ADVANCED R&D AND TECHNOLOGIES

THE NAS OF UKRAINE

FOOD INDUSTRY

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SPECIAL ISSUES

ENVIRONMENT AND NATURE PROTECTION

FOOD INDUSTRY

FUEL, LUBRICANTS, AND TECHNOLOGIES

INDUSTRIAL AGRICULTURE
AND LANDSCAPE GARDENING

INFORMATION AND SENSOR SYSTEMS
AND DEVICES

INFORMATION TECHNOLOGY

MACHINE-BUILDING AND
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MEDICAL PRODUCTS
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POWER ENGINEERING AND ENERGY EFFICIENCY

TECHNOLOGIES AND EQUIPMENT
FOR EXPLORING, ESTIMATING,
AND EXTRACTING MINERAL RESOURCES

TECHNOLOGIES FOR CONSTRUCTION
AND FUNCTIONAL MATERIALS

AEROIONIC FOOD PROCESSING TECHNOLOGY

Foodstuff manufactured using the air-ion technology (from left to right: various types of hung fish, semi-preserved fish, and dried fish)

Original fish confectionery

Areas of Application

The technology is used for energy efficient production of foodstuff storable at positive temperature without adding any chemical preservatives or stabilizers

Specification

The technology is based on specially designed air-ion electric generators. Production capacity is 90 tons per year, ion energy is 20—50 keV, power consumption is 150 W.
The technology is implemented at normal room temperature and uncontrolled humidity

Air-ionic plant for food production

Advantages

There are no counterparts in Ukraine.
As compared with foreign analogs it is less energy consuming, cheaper, and easier to apply; improves work hygiene; has no adverse effects on environment

Stage of Development. Suggestions for Commercialization

IRL6, TRL6
Technology and specifications

IPR Protection

IPR1

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AMB-3 SOMATIC CELLS DETECTOR

Specification

Digital indicator of measurement results.
Operation in semi-automatic mode.

Measurement range, thousand cells/cm^3	90—1500
Sample outflow duration (relative viscosity), s	8.0—99.9
Relative error limit, %	±5
Power supply	220 V, 50 Hz
Dimensions, mm	290×130×190
Mixer unit, mm	130×65×65
Weight, kg	≤4

Areas of Application

The detector is used to control the whole milk quality by determination of somatic cells quantity at dairy and milk processing factories

Advantages

As compared with Lithuanian and Russian devices it has a smaller size and is cheaper

Stage of Development. Suggestions for Commercialization

IRL8, TRL8
The production, supply, and maintenance of small series, upon request

IPR Protection

IPR1

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BIOSENSOR SYSTEM FOR ANALYZING THE QUALITY OF WINE AND WINE-MAKING MATERIALS

Areas of Application

The system is designed for detection of glucose, lactate, ethanol, and glycerol to control the wine production processes

Stage of Development. Suggestions for commercialization

IRL6, TRL5
The product is manufactured upon request. Seeking partners for commercial production of the system

Specification

Analyte	Analyte			
	Glucose	Lactate	Ethanol	Glycerol
Linear range of detection, mM	0.005—0.65	0.005—1.60	0.08—6.40	0.05—25.60
Operational stability, h	8—9	10	5	5
Storage stability, months	3	3	1,5	0,5
Time of analysis, min	3—5	3—5	3—5	3—5
Measurement error, %	≤5	≤5	≤5	≤5

Advantages

There are no commercial counterparts. The proposed system does not require pre-sampling, has a short time of analysis (rapid analysis), a low labor intensity and a low cost of analysis, a high sensitivity and a high selectivity; enables real-time simultaneous detection of four different substances

IPR Protection

IPR3

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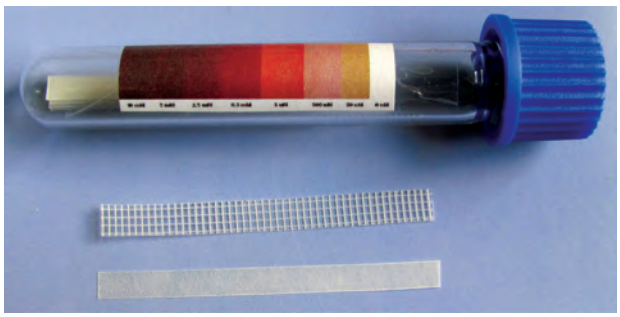
BIOSENSOR SYSTEMS FOR DETECTION OF PHENOL AND AFLATOXIN B1 BASED ON MOLECULARLY IMPRINTED AFFINITY MEMBRANES



Colorimetric sensor system for phenol detection

Fluorescent biosensor system for aflatoxin B1 detection: MIP-membrane after incubation with sample containing aflatoxin B1 (upper) and without aflatoxin B1 (lower)

Specification

Bioselective element	Analyte	Detection limit	Linear dynamic range	Storage stability, months	Time of analysis, min	Standard deviation, %
Phenol-selective MIP membranes	Phenol	50 nM	50 nM—10 mM	18	30	≤10
Aflatoxin B1 selective MIP membranes	Aflatoxin B1	14 ppb	14—200 ppb	18	30	≤10

Areas of Application

To be used in special laboratories for monitoring of environment, foodstuffs, and drinking water

Advantages

The developed systems have no counterparts in the world. They provide cheaper, faster, more sensitive and highly-selective analysis as compared with the existing Ukrainian and foreign methods for phenol and aflatoxin detection. The systems are easy-to-use, provide real-time analysis, their application does not require highly skilled specialists

Stage of Development. Suggestions for Commercialization

IRL6, TRL5
Small series of molecularly-imprinted polymer membranes selective to phenol and aflatoxin B1 has been produced and tested for analysis of real samples. The developed sensor systems are ready for implementation

IPR Protection

IPR3

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BIOTECHNOLOGICAL YEAST-BASED PRODUCTION OF VITAMIN B_2 (RIBOFLAVIN)

Areas of Application

Vitamin B_2 produced by microbial fermentation can be used for human and animal nutrition, as a food colorant, as well as a medicine

Specification

Riboflavin synthesizing strains have been constructed using advanced metabolic engineering methods. Medium composition and cultivation conditions have been optimized to maximize the yield of target product.
A laboratory procedure for vitamin B_2 production has been developed

IPR Protection

IPR3, IPR5

Advantages

There are no counterparts in Ukraine.
The constructed strains are characterized by efficient riboflavin production. The main advantage of these strains is a higher genetic stability relative as compared with available riboflavin producers. Biotechnological riboflavin production reduces energy consumption and chemical pollution of environment

Stage of Development. Suggestions for Commercialization

IRL3, TRL4
The riboflavin producer cultivation is scaled and a technology for commercial production of vitamin B_2 is developed. The constructed riboflavin overproducing strains and the developed technology can saturate the Ukrainian market with the product.
The Institute is seeking a company interested in strain commercialization

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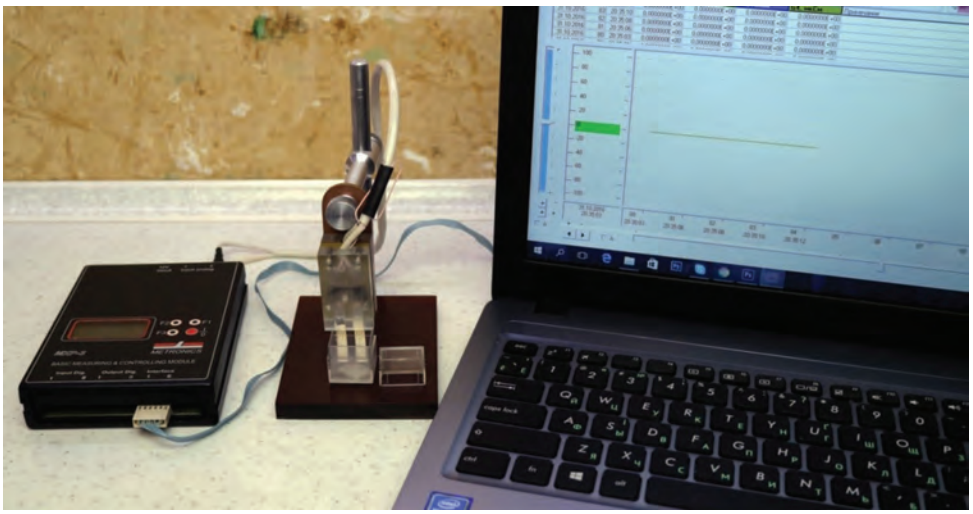
CONDUCTOMETRIC BIOSENSOR SYSTEM FOR IDENTIFICATION OF GLUCOSE, SUCROSE, MALTOSE, LACTOSE, AND FRUCTOSE



Specification

Analyte	Linear range of detection, mM	Storage stability, months	Time of analysis, min	Measurement error, %
Sucrose	0.005—3.5	4	1—5	≤5
Maltose	0.01—1.5	1.5	1—5	≤5
Lactose	0.01—2.0	3	1—5	≤5
Glucose	0.001—3.5	6	1—5	≤5
Fructose	0.05—1.5	0.5	1—8	≤10

Areas of Application

The system is designed for detection of carbohydrates in foodstuffs, pharmaceuticals, agricultural and biotechnology products

Advantages

There are no commercial counterparts. The proposed system does not require pre-sampling, has a short time of analysis (express analysis), a low labor intensity and a low cost of analysis, and a high sensitivity and selectivity; it can simultaneously detect different carbohydrates

Stage of Development. Suggestions for Commercialization

IRL6, TRL5
The product is manufactured upon request. Seeking partners for commercial production of the system

IPR Protection

IPR3

Contact Information

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FOOD LIGHT STATION FOR RADIATION MONITORING OF FOODSTUFFS, LIQUID AND DRY MATERIALS

Areas of Application

Portable workstation for complex radiation monitoring of foodstuffs, liquid and dry materials provides measurements in stationary and mobile conditions

Specification

The device uses scintillating detectors based on 63 × 63 mm CsI (Tl) crystals. The device is equipped with 40 mm thick lead protection that shields the measuring sample from external influence;
Products to be measured are placed in 1 liter Marinelli vessel;
Volume of liquid samples must be, at least, 1 liter; the weight of dry sample must be, at least, 1 kg;
Connected to a computer the device can operate as gamma spectrometer and keep measurements database

Stage of Development. Suggestions for Commercialization

IRL8, TRL9
Production sample; sale of device; manufacture, commissioning, testing, and supply of device, staff training and maintenance during warranty period are provided upon request; creation of engineering capability for manufacturing a basic configuration; prototype finalization and serial production; further upgrade of production, customization of engineering solutions for the key sales markets

Advantages

High speed of calculations and stability of measurement results

IPR Protection

IPR1

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HEAT-TECHNOLOGY FOR MANUFACTURE OF INSTANT HOT MEAL

Instant borsch

Areas of Application

The heat-technology is used to manufacture of instant hot meal

Specification

Long-term storage.

Total weight of daily ration, g	477—650
Calories, kcal	3630—4200
Cooking time, min	3—5

Advantages

The technology enables preserving functional ingredients for 93—95%; as boiling water is added the portion volume increases 7—8 times; the dry rations contain antioxidants, folates, phytoestrogenic and prebiotic properties

Stage of Development. Suggestions for Commercialization

IRL8, TRL6
Manufacture and supply of products and production equipment can be provided upon request

IPR Protection

IPR1, IPR2, IPR3

Contact Information

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HERBAL TEA BLEND FOR IMPROVING THE DIGESTIVE PROCESSES

Infusion of herbal tea for improvement of digestive processes and herbal tea blend in original packaging

Areas of Application

Herbal tea blend to be used in food industry. It enhances the human body protective capacity due to an antioxidant effect and softly stimulates the digestive processes. The tea is recommended for daily use as therapeutic prophylactic drug

Specification

The tea consists of the following natural ingredients: shredded air-dry uncommon herbs, pieces of dried fruits, and spices, which enrich the tea with vitamins, macro- and microelements, and organic acids.
The herbal tea has a pleasant sweet-spicy taste, rich caramel aroma and golden color

Advantages

The blend contains new uncommon introduced aromatic, medicinal, and food herbs: Mexican tarragon, round-leaved mint, japan quince, and others.
The tea blend enriches the assortment of national herbal teas

IPR Protection

IPR3

Stage of Development. Suggestions for Commercialization

IRL3, TRL3
The license agreement to use a patent for industrial production of herbal tea shall be signed. The patent vending is possible. Advice on commercial cultivation of plants for raw materials can be provided. The seeds and herbs for planting are available

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HERBAL TEA BLEND WITH RELAXING EFFECT

Infusion of herbal tea with relaxing effect and herbal tea blend in original packaging

Areas of Application

Herbal tea blend to be used in food industry. It has delicate relaxing, restorative, and antioxidant effects, recommended for daily use as therapeutic and prophylactic means

Specification

The tea consists of natural ingredients: shredded air-dry uncommon herbs and pieces of dried fruits containing a complex of biologically active compounds (essential oils, coumarins, betacianins, organic acids, flavonoids, vitamins A, C, E).
The herbal tea has an original taste with a slightly sour taste and delicate anise aroma and purple-pink color. The duration and frequency of its use are not limited

IPR Protection

IPR3

Advantages

The blend consists of well-balanced herbal ingredients. In addition to traditional food and medicinal plants the tea contains uncommon cornelian cherry and amaranth.
The blend enriches the assortment of national herbal teas

Stage of Development. Suggestions for Commercialization

IRL3, TRL3
The license agreement to use a patent for industrial production of herbal tea shall be signed. The patent vending is possible.
Advice on commercial cultivation of plants for raw materials can be provided. The seeds and herbs for planting are available

Contact Information

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HERBAL TEA BLEND WITH TONIC EFFECT

Infusion of herbal tea with tonic effect and herbal tea blend in original packaging

Areas of Application

Herbal tea to be used in food industry.
The blend has a positive effect on the human immune system, a tonic and rejuvenating effect. It is a balanced drink with a striking antioxidant activity. It is recommended for daily use as therapeutic and prophylactic means

Advantages

The herbal tea blend is a substitute for traditional tea. It contains spices and uncommon herbal ingredients such as catmint and chamomile and safflower dyers.
The tea blend enriches the assortment of national herbal teas

Specification

The composition consists of air-dry mix of natural herbs containing essential oil, ascorbic acid, flavonoids, carotenes, and other bioactive compounds.
The tea has a distinctive pleasant sour taste with a peppery note, rich citrus flavor, and golden color

Stage of Development. Suggestions for Commercialization

IRL3, TRL3
The license agreement to use a patent for industrial production of herbal tea shall be signed. The patent vending is possible.
Advice on commercial cultivation of plants for raw materials can be provided. The seeds and herbs for planting are available

IPR Protection

IPR3

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TECHNOLOGY FOR COMPREHENSIVE PROCESSING OF BIOLOGICAL RAW MATERIALS USING CRYOGENIC MOLECULAR FRACTIONATION

Products of cryogenic molecular fractionation

Areas of Application

The technology is designed to obtain from natural plant and animal raw materials the molecular fractions that entirely preserve the native structure of original biological material and can be ingredients for designing new vitamin-rich food, agrotechnical preparations, food additives, and natural dyes, as well as used in pharmaceutical and cosmetic industry

Specification

The main technology stages involve the use of low temperatures: cryogenic grinding (–120...–100 °C), cryosublimation fractionation (–25°C), and extraction with liquefied gases (–25...–30 °C)

Advantages

Integrated waste-free processing of biological raw materials in a consequent process cycle, selective separation of raw materials into biologically active molecular fractions with predetermined composition. The proposed technology has no counterparts in the world

Stage of Development. Suggestions for Commercialization

IRL7, TRL7
The process regulations and equipment for biological material molecular fractionation are supplied upon request

IPR Protection

IPR1, IPR3

Contact Information

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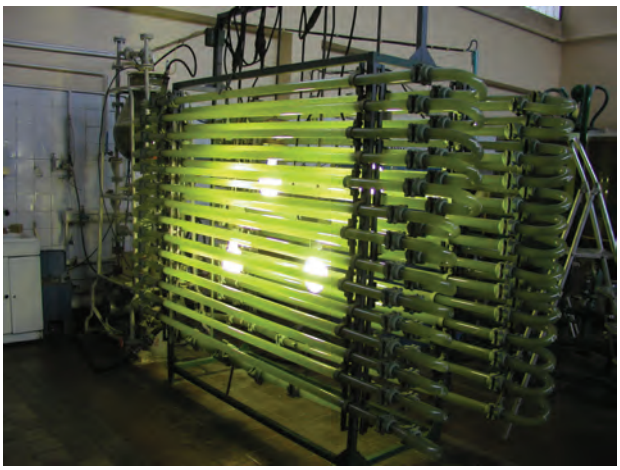
TECHNOLOGY FOR CULTIVATION OF MICROALGAE *SPIRULINA PLATENSIS* (NORDSTROM.) GEITL. IN CLOSED-TYPE PHOTOBIOREACTORS

Areas of Application

The technology for cultivation of microalgae (Cyanobacteria) *Spirulina platensis* (Nordstrom.) Geitl. in closed-type photobioreactors is designed for whole-year polycyclic production of spirulina biomass to be used in food and pharmaceutical industries for enhancing the human vitality and providing the human organism with vital natural substances



Closed-type photobioreactor for microalgae cultivation

Specification

One module of closed-type photobioreactor has a volume of 1000 l. Productivity is 50—60 g/m^2 dried product daily. Spirulina is produced as powder, pills or additives for bakery products, pasta or pastry, milk products, salads, etc.

Stage of Development. Suggestions for Commercialization

IRL5, TRL4
Technical assistance agreement is proposed. It includes engineering services and relevant R&D works

Advantages

The technology enables controlled whole-year polycyclic cultivation of microalgae (Cyanobacteria) *Spirulina platensis* in closed-type photobioreactors and obtaining of microbiologically safe product for food and pharmaceutical industries

IPR Protection

IPR1, IPR2

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TECHNOLOGY FOR MANUFACTURING DOMESTIC HYPOALLERGENIC FOOD FOR INFANTS

Adapted hypoallergenic instant food for infants

Areas of Application

Production of dry functional food for infants with allergy to proteins of various origin

Specification

The product is a mix of hydrolyzed vegetable and animal proteins, vegetable oils, carbohydrates, minerals, vitamins, and other biologically active substances. Its amino acid composition is close to that of breast milk and fully meets the conditions of Codex Alimentarius and infant physiological needs

Stage of Development. Suggestions for Commercialization

IRL8, TRL6
The onsite support of technology implementation and staff training are provided upon request

IPR Protection

IPR1, IPR3

Advantages

There are no counterparts in Ukraine.
The product is notable for highly hydrolyzed proteins (60—80%) with a molecular weight of peptides of 3—5 kDa; has reduced allergenic capacity and improves digestibility of proteins; the product is 2.5—5 times cheaper as compared with known foreign analogs

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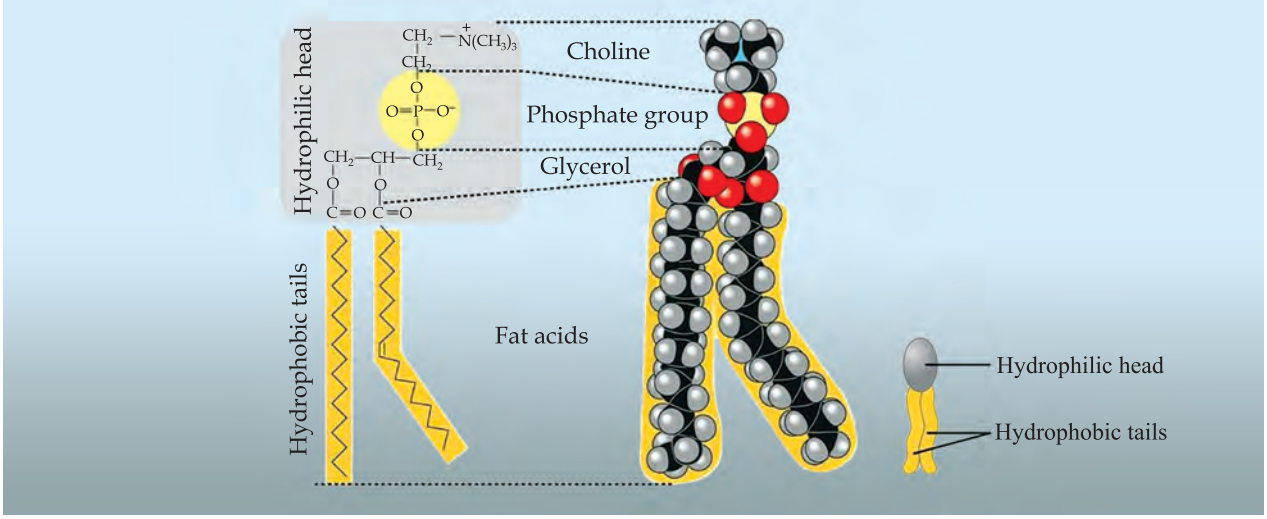
TECHNOLOGY FOR OBTAINING DRY SKIMMED LECITHIN AND ESSENTIAL PHOSPHOLIPIDS FROM SUNFLOWER SEEDS OIL FOR FOOD AND PHARMACEUTICAL INDUSTRIES



The structure of lecithin phospholipids

Areas of Application

The technology is designed for obtaining lecithin, a food additive (emulsifier, stabilizer) used in dairy, confectionery, and cosmetics industries, an additive for animal and fish feed. Purified phosphatidylcholine (a lecithin component) is phospholipid used as drug delivery system

Specification

Lecithin obtained using this technology is a powder without impurities, tasteless and odorless, colored from yellow-gray to yellow-brown.

Moisture, %	≤0.4
Mass content of oil, %	≤0.8
½O_2 peroxide number, mg/kg	≤1.5
Acid number, KOH/g	≤15

Advantages

The developed technology for obtaining dry skimmed lecithin from sunflower seed oil is unique and can give up to 30 ton product monthly. This technology is export-oriented

Stage of Development. Suggestions for Commercialization

IRL8, TRL9
Commercial production of dry skimmed lecithin from sunflower seed oil

IPR Protection

IPR3

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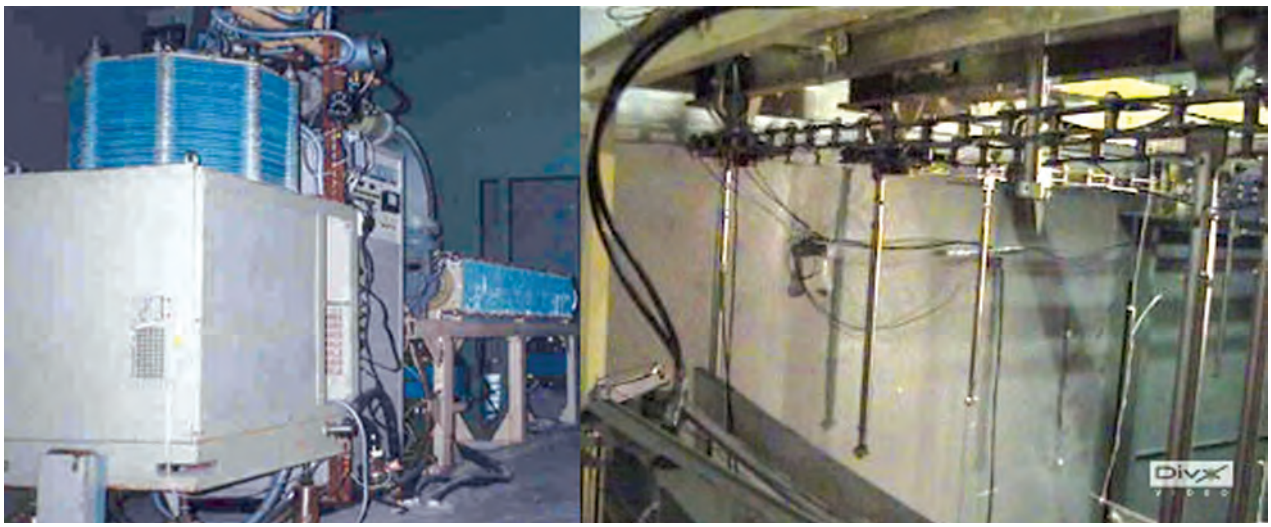
TECHNOLOGY FOR PICOWAVE PASTEURIZATION OF FOODSTUFFS



Process line

Areas of Application

The technology is proposed for pasteurization and preservation of foodstuffs by the picowave radiation technology without any chemical substances to prevent spoilage while stored and to protect the consumers against infectious diseases

Specification

The technology is based on *Electronics* electron accelerator.

Production capacity, tons annually	7500
Average energy of electrons, MeV	5
Power consumption, kW	75

Advantages

There are no counterparts in Ukraine.
This technology is cheaper as compared with foreign analogs

IPR Protection

IPR1

Stage of Development. Suggestions for Commercialization

IRL6, TRL6
Technology. Specifications

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TECHNOLOGY FOR PRODUCTION OF NATURAL PROTEIN-MINERAL COMPLEX

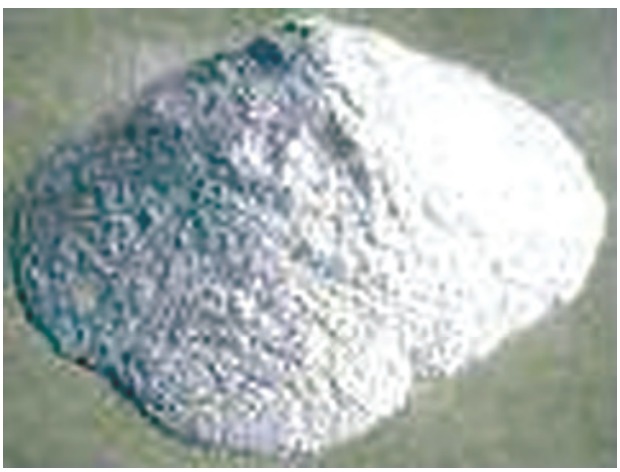
Areas of Application

Production of dry food protein complex with biologically active calcium for special diet nutrition of people with musculoskeletal system diseases and for sport nutrition

Specification

The product consists of natural components required for building and restoring bone tissue; it strengthens joints and ligaments, gives elasticity and strength to cartilages. The complex contains 80% protein and 10% minerals out of which 50–60% belongs to calcium.
The product is an instant extract containing protein and mineral substances of secondary collagen-containing raw poultry

Raw material for production of dry protein-mineral concentrate



Dry protein and mineral concentrate

Advantages

The technology has no counterparts in Ukraine. The combination of original biotechnological methods for processing of raw materials enables to effectively decalcify bone tissue and to significantly intensify the extraction of proteins and minerals. As a result, about 50% proteins assume an easily digestible hydrolyzed form while calcium takes on a biologically active citrate form

IPR Protection

IPR1, IPR3

Stage of Development. Suggestions for Commercialization

IRL7, TRL4
The onsite support of technology implementation and staff training are provided upon request

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WATER LIFE SYSTEM FOR OBTAINING WATER WITH GIVEN REDOX POTENTIAL PARAMETERS

Areas of Application

The system is designed for obtaining water with negative redox potential (Eh) under stationary and mobile conditions, thereby contributing to improvement of human life quality

Specification

Type of cooling, refrigerant: compressor	R134a
Electric power supply	220 V, 50 Hz
Cooling capacity, W	90
Temperature and cooling rate	5–10 °C, 2 l/h
Power consumption, kWh/day	1
Ambient temperature, °C	10–30
Energy efficiency class	B

Advantages

High performance and operation speed.
Improves the quality of drinking water

Stage of Development. Suggestions for Commercialization

IRL3, TRL5
Investment project
for joint manufacture. Seeking partners for a joint investment project. Development and prototype testing using the developer's facilities. Joint search for sales markets

IPR Protection

IPR1

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TECHNOLOGY READINESS LEVEL (TRL) SCALE

Stage	TRL	Interpretation	Definition and Description
Invention	TRL1	Basic principles observed	Basic scholarly research is translated into potential new basic principles that can be used in new technologies
	TRL2	Technology concept formulated	Potential areas of application of basic (technological) principles, including the technological concept are identified. Basic manufacturing principles are elaborated and potential sales markets are identified. A small research team is established to assess the project feasibility
Concept validation	TRL3	First assessment of concept and technology effectiveness	Based on preliminary study, actual research is conducted to assess technical and market feasibility of the concept. This includes active R&D works at the lab and first negotiations with potential customers. The research team expands. Market feasibility is assessed
	TRL4	Prototype validation at lab	Basic technological components are integrated to assess early feasibility by testing in laboratory environment. Manufacture options are studied with basic manufacturing principles identified. Key markets are researched to study demand. The organization is ready to scale up, possible services are analyzed. Comprehensive marketing analysis is made
Prototyping and incubation	TRL5	Prototype testing in user environment	The system is tested in user environment with broader technological infrastructure involved. The actual use is tested and validated. Production-support works and pre-production tests are done in lab environment. Trial batches of prototypes enter the key markets. The organization starts activities to further distribute the prototypes and to enter the sales markets
Pilot production and demonstration	TRL6	Pre-production, including tests in user environment	The product and manufacturing technologies are completely ready for launch of a pilot line/pilot plant (low-scale manufacture). The product and manufacturing technologies are assessed and finalized. This may include additional R&D works. The early products and manufacturing technologies are tested in the key markets with simultaneous organization of manufacture (marketing research, logistics, production facilities, etc.)
	TRL7	Low-scale pilot production demonstrated	The product manufacture is fully operational at low rate. Actual commercial products are manufactured. The final products are verified in the key markets. The organizational component is completed (comprehensive marketing strategy, all components of manufacturing activities). The products are formally launched in test markets
Initial market introduction	TRL8	Manufacture fully tested, validated, and certified	The manufacturing flow charts, product final version, production organization, and marketing tools are completed. The full-scale manufacture has been launched. The final product is sold in majority of domestic and international markets
Market expansion	TRL9	Manufacture and products fully operational and competitive	The full-scale manufacture is sustainable, with the product gaining new markets. Minor modifications and improvements create new versions. The technology and product output are optimized through implementing innovative concepts on manufacturing process. The product is fully customized to the key markets

INNOVATION READINESS LEVEL (IRL) SCALE

IRL	Innovation Readiness Level	Definition
IRL1	Inventor or team with a dream	The lowest level of readiness where the intention transforms into an idea of space system application or the space technology transforms into a business venture
IRL2	Paper studies produced	Once the basic ideas have been formulated, they are put down on paper in studies and analyses of business opportunities
IRL3	Experimental evidence of business opportunity	Active research and development are initiated, including analytical / laboratory studies to validate predictions regarding the market, the competition, and the technology
IRL4	Capability to implement limited-scope programs with project teams	Basic technological and business components have been developed to establish that they will work together; an initial business plan is available
IRL5	Capability to support project engineering development and design (no product, no revenues)	The basic technological and business components have been integrated with reasonably realistic supporting elements. The business plan is credible, but still needs to be validated against the final product characteristics
IRL6	Capability to support development and design with a market-driven business team (product, no revenues)	The representative prototype system has been tested in a relevant environment. The business team is still incomplete and the venture is not yet ready for commercialization. A full business plan including the market, the operational, the technological, and the financial aspects is available
IRL7	Capability to support limited production; full business team in place (product and limited revenues)	The business can run on a limited scale. The full team is in place
IRL8	Capability to advance to full production and distribution (product and revenues)	The technology has been proven to work and the venture structure has proven to be able to support growing market shares
IRL9	Fully articulated business with appropriate infrastructure and staffing (growing market share)	The offering incorporating the new technology has been used in operational conditions and the business is running with a growing market share

Intellectual Property Rights Protection[1] Levels

IPR codes	Protection Level
IPR1	Technical solutions are know-how[2]
IPR2	Applications for copyright protection of IPR objects are expected to be or have been submitted
IPR3	The copyright protection of IPR objects as established by the applicable law of Ukraine has been obtained and is kept in force
IPR4	International industrial patent application(s) (according to the PCT system, etc.) has (have) been submitted. Application(s) for industrial patents has (have) been submitted in foreign country(ies) under national procedure
IPR5	The industrial patent(s) in foreign country(ies) has (have) been obtained and is/are kept in force

[1] The IPR protection measures are implemented by R&D institutions in accordance with the applicable legislation of Ukraine and the requirements of paragraphs 5, 8, and 9 of the Regulations for the use of intellectual property objects at the NAS of Ukraine as approved by Resolution of the Presidium of the NAS of Ukraine No.15 of January 16, 2008, on the Structural Units Responsible for Technology Transfer, Innovation Activities, and Intellectual Property (as revised)

[2] Know-how is technical, organizational, or commercial data obtained with the use of experience and upon trials of technology and its components, which are: closely held (not a part of general knowledge or available for public) on the date of license agreement; essential, i.e. important and useful for manufacture of products, manufacturing process, and/or provision of services; and elaborate i.e. detailed and complicated enough to verify their compliance with the criteria of being never-before-known and essential (Clause 1 of the Law of Ukraine on the State Regulation of Technology Transfer Activities)

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