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Catalase activity in the blood serum and liver of intact rats during the 30-day observation process

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The paper examines the influence of animal's ageing on the catalase activity in blood serum and liver during the 30-day observation period.

Key words: catalase activity.

INTRODUCTION

Peroxides accumulation in cells is the result of free radical initiation (reactive oxygen species) [1]. A number of antioxidant enzymes are responsible for the reduction of reactive oxygen species (ROS) and free radicals and involved in breakdown of hydroperoxides by non-radical way. They are formed by transferring of the second electron to O^{++}, which leads to the formation of hydrogen peroxide (H_2O_2), the synthesis of which is carried out mainly by the enzyme superoxide dismutase (SOD). Hydrogen peroxide causes oxidative modification of distantly located enzymes and macromolecules [2]. They cause lipid peroxidation, physical and chemical degradation of proteins, nucleic acids and disrupt intracellular homeostasis [3, 4].

It is known that SOD enzyme is the only antioxidant enzymes that interrupts the chain of oxygen depended free radical reactions. Synergist of SOD in the cell is a catalase, which prevents accumulation of H_2O_2. It was determined that there is a high and significant level of correlation between the catalase activity (CA) and SOD [5]. Therefore, a number of researchers in experimental studies that are aimed at determining the degree of antioxidant defense, when the free radical formation processes are activated, find it useful to study the CA in blood serum and target organs [6, 7, 8, 9, 10, 11, 12, 13].

The aim of this work is to study the dynamics of catalase activity in blood serum and liver of rats during the 30-day observation period.

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MATERIALS AND METHODS

The study was conducted on 30 male albino rats in the autumn-winter period. Catalase activity in serum and liver was assayed at the beginning of the observation and at 5, 10, 15, 20 and 30 days intervals as described in М.А.Королюк et al. (1988) [6].

The collected data were analyzed using variation statistics methods with licensed computer program Microsoft Excel 2007.

The handling of the rats (including anesthetic management and euthanasia) was performed in compliance with the principles of the «European Convention for the Protection of Vertebrate Animals», which are used for experimental and other scientific purposes (Strasbourg, 1986) [14].

RESULTS AND DISCUSSION

Serum CA at the beginning of the 30 days period was 14.43±3.19 mkat/L ($p<0,05$) with the margin between maximum and minimum values of 8,31 mkat/L, which corresponds to 57,6% of average CA value. Measurement of CA at 5^{th} day was lower than the initial value in 1,056±0,106 fold and was 13,61±2,46 mkat/L ($p<0,01$) with a difference with the difference between maximum and minimum values of 6,66 mkat/L, which corresponds to 48.94% of average CA value. CA value at 10^{th} day of the experiment was higher than at the 5^{th} day in 1.051±0,073 fold (14,41±3,39 mkat/L at $p<0,05$). The difference between maximum and minimum rates also increased to 8,8 mkat/L, as well as the percentage to 61,05%. On the 15^{th}

day of observation CA rates increased in comparison to the 10th day value in 1,080±0,130 fold and was 15,16±2,47 mkat/L at p<0,01, but the margin and its percentage value decreased (6,2 mkat/L and 40,9%, respectively). On the 20th day of observation CA rates decreased in comparison to the 15-day value in 1,238±0,141 fold and was equal to 12,62±3,31 mkat/L (p<0,05), and the difference between the maximum and minimum rates increased to 8,4 mkat/L as well as its percentage (66,56%). Measurement of CA rates in serum at the 30th increased again and was 1,184±0,078 fold higher than that at the 20th day value. Quantitative value of the CA was 14,7±2,81 mkat/L (p<0,01) with a difference of 7,42 mkat/L, which corresponds to 50,46% of the average CA value.

Averaged level of CA in serum was 14,16±0,69 mkat/L (p<0,001) with a difference of 11,0 mkat/L, which corresponds to 77,71% of the average CA value.

Catalase activity in rat liver was 143,3±10,16 mmol/min/g (p<0,001). Initial values of CA in the central areas (CnA) of the liver was 1,038±0,010 fold higher than in peripheral areas (PA). Average value of CA in CnA of liver equaled 151,6±10,08 mmol/min/g (p<0,001) and the difference between the minimum and maximum values of 36,0 mmol/min/g. This represented 23,75% of the average CA value.

Average value of CA in PA of liver was 135,0±5,6 mmol/min/g (p<0,001) with a difference of 20,0 mmol/min/g, which corresponds to 14,81% of the average CA value.

CA value in liver at the 5th day of the observation period was 147,2±11,24 mmol/min/g (p<0,001). In CnA average level of CA was 156,4±11,12 mmol/min/g (p<0,001) with a difference of 31,0 mmol/min/g and percentage of 19,82% of the average CA value determined in CnA of liver . In the PU of liver the CA level was lower in 1,049±0,007 fold than in the CnA, and was 138,0±5,2 mmol/min/g (p<0,001) with the difference of 17,0 mmol/min/g, which corresponds to 12,32% of the average CA value.

On the 10th day of the experiment the CA in liver was 145,3±9,1 mmol/min/g (p<0,001). CA value in CnA of liver was 152,8±5,76 mmol/min/g with the difference of 23,0 mmol/min/g, which corresponds to 15,05% of the average CA value that determined in the central area of the liver of animals in the control group. CA value in the PA of liver was lower in 1,105±0,005 fold than in the CnA. Average CA value was 137,8±5,84 mmol/min/g. The difference between the maximum and minimum rates were also higher than in the CnA of the liver, and was equal to 26 mmol/min/g, which corresponds to 18,87% of the average CA value in the PU of the liver.

The CA level in the liver at the 15th day was 147,1±11,52 mmol/min/g (p<0,001). In CnA of the liver CA rate rose to 156,4±11,12 mmol/min/g in comparison with the 10th day level. The difference between maximum and minimum value was 29,0 mmol/min/g, which corresponds to 18,54% of the average value of CA rate in the CnA of the liver. In PA of the liver CA rate remained 1,171±0,012 fold lower than in the CnA (137,8±5,44 mmol/min/g) with a difference of 19 mmol/min/g, which corresponds to 13,79% of the average CA value in the PU of the liver.

The CA level in the liver at the 20th day increased to 151,2±11,04 mmol/min/g (p<0,001). In CnA of the liver CA rate also increased to 162,0±6,8 mmol/min/g in comparison with the 15th day level but the difference between maximum and minimum value decreased to 22,0 mmol/min/g, which corresponds to 13,5% of the average value of CA rate in the CnA of the liver. In PA of the liver CA rate remained 1,159±0,017 fold lower than in the CnA but higher than at the 15th day (140,4±6,16 mmol/min/g) with increased difference (22,0 mmol/min/g) comparing to previous measurement . Observed difference corresponded to 15,67% of the average CA value in the PU of the liver.

The CA level in the liver at the 30th day decreased to 141,2±11,88 mmol/min/g (p<0,001). In CnA of the liver CA rate also decreased to 152,0±6,8 mmol/min/g in comparison with the 20th day level and the difference between maximum and minimum value was to 34,0 mmol/min/g, which corresponds to 22,34% of the average value of CA rate in the CnA of the liver. In PA of the liver CA rate remained lower 1,223±0,019 fold than in the CnA (131,6±6,16 mmol/min/g) and lower than at the 20th day with the difference of 19,0 mmol/min/g, which corresponds to 14.44% of the average CA value in the PU of the liver.

The average CA value in the CnA of the liver was higher in 1,124±0,061 fold less than in PA.

CONCLUSIONS

These studies have shown instability in the level of CA rates in both blood serum and liver of tested animals. Significant variations of the difference between the maximum and minimum values of the CA indicated unequal functional state of animals during the surveillance period. However, it should be stated that the revealed dynamics of CA is within the physiological range [11, 15].

In this regard, it can be concluded that for the 30 days observation period in intact animals there is no important changes in the antioxidant protection system. Therefore, a significant variation of the level of CA can not be used as objective criteria of changes in the course of the experiment. Therefore, the dynamics of the CA values in each experimental group should be assessed by comparison to the CA established before the start of the experiment with the values obtained in the previously conducted experiment.

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В.Ф.Дрель, О.А.Виноградов. Активність каталази в сироватці крові і печінки інтактних щурів у процесі 30-добового спостереження. Луганськ, Україна.

***Ключові слова**: активність каталази.*

У статті розглянуті питання впливу віку тварини на активність каталази в сироватці крові і печінки в процесі 30-добового спостереження. Виявлена нестабільність показника активності каталази в сироватці крові і печінки тварин. Великі коливання різниці між максимальним і мінімальним показниками активності каталази вказували на неоднаковий функціональний стан тварин у процесі спостереження за ними. Проте слід зазначити, що виявлена динаміка активності каталази не виходить за межі фізіологічної норми.

В.Ф.Дрель, А.А.Виноградов. Активность каталазы в сыворотке крови и печени интактных крыс в процессе 30-суточного наблюдения. Луганск, Украина.

***Ключевые слова**: активность каталазы.*

В статье рассмотрены вопросы влияния возраста животного на активность каталазы в сыворотки крови и печени в процессе 30-суточного наблюдения. Выявлена нестабильность показателя активности каталазы в сыворотке крови и печени животных. Большие колебания разницы между максимальным и минимальным показателями активности каталазы указывали на неодинаковое функциональное состояние животных в процессе наблюдения за ними. Однако следует отметить, что выявленная динамика активности каталазы не выходит за пределы физиологической нормы.

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