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Antioxidant and Antimutagenic Potential of Extracts of Some Agavaceae Family Plants

Nazira Karamova[1] · **Syumbulya Gumerova**[1] · **Gamal Osman Hassan**[1] · **Essam Y. Abdul-Hafeez**[2] · **Omer H. M. Ibrahim**[2] · **Mohamed A. A. Orabi**[3] · **Olga Ilinskaya**[1]

Abstract The application of natural antimutagens and antioxidants, particularly those derived from higher plants has been seen as a promising approach to the protection of human health. In this work, we studied methanolic extracts from *Sansevieria cylindrica, Sansevieria trifasciata*, and *Polianthes tuberosa* plants focusing on their antioxidative and antimutagenic capacities based on the following parameters: inhibitory activity on lipid peroxidation, suppressing ability on direct-acting mutagen sodium azide-induced mutagenesis in *Salmonella typhimurium* cells. A clear dose-dependent decrease in lipid peroxidation was observed with all the extracts tested. Extracts from leaves of *P. tuberosa* and rhizomes of *S. cylindrica* and *S. trifasciata* (1 mg/mL) displayed the highest antioxidant effect. At the same time, extracts from rhizomes of *S. cylindrica* and *S. trifasciata* significantly reduced the sodium azide-induced mutations. The highest antimutagenic activity (76 %) in the *S. typhimurium* TA100 strain was obtained for the *S. cylindrica* rhizomes extract (1 mg/plate). We propose that the observed protective effects of plant extracts tested may correspond to a synergic participation of several secondary metabolites and mainly to polyphenolic compounds.

Keywords Antioxidant potential · Antimutagenic activity · Plant extracts · Secondary metabolites · Agavaceae family

✉ Nazira Karamova
nskaramova@mail.ru

[1] Department of Microbiology, Kazan Federal University, 18 Kremlevskaya str., Kazan 420008, Russia

[2] Department of Ornamental, Medicinal and Aromatic Plants, Faculty of Agriculture, Assiut University, Assiut 71526, Egypt

[3] Faculty of Pharmacy, Al-Azhar University, Assiut 71524, Egypt

1 Introduction

Oxidative stress caused by imbalance between reactive oxygen species (ROS) and antioxidant production has been shown to be linked to various chronic diseases in humans such as cancer, cardiovascular, and neurodegenerative diseases and aging [1–3]. ROS can react with nucleic acids, proteins, and membrane lipids inducing DNA damages and mutations, loss of enzyme activity or altered cell membrane permeability, and etc. [4, 5]. Antioxidant and antimutagenic substances from natural sources are believed to play a potential role in prevention of oxidative damages as well as induced mutagenesis. For this reason, significant attention is focused on the isolation, characterization, and utilization of natural antioxidants and antimutagens as potential disease-preventing agents.

Plants are the promising source of antioxidants and antimutagens since they are rich in a wide variety of secondary metabolites with diverse biological properties. The Agavaceae is a family estimated at around 600 species worldwide. The species of this family synthesize diverse secondary metabolites, which are used in traditional medicine as anti-inflammatory, antimicrobial, and antiparasitic substances.

The aim of this study was to evaluate the antioxidant activity of methanolic extracts from three plants of the Agavaceae family with regard to lipid peroxidation and antimutagenic potential with regard to gene mutations.

2 Material and Methods

Leaves and rhizomes of *Sansevieria cylindrica* and *Sansevieria trifasciata* and leaves and bulbs of *Polianthes tuberosa* were collected from different locations in Egypt during the spring of 2016. Organic extracts were prepared from fresh plant samples using 80 % aqueous methanol [6]. Total dried extracts were

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dissolved in dimethyl sulfoxide (DMSO) to obtain 20 mg/mL stock solutions. The antioxidant activity by inhibition of lipid peroxidation (LP) was determined according to the thiobarbituric acid (TBA) method [7]. The antioxidant effect of extracts was evaluated by spectrophotometry measuring the absorbance of test solutions at 532 nm and expressed as the percentage of inhibition of linoleic acid peroxidation with a control containing no extract sample. The antimutagenic assay to determine the effect of plant extracts on sodium azide (NaN_3)-induced mutagenesis was performed with the *S. typhimurium* strain TA100 as described previously [8]. The antimutagenic effect was considered strong and moderate when the inhibition effect was higher than 40 % or between 25 and 40 %, respectively. An inhibition effect less than 25 % was not considered as a positive result [9]. The results were expressed as mean ± SEM of all independent experiments. The one-way ANOVA test was used to analyze the result and $P < 0.05$ was considered significant.

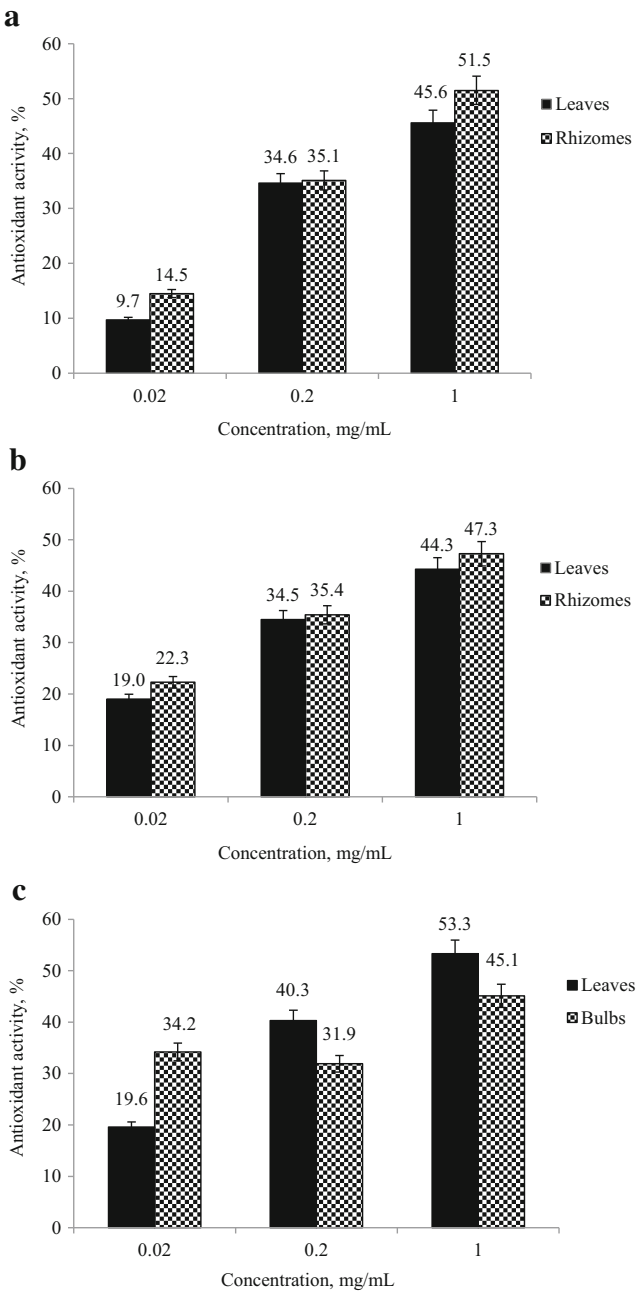

Fig. 1 Antioxidant activity of Agavaceae family plants extracts. **a** *Sansevieria cylindrica*. **b** *Sansevieria trifasciata*. **c** *Polianthes tuberosa*

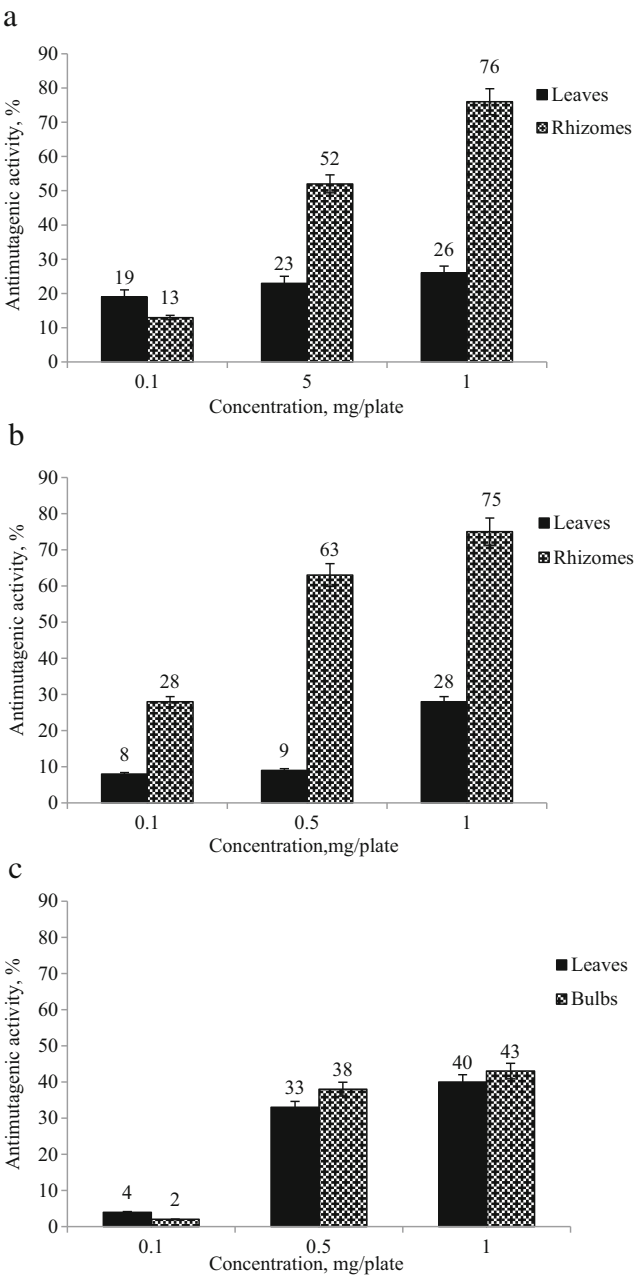

Fig. 2 Inhibitory effect of Agavaceae family plants extracts against the mutagenicity of sodium azide to *Salmonella typhimurium* TA 100. **a** *Sansevieria cylindrica*. **b** *Sansevieria trifasciata*. **c** *Polianthes tuberosa*

3 Results and Discussion

Results of TBA assay showed that all the plant extracts tested can inhibit lipid peroxidation in a dose-dependent manner (Fig. 1). The values of antioxidant activity of *S. cylindrica, S. trifasciata*, and *P. tuberosa* extracts were in the range 9.7–51.5 %, 19.7–47.3 %, and 19.6–53.3 %, respectively (Fig. 1a–c). It should be noted that extracts of rhizomes demonstrated higher antioxidant effect than those of leaves from *S. cylindrica* and *S. trifasciata*, whereas extracts from *P. tuberosa* leaves were more effective in comparison to that from bulbs. Among all tested samples, the extract of *P. tuberosa* leaves (1 mg/mL) was the most potent inhibitor of LP (53.3 %).

The results of the antimutagenic potential assessment of *S. cylindrica*, *S. trifasciata*, and *P. tuberosa* extracts using the Ames test are shown in Fig. 2. Inhibitory effect of plant extracts on direct-acting mutagen NaN_3 ranged from weak to strong, depending on the concentration of extracts per plate. Extracts from rhizomes of *S. cylindrica* and *S. trifasciata* at or above 0.5 mg/plate significantly decreased the number of induced His^+ revertant colonies. Meanwhile, the extracts from leaves of these plants displayed relatively lower efficiency in reducing NaN_3 genotoxicity (Fig. 2a, b). *S. cylindrica* rhizomes extract (1 mg/plate) demonstrated the highest antimutagenic activity (76 %) in the *S. typhimurium* TA100 strain (Fig. 2a). The samples prepared from leaves and bulbs of *P. tuberosa* showed a relatively lower efficiency than those extracted from *Sansevieria* species (Fig. 2c).

The antioxidant and antimutagenic activity shown by the extracts tested may be related to the compounds known to be present in Agavaceae family plants such as polyphenols, saponins, and glycosides [10, 11].

4 Conclusions

The overall results obtained in this study indicate that the extracts from three Agavaceae family plants have both antioxidant and antimutagenic properties and could be considered as a potent source of components for preventing the development of several oxidative stress- and mutation-related diseases.

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