviral, anticancer and immunomodulatory properties of IZATIZON therapeutic drug". - Kiev., Kolobig., 2010. - 212 p.
13. Potopalsky A.I., Jurkiewicz L.N. "Third Millennium - new plants for health, wellbeing, beauty and longevity". - Kyiv., "Kolobig"., 2005. - 168 p.
14. V.A. Katsan, A.I. Potopalsky "Features of action of exogenous DNA preparations in obtaining some new forms of tobacco". - Kyiv., "Kolobig", 2007. - 176 p.

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