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ANTIBACTERIAL EFFICACY OF LEAF EXTRACTS DERIVED FROM *FICUS ELASTICA* ROXB. EX HORNEM. (MORACEAE) AND ITS CULTIVARS AGAINST *AEROMONAS SOBRIA* STRAIN

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The range of healing targets for particular Ficus species compiled from local medicines can be competitive with that of broad-spectrum traditional remedies. In the current study, we studied the antimicrobial activity of the ethanolic extracts derived from the leaves of Ficus elastica Roxb. ex Hornem. and its cultivars (F. elastica 'Rubra', 'Robusta', 'Burgundy', 'Variegata') against Aeromonas sobria to evaluate the possible use of this plant in preventing infections caused by this fish pathogen in aquaculture. The current study was conducted as a part of an ongoing project between five universities undertaken in the frame of a cooperation program aimed at the assessment of medicinal properties of tropical and subtropical plants, cultivated in vitro. The leaves of F. elastica and its cultivars, cultivated under glasshouse conditions, were sampled at M. M. Gryshko National Botanic Garden (NBG), National Academy of Science of Ukraine. Specifically, the leaves of F. elastica and its cultivars, i.e. F. elastica 'Rubra', 'Robusta', 'Burgundy', 'Variegata' were sampled for our study. Aeromonas sobria (K825) strain, originated from freshwater fish species such as common carp (Cyprinus carpio L.) and rainbow trout (Oncorhynchus mykiss Walbaum), respectively, was isolated in the Department of Fish Diseases, The National Veterinary Research Institute in Pulawy (Poland). Antimicrobial susceptibility of the tested Aeromonas sobria was performed by the Kirby-Bauer disc diffusion method (1966) according to the recommendations of the Clinical and Laboratory Standards Institute (CLSI) (2014), with our some modifications. Our results of the antimicrobial screening revealed, that F. elastica and its cultivars possessed mild antibacterial properties against the A. sobria strain. The ethanolic extract obtained from leaves of F. elastica 'Variegata' exhibited the maximum antimicrobial activity against A. sobria. Thus, F. elastica and its cultivars (F. elastica 'Rubra', 'Robusta', 'Burgundy', 'Variegata') disclosed mild bioactivity, and this plant can be regarded as a potential source of antibacterial agents. The results of the current study provide a new perspective for the use of various species belonging to the Ficus genus as medicinal plants to improve the antibacterial responses in salmonid aquaculture.

Keywords: ***Ficus elastica* Roxb. ex Hornem., extract, antimicrobial efficacy, Kirby-Bauer disk diffusion technique, fish pathogens, susceptibility, resistance.**

In aquaculture, medicinal herbs and extracts are widely used for the treatment of aquatic animals. They are approved for their growth-promoting, anti-inflammatory and antioxidant properties. Herbal essential oils contain many bioactive components with potent antibacterial, antioxidant, and immune-boosting properties, suggesting their use in aquatic animals [9]. Moreover, the use of herbal medicines and their extracts can reduce oxidative stress caused by several stressors in fish farming. Accordingly, aquatic animals may acquire increased resistance to infectious pathogens and environmental stressors [1]. Plant powders and extracts are natural feed additives that, due to their bioactive compounds, including phenolic compounds, proteins, vitamins, and minerals, have anti-stress, antiviral, antibacterial, and antifungal effects on fish [32]. Some of these herbs are *Ficus* species that have a long history of use in traditional medicine.

Ficus has a long history of use by humans as a food source, in medicine, planting, and other industries and fields of human activity, partly owing to its great diversity and wide distribution range. Among popular ethnomedicinal uses of *Ficus* are treatments of skin damage, disorders of the digestive system and related organs, and parasitic infections. Besides these, the range of healing targets for particular *Ficus* species compiled from local medicines can be competitive with that of broad-spectrum traditional remedies [12].

Ficus elastica Roxb. ex Hornem. is a large monoecious evergreen (rarely deciduous) tree up to 30 m tall. The species is considered to naturally originate from NE India, Myanmar, Malay Peninsula, Sumatra, and Java, but is also commonly cultivated in that areas and throughout the world. It belongs to those species known as hemiepiphytes, which start life as an epiphyte in the crown of another tree and then send roots down to the ground enveloping the trunk of the host tree. Although usually occurring in forests, this species can also grow as a terrestrial tree or shrub in dry habitats such as cliffs and limestone hills. It's glabrous coriaceous spirally arranged leaves reach 10-40 cm in length and 5-22 cm in width; they are elliptic to oblong with an acuminate apex and cuneate to obtuse or rounded base. The pedunculate glabrous figs of 1-1.5 cm in diameter are born axillary or just below the leaves, in pairs or solitary, and turn yellow at maturity [3].

The latex of *F. elastica* showed significant antischistosomal activity [22]. Leaf extract of *F. elastica* is employed as a diuretic agent besides treating skin infections and allergies [18]. Standardized extracts of *F. elastica* could be used in traditional medicine for the treatment of wounds and other topical infections [14]. Mbosso Teinkela and coworkers (2018) revealed *in vitro* cell-growth inhibition activities by methanolic extract of *F. elastica* against *Plasmodium falciparum* strain 3D7 and *Trypanosoma brucei brucei*, as well as against HeLa human cervical carcinoma cells. At the 25 μg/mL concentration, the extract of *F. elastica* exhibited plasmodiacidal activity (IC_{50} value of 9.5 μg/mL) and trypanocidal (IC_{50} value of 0.9 μg/mL) activity. Extract presented low cytotoxic effects on the HeLa cancer cell line [13].

In the current study, we studied the antimicrobial activity of the ethanolic extracts derived from the leaves of *F. elastica* and its cultivars (*F. elastica* 'Rubra', 'Robusta', 'Burgundy', 'Variegata') against *Aeromonas sobria* to evaluate the possible use of this plant in preventing infections caused by this fish pathogen in aquaculture. The current study was conducted as a part of an ongoing project between the Institute of Biology and Earth Sciences (Pomeranian University in Słupsk, Poland), Faculty of Veterinary

Medicine and Animal Sciences, University of Life Sciences (Poznań, Poland), M.M. Gryshko National Botanic Gardens of National Academy of Sciences of Ukraine (Kyiv, Ukraine), and Ivan Franko National University in Lviv (Lviv, Ukraine) undertaken in the frame of cooperation program aimed at assessment of medicinal properties of tropical and subtropical plants, cultivated *in vitro*.

Materials and methods.

Collection of plant material and preparing plant extract. The leaves of *F. elastica* and its cultivars (Photo 1), cultivated under glasshouse conditions, were sampled at M.M. Gryshko National Botanic Garden (NBG), National Academy of Science of Ukraine. Specifically, the leaves of *F. elastica* and its cultivars, i.e. *F. elastica* 'Rubra', 'Robusta', 'Burgundy', 'Variegata' were sampled for our study.

A B

Fig. 1. General view of *Ficus elastica* plant (A) and a leaf of this plant (B).
Photo: Yevhen Sosnovsky

The sampled leaves were brought into the laboratory for antimicrobial studies. Freshly sampled leaves were washed, weighed, crushed, and homogenized in 96 % ethanol (in proportion 1:10) at room temperature, and centrifuged at 3,000 g for 5 minutes. Supernatants were stored at -20°C in bottles protected with laminated paper until required.

Bacterial strains for antimicrobial activity assay. *Aeromonas sobria* (K825) strain, originated from freshwater fish species such as common carp (*Cyprinus carpio* L.) and rainbow trout (*Oncorhynchus mykiss* Walbaum), respectively, was isolated in the Department of Fish Diseases, The National Veterinary Research Institute in Pulawy (Poland). Bacteria were collected from fish exhibiting clinical disorders. Each isolate was inoculated onto trypticase soy agar (TSA) (BioMérieux Polska Sp. z o.o.) and incubated at 27°C ± 2°C for 24 h. Pure colonies were used for biochemical identifications, according to the manufacturer´s instructions, except the temperature of incubation, which was at 27°C ± 1ºC. The following identification systems were used in the study: API 20E, API 20NE, API 50CH (BioMérieux Polska Sp. z o.o.). Presumptive

Aeromonas isolates were further identified to the species level by restriction analysis of 16S rDNA genes amplified by polymerase chain reactions (PCR) [11].

Bacterial growth inhibition test of plant extracts by the disk diffusion method. Antimicrobial susceptibility of the tested *Aeromonas sobria* was performed by the Kirby-Bauer disc diffusion method (1966) [2] according to the recommendations of the Clinical and Laboratory Standards Institute (CLSI) (2014) [4, 5], with our some modifications. Each inoculum of particular bacteria species in the density of 0.5 McFarland was cultured on Mueller-Hinton agar. After inoculation of bacteria, a maximum of 5 wells per Petri dish with a diameter of 6 mm each was cut into the medium, and plant extracts were added to them. Plates were incubated for 24 h at 28 ± 2°C and the inhibition zones for each well were measured. For each extract, eight replicates were assayed. The plates were observed and photographs were taken. Zone diameters were determined and averaged. Ethanol (at 96% strength, POCH, Poland) as used to prepare the extracts was also used as the negative control for the microbiological study.

***Statistical analysis*.** Statistical analysis of the data obtained was performed by employing the mean ± standard error of the mean (S.E.M.). All variables were tested for normal distribution using the Kolmogorov-Smirnov test ($p > 0.05$). To find significant differences (significance level, $p<0.05$) between groups, the Kruskal-Wallis test by ranks was applied to the data [31]. All statistical analyses were performed using STATISTICA 8.0 software (StatSoft, Poland). The following zone diameter criteria were used to assign susceptibility or resistance of bacteria to the phytochemicals tested: Susceptible (S) ≥ 15 mm, Intermediate (I) = 10–15 mm, and Resistant (R) ≤ 10 mm [15].

Results and discussion. Results on *in vitro* antimicrobial activity assessment of ethanolic extracts derived from leaves of *F. elastica* and its cultivars (*F. elastica* 'Rubra', 'Robusta', 'Burgundy', 'Variegata') against *Aeromonas sobria* strain expressed as a mean of diameters of inhibition zone is presented in Figure 1.

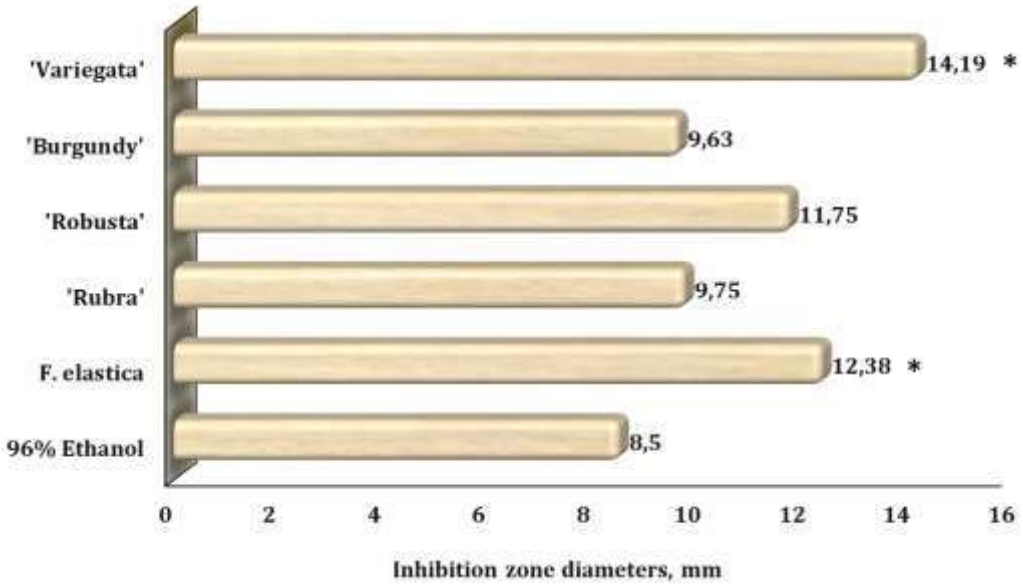

Fig. 1. The mean inhibition zone diameters induced by ethanolic extracts derived from leaves of *F. elastica* and its cultivars (*F. elastica* 'Rubra', 'Robusta', 'Burgundy', 'Variegata') against *Aeromonas sobria* strain (1000 µL inoculum) (M ± m, n = 8).

**– changes are statistically significant compared to the 96% ethanol.*

Our results of the antimicrobial screening revealed, that *F. elastica* and its cultivars possessed mild antibacterial properties against the *A. sobria* strain. The ethanolic extract obtained from leaves of *F. elastica* 'Variegata' exhibited the maximum antimicrobial activity against *A. sobria* (the mean of inhibition zone diameters was 14.19 ± 0.73 mm). *A. sobria* strain was susceptible to the *F. elastica* (12.38 ± 0.82 mm) and 'Robusta' (11.75 ± 0.53 mm). *A. sobria* strain was the most resistant to *F. elastica* 'Rubra' (9.75 ± 0.41 mm) and *F. elastica* 'Burgundy' (9.63 ± 0.38 mm) leaf extracts. Statistically significant increase in the mean inhibition zone diameters induced by ethanolic extracts derived from leaves of *F. elastica* and its cultivars was demonstrated for *F. elastica* (by 45.6%, $p < 0.05$) and *F. elastica* 'Variegata' (by 66.9%, $p < 0.05$) (Fig. 1).

Moreover, in our previous study [16], we evaluated the *in vitro* possible antioxidant effects of extracts derived from leaves of *F. elastica* and its cultivars (*F. elastica* 'Rubra', 'Robusta', 'Burgundy', 'Variegata') using oxidative stress biomarker [2-thiobarbituric acid reactive substances (TBARS) as a biomarker of lipid peroxidation] using of human erythrocytes as a cell model after incubation with plant extracts in two doses (5 mg/mL and 0.5 mg/mL). Our results revealed that treatment of human erythrocytes by extracts derived from leaves of *F. elastica* and its cultivars 'Rubra' and 'Burgundy' in the dose of 0.5 mg/mL caused a statistically significant decrease of TBARS level by 27.3% ($p < 0.05$), 32.4% ($p < 0.05$), and 33.5% ($p < 0.05$), respectively. The increase in TBARS level was observed after the treatment of human erythrocytes by extracts derived from leaves of *F. elastica* 'Robusta' and 'Variegata' (by 12.3% and 9.3%, $p > 0.05$, respectively) compared to untreated controls. After treatment of human erythrocytes by extracts derived from leaves of *F. elastica* and its cultivars ('Rubra', 'Burgundy', and 'Robusta') in the dose 5 mg/mL, the increase of TBARS level (by 5.7%, 39.5%, 82%, and 87.5%, $p < 0.05$) was observed. Only extract derived from leaves of *F. elastica* 'Variegata' (5 mg/mL) caused the decrease in TBARS level (by 29.2% $p < 0.05$) compared to untreated controls. Among extracts studied (0.5 mg/mL), *F. elastica* 'Burgundy' exhibited the lowest TBARS level (decreased by 33.5%, $p < 0.05$) while in dose 5 mg/mL, *F. elastica* 'Variegata' decreased TBARS level by 29.2% ($p < 0.05$) [16].

We also evaluated the *in vitro* effect of extracts obtained from leaves of *Ficus elastica* and its cultivars (*F. elastica* 'Rubra', 'Robusta', 'Burgundy', 'Variegata') on the levels of aldehydic and ketonic derivatives of oxidatively modified proteins in the muscle tissue of the rainbow trout (*Oncorhynchus mykiss* Walbaum) [28]. Our results revealed that the incubation of muscle tissue of rainbow trout with extracts derived from the leaves of *F. elastica* and its cultivars resulted in the same levels of aldehydic derivatives of OMP compared to the untreated samples. On the other hand, the levels of ketonic derivatives of OMP were statistically non-significant decreased to the values (12.83 ± 1.0 nmol/mg protein) for *F. elastica* extract, (12.03 ± 1.26 nmol/mg protein) for *F. elastica* 'Rubra' extract, (12.89 ± 1.25 nmol/mg protein) for *F. elastic* 'Robusta' extract, (11.81 ± 1.21 nmol/mg protein) for *F. elastica* 'Burgundy' extract, (12.39 ± 1.35 nmol/mg protein) for *F. elastica* 'Variegata' extract compared to the untreated samples (14.16 ± 1.02 nmol/mg protein). The percentage of decreased levels of ketonic derivatives of OMP in the muscle tissue of rainbow trout after incubation with extracts derived from leaves of *F. elastica* and its cultivars compared to the values of untreated controls was as follows: 9.4% for *F. elastica* extract, 15% for *F. elastica* 'Rubra' extract, 9% for *F. elastic* 'Robusta' extract, 16.6% for *F. elastica* 'Burgundy' extract, 12.5% for *F. elastica* 'Variegata' extract, respectively. Thus, two extracts derived from leaves of *F. elastica* 'Burgundy' and *F. elastica* 'Rubra' after incubation with muscle tissue of rainbow trout resulted in the maximum decrease in the levels of ketonic derivatives of

OMP. The present study ascertained the antioxidant potency of the extracts derived from the leaves of *F. elastica* and its cultivars as a potential source of natural antioxidants [28].

Many of our studies confirmed the antioxidant properties of *Ficus* plants against fish pathogens [17, 23-27, 29, 30]. In our previous study, we evaluated the antimicrobial activity of ethanolic extracts of *Ficus* plant species against *Aeromonas* strains [17]. As the average over the three *Aeromonas* species, the highest antimicrobial activity among all the tested ethanolic extracts was observed in *F. binnendijkii* leaves with inhibition zone diameters (IZD) of 23.75 ± 1.64 mm against *A. sobria*, 20.63 ± 1.45 mm against *A. hydrophila*, and 15.75 ± 0.80 mm against *A. salmonicida*. *F. craterostoma* extract was effective against *A. sobria* with an IZD of 15.25 ± 0.90 mm and against *A. salmonicida* with a zone of 15.25 ± 1.15 mm, while *F. deltoidea* extract was effective against *A. sobria* across 18.81 ± 1.25 mm and *A. salmonicida* across 20.13 ± 0.79 mm diameters. *F. hispida* extract inhibited *A. sobria* the best and showed an IZD of 25.56 ± 1.63 mm followed by the extracts of *F. binnendijkii* presenting an IZD of 23.75 ± 1.64 mm and *F. tinctoria* giving one of 22.5 ± 1.20 mm. The IZD results also showed that isolates of *A. sobria* revealed intermediate susceptibility to ethanolic extracts of *F. aspera*, *F. benjamina, F. elastica, F. formosana, F. johannis* subsp. *afghanistanica, F. natalensis* subsp. *leprieurii, F. religiosa, F. villosa*, and *F. virens*, which created mean IZDs ranging from 10 to 15 mm. The isolates appeared to be resistant to extracts of 18 Ficus species (43.9%), which only restricted growth in mean IZDs of less than 10 mm [17].

Therapeutic potential for the use of various plants of the *Ficus* genus in the control of bacterial diseases was evaluated against fish pathogens in *in vitro* study with promising results [23-27, 29, 30]. In our previous study, the *in vitro* antimicrobial activity of the ethanolic leaf extracts of various *Ficus* species against *Citrobacter freundii* was evaluated. The results proved that the extracts from *F. drupacea, F. septica, F. deltoidea*, as well as *F. hispida, F. mucuso, F. pumila, F. craterostoma*, exhibit favorable antibacterial activity against *C. freundii* (200 µL of standardized inoculum) [24]. Our results also proved that the ethanolic extracts obtained from *F. pumila, F. binnendijkii* 'Amstel Gold', *F. carica, F. erecta, F. hispida, F. mucuso, F. palmeri, F. religiosa* possess considerably sufficient antibacterial potential against *C. freundii* [24]. Among various species of *Ficus* screened ethanolic extracts of the leaves of ten *Ficus* species: *F. hispida, F. binnendijkii, F. pumila, F. rubiginosa, F. erecta, F. erecta* var. *sieboldii, F. sur, F. benjamina, F. craterostoma, F. lyrata, F. palmeri* (the species are listed in the order of effectiveness against pathogen tested) were the most effective against *P. fluorescens* (200 µL of standardized inoculum) [23]. Moreover, previous investigation has shown that the most effective against *P. fluorescens* (400 µL of standardized inoculum) were the ethanolic extracts obtained from leaves of ten *Ficus* species: *F. craterostoma, F. cyathistipula, F. drupacea* 'Black Velvet', *F. hispida, F. macrophylla, F. mucuso, F. pumila, F. villosa* [27]. In our study, most ethanolic extracts derived from *Ficus* spp. proved effective against the bacterial strain of Gram-negative *A. hydrophila* tested, with 10-12 mm zones of inhibition being observed. *A. hydrophila* demonstrated the highest susceptibility to *F. pumila*. The highest antibacterial activity against *A. hydrophila* (200 µL of standardized inoculum) was displayed by *F. benghalensis, F. benjamina, F. deltoidea, F. hispida, F. lyrata* leaf extracts [25]. Among various species of *Ficus* genus exhibiting moderate activity against *A. hydrophila* (400 µL of standardized inoculum), the highest antibacterial activity was displayed by *F. benghalensis, F. benjamina, F. deltoidea, F. hispida, F. lyrata* leaf extracts [26, 30].

It is generally assumed that the antibacterial activity of various *Ficus* species can be explained due to the presence of secondary metabolites that are probably responsible

for the test organism's susceptibility to them. The main chemical classes of the phytochemical compounds occurring in the extracts, obtained from the plants belonging to the genus *Ficus*, are alkaloids, anthocyanins, balsams, carbohydrates, flavonoids, free anthraquinones, tannins, glycosides, amino acids, organic acids, fatty acids, terpenes, resins, phytosterols, aliphatic alcohols, volatile components and saponins [10, 20, 21]. The presence of alkaloids and flavonoids both reveals their activity against pathogenic bacteria and suggests a role in the limitation of fungal infection, given that many flavonoids exhibit antifungal activity [7]. Among polyphenols, flavan-3-ols, flavonols, and tannins received the most attention due to their wide spectrum and higher antimicrobial activity in comparison with other polyphenols, and to the fact that most of them are able to suppress a number of microbial virulence factors (such as inhibition of biofilm formation, reduction of host ligands adhesion, and neutralization of bacterial toxins) and show synergism with antibiotics [8]. Furthermore, it is interesting that antibacterial flavonoids might be having multiple cellular targets, rather than one specific site of action. One of their molecular actions is to form a complex with proteins through nonspecific forces such as hydrogen bonding and hydrophobic effects, as well as by covalent bond formation [6]. The B ring of the flavonoids may intercalate or form a hydrogen bond with the stacking of nucleic acid bases and further lead to the inhibition of DNA and RNA synthesis in bacteria. Thus, their mode of antimicrobial action may be related to their ability to inactivate microbial adhesins, enzymes, cell envelope transport proteins, and so forth. Lipophilic flavonoids may also disrupt microbial membranes [6].

The results of Sackeyfio and Lugeleka (1986) indicated that *F. elastica* is a good source of antioxidants with a high anti-inflammatory effect. Sackeyfio and Lugeleka (1986) have been carried out to determine whether the aqueous extract of *F. elastica* is active as an anti-inflammatory agent in carrageenin-induced edema and adjuvant-induced arthritis in the rat. This investigation was prompted by the fact that practitioners of herbal medicine in West Africa use the plant for the treatment of muscle and joint pain. The results of the investigation clearly indicated that orally administered *F. elastica* extract markedly inhibited the experimentally induced inflammation in the two test models. This effect of *F. elastica* was very similar to that of indomethacin. Thus, in the carrageenin-induced edema, *F. elastica* (2-10 mg/kg) and indomethacin (1-5 mg/kg) produced inhibition of the magnitude of 5.41-68.92% and 27.03-69.26%, respectively. Similarly, both the extract of *F. elastica* and indomethacin inhibited the primary as well as the secondary lesions of adjuvant arthritis in the rat [19].

Conclusions. In the current study, we studied the antimicrobial activity of the ethanolic extracts of *F. elastica* and its cultivars (*F. elastica* 'Rubra', 'Robusta', 'Burgundy', 'Variegata') against *Aeromonas sobria* to evaluate the possible use of this plant in preventing infections caused by this fish pathogen in aquaculture. Our results of the antimicrobial screening revealed, that *F. elastica* and its cultivars possessed mild antibacterial properties against the *A. sobria* strain. The ethanolic extract obtained from leaves of *F. elastica* 'Variegata' exhibited the maximum antimicrobial activity against *A. sobria*. Thus, *F. elastica* and its cultivars (*F. elastica* 'Rubra', 'Robusta', 'Burgundy', 'Variegata') disclosed mild bioactivity, and this plant can be regarded as a potential source of antibacterial agents. The results of the current study provide a new perspective for the use of various species belonging to the *Ficus* genus as medicinal plants to improve the antibacterial responses in salmonid aquaculture. *The authors are grateful to The Visegrad Fund for supporting our study.*

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АНТИБАКТЕРІАЛЬНА ЕФЕКТИВНІСТЬ ЕКСТРАКТІВ ЛИСТЯ, ОТРИМАНИХ З FICUS ELASTICA ROXB. EX HORNEM. (MORACEAE) ТА ЙОГО КУЛЬТИВАРІВ ЩОДО ШТАМУ AEROMONAS SOBRIA

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У цьому дослідженні вивчали антимікробну активність спиртових екстрактів, отриманих з листя Ficus elastica Roxb. ex Hornem. та його сортів (F. elastica 'Rubra', 'Robusta', 'Burgundy', 'Variegata') щодо Aeromonas sobria, щоб оцінити можливе використання цієї рослини для запобігання інфекціям у риб, спричиненим цим збудником в аквакультурі. Поточне дослідження було проведено в рамках проекту між п'ятьма університетами, який здійснюється в рамках програми співпраці, спрямованої на оцінку лікувальних властивостей тропічних і субтропічних рослин, культивованих in vitro. Зразки листя F. elastica та його сортів, культивованих у тепличних умовах, відбирали у Національному ботанічному саду імені М.М. Гришко (НБС) НАН України. Зокрема, були відібрані зразки листя F. elastica та його сортів, наприклад F. elastica 'Rubra', 'Robusta', 'Burgundy', 'Variegata'. Штам Aeromonas sobria (K825), що походив від прісноводних видів риб, таких як звичайний короп (Cyprinus carpio L.) і райдужна форель (Oncorhynchus mykiss Walbaum), відповідно, був виділений у Відділі хвороб риб Національного ветеринарного науково-дослідного інституту в Пулавах (Польща). Антимікробну чутливість досліджуваного штаму Aeromonas sobria проводили методом дискової дифузії Кірбі-Бауера (1966) згідно з рекомендаціями Інституту клінічних і лабораторних стандартів (CLSI, 2014) з нашими деякими модифікаціями. Наші результати антимікробного скринінгу показали, що F. elastica та його сорти володіють помірними антибактеріальними властивостями щодо штаму A. sobria. Найбільш виражену антимікробну активність щодо A. sobria проявив спиртовий екстракт, отриманий із листя F. elastica 'Variegata'. Зокрема, F. elastica та його сорти (F. elastica 'Rubra', 'Robusta', 'Burgundy', 'Variegata') проявляють помірну біоактивність. Отже, цю рослину можна розглядати як потенційне джерело антибактеріальних препаратів. Результати поточного дослідження відкривають нову перспективу для використання різних видів, що належать до роду Ficus, як лікарських рослин з антибактерійними властивостями з метою використання в аквакультурі лососевих риб.

Ключові слова: Ficus elastica Roxb. ex Hornem., екстракти, антимікробна ефективність, методика дискової дифузії Кірбі-Бауера, патогени риб, чутливість, резистентність.