

Aegyptus et Pannonia VIII.



Acta Symposii anno 2021

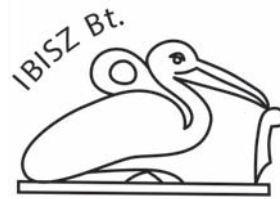
BUDAPEST

Aegyptus et Pannonia VIII.

Acta Symposii anno 2021

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Aegyptus et Pannonia VIII.

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“Plants for Health from Ancient Egypt to Present Day” Conference and the HEFS AEC

DR. HEDVIG GYŐRY PHD
HEFT AEC president

After the realization of the 2019 mummy conference, the need arose to discuss the new trends, methodologies and achievements in ancient materia medica from a phytotherapeutic point of view and to disseminate the results achieved by our in-depth research. With this conference, we also wanted to explore how many different ways there are to approach ancient plants and medicine, also from historical, cultural, religious, ethnographic and pharmacological points of view, and to compare it with other related fields. We also wanted to draw attention to other areas of research into plants that maintain and improve health. In this way, contemporary and historical treatments were juxtaposed, Egyptian, Hittite, Greek, Roman and later European herbal medicine, to mention only the most important regions studied in these proceedings. The conference was held in two languages, English and Hungarian, but all the articles in the proceedings are English. We hope that this way we can bring these issues to the attention of as many people as possible.

This time we have chosen to discuss the plants used for health problems. A significant proportion of the substances in ancient Egyptian prescriptions are of plant origin. Reviewing and studying their effects and data can also provide new opportunities for the current pharmacopoeia. Our group of doctors thought that there was a lot of new knowledge to be gained in this area worldwide, and that the knowledge of plants is becoming increasingly important, if we only think of the research into pathogens, many of which have adapted to synthetic drugs. We need thus new materials to use to eliminate them, and earlier medical practices may lead to the discovery of new active substances that are important for people today. Knowledge of these active ingredients makes it possible to apply these drugs as new medicines in a consistent quantity and quality. On the other hand, there are also many places where conditions do not allow the use of drugs produced by modern technology, but nature can help patients with its often hidden treasures. In addition to pharmacological research, folk remedies studied by ethnomedicine

and historical medical research play an essential role in getting to know them.

The HEFS AEC partly organizes its activities in cooperation with other organizations – the above-mentioned international workshop of the Nephthys project in 2022 was co-organized by the Hungarian Natural History Museum, while this very conference took place in partnership with the HNM Semmelweis Museum of Medical History, whose members gave several lectures on historical medicine and modern ethnomedicine, and where a special chamber exhibition would have welcomed the participants in honour of the conference, if the COVID had not prevented the organization of a face-to-face meeting. Nevertheless, we were able to offer the possibility of discussions and consultations in special virtual chambers, allowing the exchange of professional experiences.

The HEFS AEC has published these new proceedings, this time in two volumes (*Aegyptus et Pannonia VII-VIII*), containing more than half of the papers presented at the conference: “Plants for Health from Ancient Egypt to Present Day”. As we focused on our main research topic in the Medical Research Group of the HEFC Ancient Egyptian Committee, we wondered what the scientific community thought about the ancient Egyptian use of plants in various fields of human and natural sciences, the continuity of related knowledge, and the implications and possibilities of these ancient practices for people today. We also wanted to present the ideas we had developed and the results we had achieved in the professional field, and to provide an opportunity for specialists to discuss different topics. In terms of the structure of the proceedings, we have returned to the previous method of the series, so that the articles are once again listed in alphabetical order of authors, rather than by subjects

THE HEFS ANCIENT EGYPTIAN COMMITTEE AND THE MEDICAL HISTORY

The HEFS, which has been operating since 1995, carries out several activities in the tradition of its earlier activities: the general programs focus on the last five thousand years, selecting interesting and important topics, while the work of the AEC is mainly directed in three directions. An important objective is (1) the cultural transmission and dissemination of knowledge about ancient Egyptian culture through lectures and public meetings for interested adults, also in the framework of the Hungexpo. We also organise (2) artistic and handicraft activities, workshops accompanied by discussions on various topics with children, launching every year a fine arts competition (drawing/painting), the results of which will be exhibited for the third time in January 2023 in the Deák 17 Children’s and Youth Art Gallery of the Budapest History Museum; and (3) following scientific and scholarly research into the use of ancient objects, human and animal remains – including an international event of the Nephthys Project in 2022 – and medical history, concentrated on phytotherapy and surgery.

As far as our material at the conference is concerned, we present here as a starting point our research focused primarily on the use of plants in surgery, if only because several members of the group are doctors from the Department of Surgical Research and Techniques at the Faculty of Medicine in Semmelweis University, Budapest. The first scientific results of this new direction are published of today's surgical tools and materials. Thus our conference papers focus on the ancient Egyptian surgery from the point of view of the application of plants in these volumes, but research is also being carried out in other areas. Firstly we present research in the direction that is mainly focused on comparative analysis, directed towards the ancestors surgical kit, the plant materials used for wound care and the general knowledge of ancient Egyptian surgeons, with a view to the surgical culture of other peoples and periods or the use of pharmacognostic knowledge. We have also considered it essential to investigate into possible reasons for the use of plants, which may allow us to consider modern phytotherapeutic applications.

Two other areas of our phytotherapy research are also represented in these volumes. The origin and treatment of various diseases throughout the world, and especially in ancient Egypt, is also an interesting topic. In this direction, we have chosen to focus one disease in particular. Diabetes is one of the most widespread diseases of our time, and we have chosen to study its ancient treatment methods. In this case, as in the case of surgery, we have compared several cultures to find out the ancient knowledge and problem-solving methods, and have pointed out herbs that are officially used in the world, or in Hungary.

Another problem of our time, seemingly far removed from the history of medicine, is the conservation and preservation of biodiversity, which is affected not only by climate change and other natural factors, but also by human activity. This phenomenon can be traced back even to ancient Egypt, although the process has accelerated in the last hundred years. One of our topics in this respect is presented here, showing how an ancient curiosity herb has become a plant of large-scale production in the 21st century, and saving this way the species from extinction.

A new direction of the group is the study of the history of Hungarian phytotherapy in partnership with the Semmelweis Museum for Medical History. We have just taken the first steps in this direction, but we can already say that the classical Roman authors, and the ancient Egyptian knowledge they transmitted also played an important role in official medical practice and influenced folk medicine in our country. It seems that the herbaria published in Hungarian language played a key role in this process.

The interweaving of contemporary and historical issues characterizes many of the articles in the volumes. At the same time, mutual influences, shifts of emphasis and reinterpretations within the ancient world, or elements of later historical periods that reach into the past or present, play a prominent role. In this field, it is essential to collect and examine the sources from a new perspective in order to obtain a clearer picture of certain details of the past. Historical, artistic, literary, religious, economic, museological, pharmaceutical, phytotherapeutic, ethnobotanical or even chemical points of view appear in individual articles. It has been proven that the ingredients listed in many of the ancient Egyptian recipes studied so far can still be used as effective medicines today.

This volume contains 16 contributions on the role of drug use in different periods. There are chapters on the reconstruction of some ancient Egyptian remedies, on the ancient method prescribed for the preparation of antjw ointment, or on the preparation and action of kyphi, and pelargonium, traced through biochemical and experimental research; Others are devoted to the materia medica used in Hungary over the centuries, or to the comparison of contemporary Egyptian folk medicine and pharaonic materia medica in the field of gynaecology; another is devoted to studies on the possible identification of magical Egyptian plant names with a dominant connection to the moon, or to the ritual and non-ritual use of some plant substances with religious names in Egypt. Others relate to the popular treatment of diseases such as tuberculosis and cholera in Hungary, or which edible plants have been identified in Coptic medical therapies. Sedative plants are also featured in the current volume, and a plant closely associated with a butterfly is discussed. Another article focuses on the pomegranate, with its many meanings as a symbol of fertility and female power. Yet another focuses on the worldwide surgical use of plants, while others discuss the balance between practical and religious beliefs in the use of medicinal plants. The pop-up exhibition for the conference is briefly introduced, hinting at the museological aspect of medical history.

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The editors of these volumes would like to thank again all the organizations and individuals who made the conference and the publication of these volumes possible, as well as the speakers, the members of the Organizing and Scientific Committees, the secretary of the conference, and the technical assistance, i.e. all those who contributed to the realization of the conference and who have contributed with their knowledge to these volumes. Special thanks are also due to the authors of the papers for their work and cooperation.

We would also like to express our gratitude to all those colleagues and volunteers who have shared their expertise and offered their generosity by providing scientific or linguistic proofreading for these volumes.

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IMPACT OF PELARGONIUM SIDOIDES ON PERIODONTAL INFLAMMATION AND IMPROVEMENT OF ORAL HEALTH

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ABSTRACT

The current study inspects the antioxidant capacity of *Pelargonium sidoides* DC. crudum root extract (PSRE) and proanthocyanidins isolated from *Pelargonium sidoides* root extract (PACN) for periodontal disease. A total of 77 subjects with periodontitis were enrolled in this study. Oxidative damage to lipids (MDA Adduct, enzymatic antioxidant Cu, Zn-Superoxide Dismutase (Cu, Zn-SOD) activity and Total Antioxidant Status (TAS) were detected in saliva before and after treatment with PSRE or PACN gum chips in different formulations. The initial antioxidant status of periodontal patients' saliva is characterized by increased concentration of MDA Adduct, TAS and Cu, Zn-SOD. After 3 months of treatment MDA Adduct level decreased using only Ferentis PSRE and PACN gum chips, Cu, Zn-SOD activity decreased in all formulation groups, while TAS remained unchanged. In conclusion, Ferentis PSRE, and PACN gum chips possess antioxidant properties and are suggested as additional support for treatment of the periodontal disease.

KEYWORDS: *Pelargonium sidoides*, periodontitis, antioxidants, oxidative stress

INTRODUCTION

If we want to find out when people began to eat plants, we should return millions of years to the past. It was studied by *Homo habilis* and *Homo erectus*, *Homo neanderthalensis* and *Homo sapiens*. Plants as medicine *per se* and plants as medicine after simple (drying) or complex (extraction, lyophilization) preparation – ancient in the past, nowadays – at the highest level of technology.

All the nations of the world have stories, legends, tales of miracle cures, that plants cured or saved them from death. These stories have become part of the folklore of many nations. For Latvians, there are folk songs “Latvju Dainas” (Figure 1A). They came from prehistory, they tell us about a person’s life throughout its lengths: during births, baptisms, weddings, deaths, the afterlife, they tell about things, livestock, about nature and nature’s participation in every person’s life. Folk songs also tell about flowers, trees, plants, how they help get over diseases, how they help to conceive a child, how they help to live. Latvian songs have been translated into the languages of many nations of the world. Two publications are given here.

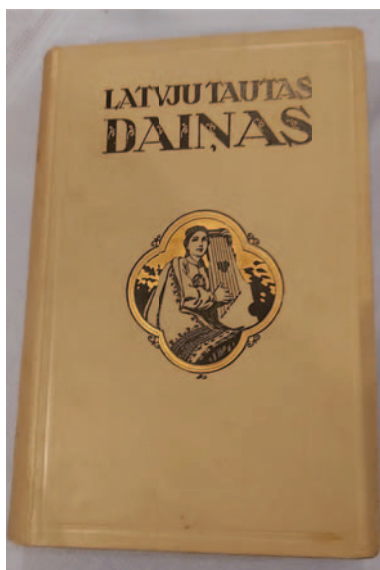


Figure 1A. Book cover of Latvju Dainas (*Latvian folk songs*), in volumes 6, volume 3, part 1. and

Figure 1B. Book cover for Latvju Tautas Dainas (*Latvian national folk songs*), in 7 volumes, vol. 1. (Riga: Literatūra 1928)

<p><i>“The whiter blossoms of the chokecherry, The blacker its berries grew; The more beautiful a mother’s daughters, The more handsome the son-in-love come to her”¹</i></p>	<p><i>Jo baltāka ieva zied, Jo melnākas ogas auga; Jo skaistāka mātes meita, Jo diženi precinieki.</i></p>
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¹ VIKE-FREIBERGA 2019, 287.

– or in Midsummer night, during which all the flowers, all the plants gain magical power to heal peoples

“All flowers ceased blossoming,
Only the fern has not blossoming yet;
It blossoms on Midsummer night;
Sending out a golden mist”.²

Visas puķes noziedēja,
Papardīte vien ne zied.;
Tā ziedēja Jāņu naktī,
Zelta miglu miglodama.

Nowadays, herbal products are being used more often in official medicine based on their biologically active substances. One of such plant is *Pelargonium sidoides* (Ps), which is native to South-Africa and nonetheless, it is found all over the world, both in room decor, gardens and streets (Figure 3).

THE PLANT AND ITS HISTORY

The genus *Pelargonium* comprises about 220-280 species. They originate from tropical South-Africa, and are so similar to the genus *Geranium* (European genus), that even Carl Linné thought them to be identical (1735). Only Charles Louis L'Héritier de Brutelle, who was interested not only in French botany but also in exotic flora, has separated them (1789). The most important difference between geranium and pelargonium is, that the flowers of the pelargonium are not symmetrical, while those of geranium are. Nevertheless, in common talk, the vernacular name for both plants is geranium.

The *Pelargonium* genera is evergreen, and used to drought and heat, but can tolerate a short frost. Various cultivars became popular ornamental plants all over the world. The name derives from πελαργός “stork”, the seed heads being similar to a stork's head (Fig. 2).



Figure 2. *Pelargonium sidoides* seed. Photo: <https://strictlymedicalseeds.com/product/geranium-umcka-pelargonium-sidoides-packet-of-5-seeds-organic/>.

It reached Europe from the Dutch colony in the 1690's by French and English botanists, who installed the plant into their gardens and greenhouses.

² BARONS 2012.

The first species were the *P. cucullatum*, *P. peltatum* and *P. radens*. In the 18th century, this last one in its *var. roseum*, was even cultivated for the perfume industry.³ In the intervening centuries, by domestication and cross-breeding many cultivars were developed for ornamental purposes. In their native country, some of them was, however, medicinal plant. The *Pelargonium sidoides* is an important species among them.

Geraniums (pelargoniums) have been known in Latvia for several centuries. If at first they were indoor flowers in the homes of the urban aristocracy, later of all townspeople, over time they became popular in the countryside as well. In Latvia, similarly to Lithuania and Estonia, folk medicine was (and is) highly developed – folk medicine was known as „medicine aunties“, so in every Latvian family, grandmothers passed on their knowledge to their daughters and granddaughters. It is possible that in the beginning pelargoniums were used for their specific smell, later they also discovered their anti-inflammatory activity; tried to reduce the pain in the ear by crushing the leaves and putting them in the ear. That’s how the name was born – ear flower (*ausu puķe*).



Figure 3. Flowering *Pelargonium sidoides*. Photo by Andrejs Skester.

3 Probably this is also the period, when it gained ground in Hungary, as its first mention originates from 1783 (“Magyar könyvház” by József Benkő), as “hungaris muskáta” – a fragrant crane’s nose versions. Its nationwide spread in the 19th century is due to the Royal Hungarian State Railways, as its program included not only uniform station buildings, but also the decoration with from above hanging potted pelargoniums. Source: Kiss Nóra / Göcsej Museum [editor]

MEDICINAL PROPERTIES

The healers in the South-African Zulu, Xhosa and Nfengi tribes used its root (Figure 4) to cure several diseases, among them dysentery, diarrhea, injury, liver complaints, fever, fatigue and in particular respiratory infections (such as bronchitis, pharyngitis, cough, but also TB). Its medical use in Europe is due allegedly to Charles Henry Stevens. He was working as an engineer in Lesoto Kingdom, where a healer treated his TB with the root extract of the *Pelargonium sidoides*. When he returned to Britain in 1897, due to his recovery, the extract got registered as a medicine. It is called by the Zulu name of the plant, transmitted by Stevens: Umckaloabo, which refers to cough and chest pain.⁴

It is available in pharmacies in liquid and tablet form. The medicinal use is proven because the phytochemical characterization of *Pelargonium sidoides* comprises a multitude of chemical components including gallic acid, methyl gallate-3, myricetins, quercetin-3-O- β -D-glucoside, coumarins, catechins, dihydrokaempferol and other biologically active substances.

Previous Ps studies suggested it for treatment different conditions, such as acute bronchitis, sinusitis, common cold and, tonsillopharyngitis, because of its anti-tuberculosis, antibacterial, antiviral and antifungal activities.⁵ It is even a potent HIV-1 attachment inhibitor.⁶

Students of the faculties of medicine and stomatology, and pharmacy and rehabilitation develop their qualification, Bch and MA theses in our laboratory. We „play“ with juices, extracts in organic and aqueous solutions. We determine the antioxidative and antiradical abilities, neutralize free radicals and active forms of oxygen [model experiments and *in vivo* too]. When we tested water extracts of pelargonium leaves, we found a very high antioxidant and antiradical potential. Periodontitis can be considered an inflammatory disease. Where there is inflammation, there are lipid and/or proteins peroxidation processes. Together with colleagues from Lithuania, we came up with the idea to test whether pelargonium root extracts (crudum) and some extracted active substances from root extract, can improve oral health. In Latvian folk medicine, pelargonium has been called for a long time an “ear” flower, thus, why not a “tooth” flower? This is how the Pelogargodont project was born.

4 BRENDLER – VAN WYK 2008

5 USLU ET ALII 2009; TIMMER ET ALII 2013; SAVICKIENE ET ALII 2018; WILLCOX ET ALII 2021.

6 HELFER ET ALII 2014.



Figure 4. *Pelargonium sidoides* root / Geranium, Umcka, Garnet Geranium (Photo. <https://strictlymedicalseeds.com/product/geranium-umcka-pelargonium-sidoides-packet-of-5-seeds-organic/>)

PERIODONTITIS

Periodontal disease affects 10-15% of the world population and it is one of the leading reasons of tooth loss.⁷ The oral cavity is an essential part of the human body being distressed by many various external factors such as food, air, microorganisms as well as xenobiotics (cigarette smoke, alcohol, dental materials, medications,⁸ and certainly dental diseases, including periodontitis.

Periodontitis is a chronic inflammatory disease, characterized by gingival bleeding, periodontal pocket formation, tissue destruction and alveolar bone resorption leading to tooth loss. Traditionally periodontitis academic treatment includes use of antibiotics and synthetic antiseptics that is accompanied by systemic side effects and increases bacterial resistance. Furthermore, reactive oxygen species (ROS), including superoxide anion radical, hydrogen peroxide, hydroxyl- and lipid radicals, are products of physiological cellular metabolism. In addition, periodontitis induces excessive ROS production in periodontal tissues, and simultaneously increases the

7 SHILPA – NAND 2017, 54-55.

8 ŽUKOWSKI ET ALII 2018.

content of ROS in saliva. ROS overproduction represents oxidant/antioxidant imbalance and initiates inflammatory pathways, which could be one of the possible potential mechanisms in periodontal tissue breakdown. It would be essential to evaluate the impact of Ps on the saliva antioxidative system by determining antioxidative status (TAS), enzymatic antioxidant – Cu, Zn-superoxide dismutase (SOD) and malondialdehyde adduct (MDA Adduct).

The aim of the present investigation was to detect changes of RedOx homeostasis in saliva from periodontitis patients (Pp) after 3-month treatment with *Pelargonium sidoides* root extract (PSRE) and proanthocyanidins from *Pelargonium sidoides* root extract (PACN).

MATERIALS AND METHODS

STUDY SUBJECTS

Saliva samples were obtained within European multi-centre study using data from project *Engineering and functionalization of delivery system with Pelargonium sidoides biologically active substance and inflamed periodontal surface area*. The selection criteria were subject age over 18 years and diagnosis of periodontitis. Ethical approval for this study was obtained from the Riga Stradins University Ethics Committee. Participation in the study was voluntary and written informed consent was obtained from each study participant. Confidentiality of study participants was maintained. Data were collected and processed in accordance with the General Data Protection Regulation (GDPR) 2016/679 on the protection of natural persons with regard to the processing of personal data.

The study was conducted involving 117 subjects (male and female) with age ranging from 26 to 83 years old (mean = 49 years).

SAMPLE PREPARATION

Saliva samples were collected in the morning following an overnight fast. The patients were asked to rinse their mouths using distilled water. After 5 min. we started to gain unstimulated saliva samples. For saliva collection Salivette®, product number 51.1534, manufactured by SARSTEDT, was used. Samples were centrifuged immediately at 1000 x g 2 min +4 °C. Upper parts were drawn and stored till analysis at -80 °C.

For Total Antioxidant Status (TAS) determination we used diagnostic kit NX 2332 with Total Antioxidant Control (Cat. No. NX 2331) on the clinical biochemistry analyser RX Daytona, all produced by Randox Laboratories, Ltd., Crumlin, UK, according to the manufacturer's instructions. This spectrophotometric assay principle for TAS determination is based on ABTS® (2,2-Azino-di-{3-ethylbenzthiazoline sulphonate}) which is incubated with peroxidase (metmyoglobin) and H₂O₂ to produce the radical cation ABTS^{•+}. This has a relatively stable blue-green colour, which is measured at 600 nm.

Antioxidants in the added sample cause suppression of this colour production to a degree which is proportional to their concentration.⁹

The activity of Superoxide dismutase (Cu, Zn-SOD) was measured using commercial kit RANSOD Cat.No.SD125 with RANSOD Diluent (Cat. No. SD 124) (0.01 mol/l Phosphate Buffer, pH 7.0), control RANSOD Control (Cat. No. SD 126) on the clinical biochemistry analyser RX Daytona, all produced by Randox Laboratories, Ltd., Crumlin, UK, according to the manufacturer's instructions. Assay principle: method employs xanthine and xanthine oxidase (XOD) to generate superoxide radicals which react with 2-(4-iodophenyl)-3-(4-nitrophenol)-5-phenyltetrazolium chloride (I.N.T.) to form a red formazan dye. The superoxide dismutase activity is then measured by the degree of inhibition of this reaction. One unit of SOD is that which causes a 50% inhibition of the rate of reduction of I.N.T. under the conditions of the assay.¹⁰

MDA-protein adducts in saliva were analysed by the ELISA method using a commercially quantitative OxiSelect™ MDA Adduct Competitive ELISA (STA-832) Kit (CELL BIOLABS, Inc.) according to the manufacturer's instructions. Used equipment – microplate analyser SPARK, (TECAN Austria GmbH) with SPARKCONTROL Magellan software (Mannedorf, Switzerland). Assay principle: MDA conjugate is coated on an ELISA plate. The unknown MDA protein samples or MDA-BSA standards are then added to the MDA conjugate preabsorbed ELISA plate. After a brief incubation, an anti-MDA polyclonal antibody is added, followed by an HRP conjugated secondary antibody. The content of MDA protein adducts in unknown samples is determined by comparison with a predetermined MDA-BSA standard curve.¹¹

STATISTICAL ANALYSIS

Results were expressed as the mean \pm standard deviation (SD). The results corresponded to a normal distribution and were processed with a two-sample T-Test assuming Equal variance in MS Office Excel. All statistical calculation and image creation were carried out using IBM SPSS 20.0 and MS Excel.

RESULTS AND DISCUSSION

A total of 77 subjects with age ranging from 26 to 83 years old (mean = 49 years) with periodontitis were enrolled in this study. Patients were divided into five groups as represented in Table 1.

9 MILLER ET ALII 1993.

10 WOOLLIAMS ET ALII 1983.

11 HOFF – NEIL 1993.

The antioxidative system in saliva was evaluated according to total antioxidative status (TAS), enzymatic antioxidant Cu, Zn-superoxide dismutase (Zn-SOD) and malondialdehyde adduct (MDA Adduct). As reported in Table 2, it was found that at the beginning of the study TAS level in saliva was significantly increased in all groups. After 3 month-treatment TAS levels decreased in E2 and E3 groups compared to the initial period. Also, it was found that at the beginning of the study Cu, Zn-SOD activity was statistically higher in E1 and E4 groups compared to the control group. After treatment Cu, Zn-SOD activity decreased statistically significantly in E3 and E4 groups compared to the initial period and reached control level. Cu, Zn-SOD activity in E2 group remained without significant deviations within the treatment period.

Table 1. Patient separation according to formulation of *Pelargonium sidoides*

Group	Formulation type
Control	Healthy subjects
E1	Gum chips with PACN – Ferentis (collagen hydrogel-based) (N. Savickiene, et al., 2018)
E2	Gum chips with PSRE – Ferentis (collagen hydrogel-based) (N. Savickiene, et al., 2018)
E3	PEL-68-PACN – Gelan gum-based chips with PACN produced by Centre of Polymer and Carbon Materials Polish Academy of Sciences
E4	PEL-69-PSRE – Gelan gum-based chips with PSRE produced by Centre of Polymer and Carbon Materials Polish Academy of Sciences

The results of our investigations showed that there are not any statistically significant correlations between tested parameters, but in the meantime, we can confirm tendencies using different active agents from *Pelargonium sidoides* and different formulations in medical treatment against periodontitis. The level of oxidative stress in saliva can be judged by determining MDA-adducts concentrations. MDA-adducts in the saliva of the patients also decreased in groups E1 and E2. These groups presented a complex therapy with Ferentis-PACN and Ferentis-PSRE, respectively. After treatment, we found decreasing of MDA-adducts formation in comparison to the initial conditions to all patients in these groups, and also compared to the control group. We can assess this as a positive result.

Table 2. The effect of treatment on the amount of TAS and activity of Cu, Zn-SOD

Group	TAS, mmol/L		Cu, Zn-SOD, U/mL	
	Treatment period		Treatment period	
	before	after	before	after
Control, n=23	0,67 ± 0,30		0,59 ± 0,37	
E1, (Ferentis-PACN), n=20	0,83 ± 0,28 [#]	0,81 ± 0,35 [#]	0,81 ± 0,35 [#]	0,66 ± 0,43
E2, (Ferentis-PSRE), n=21	0,85 ± 0,29 [#]	0,74 ± 0,34	0,74 ± 0,34	0,61 ± 0,46
E3 (PEL-68-PACN), n=18	0,87 ± 0,38 [#]	0,78 ± 0,51	0,78 ± 0,51	0,50 ± 0,31 [*]
E4 (PEL-69-PSRE), n=18	0,83 ± 0,27 [#]	0,86 ± 0,49 [#]	0,86 ± 0,49 [#]	0,51 ± 0,31 ^{**}

The results are presented as average ± STdev;

n - number of participants in the group.

[#] - statistically significant in comparison to control group, p < 0,05;

^{*} - statistically significant in comparison to initial stage, p < 0,01;

^{**} - statistically significant in comparison to initial stage, p < 0,001;

No positive outcome was found in groups E3 PEL-68-PACN and E4 PEL-69-PSRE, respectively. Even so, the concentration of MDA-adducts increased in E4 PEL-69-PSRE group by 20.4% compared to the initial data. Unfortunately, due to the insufficient number of patients in each group and their individual characteristics, the results of the studies are not statistically significant and reflect only a certain tendency (Table 3).



Figure 5. Flowering *Pelargonium sidoides*. Photo by Andrejs Skester

Table 3. Effect of treatment on the level of MDA Adduct

Group	MDA Adduct, pmol/mL	
	Treatment period	
	before	after
Control, n=23	36.50 ± 3.6	
E1, (Ferentis PACN), n=20	45.94 ± 6.96	34.93 ± 4.58
E2, (Ferentis PSRE), n=21	57.01 ± 10.45 [#]	26.32 ± 2.95 ^{#**}
E3 (PEL_68_PACN), n=18	72.23 ± 10.29 [#]	73.89 ± 10.41 [#]
E4 (PEL_69_PSRE), n=18	74.58 ± 10.94 [#]	89.92 ± 10.11 [#]

The results are presented as average ± STdev;

n – number of participants in the group.

[#] – statistically significant in comparison to control group, p < 0,05;

^{**} – statistically significant in comparison to initial stage, p < 0,001;

CONCLUSIONS

After 3 months of treatment with Ferentis PACN and PSRE gum chips, normalization of antioxidative capacity was detected in these groups.

We believe that type of formulation for biologically active substances, PACN and PSRE is a key point for effective delivery to reduce inflammatory processes in the gum and around the tooth as evidenced by normalization of individual components of antioxidative capacity. We consider that further research is desired to fully understand which of the proposed preparations/formulations is more suitable for one or other patient depending on severity of the disease, tooth localization and other influencing factors.

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