blood plasma of rats. All calculations were performed mathematically and statistically (one-way ANOVA) using Microsoft Excel software.

Cr(VI)-induced oxidative stress was accompanied by a significant increase in the enzymatic activity of ALP in the blood plasma of animals of groups III and IV by 41 and 39%, respectively, compared with the control. Cr(VI) toxicity can cause membrane disintegration of ALP in hepatocytes with subsequent transfer of the corresponding enzyme to the blood plasma [4; 7]. The preliminary effect of ETS with subsequent Cr(VI) intoxication for 7 and 14 days contributed to a significant activation of ALP in rat plasma by 20 and 46%, respectively, compared with group II. However, the level of ALP activity of group VI (20%) compared to the group II was by 21% lower than the level of ALP activity in group III (41%) compared to the group I. The ALP activation in the blood of animals of group VII compared to group II remained at the level of the indicators of ALP activity in the blood plasma of rats of group IV relative to group I.

The results of the research show that the Cr(VI) toxicity causes the elevation of ALP activity in blood plasma of rats, which may indicate a hepatotoxic effect. The previous impact of ETS partially offset the negative effect of 7 days Cr(VI) toxicity by twofold lowering of blood plasma ALP activity. However, the antioxidant effect of ETS in the studied dose was insufficient to normalize ALP activity during the 14-day period of Cr(VI) toxicity.

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IN VITRO ANTIBACTERIAL ACTIVITY OF COMMERCIAL NATURAL ESSENTIAL OIL OBTAINED FROM STAR ANISE SEED (*ILLICIUM VERUM* HOOK.F.) AGAINST *ENTEROCOCCUS FAECALIS* STRAINS

Halina Tkaczenko, D.Sc., Professor, Institute of Biology and Earth Sciences, Pomeranian University in Słupsk, Słupsk, Poland;
ORCID: https://orcid.org/0000-0003-3951-9005
Maryna Opryshko, Researcher, M.M. Gryshko National Botanic Garden, National Academy of Science of Ukraine, Kyiv, Ukraine;
ORCID: https://orcid.org/0000-0001-5048-4961

Myroslava Maryniuk, Researcher, M.M. Gryshko National Botanic Garden, National Academy of Science of Ukraine, Kyiv, Ukraine;
ORCID: https://orcid.org/0000-0003-2590-448X
Oleksandr Gyrenko, Ph.D., Researcher, M.M. Gryshko National Botanic Garden, National Academy of Science of Ukraine, Kyiv, Ukraine;
ORCID: https://orcid.org/0000-0003-3296-3787
Lyudmyla Buyun, D.Sc., Leading Researcher, M.M. Gryshko National Botanic Garden, National Academy of Science of Ukraine, Kyiv, Ukraine
ORCID: https://orcid.org/0000-0002-9158-6451
Natalia Kurhaluk, D.Sc., Professor, Institute of Biology and Earth Sciences, Pomeranian University in Słupsk, Słupsk, Poland;
ORCID: https://orcid.org/0000-0002-4669-1092

Introduction. The escalating threat of antibiotic resistance has become a major global health concern, necessitating the search for alternative antimicrobial agents [Salam et al., 2023]. Natural products, particularly essential oils derived from various plant sources, have attracted attention for their potential antibacterial properties [Vaou et al., 2021]. Among these, the essential oil obtained from star anise seed (*Illicium verum* Hook.f.) has been traditionally used for its therapeutic properties and is known for its rich chemical composition [Sharafan et al., 2022]. The fruit contains tannins and essential oil (9–10%), consisting of anethole (85–90%), α-pinene, limonene, β-phellandrene, α-terpineol, and farnesol [Noumi et al., 2023].

Star anise, a spice native to southwest China, has a distinctive aroma and flavour that make it a popular ingredient in culinary and medicinal preparations worldwide [Howes et al., 2009]. In addition to its culinary uses, star anise has been extensively studied for its pharmacological properties, including carminative, digestive, antispasmodic, expectorant, antirheumatic, and diuretic properties [Noumi et al., 2023]. Previous research has highlighted the potential antioxidant [Padmashree et al., 2007], insecticidal, fumigant [Kim et al., 2003] and antimicrobial [Singh et al., 2006] activities of star anise essential oil.

In this context, the present study aims to investigate the *in vitro* antibacterial activity of commercial natural essential oil extracted from star anise (*Illicium verum* Hook.f.) seed against *Enterococcus faecalis* strains. Understanding the antimicrobial potential of this natural essential oil could provide valuable insights for its use in the development of novel antibacterial agents, thereby contributing to the ongoing efforts to combat antibiotic resistance.

Materials and methods. ***Star anise seed essential oil (SAS EO).*** The SAS EO was provided by a Polish producer of essential oils (Etja sp. z o.o., Elbląg, Poland). Etja is a Polish brand of natural products launched in 1991. This traditional company was founded by natural oil enthusiasts with extensive experience in the aromatherapy industry. The sample tested contained no additives or solvents and was confirmed by the manufacturer to be natural. Samples were stored in resealable vials at 5°C in the dark but allowed to reach room temperature before testing. The geographical origin was Italy.

Determination of antibacterial activity of essential oils by disc diffusion method. The antibacterial activity of SAS EO was tested *in vitro* using the Kirby-Bauer disc diffusion technique (1966). Gram-positive strains of *Enterococcus faecalis* (Andrewes and Horder) Schleifer and Kilpper-Balz (ATCC®51299™) (resistant to vancomycin; sensitive to teicoplanin) and *Enterococcus faecalis* (Andrewes and Horder) Schleifer and Kilpper-Balz (ATCC®29212™) were used. The strains were inoculated onto Mueller-Hinton (MH) agar plates. Sterile filter paper discs impregnated with SAS EO were placed over each culture dish. Bacterial isolates were then incubated with SAS EO at 37°C for 24 h. The Petri dishes were then observed for the zone of inhibition produced by the antibacterial activity of SAS EO. A control Petri dish impregnated with 96% ethanol was used in each experiment. At the end of the 24-hour period, the inhibition zones formed were measured in millimetres using a vernier. Eight replicates were tested for each strain (n = 8). The Petri dishes were observed and photographed. The susceptibility of the test organisms to

SAS EO was indicated by a clear zone of inhibition around the discs containing SAS EO and the diameter of the clear zone was used as an indicator of susceptibility. Zone diameters were measured and averaged. The following zone diameter criteria were used to classify bacteria as susceptible or resistant to the tested phytochemicals: Susceptible (S) ≥ 15 mm, intermediate (I) = 10-15 mm and resistant (R) ≤ 10 mm [Okoth et al., 2013].

Statistical analysis. Statistical analysis of the data obtained was performed using the mean ± standard error of the mean (S.E.M.). All variables were randomised according to the phytochemical activity of the SAS EO tested. All statistical calculations were performed on separate data from each strain. The data were analysed by one-way analysis of variance (ANOVA) using Statistica v. 13.3 software (TIBCO Software Inc., USA).

Results. *E. faecalis* strains were sensitive to the effect of SAS EO. Diameters of inhibition zones after application of SAS EO were (14.41 ± 0.66 mm) compared to 96% ethanol as a control sample (7.53 ± 0.60 mm) for *E. faecalis* (Andrewes and Horder) Schleifer and Kilpper-Balz (ATCC®51299™) strain and (17. 28 ± 0.83 mm) compared to the 96% ethanol control sample (8.18 ± 0.55 mm) for *E. faecalis* (Andrewes and Horder) Schleifer and Kilpper-Balz (ATCC®29212™) strain. The increase in inhibition zone diameter after application of SAS EO was 91.4% ($p < 0.05$) and 111.3% ($p < 0.05$) for *E. faecalis* (Andrewes and Horder) Schleifer and Kilpper-Balz (ATCC®51299™) and *E. faecalis* (Andrewes and Horder) Schleifer and Kilpper-Balz (ATCC®29212™) strains, respectively.

The study demonstrates the potent antibacterial properties of the natural EO extracted from star anise seed (*Illicium verum*) against *E. faecalis* strains, suggesting its potential as an alternative antimicrobial agent. In the study by Noumi and co-workers (2023), these researchers confirmed the antibacterial activity of star anise EO. *Staphylococcus aureus* (Gram-positive bacteria) was more sensitive to the action of *I. verum* EO compared to Gram-negative bacteria (*Pseudomonas aeruginosa* PAO1, *Shigella flexeneri* and *Vibrio vulnificus*). Freire and co-workers (2011) showed that EO from *I. verum* was effective against *Escherichia coli* strains. Ebani and co-workers (2018) demonstrated that the EO from *I. verum* has antibacterial activity against many bacterial strains, except *Enterococcus*. The aqueous methanol extract of *I. verum* has antibacterial activity against multidrug-resistant *Acinetobacter baumannii* and methicillin-resistant *Staphylococcus aureus* [Salem et al., 2021]. It has been reported that much of this antimicrobial property is due to the anethole present in the dried fruit. Studies with isolated anethole (compared to standard anethole) showed that it was effective against bacteria, yeast and fungal strains [De et al., 2002]. Understanding the antibacterial efficacy of star anise essential oil may lead to the development of new therapeutic strategies for treating *E. faecalis* infections in clinical settings. Research into natural essential oils, such as star anise seed oil, offers hope in the fight against antibiotic resistance by providing new avenues for effective antimicrobial treatment. Identifying the antibacterial properties of plant-derived essential oils can promote sustainable healthcare practices by reducing reliance on synthetic antibiotics and exploring environmentally friendly alternatives.

Conclusions. The study investigated the potential of star anise essential oil as a novel and natural alternative to traditional antibiotics in the treatment of *E. faecalis* infections. The results indicate that the commercial natural essential oil derived from star anise seed has significant antibacterial activity, highlighting its efficacy in inhibiting the growth of *E. faecalis* strains *in vitro*. These findings support the use of star anise essential oil as a promising natural remedy to combat *E. faecalis* infections, offering a sustainable and potentially safer alternative to traditional antibiotics. Further research and clinical trials are warranted to explore the full therapeutic potential of star anise essential oil against *E. faecalis* infections, paving the way for its potential use in antimicrobial strategies and pharmaceutical development.

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MICROFLORA IN THE COMPOSITION OF BIOAEROSOLS OF PIG FARMS

Grigorash P.B., Postgraduate student, Podillia State University, Kamianets-Podilskyi, Ukraine
ORCID: https://orcid.org/ 0009-0005-5216-6381
Horiuk Y.V., Doctor of Veterinary Sciences, Associate Professor, Podillia State University, Kamianets-Podilskyi, Ukraine
ORCID: https://orcid.org/0000-0002-7162-8992

Aerosols from pig farms can contain a large number of bacteria, fungi, viruses, spores, metabolites, resistance genes, etc. This causes concern due to the possibility of infection of animals by airborne droplets, the development of respiratory infections and impaired lung function. It was found that bioaerosols from pig farms are capable of inducing the activation of a nonspecific immune response, causing various inflammatory reactions of the respiratory tract [2, 3].

The purpose of the work: to study the composition of bioaerosols of pig farms in order to improve strategies for improving their microclimate.

The main components of bioaerosols on pig farms are bacteria. The composition of the microflora of bioaerosols may differ depending on the geographical location, climate, season, type of piggery, feeding regime and keeping of animals. Many researchers have found that the predominant number of microorganisms is represented by the *Firmicutes* and *Bacteroidetes* bacteria division. Other scientists have shown that the bioaerosol of the pig farm contained *Proteobacteria*, *Actinobacteria*, *Bacteroidetes* and *Firmicutes* bacteria. Bacterial communities on the same farm and on the same farm also differed. For example, a researcher [1] found that the genus *Acinetobacter* predominated in a room where weaned piglets and fattening animals were kept, while *Psychrobacter* and *Rothia* were most often isolated in rooms for keeping pregnant sows and farrowing sectors. A group of other scientists found that a number of *Clostridiales* bacteria were the most common in the fattening and farrowing room, while *Lactobacillus predominated* in the weaning room [3]. An important indicator of the danger of bioaerosols is the content of pathogenic microorganisms in them. Separate studies show that the content of potentially dangerous bacteria in bioaerosol can reach up to 40%.

In addition, the widespread use of antibiotics and veterinary drugs on pig farms has led to the discovery of a large number of antibiotic-resistant microorganisms in the air of these farms. Thus, methicillin-resistant *Staphylococcus aureus* (MRSA) is one of the frequently identified resistant microorganisms in the air of pig farms. In addition, scientists have shown that *Staphylococcus aureus* and *Salmonella* spp. inside the pigsties were resistant to ampicillin, erythromycin, oxytetracycline, penicillin, tetracycline, tylosin. Also, high concentrations of airborne antibiotic resistance genes and mobile genetic elements were detected on pig farms. Scientists have determined that approximately 63–73% of the resistome in the dust comes from the aerosolization of animal muzzles, and the rest, respectively, from other parts of the animals' bodies and tools present on the farm [2].

There are many strategies to deal with such problems. Yes, there are studies that the production of pig feed is the biggest environmental impact factor in pig farming. In this regard, many alternative feeding methods and ration compositions aimed at reducing environmental pollution have been developed. The use of these strategies depends mainly on the economic capabilities of the farm and the animal husbandry system of an individual country [2]. Some of them still need to be tested or validated in production conditions, while others are difficult to implement on existing farms. In addition, the interaction of harmful gases, dust, solid particles and microorganisms, which can increase the toxic effect of each other on the animal's body, is rarely taken into account.