

# METABOLITES AND CORRECTION OF METABOLIC PROCESSES

## AGE DIFFERENCES OF LIPID AND LIPOPROTEIN METABOLISM IN MALE SYRIAN HAMSTERS UNDER THE HIGH-CALORIC DIET

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Unbalanced or high-caloric diet can cause numerous pathologies, including the metabolic syndrome. The metabolic syndrome is a complex of hormonal and metabolic disorders that have pro-atherogenous complications. The major factor of that is the alteration in blood lipoprotein profile.

The aim of the research was to investigate changes in lipoprotein metabolism indices under experimental metabolic syndrome model.

Activities of key enzymes of lipogenesis and lipoprotein content were measured in liver homogenates on male Syrian hamsters fed with high-caloric diet.

Despite more favorable blood serum lipid profile of animals at the age of 4 weeks, after being fed by high-caloric diet subsequent metabolic syndrome and dyslipidemia develops in all animals regardless of age. An increase in triglycerides level in blood under the metabolic syndrome is a key factor in atherogenic dyslipidemia formation. We established direct correlation between the levels of free fatty acids in blood serum of the animals receiving

a high-energy diet and ApoB-lipoproteins in the liver. Free fatty acids levels also correlate with triglycerides and ApoB-lipoproteins in blood serum of experimental animals. Hydrolysis of triglycerides in high-density lipoprotein particles by hepatic lipase leads to their rapid removal from blood circulation. We also observed the decrease of lipoprotein lipase activity in blood serum of young hamsters that were fed with high-caloric diet. We established that hepatic lipase activity in blood serum of the experimental hamsters was increased regardless of age. The increase of hepatic lipase activity is one of key factors in development of an atherogenic dyslipidemia under the obesity and metabolic syndrome.

Lipoprotein profile of male hamsters gets less favorable with age. Increased levels of free fatty acids and triglycerides, as well as decreased levels of cholesterol-rich high-density lipoproteins were observed in hamsters under the experimental metabolic syndrome. Under the high-caloric diet atherogenic dyslipidemia develops in experimental animals regardless of age.

## THE EFFECT OF N-STEAROYLETHANOLAMINE ON ADIPOCYTES FREE FATTY ACIDS COMPOSITION AND PLASMA LEPTIN OF RATS WITH OBESITY-INDUCED INSULIN RESISTANCE

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Obesity is a complex metabolic disorder often associated with insulin resistance (IR) as well as type 2 diabetes. Chronic hypernutrition and high fat diet rich in saturated fatty acids leads to molecular changes in insulin sensitive tissues (the liver, muscle and adipose tissue), impairment in insulin signaling and following dyslipidemia. Leptin is an important adipose tissue-derived hormone that has been shown to be involved in pathophysiological mechanisms of diabetes. That is why the aim of our study was to investigate the free fatty acid (FFA) composition of adipocytes and plasma leptin level of obesity-induced IR rats and its changes induced by the N-stearoylethanolamine (NSE)

The experimental model was induced by the 6-month high-fat-diet (HFD). NSE was administered as water suspension per os at a dosage 50 mg/kg of body weight daily during 2 weeks. Adipocytes were isolated from abdominal fat using Type 1 Collagenase solution. Adipocytes lipid extract was separated on the fractions by thin-layer chromatography. Free fatty acids composition was analyzed by gas-liquid chromatography. The fatty acids desaturase activity  $\Delta 9$ -D was estimated using product-to precursor index (oleinic/stearic acids ratio). Plasma leptin level

was measured using ELISA. Experimental data were processed statistically using Student's *t*-test. The statistical significance was determined for  $P < 0.05$ .

The investigation of FFA content demonstrated that the content of saturated FFA significantly increased in adipocytes of obese IR rats compared to control. The assay of unsaturated FFA showed a statistically significant growth in monounsaturated and bi-unsaturated FFA content whereas the level of polyunsaturated FFA decreased dramatically in IR-group in comparison to control. The plasma leptin content growth was also observed in IR rats in comparison to control. NSE administration had a considerable effect on normalization of FFA composition and caused statistically significant decrease in plasma leptin level in IR rats.

It was demonstrated, that obesity-induced IR caused by prolonged HFD leads to impairment in adipocytes FFA profile and is followed by the considerable increase of leptin content in plasma. As far as NSE administration normalized FFA composition of adipocytes and plasma leptin level, we can consider NSE as a prospective agent for the treatment of obesity.

**STRAINS *PSEUDOMONAS FLUORESCENS* ONU541,  
*BACILLUS MEGATERIUM* ONU542 ARE PROMISING  
PRODUCERS OF SURFACE-ACTIVE METABOLITES  
AND DESTRUCTORS OF PETROLEUM PRODUCTS**

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**M**ethods for eliminating oil pollution, based on their decomposition by non-pathogenic microorganisms, are recognized as effective and ecologically safe. The degree of purification is increased in the case of the production of biosurfactants by microorganisms. The urgent task of ecobiotechnology remains the search for new oil-oxidizing microorganisms capable of producing biosurfactants on a cheap nutrient medium. The purpose of the work is to screen microorganisms isolated from the oil-contaminated soil of Zmiiny Island, promising in the biotechnological plan for the production of surface-active metabolites and the destruction of petroleum hydrocarbons.

Screening of microorganisms is carried out to reduce the equilibrium value of surface tension (Wilhelmi method) of liquid bacterial cultures and the appearance of emulsified capacity of their supernatants, by ability to destroy petroleum hydrocarbons. The ability of microorganisms to produce biosurfactants is evaluated depending on the presence of organic components (peptone, yeast extract, glucose) in M-9 medium. Biotechnologically promising non-pathogenic strains of microorganisms for the comparative analysis of their fatty acid profiles using the Sherlock MIDI system are identified as *Pseudomonas fluorescens* ONU541, *Bacillus megaterium* ONU542. The residual content of petroleum hydrocarbons in bacterial suspensions is determined by

IR spectrometry in the wave number range of 2700-3200 cm<sup>-1</sup>. Results. Strains *P. fluorescens* ONU541, *B. megaterium* ONU542 in medium M-9 in the absence of peptone and yeast extract in its composition for five days produce metabolites with surface-active properties to a greater degree than in the presence of these organic components. This ability for soil strains of *P. fluorescens* ONU541, *B. megaterium* ONU542 increases from 12.1 to 28.9% and from 17.2 to 28.0%, respectively. It has been established that the strain *P. fluorescens* ONU541 produces both cell-bound and extracellular biosurfactants, *B. megaterium* ONU542 strain is mainly extracellular biosurfactants. The emulsified properties of the supernatants obtained, estimated by the emulsification index (E24,%), are high and in relation to sunflower oil make over 50%. An experimental test of the ability of selected strains to utilize petroleum hydrocarbons with an initial concentration of 1000 mg/l showed that both strains, when cultured in M-9 medium, decompose oil hydrocarbons for 30 days at 30 °C by 60.3-74.6% taking into account the correction for control samples.

The isolated non-pathogenic strains identified by the fatty acid composition of cellular lipids as *P. fluorescens* ONU541, *B. megaterium* ONU542, can be recommended for use in biotechnologies of environmental purification from chronic oil contamination.

## SCREENING OF MARINE MICROORGANISMS RESISTANT TO ACTION OF DECA (ETHYLENE GLYCOL) MONOOCTYLPHENOL ETHER

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Synthetic surfactants are a part of all domestic and most industrial wastewater. 95-98% of the total amount of detergents used in Ukraine are synthetic detergents based on surfactant mixtures, which, as a rule, are characterized by low biological decomposition and because of their chemical nature have a negative impact on water bodies. Getting into water, synthetic surfactants actively participate in the processes of redistribution and transformation of other pollutants, activating their toxic effect. Therefore, for today, the actual task of biotechnologists remains the search for new microorganisms with increased resistance to these compounds and the ability to destroy them. The purpose of this work is to screen microorganisms isolated from the sea water of the Odesa coast in the zone of splash (psammoconture), resistant to the action of deca (ethylene glycol) monoethylphenol ether (nonionic surfactant, Triton X-100) in 2016, and to carry out biotechnological indicators for selection of the most active strains of microorganisms-destructors of compounds with phenolic fragments.

To isolate a specific microbiota, a "hungry" agar was used, in which Triton X-100 was added at a concentration of 1%. The cultivation was carried out at a temperature of 30 °C for 30 days. The presence of growth on Petri dishes and the zones of medium enlightenment indicated not only the stability of strains to Triton X-100, but also indicators of destructive activity-the ability of microorganisms to use a surfactant as the sole carbon source.

The results of the research indicate that strains Nos. 64 and 65, isolated from the pore water of the psammocontura in the area of discharge of urban wastewater into the Black Sea aquarium, exhibited a high level of resistance and destructive activity with respect to Triton X-100. After 7 days, on the nutrient medium containing a nonionic surfactant, the appearance of bacterial colonies was registered in an amount of 3-9 colony-forming units, respectively, after 10 days their number increased 4-7 times, and after 30 days reached 58 (strain No. 64) and 83 colony-forming units (strain No. 65). Among the strains (Nos. 66-68) isolated from the pore water of the psammoconture in a relatively clean area of the water area (at the Hydrobiological Station), only strain No. 66 had a high destructive potential with respect to Triton X-100 in comparison with strains No. 67 and No. 68. The number of colonies grown on "hungry" agar on the 30<sup>th</sup> day of cultivation of strain No. 66 reached 42 colony-forming units.

The screening of microorganisms isolated in 2016 from the coastal zones of the Black Sea made it possible to select three biochemically active strains (No. 64, No. 65, No. 66) resistant to deca (ethylene glycol) monoethylphenol ether. Selected strains of microorganisms are non-pathogenic, can be used in biotechnologies for cleaning the environment from nonionic surfactants and other organic compounds with phenolic fragments. Their identification is planned in the future.

## EFFECT OF MEAT RAW CONTAINING ONION SKIN EXTRACT AT BLOOD GLUCOSE AND HEART FUNCTION OF SPONTANEOUSLY HYPERTENSIVE RATS KEPT AT HIGH-FRUCTOSE DIET

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Arterial hypertension is compulsory component of the metabolic syndrome as well as abdominal obesity and hyperglycemia. Genetic predisposition and food habits are the main factors determining progress of arterial hypertension. Increased nutrition value of food and fast-digesting carbohydrates (glucose, fructose etc) induce changes of metabolism, thus, provoke metabolic syndrome. Additional changes are about to form namely endothelial dysfunction as soon as in young and middle age. However, individuals with metabolic syndrome not always change their diet and continue consume meat products like sausages and so on. Thus, development of new functional food product with antihypertensive effect is priority task for food industry. Quercetin is flavonoid with hypotensive effect that might be effectively extracted from onion skin that is secondary raw. We investigated the effects of meat raw with onion skin extract on glucose and heart function of isolated heart in spontaneously hypertensive rats (SHR) kept at high-fructose diet.

Five groups were studied: Wistar rats, SHR, SHR+fructose, SHR+fructose+meat with quercetin (2,25 mg per rat), SHR+fructose+meat with onion skin extract. Fructose was administered as 25%

solution in drinking water. Meat was administered *per os*, 1 g per rat daily for 3 month. After sacrificing the rats at the end of the treatment, glucose was measured in arterial blood. Rat isolated hearts were perfused by Langendorff preparation. Contractile function was evaluated as left ventricle developed pressure (LVDP) and its first derivative (dP/dt).

Glucose was higher in blood of SHR by 59% ( $8.84 \pm 0.3$  mmol/l) compared to Wistar ( $5.56 \pm 0.86$ ,  $P < 0.01$ ). Fructose supply increased glucose in SHR only by 5% ( $9.3 \pm 0.4$  mmol/l). Glucose level was not affected by quercetin; however, onion skin extract decreased the level of glucose by 14%. LVDP and dP/dtmax were significantly higher in SHR. Fructose decreased dP/dtmax and dP/dtmin by 20% and 21% respectively, increased coronary flow by 30% in SHR. However, onion skin extract as well as quercetin significantly decreased LVDP, dP/dtmax and heart work compared to SHR ( $P < 0.01$ ) normalizing these parameters to the values in Wistar rats.

Our data indicate that long-term intake of meat with onion skin extract is safe and reveal hypotensive and hypoglycemic potential that might be used for development of new functional food product.

## EFFECT OF FREE IODINE ON FREE-RADICAL OXIDATION IN BLOOD OF RATS WITH ALIMENTARY OBESITY

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Nowadays, obesity is one of the most common pathological conditions in the world and according to World Health Organization (WHO) the overweight bothers more than 30% of the planet. It is known that obesity occurs on a background of violations of all types of metabolism in the body, but especially of the lipid metabolism and later its exacerbate effect. Endocrine glands including thyroid, have a regulatory effect on the metabolism of lipids, lipolysis and lipogenesis process, controlling the use of lipids as energy material. Deficiency of thyroid hormones is common for the regions of endemic iodine deficiency. Iodine deficiency refers to the states that serve to develop of dyslipidemia, atherosclerosis, abdominal obesity, endothelial dysfunction and other complications. The consequence of reducing the synthesis of thyroid hormones due to iodine deficiency is a dysfunction of several organs and systems, including the immune, antioxidant and free-radical processes. Iodized salt, iodine-containing tablets and dietary supplements, which contain inorganic iodine in the form of iodide or iodate, are often used to prevent hypothyroidism. Biologically active iodine supplements as a part of food supplement of Jodis-concentrate, which is similar organic iodine and safe and effective for learning thyroid gland becomes more and more popular. Therefore, the aim of research was to determine some indicators of free-radical oxidation in the blood of rats with experimental alimentary obesity (EAO) on the impact of inorganic and biologically active iodine.

The study was conducted over 45 days on 24 white female Wistar rats weighing 160-180 g, which were divided into four groups of 6 animals each. The 1<sup>st</sup> group (a control group) animals had a typical diet. Animals of 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> groups had EAO (Maruschak, 2016). Animals of the 3<sup>rd</sup> group were intragastric administered in the form of inorganic iodine as potassium iodide in medicine "Iodomarin" (IM) as of 0.4 µg of potassium iodide per kg of body weight a day, and animals in group 4 received biologically active iodine in the composition of "Jodis-concentrate" (J-K) as of 0.1 ml (0.4 µg of iodine) per kg of body weight a day. The blood plasma of rats was studied and it was determined the concentration of conjugated diene (CD), TBA-active products (TBP) on the background of spectrophotometric method.

Changes of free radical oxidation were found in blood plasma of researched groups of rats compared to controls. Thus, on the 45<sup>th</sup> day of the experiment plasma of rats with EAO had CD content 1.36 times higher, and the content of TBP –1.42 times higher as compared to the control group. The contents of CD and TBP in the blood plasma of the 3<sup>rd</sup> group of animals (EAO + IM) decreased, respectively, 1.13 and 1.16 times, and the animals of 4<sup>th</sup> group (EAO + J-K) 1.24 times and 1.29 times compared to animals of the 2<sup>nd</sup> group (EAO). So, biologically active iodine in the composition "Jodis-K" largely reduces CD and TBP in the blood plasma of rats with EAO (the 4<sup>th</sup> group), inorganic iodine in the "Iodomarin" (the 3<sup>rd</sup> group).

## COLTSFOOT (*TUSSILAGO FARFARA*) FOR PHYTO-BIOREMEDIATION - DEVELOPING OF A PLANT RESEARCH MODEL

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The plant research model to investigate plant-bacteria-environment interactions under mercury contamination conditions was developed. The research sources of material were coltsfoot (*Tussilago farfara* L.), a mercury hyperaccumulator plant, and coltsfoot endosymbiotic bacteria. Plants were collected from areas uncontaminated or postindustrial, contaminated with Hg, and bacteria were isolated from coltsfoot tissues, respectively. The research covered: two-seasonal collecting of coltsfoot samples as well as obtaining callus tissue and organogenesis, analyses of Hg concentration in different plant organs, determination of antioxidant properties of tissues extracts; isolation and identification of endosymbiotic bacterial strains of *T. farfara* as well as optimization of their culturing conditions and determination of Hg resistance and growth kinetics with and without Hg.

The content of Hg in soil and in tissue of different organs collected in spring (inflorescence stem, rhizome) and autumn (young and old leaves) was measured by cold vapor atomic absorption spectroscopy (CVAAS). Obtained results showed, that coltsfoot tissues contain on average 0.14 mg Hg/kg

d.m. on uncontaminated and 82 mg Hg/kg d.m. on contaminated area, young leaves – 17 mg/kg d.m. and old leaves 72.5 mg/kg d.m. The antioxidant properties of contaminated and uncontaminated leaves were determined by ABTS<sup>•+</sup> radical cation decolorization assay. Results demonstrated that there were no statistically significant differences between antioxidant properties of tissue from uncontaminated and Hg contaminated areas and reached the values 52.0-55.5% inhibition/0.1 mg of d.m. The 14 strains of bacteria colonizing plant tissue were isolated. Isolates were identified by 16S rRNA sequencing and banked. The most of strains isolated from uncontaminated plants did not show the resistance to applied Hg concentration (0.01% (w/v)).

To determine the effect of selected endosymbionts on Hg hyperaccumulation, antioxidant properties as well as secondary metabolites production by *T. farfara*, callus and subsequently sterile *in vitro* plant culture were obtained. Callus induction of coltsfoot was performed on MS medium containing 2 mg/l Picloram+2 mg/l BAP. The organogenesis on MS including BAP resulted in obtaining plantlets, subsequently cultured on MS medium.

## ACCUMULATION OF ROS IN THE PRESENCE OF EXOGENOUS $H_2O_2$ IN HUMAN CORD BLOOD NUCLEATED CELLS DURING CRYOPRESERVATION

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**R**eactive oxygen species (ROS) are constantly generated under normal conditions in cellular metabolism. However, the cell has an extensive direct (interception) or indirect (oxidative damage reversal) antioxidant defense system for ROS inactivation. When the level of ROS exceeds the cell defense mechanisms and redox homeostasis is altered, the state of oxidative stress develops. In this state an accumulation of ROS high concentrations is observed and it can cause peroxidation of lipids, oxidation of proteins, damage to nucleic acids, enzyme inhibition, activation of programmed cell death pathway and ultimately leading to death of the cells.

Cryopreservation of cord blood (CB) units is the only way for long-term storage of hematopoietic stem cells (HSC) that is widely and successfully used in clinical practice for the treatment of many diseases. It is important to understand that homeostasis disruption can occur at each stage of cryopreservation technology: isolation of total nucleated cells (TNCs), which contain HSC, TNCs treatment with CPA and, especially, at freeze-thawing stage.

Thus, in this study, we assessed the redox state of TNCs at each stage of cryopreservation technology by monitoring of the intracellular ROS in the presence or absence of exogenous  $H_2O_2$ .

Dextran-isolated TNCs were cryopreserved with 5% DMSO. For redox state assessment, TNCs were incubated in the presence of 0.01 or 0.025 mM  $H_2O_2$ . Intracellular content of ROS was evaluated

by flow cytometry (FACS Calibur, BD, USA) using DCFH2-DA in terms of geometric mean fluorescence intensity (MFI).

It was shown that after 15 min of incubation of whole CB and dextran-isolated TNCs with different concentration of exogenous  $H_2O_2$  the MFI was reduced to the control level in non-treated samples. Further incubation with  $H_2O_2$  led to more pronounced rise in MFI versus the control: 1.8 times for CB and 3.0 times for isolated TNCs. For DMSO-treated TNCs, MFI decreasing was less pronounced in first 15 min and did not reach the control remaining 3-times higher level regardless of  $H_2O_2$  concentration. Continued incubation resulted in a 4-fold increase in the MFI versus the control level.

For freeze-thawing samples, a decrease in MFI index in first 15 min after  $H_2O_2$  adding was not observed. Moreover, the prolonged incubation with hydrogen peroxide led to MFI decline: from 3.5 to 1.9-fold for 0.01 mM  $H_2O_2$  and from 6.5 to 3.0-fold for 0.025 mM  $H_2O_2$ . This kind of cell response can indicate a delayed recovery of antioxidant defense system after cryopreservation. However, in the dynamics up to 45 min, the MFI index decreased to the control level in samples without exogenous  $H_2O_2$  and became comparable with MFI index in the whole CB.

Thus, cryopreservation did not result in a significant redox homeostasis disruption in CB TNCs and activity of antioxidant system remained at the level close to the control in the whole CB.

## MITOCHONDRIAL FUNCTION UNDER FRUCTOSE INTAKE IN SPONTANEOUSLY HYPERTENSIVE RATS

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**M**itochondrial membrane potential ( $\Delta\psi_m$ ) plays an important role in the functioning of cardiomyocytes as the motive force for ATP synthase, which provides the energy for the contraction and relaxation of the heart. The prolonged fructose intake increases the risk of metabolic diseases (diabetes, obesity, arterial hypertension, reduced mitochondrial biogenesis), however, the effect of short fructose intake is under debate. In our research, we studied the effect of fructose diet on function cardiac mitochondria of spontaneously hypertensive rats (SHR).

Our research was conducted on six-month-old male Wistar, SHR and SHR kept at 25% fructose in drinking water for 3 months. Cardiac mitochondrial then were isolated and incubated in the medium at 37 °C. Mitochondrial respiration was induced by sodium succinate addition and registered by Clark electrode. Mitochondrial membrane potential was measured with lipolytic cation methyltriphenylphosphonium (TPMP<sup>+</sup>) and TPMP<sup>+</sup>-sensitive electrode.  $\Delta\psi_m$  was calculated by the Nernst equation. Proton leak was titrated 3 times by sodium malonate additions. The ROS generation in mitochondria was measured: generation rate of superoxide radical ( $\cdot\text{O}_2^-$ ) was determined by oxidation of cytochrome c and

generation rate of hydroxyl radical ( $\cdot\text{OH}$ ) was measured using 2-deoxy-D-ribose. Data were analyzed by Mann-Whitney U-test.

$\Delta\psi_m$  of SHR cardiac mitochondria was significantly decreased ( $163 \pm 0.7$  mV vs  $169 \pm 1.3$  mV in Wistar,  $P < 0.01$ ), however, oxygen consumption did not changed indicating uncoupled oxidative phosphorylation. It was accompanied by increased ROS generation, namely  $\text{O}_2^-$  generation rate was  $9.7 \pm 1.7$  vs  $5.2 \pm 1.1$  nmoles/min/mg in Wistar,  $P < 0.05$ . Fructose intake significantly increased  $\Delta\psi_m$  of cardiac mitochondria of SHR ( $168.4 \pm 1.1$  mV,  $P < 0.01$ ) and improved oxygen utilization by decreasing oxygen consumption ( $167 \pm 6$  vs  $188.3 \pm 5.6$  nmoles  $\text{O}_2$ /mg protein/min in SHR,  $P < 0.05$ ). Additionally, ROS generation was attenuated under fructose intake:  $\text{O}_2^-$  generation rate was decreased ( $4.2 \pm 1.0$  vs  $9.7 \pm 1.7$  nmoles/min/mg in SHR) as well as  $\cdot\text{OH}$  generation rate ( $1.4 \pm 0.1$  vs  $3.5 \pm 0.4$  in SHR,  $P < 0.05$ ). Proton leak at 157 mV was  $87.5 \pm 6.4$  in Wistar,  $112 \pm 8$  in SHR and  $89.7 \pm 3.3$  nmoles  $\text{O}_2$ /mg protein/min under fructose intake,  $P < 0.05$ .

Thus, three months of fructose intake improves mitochondrial respiratory chain functioning and decreases of ROS generation in spontaneously hypertensive rats.

## BIOMARKERS FOR SPECIES-SPECIFIC DETECTION OF A SOIL STRAIN OF *BACILLUS MEGATERIUM* 22-DESTRUCTOR OF ORGANIC COMPOUNDS

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The progress of environmental biotechnology depends critically on the formation and constant replenishment of the stock of cultures of microorganisms possessing. The ability to decompose and utilize toxic compounds has been studied. The aim of the work is to offer reliable criteria - biomarkers for species-specific detection of a non-pathogenic strain of a microorganism isolated from an oil contaminated soil that has an oxidizing ability with respect to most organic compounds (petroleum products, synthetic surfactants, phenols).

The fatty acid analysis of the strain under investigation was carried out by comparing it with known standards using an automatic microorganism identification system Sherlock (MIDI, USA) based on the Agilent 7890 gas chromatograph (Agilent Technologies, USA).

The dominant in the fatty acid profile of the bacterial strain 22 were the isomers of saturated fatty acids (56.6%), of which 16.9% and 23.3% were the C13:0 and C15:0 isomers. The total content of isomers of saturated fatty acids with an odd number of carbon atoms in the hydrocarbon radical (43.3%) was 3.25 times higher than the total isomer content of saturated fatty acids with the even number of carbon atoms in the hydrocarbon radical (13.3%). Among the fatty acids of the normal structure, fatty acids with the even number of carbon atoms in the hydrocarbon radical are found, namely: lauric (dodecanoic) C12:0, myristic (tetradecanoic) C14:0 and

palmitic (hexadecanoic) acids C16:0 in an amount of 1.1, 6.6 and 2.6%. The fraction of the acids C13:0 anteiso and C15:0 anteiso from the total area of the peaks was 3.1 and 5.2%. With the total content of saturated fatty acids - 75.2% from the number of cellular lipids of the strain 22 under study, their exaggeration with respect to unsaturated fatty acids (17.8%) is quite noticeable. A characteristic feature is that with the same number of carbon atoms in the hydrocarbon radical (C16), the total proportion of saturated fatty acids C16:0 (2.6%) and C16:0 iso (4.8%) is 1.78 times less than the fraction of unsaturated C16 fatty acids: 1 w6c/C16:1 w7c (13.3%). The saturation factor (K<sub>nas</sub>), calculated from the ratio of total saturated fatty acids to unsaturated fatty acids, can serve as a biomarker value, for strain 22 it is 4.2. Biomarkers for detection of selected biochemically active strain 22 with organic compounds are hydroxy acid C15:0 2OH ( $\omega = 0.6\%$ ) and a fragment of hydroxy acid C14:0 3OH,  $\omega$  (C14:0 3OH/C16:1 iso I) = 3, 3%.

According to the obtained fatty acid composition, deciphered using the Library RTSBA6 6.21 program Version 6.2. Of the Sherlock MIDI system, the microorganism studied was identified with a high similarity index to the genus *Bacillus megaterium* 22. Reliable biomarkers were detected for species-specific detection of the soil strain of *B. megaterium* 22-destroyer of organic compounds.

## THE ROLE OF FERULIC ACID IN ELICITATION OF *TRITICUM AESTIVUM* RESISTANCE TO *SEPTORIA TRITICI* INFECTION

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Ferulic acid is an important compound for lignin biosynthesis. As an initiation site of plant cell wall structure it plays a key role in defense system against pathogenic agents. Ferulic acid also may be a biotic elicitor, the compound that activates nonspecific plant disease resistance to fungal infections. The usage of biotic elicitors for elicitation of defense responses may prevent increased environmental pollution by pesticides.

The aim of research was to analyze in field trials participation of ferulic acid in elicitation of winter wheat *Triticum aestivum* L. resistance to *Septoria tritici*.

Content of endogenous hydrogen peroxide, peroxidase, catalase and ascorbatperoxidase activities were measured in elicitor-treated and inoculated by *S. tritici* winter wheat plants (cv. Poliska 90) during different ontogenetic phases. The extent of disease development, morphometric parameters and yield structure were analyzed. The results were statistically analyzed by ANOVA.

The data obtained suggest that ferulic acid induced defense responses in winter wheat against

*S. tritici* blotch agent. Initiation of defense responses in elicitor-treated plants occurred shortly. Hydrogen peroxide content was enhanced in elicitor-treated plants. Ascorbatperoxidase activity also increased in last wheat leaves treated by ferulic acid and infected by *S. tritici*. But peroxidase activity decreased and catalase stabilized under ferulic acid action in last wheat leaves infected by *S. tritici*. It is shown that the effect of ferulic acid stimulated plant growth and development, increased the grain quantity of winter wheat cv. Poliska 90 in field trials. It is estimated by Saari-Prescott scale that the ferulic acid influence decreased disease symptoms in winter wheat plants and enhanced the *Triticum aestivum* resistance *Septoria tritici* infection.

Ferulic acid could be used as biotic elicitor. Elicitation of biochemical nature of induced defense responses revealed the increased hydrogen peroxide content and changes of antioxidant enzyme activities for redox signal transduction, plant defense responses, lignin biosynthesis and mechanical strengthening of the plant cell walls.