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INFLUENCE OF THE RADIOFREQUENCY ELECTROMAGNETIC FIELD 40.68MHz ON ADHESION OF *SACCHAROMYCES CEREVISIAE* CELLS DEFICIENT IN POLYPHOSPHATASE PPN1 TO DENTAL ALLOYS

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Adhesion is one of the most important properties of living organisms that help them to survive in a complex environment, but at the same time cause a variety of medical, industrial and economic problems. A lot of factors may affect adhesion and a variety of chemicals are used to decrease or prevent it, however, the influence of electromagnetic fields may significantly impact the efficiency of such compounds that is rarely considered in researches. The biosynthesis of specific adhesins requires energy stored in cells in the form of high-energy compounds, among which a special place belongs to polyphosphates (poly(P)). Poly(P) are structural units of the cell walls and influence surface charge as well. The deficiency in polyphosphatases, enzymes of the poly(P) metabolism, was shown to affect the adhesive properties of cells. Therefore, ***the aim*** *of this work was to study the ability of the radiofrequency electromagnetic field to affect the adhesion of yeast cells to dental alloys and to evaluate the role of PPN1 polyphosphatase in the perception of electromagnetic signals and cell adhesion.* ***Methods.*** *Saccharomyces cerevisiae yeast cells of the wild type strains Y-517 and CRY, and the PPN1-deficient cells (strain CNX) were used in the study. The Ni-Cr (Wiron 99, Wirocer plus, Gialloy CB/N) and Co-Cr (Wirobond 280, Wironit, Gialloy PA) dental alloys prepared with three different casting methods were used. Yeast cells were treated with radiofrequency electromagnetic fields (RF-EMF) (40.68 MHz, 30 W, 60 min, at thermostatic conditions) before their interaction with the alloys. Adhesion indexes were determined after direct contact of yeast cells with the surfaces of the alloys for 60 min at room temperature.* ***Results.*** *Chromium in the composition of the alloys had a negative effect on the adhesion, while niobium, carbon, and silicon, in contrast, stimulated it. Alloys prepared by the method of vacuum casting had the highest adhesion, while alloys prepared by centrifugal casting with melting by high-frequency current showed the greatest resistance to microbial adhesion. The efficiency of these factors significantly reduced in the case of pretreatment of yeast cells with RF-EMF and in case of deficiency of cells in PPN1: in both cases, yeast adhesion to all types of alloys was increased. The mechanisms that underlie such effects, may be different, and considering that cell surface charge and the hydrophobic properties were not changed, the effect of EMF may be a result of induction of "adaptive response" process within the yeast cells that increasing the resistance of the cell to the action of individual elements in the alloys, while, in the second case, it may be a consequence of changes in the extracellular polysaccharides composition, which take place it the PPN1-deficient cells.* ***Conclusion.*** *Thus, the efficiency of physical and chemical properties of dental alloys, which are aimed at the reduction of microbial adhesion, may be significantly reduced after RF-EMFs influence on the cells and in the case of polyphosphatase PPN1 activity disruption.*

Keywords: adhesion, dental alloys, yeast, polyphosphatase, radiofrequency electromagnetic fields.

One of the features of all microorganisms is the ability to attach to surfaces of different nature (biotic and abiotic). This process occurs due to the physical and chemical (biochemical) properties of the surfaces and therefore, many biological and non-biological factors can influence it. The ability to attach reflects a number of properties inherent not only to cell shell (passive adhesion), but also to an intracellular organization that connected to a synthesis of specific adhesion factors (active adhesion). Microorganisms can adapt to live almost on any surface, but this does not always have

positive consequences and microbial adhesion to dental alloys becomes extremely relevant today since related to the spread of oral diseases [1]. To reduce the adverse effects associated with microbial contamination of various materials, appropriate standards were proposed to assess the ability of surfaces to resist microbial adhesion (bacteria, fungi, yeast, etc.), such as ASTM (American Society for Testing and Materials) standards D4300 and D4783. To prevent microbial adhesion, various chemical elements are added to metal alloys, but they are toxic not only to the oral microbiota but to the cells of macroorganism, with which they come into contact, as well [2]. The line of toxicity of metals that are part of dental alloys Hg→Ag→Au→Cu, Ni, Co, Zn, determined on the model of *Saccharomyces cerevisiae* cells [2], indicates fairly high toxicity of mercury and the lowest toxicity of nickel and cobalt, which are currently the main components of a wide range of nickel-chromium and cobalt-chromium alloys. Nevertheless, chromium, nickel, and cobalt may cause apoptosis at concentrations below those that lead to cellular necrosis [3].

However, the cells of all living organisms are an open biological system that changes dynamically in response to physicochemical fluctuations in the environment. One of the main abiotic factors of anthropogenic origin that gains growing influence in the last decades is the non-ionizing electromagnetic fields (EMFs). This factor is considered to be the cause of a number of medical and biological problems that include an increase of microbial resistance to antibiotics, an increasing number of cardiovascular and cancer diseases, etc. [4]. EMFs are not studied among factors that may affect denture contamination, however, they are able to change the properties of cells depending on physical parameters of the field (frequency, power, etc.) and physiological and biochemical properties of the cells [5]. Ion channels in membranes, volutin granules in vacuoles and acidocalcisomes, enzyme active centers, etc., can be intracellular receptors of non-ionizing radiation of anthropogenic and natural origin [4, 6, 7]. In turn, the metabolism of inorganic polyphosphates, which contain high-energy bonds and are the main components of volutin granules, affects many intracellular processes, including various enzymatic processes and gene expression processes, as well as adhesion, motility, virulence, etc. [8]. These molecules (polyphosphates) and the enzymes of their metabolism respectively can be one of the main factors in the perception of external electromagnetic signals [7]. Three main polyphosphatases (PPN1, PPN2, and PPX1) are known in yeast cells. The PPX1 is located in the cytoplasm, outer membrane, mitochondria, and, along with providing an exopolyphosphatase activity PPX1 is involved in the transport of mannose across the cytoplasmic membrane to the cell wall [8]. Both PPN1 and PPN2 enzymes have an endopolyphosphatase activity, and PPN1 also exhibits exopolyphosphatase activity, they are located in vacuoles and are considered the main enzymes of volutin granules degradation [8, 9]. In mammalian cells and yeasts, the PPN1 is also present in the nuclei, where it promotes the release of mRNA, and in yeast cells defective in PPX1, the PPN1 activity is observed in the cytoplasm.

The **aim** of this work was to study the ability of the radiofrequency electromagnetic field to affect the adhesion of yeast cells to dental alloys and to evaluate the possible role of PPN1 in this process.

Materials and Methods

Yeast strains and cultivation parameters

Saccharomyces cerevisiae yeast strains Y-517, CRY, and CNX were used in the study. Strain Y-517 was obtained from the Ukrainian Collection of Microorganisms at Zabolotny Institute of Microbiology and Virology of the National Academy of Sciences of Ukraine, Kyiv, Ukraine. The other two strains were kindly provided from the Institute of Biochemistry and Physiology of Microorganisms of the Russian Academy of Sciences (Pushchino). Cells of Y-517 and CRY strains were of the wild type (Wt), diploid and haploid, respectively. Cells of CNX strain were originated from CRY strain [10] and were deficient on the *PPN1* gene (encodes the endopolyphosphatase PPN1) only that was confirmed by PCR with primers to *PPN1* and *PPX1* (exopolyphosphatase PPX1) genes. The next primers were used: $PPN1_F$ 5'-TTTCCACATA ACATGTTTGCACTAGGA-3' and $PPN1_R$ 5'-TT CAGTTTCTTCGTCCTCTTCATTACTG-3' with expected amplicon length 531 bp, and $PPX1_F$ 5′-AC ACAAAGGGTTAGAGATTGGTCTTTC-3' and $PPX1_R$ 5'-CTTCCAGGTTTGAGTACGCTTCC-3' with expected amplicon length 362 bp.

Yeasts were initially grown on agar medium at 28° C for 24 h and then washed off with sterile distilled water, filtered through a sterile cotton filter, twice washed off from the remnants of the nutrient

medium by centrifugation at ×500g in the distilled water and diluted in the same water to 10^7 cells/ml.

RF-EMF treatment

Solenoid connected to the generator of EMF with frequency 40.68 MHz (27.5 V/m, 22 A/m, the capacity of radiation 30 W, polarized in a horizontal plane) was used as a source of electromagnetic radiation. The RF-EMF parameters were measured with Magnetometer TESTLA DKP-B-2827 (Czech Republic). The irradiation of cells was performed under room temperature for 60 min. The control samples were kept under the same conditions without irradiation.

Dental alloys

Nickel-chromium alloys (Ni-Cr) (Wiron 99, Wirocer plus, Gialloy CB/N) and cobalt-chromium alloys (Co-Cr) (Wirobond 280, Wironit, Gialloy PA) produced by BEGO GmbH & Co. KG (Germany) and BK Giulini GmbH (Germany) were used in the study. Each alloy was cast in three different ways: centrifugal casting with open flame melting, centrifugal casting with induction melting (dental casting machine "Ducatron Quatro", Ugin' Dentaire, France) and vacuum casting (vacuum pressure-casting machine "Nautilus T", BEGO GmbH & Co. KG, Germany). Samples with a size of 10×10 mm were formed and the surfaces were polished with the gradual use of abrasives to decrease roughness to about 5 nm.

Study of yeast cell adhesion to metal alloys

Immediately before the start of each series of experiments, the samples of alloys were washed in running water, dried, treated with 95 % ethanol, and dried. Aliquots (50 ml) of yeast cell suspensions were dropped on the alloy surface. The samples were placed in a glass chamber to prevent evaporation of moisture from the surface of the alloys and left at room temperature for 60 min, after which each sample was transferred into a container with 4.95 ml of sterile distilled water and stirred vigorously to resuspend the non-adherent cells. From the obtained suspensions a series of dilutions was performed and plated on agar nutrient medium to determine the colony-forming unit. All experiments were performed under sterile conditions.

Yeast adhesion to alloys surfaces was checked with scanning microscopy techniques. Adhesion (in %) was determined as the difference between the initial concentration of cells in the suspension and the number of cells that grew on the surface of agar nutrient medium after interaction with the surface of the alloys.

Statistics

Data analyses were performed with Statistica 10 software (StatSoft Inc., 2011). The significance of differences between mean values was assessed by the *F*-test. The influence of individual factors was evaluated using factorial ANOVA. Linear and quadratic effects of the studied factors on the adhesion index were evaluated by the method of central composite. Correspondingly, the categorical predictors and independent variables in these analyzes were alloys properties (the type of casting and melting), component composition (which corresponds to the name of the alloy), the group to which the alloy belongs is nickel-chromium or cobalt-chromium (Ni-Cr or Co-Cr), the content of individual elements in the alloys, RF-EMF treatment, and strain properties (which corresponded to the strain number). The results of the calculations are presented in the form of box-plots and Pareto charts, which show the magnitude of the effects of each factor in absolute values and the level $p < 0.05$.

Results

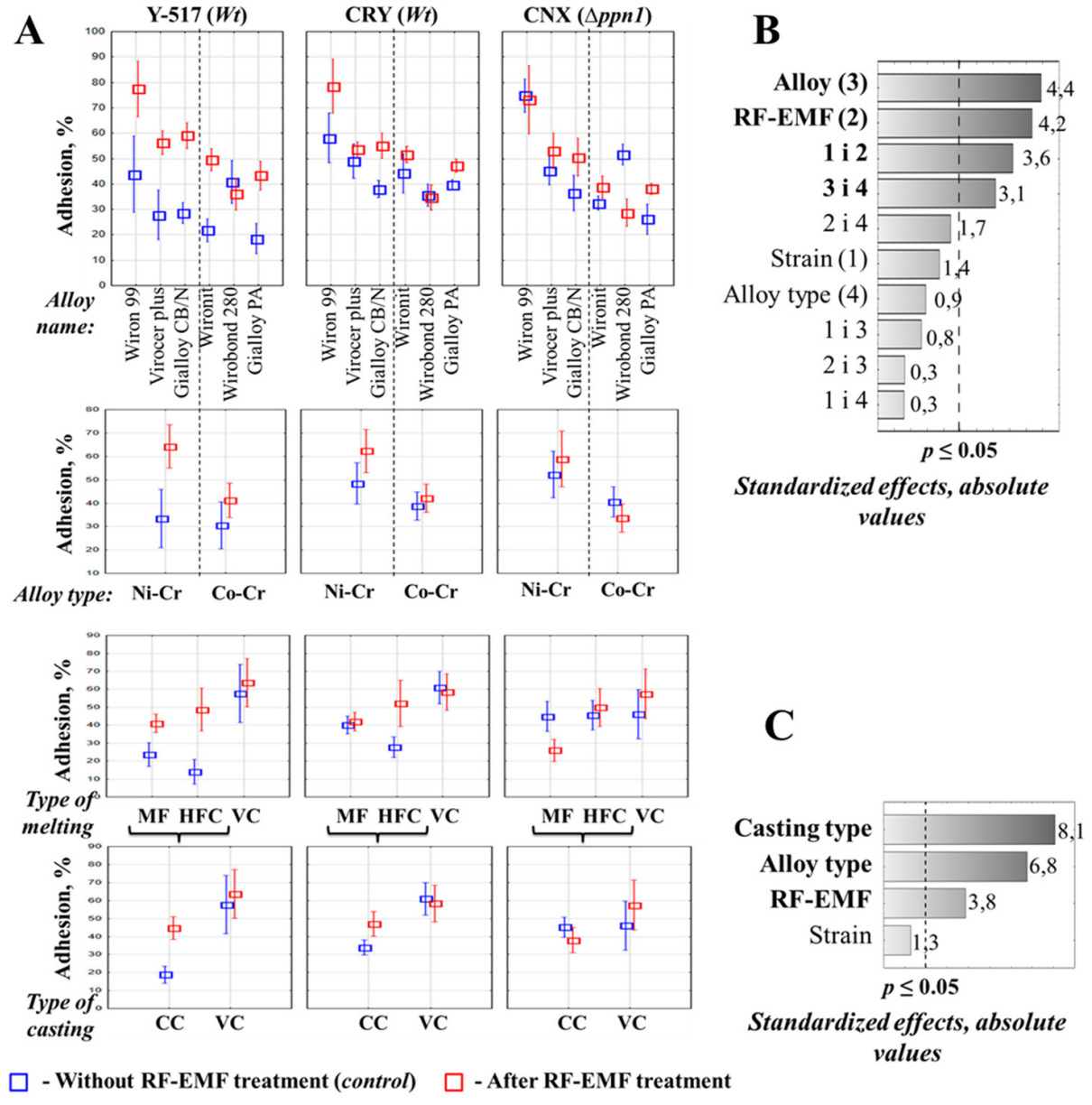
Adhesion of yeast cells to the surface of dental alloys

Yeast cells formed dense, sometimes multilayered groups on the surface of metal alloys. The number of adhered cells per unit of area varied significantly depending on the type of metal alloy and the method of its casting (Fig. 1A). In some cases, the contact of yeast cells with the studied alloys resulted in the stimulation of their growth that was determined by the optical density of the cell suspension and the corresponding increase (1.5–3 times) of the number and diameter of colonies formed on agar medium. This effect was marked for the yeast cells of strain Y-517 after their interaction with nickel-chromium alloy Wiron 99 prepared by open flame melting and with cobalt-chromium alloys Wirobond 280 and Gialloy PA prepared by induction melting, as well as for cells of strain CNX after their contact with the alloy Gialloy PA prepared by vacuum casting. The growth stimulation was exclusively strain-dependent.

The adhesion of the yeast cells to nickel-chromium alloys was slightly higher compared to cobalt-chromium alloys, but the difference showed no statistical significance (Fig. 1B). The individual properties of the alloys were found to be the most

important factor determining the adhesion index (Fig. 1B) and the highest value of adhesion of yeast cells was observed for the nickel-chromium alloy Wiron 99, while the lowest one for the cobalt-chromium alloy Gialloy PA (Fig. 1A).

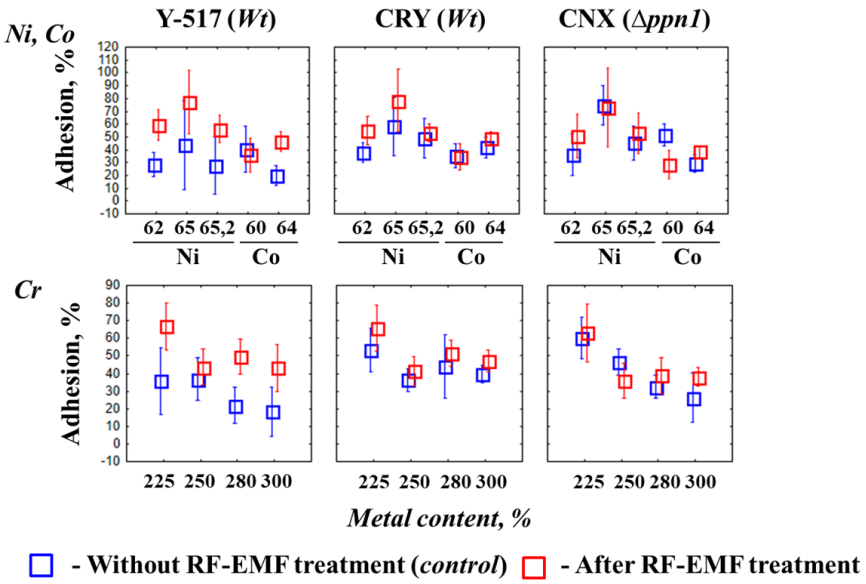
The individual features of alloys include surface roughness, surface charge, hydrophobicity, component composition, etc. The roughness of the surface is considered among the primary factors that may influence the adhesion of microorganisms. However, the alloys were polished by the same technology and their roughness did not exceed 6 nm, which allows to exclude this indicator as a potential adhesion factor. The potential on the surface of the alloys and their hydrophobic properties were different for the alloys, but they showed only limited (not for all studied strains) correlations with the determined adhesion indexes, and therefore possess no predictive value (*data not shown*).



F i g. 1. The effect of RF-EMF (40.68 MHz, 15W, 30 min) on the adhesion of yeast cells *Saccharomyces cerevisiae* strains Y-517, CRY, and CNX to the nickel-chromium and cobalt-chromium alloys. (A) – the percentage of adhesion depending on the type of alloy and the method of its preparation (melting and casting). (B and C) – Pareto charts showing the significance of the studied factors effects on adhesion.
***Legends*: "MF" – melting with flame, "HFC" – high-frequency current, "VC" – vacuum casting, "CC" – centrifugal casting.**

Dependence of the yeast adhesion on the content of specific elements in the alloys

Evaluation of the yeast cells adhesion to the surface of alloys that differ in the content of major components (nickel, cobalt, and chromium) showed an inverse relationship with the content of chromium: cell adhesion decreased significantly with increasing of chromium content, and not depended on the content of nickel and cobalt (Fig. 2). The absolute content of chromium was the main factor of the normal grown yeast cells adhesion. However, this dependence was disrupted after pretreatment of the yeast cells with RF-EMF, the adhesion of which showed dependence on the ratio of all three major components (Fig. 5).



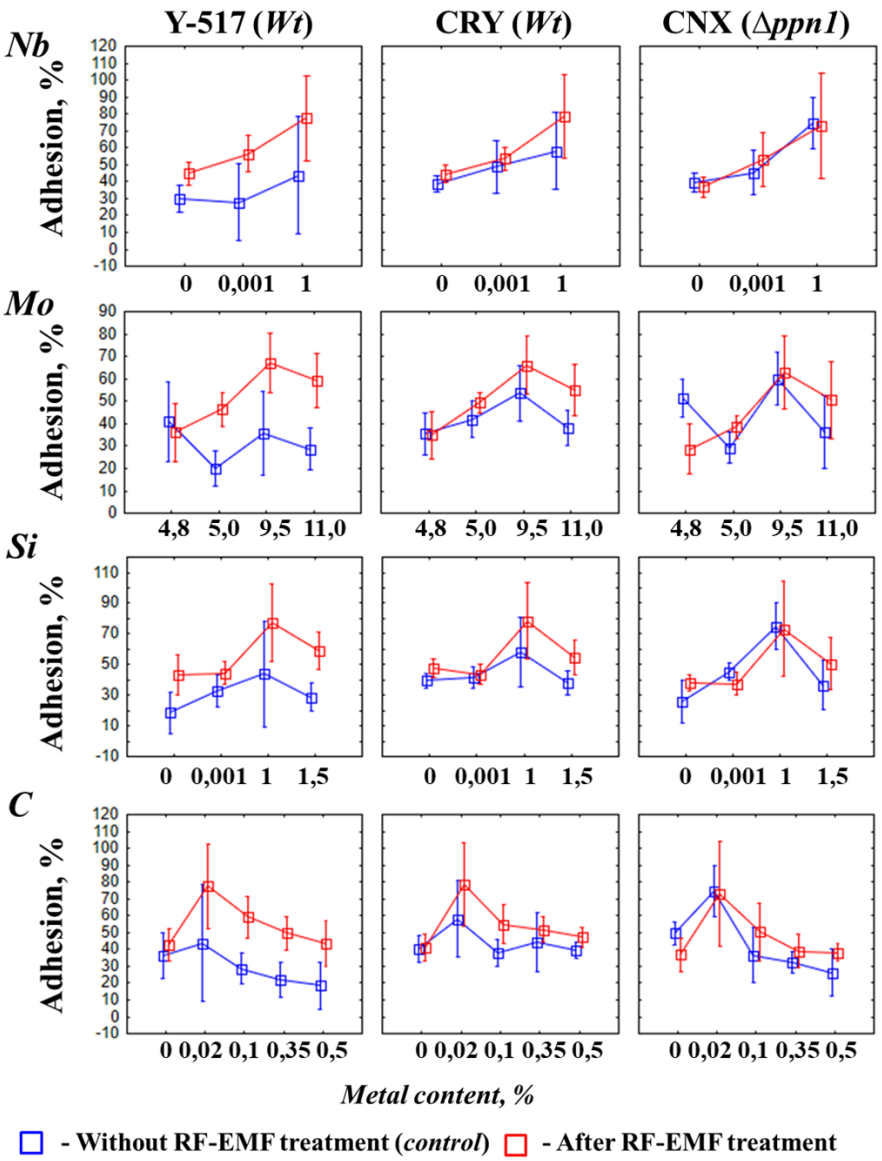
F i g. 2. Dependence of adhesion of irradiated and non-irradiated with RF-EMF cells of yeast *Saccharomyces cerevisiae* strains Y-517, CRY and CNX to nickel-chromium and cobalt-chromium alloys with different content of major components (nickel, cobalt and chromium)

The nickel-chromium and cobalt-chromium alloys contain varying amounts of other elements such as Nb, Fe, W, Mo, Si, C, Mn and Ga. Analysis of dependencies between the content of these elements and the yeast cells adhesion showed that in the composition of nickel-chromium alloys the main factor was niobium (F = 9.4 and p = 0.002), which content positively correlated with the adhesion (Fig. 3) and the effect of which slightly prevailed over the negative effect of chromium (F = 9.0 and p = 0.003) (Fig. 5). Another element, molybdenum, had a statistically significant effect only for the adhesion of yeast cells treated with RF-EMF and, like niobium, increased adhesion of irradiated cells (Fig. 5).

The cobalt-chromium alloys do not contain niobium but contain molybdenum that was one of three main factors affecting adhesion. Molybdenum in cobalt-chromium alloys had a negative effect (-2.5 absolute units at F = 6.4 and p = 0.01) on adhesion of the yeast cells and the magnitude of it effect was close to the effect of chromium (-2.6 absolute units at F = 6.7 and p = 0.01) (Fig. 5). The other two factors were silicon (F = 5.6 and p = 0.02) and carbon (F = 4.0 and p = 0.05), which had a positive effect on the adhesion index and thus can be considered the mediators of adhesion of the yeast cells to the surface of cobalt-chromium alloys. The role of silicon and carbon was more important for yeast cells treated with RF-EMF for which molybdenum had no significant effect and thus adhesion positively depended on the content of silicon and carbon, and negatively on the chromium content (Fig. 5).

Influence of the alloy casting method on the yeast cells adhesion

The type of alloy casting was also a significant factor that had an impact on the adhesion of yeast cells (F = 65.2 at $p < 0.001$) (Fig. 1B, C). The highest adhesion values of yeast cells were determined for alloys prepared by vacuum casting (Fig. 1A). The type of alloy melting (with flame or with the high-frequency current) did not have significant effect.



F i g. 3. Dependence of adhesion of irradiated and non-irradiated with RF-EMF yeast cells to nickel-chromium and cobalt-chromium alloys on the content of minor components (Nb – niobium, Mo – molybdenum, Si – silicon, C – carbon)

The method of alloy casting determines, first of all, the features of microcrystalline structure: the degree of texturing and the ratio of crystalline and amorphous phases, which has a significant impact on the anticorrosive properties of the alloy surface [11, 12]. Consequently, the cobalt-chromium alloys prepared by centrifugal casting with induction melting had the highest corrosion resistance. Among cobalt-chromium alloys the Wirobond 280 alloy resistance was the highest, however, the adhesion of yeast cells to this alloy did not show significant differences from other cobalt-chromium alloys (Fig. 1), and therefore it should be concluded that anticorrosive properties of the alloys do not impact significantly the yeast adhesion and could not be a determining factor.

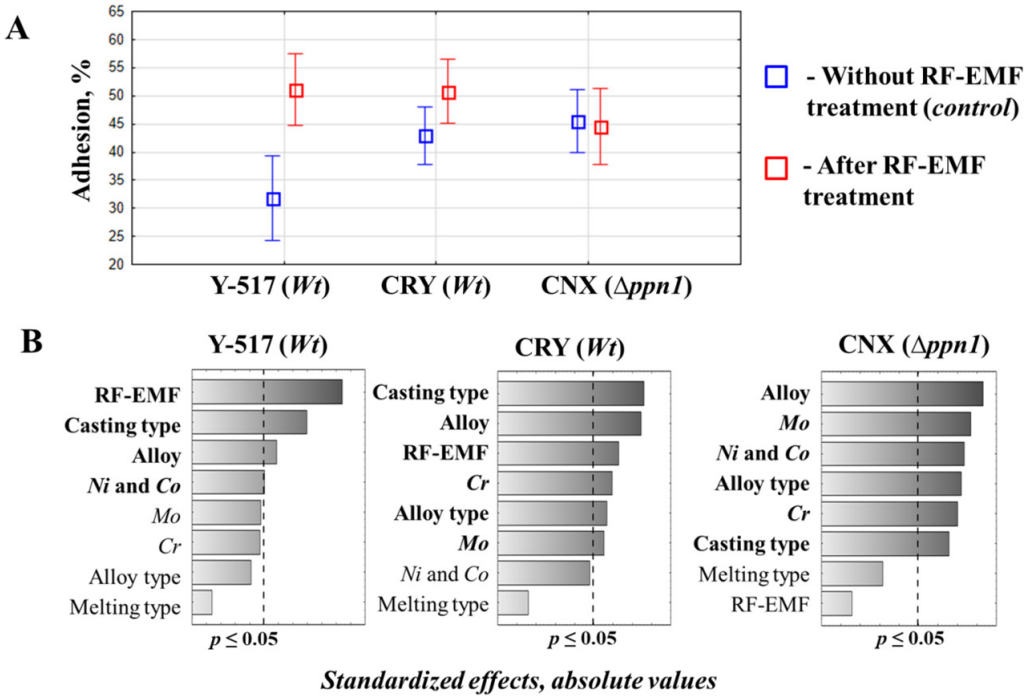
Influence of the RF-EMF exposure of yeast cells on their adhesion to the surface of alloys

The RF-EMF was one of the most important factors that influenced yeast adhesion regardless of the alloys' composition and method of casting. This was marked for the cells of both wild-type strains Y-517 and CRY. However, this RF-EMF had no significant impact on the adhesion of the *ppn1*Δ-cells (deficient in polyphosphatase PPN1), which adhesion depended on the alloys component composition and the method of their preparation (Fig. 4), the factors that were important for the wild-type cells as well.

That is, adhesion of the *ppn1*Δ-cells to nickel-chromium and cobalt-chromium alloys did not depend on the action of RF-EMF that was the main

difference between these cells and the wild-type cells.

The reason for the marked differences in the adhesive properties of the *ppn1*Δ-cells and the *Wt*-cells may be in the specific properties of their surfaces. The most important factors influencing the adhesive properties of yeast cells are the charge of the cell surface and their hydrophobicity, as well as such biological factors, as specific adhesion factors, among which are adhesins, and so on.



F i g. 4. Influence of the RF-EMF (40.68 MHz) on adhesion of yeast cells to nickel-chromium and cobalt-chromium dental alloys (A), (B) – Strain-specific impact of the RF-EMF

Analysis of the yeast cell surface charge showed that the cells of the studied strains, including *ppn1*Δ-cells, have the same negative charge -20.5 mV. The effect of the RF-EMF did not cause changes in this indicator and the only factor that had an impact was the slight fluctuations in the properties of the buffer system in which the relevant determinations were performed. The maximum observed value of the surface charge was -27 mV, but it was the same for cells of all studied yeast strains. Therefore, this indicator was stable for cells of different yeast strains, did not depend on deficiency in PPN1, and did not change after exposure with RF-EMF.

Hydrophobicity of the yeast cells that was determined in a mixture of water : *n*-octane, as well as water : *n*-hexane, was the same for yeast cells of the studied strains and did not change after the RF-EMF exposure. In general, the cells had a fairly low level of hydrophobicity – 14–18 %.

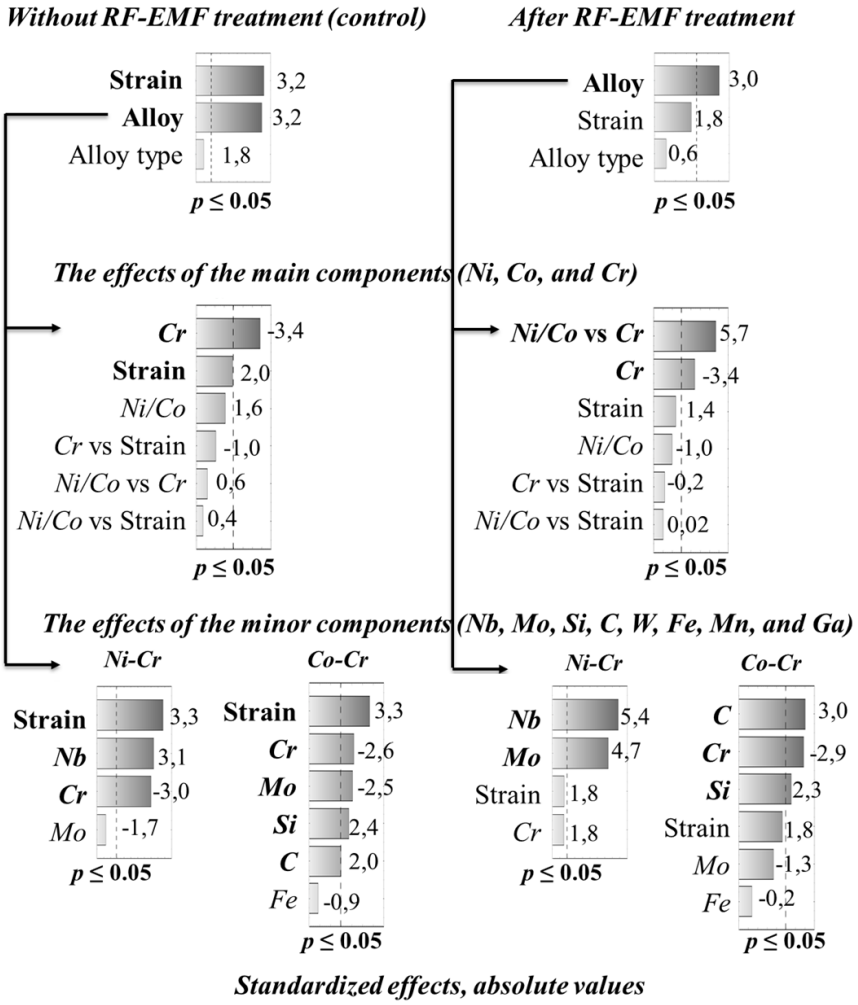
An attempt to detect on the cells surface some specific adhesion factors, adhesins with a lectin-like type of adhesion, by the agglutination test with the rabbit erythrocytes, showed that yeast cells do not have such structures on their surface. The disadvantage of this method was in the rather narrow specificity to mannan-associated adhesion. Therefore, the obtained negative result, of course, did not exclude the possibility of existence of adhesins specific to other sugar residues on the yeast surfaces or the existence of other types of adhesins as well.

In general, the result showed that the basic physical properties of the yeast cell surface were the same for cells of different strains and did not change after the action of RF-EMF, and therefore they cannot be the cause of marked changes in the adhesion of these cells to different metal alloys.

Discussion. The degree of adhesion of yeast cells to nickel-chromium and cobalt-chromium alloys depended on both biological (strain) and non-biological (alloy type, component composition, etc.) factors (Fig. 5). The charge on the cell surface and its hydrophobicity are among the main factors of the nonspecific adhesion, however, these values were the same for cells of the different yeast

strains and did not change in cells defective in polyphosphatase PPN1, as well as after the action of the RF-EMF 40.68 MHz.

The biotic strain-specific factors and several non-biological factors (the individual properties of the alloys, their elemental composition, and the method of casting) had the biggest effect on the yeasts cells adhesion. The individual effects of each factor were more significant compared to their interactions. The role of abiotic factors increased after the treatment of cells with the RF-EMF, and the role of biological factors decreased (Fig. 5) that stimulated adhesion. However, the efficiency of the adhesion of even irradiated yeast cells depended on the casting method (centrifugal or vacuum). Casting, along with the chemical composition, predetermines the microcrystalline structure of the alloys, the roughness of their surfaces, their hydrophobic properties, and potential, but only some of these properties showed rare links with the adhesion of yeast cells to the alloys and thus had no prognostic value.

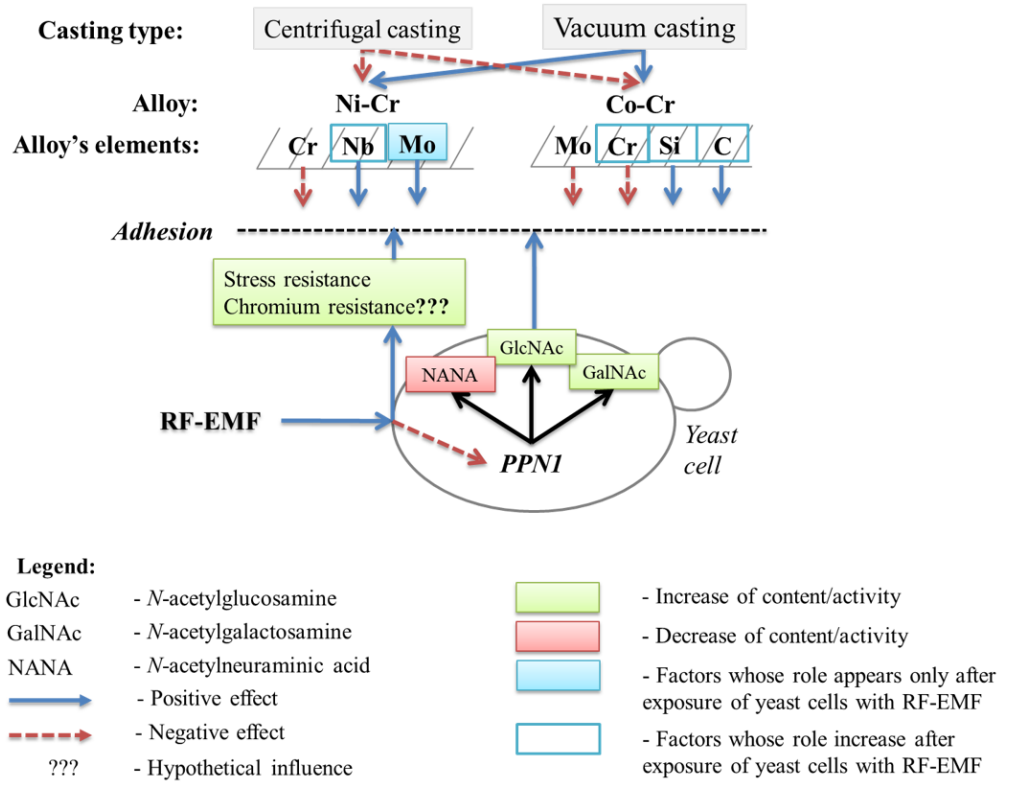


F i g. 5. Dependence of the yeast adhesion to the nickel-chromium and cobalt-chromium alloys on the chemical composition of the alloys and the action of RF-EMF 40.68 MHz.
Note: **standardized individual effects and linear interactions of the factors (marked by "vs") are shown. The factors whose influence on adhesion was significant at $p \leq 0.05$ are highlighted in bold.**

The deficiency of yeast cells in PPN1 significantly affected the sugar composition of the extracellular matrix in which an increased amount of *N*-acetylneuraminic acid and a decreased content of *N*-acetylglucosamine and *N*-acetylgalactosamine were marked [13]. Considering that other properties of the cells' surfaces (their charge and hydrophobicity) were the same for cells of these strains, it could be assumed that some components of the extracellular matrix may be the factors that specify yeast cells adhesion to the surface of alloys (Fig. 6).

In contrast, the treatment of yeast cells with the RF-EMF 40.68 MHz did not have a direct effect on the content of sugar residues, but affected the way the extracellular sugars content change in response to the stress factors [13], thereby increasing the resistance of yeast cells to the stresses. Considering that content of chromium in the alloys had a negative effect on adhesion, thus being a potential stress factor, it can be assumed that the RF-EMF exposure increased cell resistance to this element and thus increased yeast cells adhesion.

Thus, the action of the RF-EMF increased cell adhesion, while the deficiency in PPN1 reduced cell sensitivity to the action of this EMF and increased adhesion of yeast cells as well. Therefore, it can be assumed that this type of RF-EMF may decrease the activity of PPN1 through the direct action of the EMF on a conformational state of the enzyme. And, as a result, the composition of sugars in the extracellular matrix of irradiated cells changed and adhesion of these cells to the alloys increased (Fig. 6).



F i g. 6. Scheme of the RF-EMF 40.68 MHz action on the adhesion of yeast cells deficient in polyphosphatase PPN1 to nickel-chromium and cobalt-chromium alloys.

Conclusion. Adhesion of the yeast cells to the surface of nickel-chromium and cobalt-chromium dental alloys depends on both the biological properties of cells, and the physical-chemical properties of alloys. The chromium content as well as the method of preparation of alloys by centrifugal melting with high frequency current negatively affected adhesion. However, the deficiency of yeast cells in polyphosphatase PPN1, as well as the action of the RF-EMF 40.68 MHz on the cells increased their adhesive properties regardless of the alloy type. The RF-EMF was one of the most important factors that enhanced the adhesion of the yeast cells to nickel-chromium and cobalt-chromium dental alloys. In contrast, the activity of PPN1 aimed at reducing the adhesion. The RF-EMF exposure reduced the role of PPN1, increasing yeast adhesion, while the deficiency in this enzyme reduced the sensitivity of yeast cells to the action of this type of EMF. Therefore, a close relationship exists between the functional activity of the polyphosphatases PPN1 and the biological effects of the RF-EMF.

Acknowledgments.

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ВПЛИВ РАДІОЧАСТОТНОГО ЕЛЕКТРОМАГНІТНОГО ВИПРОМІНЮВАННЯ (40,68 МГц) НА АДГЕЗІЮ КЛІТИН ДРІЖДЖІВ *SACCHAROMYCES CEREVISIAE* ДЕФЕКТНИХ ЗА ПОЛІФОСФАТАЗОЮ PPN1 ДО СТОМАТОЛОГІЧНИХ СПЛАВІВ МЕТАЛІВ

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Резюме

Адгезія – одна з найважливіших властивостей живих організмів, яка допомагає їм виживати в складних умовах, але в той же час вона є причиною багатьох проблем медичного, промислового та економічного характеру. Низка факторів можуть впливати на адгезію. Для її зменшення або повного запобігання застосовуються різноманітні хімічні сполуки. Тим не менше, ефективність дії таких сполук може суттєво змінюватися в результаті дії на клітини живих організмів електромагнітного випромінювання, що не часто враховується в дослідженнях. Біосинтез специфічних адгезинів вимагає енергії, яка зберігається в клітинах у вигляді високоенергетичних сполук, серед яких особливе місце належить поліфосфатам (полі(Ф)). Полі(Ф) – це також структурні одиниці клітинних стінок, які впливають на поверхневий заряд. Дефектність за полі(Ф)азами, ферментами метаболізму полі(Ф) впливає на адгезивні властивості клітин. Тому **метою** даної роботи було вивчити здатність радіочастотного електромагнітного випромінювання (РЧ-ЕМВ) впливати на адгезію клітин дріжджів до стоматологічних сплавів та оцінити роль полі(Ф) ази PPN1 у сприйнятті електромагнітних сигналів та адгезії клітин. **Методи.** У дослідженні були використані клітини дріжджів *Saccharomyces cerevisiae* дикого типу штамів Y-517 та CRY, а також клітини, дефектні за PPN1 (штам CNX). Використовували Ni-Cr (Wiron 99, Wirocer plus, Gialloy CB/N) та Co-Cr (Wirobond 280, Wironit, Gialloy PA) стоматологічні сплави, приготовлені за допомогою трьох різних методів лиття. Клітини дріжджів обробляли РЧ-ЕМВ (40,68 МГц, 30 Вт, 60 хв, в термостатних умовах) до моменту їх взаємодії зі сплавами. Індекси адгезії визначали після безпосереднього контакту клітин дріжджів з поверхнями сплавів протягом 60 хв за кімнатної температури. **Результати.** Хром у складі сплавів негативно впливав на адгезію, тоді як ніобій, вуглець і силіцій, навпаки, стимулювали її. Сплави, приготовлені методом вакуумного лиття мали найбільші показники адгезії, в той час, як сплави, приготовлені методом центробіжного лиття з плавкою високочастотним струмом виявляли найбільшу протидію мікробній адгезії. Однак ефективність цих чинників суттєвим чином знижувалася в разі дефектності клітин дріжджів за полі(Ф)азою PPN1 і після дії на клітини дріжджів РЧ-ЕМВ: в обох випадках відмічене збільшення величини адгезії клітин дріжджів до всіх типів сплавів. В основі цих ефектів, вочевидь, лежать різні механізми і в першому випадку – це може бути зміна складу позаклітинних полісахаридів, яка має місце в *ppn1*Δ-клітин, а в другому – це результат індукції процесу «адаптивної відповіді», який має місце внаслідок дії даного типу випромінювання на клітини дріжджів: збільшення стійкості опромінених клітин дріжджів до дії окремих елементів у складі сплавів. **Висновки.** Незважаючи на вміст у складі сплавів хімічних сполук, які здатні знижувати мікробну адгезію до поверхні сплавів, активність ферментів фосфорного метаболізму, а також дія на клітини мікроорганізмів РЧ-ЕМВ можуть нівелювати антимікробну ефективність фізико-хімічних чинників і призвести до підвищення мікробної адгезії.

Ключові слова: адгезія, стоматологічні сплави металів, дріжджі, поліфосфатаза, радіочастотне електромагнітне випромінювання.

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