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### *Summary*

## **LOW-MOLECULAR WEIGHT SULFUR-CONTAINING COMPOUNDS IN SOME BRAIN REGIONS OF RATS FOLLOWING METHIONINE LOAD**

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We studied the influence of methionine-induced hyperhomocysteinemia in rats on the pool of low molecular weight sulfur-containing compounds in brain regions. Methionine load led to a unidirectional imbalance of sulfur-containing compounds in all regions of the brain studied. The most pronounced changes were observed in the hypothalamus and less expressed – in the striatum. We found the methionine load to induce very active transsulfuration and changes in the taurine synthesis limited by availability of substrates.

## **THE ANTIBACTERIAL ACTIVITIES OF ETHANOLIC EXTRACT OBTAINED FROM *RHODODENDRON MYRTIFOLIUM* SCHOTT & KOTSCHY LEAVES AGAINST CLINICALLY ISOLATED BACTERIAL STRAINS**

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**Introduction.** Antimicrobial resistance has become a pre-eminent concern in medicine and public health. This problem is widespread, and the causative factors are uncontrolled (Mah and Memish, 2000). Several multi-drug resistant bacteria that are most commonly found, especially through nosocomial infections, are *Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter*

*baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter* spp. (Rice, 2008). In the past few decades, these strains become increasingly important pathogens in hospitals and play an important role in the colonization and infection of hospitalized patients by a variety of nosocomial infections including bacteremia, urinary tract infections, and nosocomial pneumonia (Radji et al., 2013).

Treatment of these infections is often very difficult due to the cross-resistance of these bacteria with a large group of antibiotics. Therefore, it seems reasonable to explore alternative antimicrobial agents for control multi-drug resistant bacteria. Recently, there has been growing interests to find antimicrobial compounds from medicinal plant extracts as an alternative approach to discover new antimicrobial compounds (Radji et al., 2013).

*Rhododendron* species have been traditionally used in China, Nepal, Russia, and North America against inflammation, pain, skin ailments, common cold, and gastrointestinal disorders and for treating human diseases like asthma and skin diseases. These species are known to be a good source of polyphenolic plant secondary plant metabolites (Popescu and Kopp, 2013).

The aim of this study was to assess possible antibacterial effects of an ethanolic extract derived from *Rhododendron myrtifolium* leaves against *Citrobacter freundii*, *Enterobacter cloacae*, *Klebsiella pneumoniae*, and *Escherichia coli* strain locally isolated from human biological fluids. Thus, the study contributes to on-going investigations on the bioactivity potential of plant species such as the *Rhododendron*. Hence, the effects of *Rhododendron myrtifolium* leaf extract against bacterial strains were monitored *in vitro* by the disk diffusion method.

**Materials and methods.** Collection of Plant Materials. Leaves of *Rhododendron myrtifolium* were harvested on the side of the road between the Menchul valley and Rogneska valley (Kvasy village, Rakhiv district, Zakarpattia region, Ukraine; N 48°09'28.4", E 24°20'05.6", 1485 m a.s.l.). Freshly leaves were washed, weighed, crushed, and homogenized in 96% ethanol (in proportion 1:19) at room temperature. The extract was then filtered and investigated for antimicrobial activity.

Antimicrobial susceptibility testing. Non-repetitive clinical strains isolated from biological materials of infected patients were obtained from the Department of Bacteriology, Regional Hospital in Koszalin

(West-Pomeranian Voivodeship, Poland). The purity, as well as the identity of isolate, was confirmed in the laboratory conditions by standard microbiological methods and were interpreted according to the Guidelines of the Clinical Laboratory Standards Institute (2014).

The antibacterial susceptibility profile of the isolates revealed that many isolated strains were classified as multi-drug resistant (MDR) bacteria.

For the current study, four bacterial strains were used for the study of susceptibility or resistance of bacteria to the phytochemicals:

Isolate 1 - *Citrobacter freundii* strain was susceptible to all antibiotics used;

Isolate 2 - *Enterobacter cloacae* strain was resistant to the amoxicillin, cefuroxime, trimethoprim-sulphamethoxazole, and cefotaxime;

Isolate 3 - *Klebsiella pneumoniae* was resistant to piperacillin-tazobactam (100/10 µg), gentamicin (10 µg), tobramycin (10 µg), and ciprofloxacin (5 µg);

Isolate 4 - *Escherichia coli*, not β-lactamase (ESBL)-producing strain, was a sensitive strain to antibiotics tested.

Bacterial Growth Inhibition Test by the Disk Diffusion Method. The antimicrobial susceptibility testing was done on Muller-Hinton agar by the disc diffusion method (Kirby-Bauer disk diffusion susceptibility test protocol) (Bauer et al., 1966).

Statistical analysis. Statistical analysis of the data obtained was performed by employing the mean ± standard error of the mean (S.E.M.). All statistical analyses were performed using STATISTICA 8.0 software (StatSoft, Poland).

**Results and discussion.** The results revealed that extract exerts antibacterial activity against *Citrobacter freundii*. However, the *Enterobacter cloacae*, *Klebsiella pneumoniae*, and *Escherichia coli* were resistant to *Rh. myrtifolium* leaf extract. Maximum in vitro inhibition was scored against *Citrobacter freundii*, followed by *Escherichia coli*, *Klebsiella pneumoniae*, and *Enterobacter cloacae*, which presented inhibition zones of (12.1 ± 0.9) mm, (9.1 ± 0.5) mm, (7.5 ± 0.6) mm, and (7.2 ± 0.5) mm, respectively. In the case of the positive controls, 96% ethanol possesses a mild antibacterial effect, which presented inhibition zones of (6.5 ± 0.7) mm.

**Conclusions.** It can be concluded that extract derived from *Rhododendron myrtifolium* leaves can be as complementary medicine in treating diseases caused by multidrug-resistant strains of *Citrobacter freundii*. However, further investigation is needed to determine the bioavailability of the active compounds and to determine the dose and toxicity before it can be used as therapeutic agents.

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### Summary

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The aim of this study was to assess possible antibacterial effects of an ethanolic extract derived from *Rhododendron myrtifolium* leaves against *Citrobacter freundii*, *Enterobacter cloacae*, *Klebsiella pneumoniae*, and *Escherichia coli* strain locally isolated from human biological fluids. Thus, the study contributes to on-going investigations on the bioactivity potential of plant species such as the *Rhododendron*. The results revealed that extract exerts antibacterial activity against *C. freundii*. However, the *Enterobacter cloacae*, *Klebsiella pneumoniae*, and *Escherichia coli* were resistant to *Rh. myrtifolium* leaf extract. Maximum *in vitro* inhibition was scored against *C. freundii*, followed by *E. coli*, *K. pneumoniae*, and *E. cloacae*. Further investigation is needed to determine the bioavailability of the active compounds and to determine the dose and toxicity before it can be used as therapeutic agents.

## **THE ANTIBACTERIAL ACTIVITY OF ETHANOLIC EXTRACTS OBTAINED FROM LEAVES OF SOME *THYMUS* (LAMIACEAE) REPRESENTATIVES AGAINST *ACINETOBACTER BAUMANNII***

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Introduction. *Acinetobacter baumannii* is an opportunistic pathogen and one of the six most important multidrug-resistant microorganisms in hospitals worldwide responsible for hospital-acquired nosocomial infections (Antunes et al., 2014; Lee et al., 2017). This human pathogen is responsible for a vast array of infections, i.e. ventilator-associated as well as bloodstream infections in critically ill patients, and mortality rates can reach 35% (Antunes et al., 2014). The