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THE EFFECT OF MAGNETC FIELD TREATMENT *ON CARBOHYDRATE FERMENTATION BY YEAST* SACCHAROMYCES CEREVISIAE

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Обработка дрожжевых культур с использованием магнитного поля дает возможность лучше понять действие магнитного поля на активность ферментов дрожжевых культур а также на колебания концентрации макро- и микроэлементов.

Перед и после обработки магнитным полем определяли в суспензиях дрожжевых культур показатели азотного, белкового, углеводного, жирового метаболизма и активность ферментов.

При биохимическом исследовании отмечалось снижение активности ферментов, концентрация макро- и микроэлементов после обработки магнитным полем, концентрация триглицеридов и мочевины после обработки магнитным полем также резко снижалась. Концентрация глюкозы оставалась стабильной без тенденции к снижению. Обработка магнитным полем культур дрожжей вида Saccharomyces cerevisiae проводилась в течение 840 секунд при магнитной модуляции 3,3 мТ (миллитесл) и вращении магнитного поля 100 Гц в результате чего доказана неэффективность такой обработки для процесса брожения, поскольку ингибирование активности ферментов, делает процесс брожения невозможным.

Обработка магнитным полем, дрожжевые культруы, Saccharomyces cerevisiae, ферменты, брожение.

Spontaneous fermentation of grape must is always accompanied with complex biochemical reactions such as carbohydrates transformation into ethyl alcohol and carbon dioxide. The mechanism of such processes starts up due to the yeast enzymes produced during their reproduction in cultural solution. Together with bacteria and fungi the yeasts are located on the skin of ripe grapes. In anaerobic conditions yeast enzymes participate in the process of grape must transformation into ethyl alcohol, carbon dioxide and other products [2, 3, 9]. All of this play an important role in the technology of making high quality natural wine. Taste and wine delicate aroma depend on the yeast culture which used in the fermentation process of winemaking.

The products of primary fermentation are aromas and flavours, the gas carbon dioxide, and heat. The production of heat during fermentation (it is an exothermic process) means that during fermentation the temperature of the fermentation vessel will rise, and will require action on the part of the winemaker to cool it down up to optimal temperature.

White grape must fermentation is usually conducted in the range of 8–19^{0}C, and red must fermentions typically are allowed to run at between 25 and 32^{0}C. At temperatures higher than this, there can be a loss of desirable aroma and flavour compounds.

In nature, there are different wild yeast species that are able to participate in the process of grape must fermentation as well. Therefore our task was to determine enzyme activity, concentration of macro- and microelements and some other parameters of cellular mehabolism including nitric, protein, carbohydrate and lipid metabolism of isolated yeast species. Pure yeast culture makes biotechnological process more controllable and for this reason it is more preferable in wine industry.

Pure yeast cultures resistant to ethyl alcohol, acid and potassium sulphite, provide possibility for fermentation of grape must even in unusual, extreme conditions [7, 8, 11].

Specific difference in yeast cultures plays an important role in receiving wine with high quality. The grape must possess yeast strains with high zymotic activity [6, 7, 10].

The aim of this research was to study the effect of magnetic field treatment to yeast cultures *S*accharomyces cerevisiae before and after magnetic field treatment. For this purposes it was determined activity for some enzymes, concentration of macro- and microelements and some other parameters of yeast metabolism.

MATERIALS AND METHODS

Samples from different industrial grape varieties were collected during the season of vintage from vineyard of winery Company «Koblevo», Nikolaev`s region. The total amount of the varieties which were selected for the research was fourteen. The following industrial varieties of grape were selected for the research: Chardonnay, Cabernet Sauvignon, Merlot, Sauvignon, Wrestling Rhenish, Aligote, Rkatsiteli, Bastardo, Traminer, Irshai Oliver, Muscat Ottonel, Hamburg`s Muscat, Fetyaska, Isabella.

The grape sorts were cultivated on the soils in the district located between Black See and Tiligul estuary.

The grape must made from different grape varieties was placed into the sterile glass flasks to half volume. Each flask was carefully closed with a rubber stopper with an injection needle in it. During the

fermentation process it was necessary to remove carbon dioxide, which was a result of active anaerobic fermentation processes in grape must. At the end of grape must fermentation pure yeast cultures were isolated using traditional microbiological methods [2] by consistent inoculation of a sample into Petri dish with a few modifications of nutrient selective agar for yeast isolation and cultivation. Primary yeast isolation was done on Inhibitory Mold Agar medium, (Becton Dickinson Company, USA). The yeast culture morphological properties were checked after the primary yeast culture isolation. Yeasts were identified by polymerase chain reaction (PCR) using universal yeast primers [20, 11]. After yeast cultures identification the next step yeast cultivation was done on Wort Agar medium (Becton Dickinson Company, USA). Each isolated yeast culture after identification was deposited in the NRRL Culture Collection (Nord Regional Research Laboratory), Peoria, USA and in British National Collection of Yeast Culture (NCYC), Norwich, UK. For yeast isolate identification it was used amplification of ITS1– 5,8S – ITS1–2b and D1-D2 26S genome locus fragments that code ribosomal RNA with the next direct sequencing of received DNA fragments [3].

It was done in cooperation with Dr. Maxim Filipenko, Head the Laboratory of Pharmacogenomics, Research Institute of Chemical Biology and Fundamental Medicine, Novosibirsk, Russia and their Sequencing Center.

After PCR identification of yeast species as *Saccharomyces cerevisiae*, each isolated yeast culture was tested for mating type also by PCR in cooperation with Dr. Yoshinobu Kaneko, Department Biotechnology, Osaka University, Japan. As soon as it was specified, the mating type for each yeast culture, also their morphological, physiological and biochemical properties were determined.

Each yeast culture were tested for technological characteristics such as growth resistance at high temperature +42°C and low temperature 6–8 °C, growth at low pH 2.6–3.0 (acid resistance), growth at the presence of 5, 10, 15% of ethyl alcohol (ethyl alcohol resistance), growth at the presence of high sulfite concentration (sulfite resistance), hydrosulfide synthesis (production, gassing) were studied as well.

Magnetic field treatment of yeast Saccharomyces cerevisiae was made with magnetic field induction 3,3 Milli Tesla-level at magnetic field rotation frequency 100 Hz. Such basic power rating of magnetic induction makes magnetic field treatment efficient for yeast research. It was used for yeast cultures magnetic field treatment at 3,3 Milli Tesla-level. It was used magnetic field device the “Magnetor” model. Total number of conducted magnetic field yeast treatments was 10 performed with an interval of 24-48 hours between the treatments [1, 4, 5].

Magnetic field treatment used for yeast cultures *Saccharomyces cerevisiae* was performed with magnetic field inductor, the “Magnetor” model [6, 8].

Magnetic field treatment during use for yeast culture *Saccharomyces cerevisiae* treatment worked at the streaming conditions with magnetic field induction of 3.3 Milli Tesla-level *and magnetic field rotation frequency 100 Hz*. Total time of exposure was at 840 sec for one procedure by stepwise [7].

Total number of magnetic field treatments was 10 with an interval of 24–48 hours between yeast magnetic field treatments.

Enzyme activity was t-tested, concentration of macro- and microelements and some other parameters which include nitric, protein, carbohydrate and lipid cellular mehabolism of isolated yeast species including control tests. For testing parameters activity of the following enzymes was determined: Lactate dehydrogenase, Phosphatase, Amylase, Cholinesterase, Glucose-6-phosphatedehydrogenase, Transferase to such aminoacids as Alanine, Aspartate, Glutamine was determined as well. In addition parameters of macro- and microelements and protein (total), glucose, triglycerides, urea were studied. All the above listed parameters are based on a principle of spectrophotometric analysis and made using biochemical analyzer Cobas, which produce (Hoffman La Roche Company, Switzerland). All tests were conducted using specific test kits for each studied parameter. The kits were made by the (BioSystems Company S.A. Costa Brava, Spain). It was used the kits made by the (Sentinel Company, Italy) for the Glucose-6-phosphate dehydrogenase testing, and by (Pliva Lachema Diagnostika, Brno, Czech Republic) for the Chlorides and Cholinesterase testing.

Statisitical deviation and significance of difference was evaluated by Student`s t-test with coefficient ($P<0,05$). Also it was calculated Spearman's rank correlation coefficient for the tested biochemical parameters before, 16 and 40 hours after magnetic field treatment.

RESULTS AND DISCUSSION

Refreshed yeast cultures were inoculated into glass test tubes contained pure 20 % solution of D-glucose and it was tested yeast suspensions before and after 16 and 40 hours of magnetic field treatment of yeast cultures. The following parameters were tested: Protein (total), Glucose, Triglycerides, Urea, Calcium, Phosphorus, Magnesium, Iron, Chlorides.

The following enzyme activity was tested: Lactate dehydrogenase, Phosphatase, Amylase, Cholinesterase, Glucose-6-phosphatedehydrogenase, Transferase to such aminoacids as Alanine, Aspartate, Glutamine was determined as well. All the above listed parameters are based on a principle of spectrophotometric analysis and made using biochemical analyzer Cobas, which produce (Hoffman La Roche Company, Switzerland). All the tests were conducted using specific test kits for each studied parameter. The kits were made by the (BioSystems Company S.A. Costa Brava, Spain). It was used the kits made by the (Sentinel Company, Italy) for the Glucose-6-phosphate dehydrogenase testing, and by (Pliva Lachema Diagnostika, Brno, Czech Republic) for the Chlorides and Cholinesterase testing [2, 13, 15].

The most perspective yeast cultures used for biotechnology of wine making were chosen for the further research associated with their graded adaptation to ultra violet, magnetic, infrared, red and green spectrum of laser treatment [4, 5]. The purpose was to make selection for further use in biotechnology of wine making.

ALP – Phosphatase (alkaline).

ALT – Alanine aminotransferase.

AST – Aspartate aminotransferase.

AmL – Amylase.

CHE – Cholinesterase.

G6PDH – Glucose-6-phosphatdehydrogenase.

γ-GT – gamma-glutamyltransferase.

LDH – Lactate Dehydrogenase.

1 μmol – it is enzyme activity catalized transformation substrate during 1 min.

1 enzyme unit/L equivalent to 0.0166 μkat/L.

1 Unit = 1 μmol/min = 1/60 μmol/sec = 1/60 μkat = 16,6 nkat.

Table 1 – Enzyme activity for yeast cultures *Saccharomyces cerevisiae* before, 16 and 40 hours after magnetic field treatment.

Name of Enzyme µmol/ (min x L)	Yeast suspension without treatment (control)					Yeast suspension 16 hours after magnetic field treatment					Yeast suspension 40 hours after magnetic field treatment				
	Aligote	Bastardo	Cabernet	Chardonney	Irshai Oliver	Aligote	Bastardo	Cabernet	Chardonney	Irshai Oliver	Aligote	Bastardo	Cabernet	Chardonney	Irshai Oliver
Alanine aminotrans-ferase, µmol/min x 10^{-2}L	16,6± 0,4	83,0± 2,0	75,9± 0,6	107,9± 1,8	81,3± 0,5	3,32± 0,2	6,6± 0,2	11,6± 0,4	16,6± 0,2	4,9± 0,3	1,6± 0,2	1,6± 0,1	1,6± 0,1	3,3± 0,2	1,6± 0,2
Aspartate aminotrans-ferase, µmol/min x 10^{-2}L	14,9± 0,3	64,7± 0,4	141,1±0 ,3	66,4± 0,3	49,8± 0,3	3,9± 0,3	6,6± 0,2	3,3± 0,2	3,3± 0,2	3,3± 0,2	1,6± 0,2	3,3± 0,2	4,9± 0,3	3,3± 0,2	4,9± 0,2
Amylase, µmol/(min x 10^{-2}L	69,2± 0,5	50,9± 1,2	175,9± 1,2	149,4± 0,6	116,2± 0,9	3,9± 0,4	0,99± 0,08	0,83± 0,02	1,49± 0,1	1,32± 0,05	7,80± 0,5	6,47± 0,04	4,48± 0,7	3,48± 0,1	1,82± 0,03
Cholineste-rase, µmol/min x 10^{-2}L	58,1±0 ,9	83,0±0, 5	74,7±0, 7	16,6±0,4	33,2±0 ,2	16,6±0 ,7	19,9±0, 5	14,9±0, 5	13,2± 0,3	11,6±0 ,4	8,3± 0,2	6,6±0,4	3,3±0,2	4,9±0,5	6,6±0 ,2
Gamma-glutamyl transferase, µmol/min x 10^{-2}L	18,2± 0,7	1,6± 0,2	6,6± 0,2	1,6± 0,2	6,6± 0,2	9,9± 0,6	9,9± 0,8	8,3± 0,2	8,3± 0,2	4,9,± 0,5	3,3± 0,2	4,9± 0,4	1,6± 0,2	3,3± 0,2	4,9± 0,3
Glucose-6-phosphatedehydrogenase, µmol/min x 10^{-2}L	49,9± 0,8	23,2± 0,2	19,9± 0,7	24,9± 0,4	39,8± 0,4	8,3± 0,2	4,9± 0,2	6,6± 0,2	8,3± 0,2	3,3± 0,2	1,6± 0,1	4,9± 0,4	3,3± 0,2	6,6± 0,2	3,3± 0,1
Lactate dehydrogenase, µmol/min x 10^{-2}L	16,6± 0,2	33,2± 0,2	58,1± 0,3	49,8± 0,8	66,4± 0,3	1,6± 0,2	6,6± 0,2	8,3± 0,2	4,9± 0,3	3,3± 0,2	6,6± 0,2	8,3± 0,1	4,9± 0,3	3,3± 0,2	1,6± 0,2
Phosphatase (alcaline), µmol/min x 10^{-2}L	16,6± 0,4	58,1± 0,1	83,0± 0,3	49,8± 0,5	58,1± 0,2	83,0± 0,1	33,2± 0,2	53,1± 0,2	39,8± 0,5	44,8± 0,2	3,3± 0,2	1,6± 0,2	4,9± 0,3	3,3± 0,2	1,6± 0,2

Standard deviation was calculated, and statistical significance of difference was evaluated by Student`s t-test ($P<0,05$)

Table 2 – Macro- and microelements concentration and some other parameters of carbohydrate, protein and lipide metabolism in yeast cultures *Saccharomyces cerevisiae* before, after 16 and 40 hours magnetic field treatment

Tested parameter	Yeast suspension without treatment (control)					Yeast suspension 16 hours after magnetic field treatment					Yeast suspension 40 hours after magnetic field treatment				
	Aligote	Bastardo	Cabernet	Chardonney	Irshai Oliver	Aligote	Bastardo	Cabernet	Chardonney	Irshai Oliver	Aligote	Bastardo	Cabernet	Chardonney	Irshai Oliver
Calcium, mmol/L	12,06±0,4	14,63±0,1	16,26±0,2	15,86 ±0,3	14,04±0,1	0,91±0,03	0,74±0,05	0,80±0,04	0,93±0,05	0,82 ± 0,04	1,91±0,03	1,47±0,07	1,70±0,06	1,24±0,04	1,55 ± 0,04
Phospho-rus mmol/L	0,81±0,03	2,08±0,09	1,13±0,01	1,40±0,1	1,32±0,02	0,22±0,01	0,21±0,01	0,24±0,01	0,30±0,02	0,26 ± 0,02	0,06±0,01	0,1±0,01	0,09±0,01	0,08±0,02	0,19 ± 0,02
Magnesium mmol/L	0,51±0,03	8,44±0,03	9,22±0,07	9,82±0,04	8,56±0,04	0,07±0,003	0,06±0,003	0,07±0,005	0,08±0,003	0,04 ± 0,005	0,10±0,005	0,24±0,02	0,18±0,01	0,30±0,01	0,25 ± 0,02
Iron µmol/L	16,0±0,2	30,0±0,6	57,0±0,4	44,0±0,2	37,9±0,5	8,4±0,1	3,9±0,3	5,0±0,2	4,7±0,2	6,1±0,2	1,0±0,1	0,9±0,1	2,0±0,2	1,3±0,1	0,8±0,1
Chlorides mmol/L	142,2±3,4	546,7±4,0	514,2±1,0	588,7±3,3	485,3±2,2	7,1±0,2	5,4±0,2	2,1±0,2	4,2±0,2	3,0±0,1	0,9±0,02	0,5±0,04	0,8±0,02	0,8±0,01	0,4±0,02
Protein (total) g/L	0,3±0,02	0,1±0,005	0,1±0,005	0,2±0,01	0,2±0,01	0,3±0,02	0,3±0,03	0,1±0,005	0,5±0,04	0,3±0,03	0,02±0,003	0,3±0,02	0,3±0,04	0,6±0,03	0,1 0,003
Glucose mmol/L	10,8±0,4	12,53±0,04	11,67±0,09	11,41 ±0,03	9,79 ±0,11	9,59 ±0,05	8,53 ±0,07	7,72 ±0,1	9,17 ±0,1	9,55 ± 0,1	12,14±0,8	10,54±0,5	12,04±0,1	11,40±0,3	13,48 ± 0,2
Triglycerides mmol/L	5,90±0,5	13,55±0,1	15,61±0,3	13,86±0,2	15,89±0,1	4,71±0,1	4,64 0,1	4,60 0,1	4,59 0,04	4,65 0,04	4,78±0,06	4,75±0,06	4,71±0,06	4,69±0,2	4,52 ± 0,05
Urea mmol/L	0,52±0,03	0,70±0,02	0,38±0,01	0,91±0,02	0,64±0,03	3,25 0,03	3,30 0,2	2,32 0,03	0,70 0,03	1,49 0,06	1,70±0,02	1,52±0,06	1,31±0,02	1,26±0,03	1,58 ± 0,04

Standard deviation was calculated, and statistical significance of difference was evaluated by Student`s t-test ($P<0,05$)

It was determined that magnetic field treatment of yeast culture *Saccharomyces cerevisiae* inhibits activity for such enzymes as: Lactate dehydrogenase, Transferases by aminiacids: alanine, aspartate, glutamine [2]. Contrary treatment with magnetic field after 16 hours stimulate activity for such enzyme as Phosphatase and Cholinesterase. All other parameters compare with a control without magnetic field treatment are low. Concentration for macro- and microelements 16 hours after magnetic field treatment low including concentration of calcium, phosphorus, magnesium, iron and chlorides.

Concentration for macro- and microelements 40 hours after magnetic field treatment still is low, but some parameters increased including concentration of calcium and magnesium. For concentration of phosphorus, iron and chlorides decreasing still continue [12, 14].

Enzyme activity before magnetic field treatment and 16 and 40 hours after magnetic field treatment of yeast cultures *Saccharomyces cerevisiae* showed that fermentation of grape must inhibits [10, 15] after such magnetic field treatment, see tab.1.

Concentration of protein (total), glucose, triglycerides before magnetic field treatment, 16 and 40 hours after magnetic field treatment of yeast cultures *Saccharomyces cerevisiae* showed some variety, see tab. 2.

The author analyzed the data using Spearman's rank correlation coefficient, which converts the measurement variables to ranks, and the relationship between the variables which is significant.

The alanine aminotransferase activity after 16 hours magnetic field treatment twice decreased compare with enzyme activity without magnetic field treatment and then after 40 hours magnetic field treatment again activity twice decreased. Spearman's rank correlation coefficient before and 16 hours after: (Rs=0,70 moderate correlation, (P=0,05), before and 40 hours: (Rs=0,70, P=0,05), 16 hours and 40 hours after treatment: (Rs=0,71, P=0,05).

The aspartate aminotransferase activity after 16 hours magnetic field treatment trice decreased compare with enzyme activity without magnetic field treatment and then after 40 hours magnetic field treatment again activity twice decreased. Spearman's rank correlation coefficient before and 16 hours after: (Rs= -0,44, P=0,05), before and 40 hours after: (Rs=0,52, P=0,05), after 16 and 40 hours treatment: (Rs= -0,05, P=0,05).

The amylase activity after 16 hours magnetic field treatment very decreased compare with enzyme activity without magnetic field treatment and then after 40 hours magnetic field treatment again activity a bit increased. Spearman's rank correlation coefficient before and 16 hours after: (Rs= -0,30, P=0,05), before and 40 hours after: (Rs= -0,5, P=0,05), 16 and 40 hours after treatment: (Rs= 0,2, P=0,05).

The cholinesterase activity after 16 hours magnetic field treatment trice decreased compare with enzyme activity without magnetic field treatment and then after 40 hours magnetic field treatment again twice activity decreased.

Spearman's rank correlation coefficient before and 16 hours after: (Rs= 0,8 high correlation, P=0,05), before and 40 hours after: (Rs= 0,05, P=0,05), 16 and 40 hours after treatment: (Rs= 0,31, P=0,05).

The gamma-glutamyltransferase activity after 16 hours magnetic field treatment twice increased compare with enzyme activity without magnetic field treatment and then after 40 hours magnetic field treatment again twice activity decreased.

Spearman's rank correlation coefficient before and 16 hours after: (Rs= 0,02, P=0,05), before and 40 hours after: (Rs= -0,3, P=0,05), 16 and 40 hours after treatment: (Rs= -0,03, P=0,05).

The glucose-6-phosphatedehydrogenase activity after 16 hours magnetic field treatment in 3-4 times decreased compare with enzyme activity without magnetic field treatment and then after 40 hours magnetic field treatment again activity decreased.

Spearman's rank correlation coefficient before and 16 hours after: (Rs= 0,2, P=0,05), before and 40 hours after: (Rs= -0,46, P=0,05), 16 and 40 hours after treatment: (Rs= 0,01, P=0,05).

The lactate dehydrogenase activity after 16 hours magnetic field treatment trice decreased compare with enzyme activity without magnetic field treatment and then after 40 hours magnetic field treatment activity was stable decreased.

Spearman's rank correlation coefficient before and 16 hours after: (Rs= 0,3, P=0,05), before and 40 hours after: (Rs= -0,8, P=0,05), 16 and 40 hours after treatment: (Rs= 0,2, P=0,05).

The phosphatase (alcaline) activity after 16 hours magnetic field treatment increased and was high compare with enzyme activity without magnetic field treatment and then after 40 hours magnetic field treatment activity was very decreased in 20-35 times.

Spearman's rank correlation coefficient before and 16 hours after: (Rs= -0,2, P=0,05), before and 40 hours after: (Rs= 0,11, P=0,05), 16 and 40 hours after treatment: (Rs= 0,58, P=0,05).

Comparative analysis before magnetic field treatment, tested result between concentrations of calcium and chlorides, Spearman's rank correlation coefficient: (Rs=0,7 moderate correlation, P=0,05).

Comparative analysis before magnetic field treatment, tested result between concentrations of chlorides and iron, Spearman's rank correlation coefficient: (Rs=0,5, P=0,05).

Comparative analysis before magnetic field treatment, tested result between concentrations of magnesium and chlorides, Spearman's rank correlation coefficient: (Rs=0,7 moderate correlation, P=0,05).

The calcium concentration after 16 hours magnetic field treatment decreased and then after 40 hours magnetic field treatment again increased. Spearman's rank correlation coefficient before and 16 hours after: (Rs= -0,2, P=0,05), before and 40 hours after: (Rs= -0,4, P=0,05), 16 and 40 hours after treatment: (Rs= -0,1, P=0,05).

The phosphorus concentration after 16 hours magnetic field treatment decreased and then after 40 hours magnetic field treatment again decreased. Spearman's rank correlation coefficient before and 16 hours after: (Rs= 0,01, P=0,05), before and 40 hours after: (Rs= 0,5, P=0,05), 16 and 40 hours after treatment: (Rs= 0,01, P=0,05).

The magnesium concentration after 16 hours magnetic field treatment very decreased and then after 40 hours magnetic field treatment again increased. Spearman's rank correlation coefficient before and 16 hours after: (Rs= 0,46, P=0,05), before and 40 hours after: (Rs= 0,70, P=0,05), 16 and 40 hours after treatment: (Rs= 0,05, P=0,05).

The iron concentration after 16 hours magnetic field treatment very decreased and then after 40 hours magnetic field treatment again decreased. Spearman's rank correlation coefficient before and 16 hours after: (Rs= -0,30, P=0,05), before and 40 hours after: (Rs= 0,60, P=0,05), 16 and 40 hours after treatment: (Rs= -0,10, P=0,05).

The chlorides concentration after 16 hours magnetic field treatment very decreased and then after 40 hours magnetic field treatment again decreased. Spearman's rank correlation coefficient before and 16 hours after: (Rs= -0,2, P=0,05), before and 40 hours after: (Rs= 0,21, P=0,05), 16 and 40 hours after treatment: (Rs= 0,41, P=0,05).

The glucose concentration after 16 hours magnetic field treatment a bit decreased, and then after 40 hours magnetic field treatment was stable. Spearman's rank correlation coefficient before and 16 hours after: (Rs= -0,80, P=0,05), before and 40 hours after: (Rs= -0,90, P=0,05), 16 and 40 hours after treatment: (Rs= 0,60, P=0,05).

The triglycerides concentration after 16 hours magnetic field treatment, decreased and then after 40 hours magnetic field treatment was stable decreased. Spearman's rank correlation coefficient before and 16 hours after: (Rs= -0,3, P=0,05), before and 40 hours after: (Rs= -0,9, P=0,05), 16 and 40 hours after treatment: (Rs= 0,40, P=0,05).

The urea concentration after 16 hours magnetic field treatment, increased and then after 40 hours magnetic field treatment again decreased. Spearman's rank correlation coefficient before and 16 hours after: (Rs= -0,3, P=0,05), before and 40 hours after: (Rs=-0,4, P=0,05), 16 and 40 hours after treatment: (Rs= 0,5, P=0,05).

CONCLUSIONS

1. It was determined that activity for such enzymes as: alanine aminotransferase, aspartate aminotransferase, gamma-glutamyltransferase, glucose-6-phosphatedehydrogenase, lactate dehydrogenase, amylase after magnetic field treatment decreased.
2. Activity for such enzymes like cholinesterase and phosphatase (alcaline) after magnetic field treatment increased.
3. The calcium concentration after magnetic field treatment decreased in 10-12 times after 16 hours, however after 40 hours concentration increased twice.
4. The phosphorus concentration after magnetic field treatment decreased in 4-5 times after 16 hours, but 40 hours after magnetic field treatment contunied to decrease.
5. The magnesium concentration after magnetic field treatment decreased in 12-15 times after 16 hours, but 40 hours after magnetic field treatment concentration increased in 2-3 times.
6. The protein (total) and glucose concentration before and after magnetic field treatment was stable.
7. The triglycerides concentration after magnetic field treatment decreased in 6-8 times and was low during all the time of study.
8. The urea concentration after magnetic field treatment increased in 3-5 times after 16 hours and then after 40 hours was twice decreased.

9. It was found moderate correlation before and 40 hours after magnetic field treatment for concentrations of phosphorus, magnesium and iron.
10. High correlation between macro- and microelements was determined if no magnetic field treatment was in place. The high correlation between such parameters as: calcium and magnesium r=0,8, calcium and iron r= 0,9, magnesium and iron r=0,9, phosphorus and chlorides r=0,8.
11. It was found that magnetic field treatment during 840 sec with magnetic modulation - 3,3 Milli Tesla-level and magnetic field rotation frequency 100 Hz is ineffective for activation of fermentation process, because inhibit enzymes activity and total fermentation process.
12. Magnetic field treatment during 840 sec with magnetic modulation - 3,3 Milli Tesla-level and magnetic field rotation frequency 100 Hz is ineffective for the fermentation process, however it could be used in biotechnology of wine, food or pharmaceutical industry in those cases when it is necessary to stop immediately enzymatic activity.

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THE EFFECT OF MAGNETC FIELD TREATMENT *ON CARBOHYDRATE FERMENTATION BY YEAST* SACCHAROMYCES CEREVISIAE

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Treatment of yeast cultures using magnetic field induction gives an ability to understand better the magnetic field action to enzyme activity of yeast cultures, also fluctuation of macro- and microelements concentration.

Before and after magnetic field treatment it was determined in yeast suspension parameters of nitrogenic, proteinic, carbohydrate, lipidic metabolism and enzymatic activity.

The following enzymes activity was determined for such enzymes as: glucose-6-phosphate dehydrogenase, lactate dehydrogenase, gamma-glutamyltransferase, phosphatase, amylase, cholinesterase, some aminotranspherases.

During biochemical testing it was found that there is a decrease of enzyme activity, concentration of macro- and microelements after magnetic field treatment also decresed, concentration of triglycerides level and urea after magnetic field treatment also decreased. The glucose concentration was stable without tendency to decrease. Magnetic field treatment was used for yeast cultures Saccharomyces cerevisiae during 840 sec with magnetic modulation 3,3 Milli Tesla-level.

It was found that for yeast cultures Saccharomyces cerevisiae magnetic field treatment with magnetic modulation – 3,3 Milli Tesla-level and magnetic field rotation frequency 100 Hz was found ineffective for the fermentation process, because it inhibit enzyme production and enzyme activity and make impossible fermentation process.

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Обробка дріжджових культур з використанням магнітного поля дає можливість краще зрозуміти дію магнітного поля на активність ферментів дріжджових культур, а також на коливання концентрації макро- і мікроелементів. Перед і після обробки магнітним полем визначали в суспензіях дріжджових культур показники азотного, білкового, вуглеводного, жирового метаболізму і активність ферментів.

Через 16 і 40 годин після обробки магнітним полем ферментація виноградного сусла інгибувалася. Бродіння вуглеводів у виноградному суслі була практично зупинена.

Обробка магнітним полем культур дріжджів виду *Saccharomyces cerevisiae* проводилася протягом 840 секунд при магнітній модуляції 3,3 мТ (мілітесл) і обертанні магнітного поля 100 Гц внаслідок чого доведена неефективність такої обробки для процесу бродіння оскільки інгібує активність ферментів, робить процес бродіння неможливим.
Бібл. 16. Табл. 2.