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STUDY OF THE EFFECT OF DIFFERENT DRYING MODES ON THE ANTIOXIDANT AND ANTIBACTERIAL ACTIVITIES OF *oudneya africana*

Mahboub N.^{1*, 2}, Slimani N.^{2, 4}, Khelil A.^{1, 3}

1. Laboratory of Protection of Ecosystem in Arid and Semi-Arid Area, University of KASDI Merbah-Ouargla, Algeria

2. Faculty of Nature and Life Sciences, Univ. Of Echahid Hamma Lakhdar El oued, Algeria

3. Faculty of Nature and Life Sciences Univ. Of Kasdi Merbah-Ouargla, Algeria

4. Laboratory of Saharan bioresources preservation and valorisation. Univ. Kasdi Merbah-Ouargla, Algeria

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ABSTRACT

The main object of the present study was to investigate the impact of different drying methods (shade, lyophilization, oven, solar dryer) on the antioxidant and antibacterial activities of *Oudneya africana* (spontaneous medicinal plants) in the Northern Algerian Sahara. The experiments were based on drying the leaves by four different methods (in the shade, oven (45°C.), solar dryer and lyophilization). The fresh plants were used as control. The extract was performed by using cold maceration with mixture of 70% methanol and 30% distilled water. Lastly, the different extracts were used to evaluate their biological activities. Our results showed that lyophilization and solar dryer were the better modes for preserving the antioxidant activity of *Oudneya africana* extracts where the EC₅₀ value was 0.333 mg/ml. Furthermore, the four studied bacterial strains (*Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus* and *Micrococcus luteus*) showed a low resistance against *Oudneya africana* extracts dried by a solar dryer and lyophilization.

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Introduction

The Saharan flora is characterized by its adaptation to dry climate, and to soil salinity. The Sahara Desert comprises only 1200 species [1] which would be considered very poor when compared with the small number of species to the enormity of this area. Recently, the scientific research was interested in plant compounds that are intended for benefiting people. Molecules derived from so-called natural plants are considered as a major source of drugs, knowing that more than 120 compounds from plants are used today in modern medicine and nearly 75% of them are applied according to their traditional [2]. There are several studies on spontaneous medicinal plants in the Northern Algerian Sahara. For example, the inventories that were made by [3]; [4] studies were accompanied by chemical analyzes and other work on phytochemical studies and biological activities of the *Limoniastrum guyonianum* [5] and [6].

The objectives of this work were to study the effect of some drying modes on the antioxidant and antibacterial activities of biological compounds, which may become substitutes for synthetic drugs, and to determine the effect of loss of these active compounds, the latter can change their phytotherapeutic characteristics by different drying modes. The study is based on the extraction of solution of *Oudneya africana*, the leaves of this plant are subjected to different drying modes, in the shade, oven at 45°C., solar dryer, lyophilizer and fresh leaves as control.

Corresponding Author: MAHBOUB N., Laboratory of Protection of Ecosystem in Arid and Semi-Arid Area, University of KASDI Merbah-Ouargla (Algeria)

Materials and Methods

Collection of plant material

The choice of plant was based on a sample taking into account the structure of the vegetation where ecological floristico-homogeneity criterion is privileged. For good success of the sampling, the plant material was collected in the season in which the development and floristic diversity is maximum. Flowering perennials and annuals were easily identified using [7]. The spontaneous species are harvested in two areas of Ghardaïa (Northern Sahara) between February and April. The plant samples were transported to the laboratory in Kraft papers in which we noted all the information about plant.

Preparation of extract

The plant leaves were macerated in a water-alcohol mixture (methanol / water, 70/30, v/v) the maceration is repeated 3 times with solvent renewal. The three extracts were combined after careful decanting with Whatman paper filter, the filtrate is evaporated by rotary evaporator (Buchi) of 45 °C to 60 °C until the total elimination of methanol and dried in the oven with a temperature not exceeding 40 °C, after vacuum concentration, to obtain at the end the dry residue [8].

Biological activities

Determination of DPPH free radical scavenging activity

DPPH radical scavenging activity was measured by using methods of [9]. 1 ml of each extract was added to 2 ml of a DPPH solution (0.1 mM) prepared in methanol. The reaction mixture was incubated for 15 minutes in the dark and absorbance was measured at 515 nm, using spectrophotometer. The percentage of inhibition of DPPH free radical scavenging activity was calculated using the following equation.

$$\% \text{ Reduction scavenging activity} = [(\text{control absorbance} - \text{test absorbance}) / \text{control absorbance}] * 100$$

Test for antimicrobial activity

The antimicrobial test was performed by the disk method [10]. The culture medium consists of nutrient agar for the isolation of bacterial strains. Mueller-Hinton agar (MHA) was used to incubate the bacteria with the samples. *Staphylococcus aureus* (ATCC 27923), *Micrococcus luteus*, *Pseudomonas aeruginosa* (ATCC 25853) and *Escherichia coli* (ATCC 25922), were the microbial strains used for the determination bacteriostatic, which have been isolated from pathological products from the Biskra bacteriology laboratory.

These strains were grown in for 24 hours of incubation at 37 °C., in nutrient agar. After the microbial suspensions were prepared for each strain in water physiology, the antibacterial activity was determined with diameter of inhibitory zone produced around the disks sensitivity after 24 hr of incubation at 37 °C.

The sensitivity of a bacterium to an antibacterial agent varies depending on the nature of the antibacterial agent, against of a given antibacterial agent; the susceptibility of a bacterium can be very different according to the strain of belonging [11].

Results and discussion

Biological activities of extracts of *Oudneya africana*

Antioxidant activity of extracts by DPPH test

To evaluate the antioxidant activity of the studied plant, a calibration curve was carried out with Gallic acid. The EC₅₀ values determined in mg / ml expressing the effective concentration of the extract necessary for trapping and reducing 50% moles of DPPH dissolved in methanol. The antioxidant property of plant extracts was determined by the decrease in the absorbency of DPPH, induced by plant antioxidants (Table 1).

Table I shows that there is a fluctuation of the EC₅₀ of all the studied plant extracts according to different drying methods. The best antioxidant activity observed in lyophilization method whose EC₅₀ value of their extract was about 0.333 mg / ml (Table1).

The importance of the anti-free radical activity of plants sample dried in oven, solar dryer according to their desiccation temperature which not exceeding 45°C. Indeed, the low and controlled temperature allows the preservation of the active ingredients of the plants and consequently their anti-free radical activity.

The improvement of antioxidant activity by lyophilization method suggested that the removal of water by sublimation would be the best means of eliminating water activity and preserving the bioactive molecules of lyophilized plants.

The decrease in antioxidant activity for heat-treated samples was attributed to thermal degradation of phenolic compounds [12]. DPPH is a stable free radical, which accepts an electron or a proton to give a stable diamagnetic molecule. It is widely used in the screening of free radical scavenging activities [13]. [14] postulated that the functional groups present in phenolic compounds in general can easily yield an electron or a proton to neutralize these free radicals.

Antibacterial activity

The antibacterial activity of *Oudneya africana* against four bacterial strains: *Pseudomonas aeruginosa* and *Escherichia coli* (Gram negative), *Staphylococcus aureus* and *Micrococcus luteus* (Gram positive) was evaluated by the agar diffusion method, by measuring the diameter of inhibitory zone appears around the disk impregnated with different extracts of studied plant species.

FIG. 1 indicates that there is a variation of the inhibitory zones of *Oudneya africana* at different drying modes for bacterial strains of gram negative (*Pseudomonas aeruginosa* and *Escherichia coli*).

Extract of studied plant dried in Oven, lyophilization the inhibitory activity doesn't affect regardless of the concentration tested.

This activity was proportional with concentration extracts, we were recorded the values 6.0; 6.25; 7 and 7 mm in the presence of 0.25 mg / ml of the solar dryer dried plant extract, in the shade, oven and lyophilizer respectively, and between 7.31; 7.75; 8.37 and 8.5 mm in the presence of 1 mg / ml of plant extracts dried with a solar dryer, shade, lyophilizer and oven.

FIG. 2 shows differences in inhibitory zones of *Oudneya africana* with different drying modes with against two bacterial strains of Gram positive (*Staphylococcus aureus* and *Micrococcus luteus*).

The activity of *Staphylococcus aureus* and *Micrococcus luteus* of *Oudneya africana* was greater when it was dried by a solar dryer or lyophilized. Indeed, in the presence of these extracts at different concentrations, diameters of inhibitory zones were greater than those observed in the extracts of fresh plant. These diameters varied between 6.5 mm and 9.125 mm for *Staphylococcus aureus* and 7 and 10.5 mm for *Micrococcus luteus*.

According to [15] and [16], several studies have also reported that aqueous extracts of different plant family Asteraceae showed no antibacterial activity, while the organic extracts and essential oils of these plants inhibit very significant growth strains tested.

It was reported that the compounds responsible for the antibacterial action seems likely to be the phenolic diterpenoids, which are the main components of the non-polar fraction extracts of plants [17].

As long as the two extracts were the same antioxidant capacity, and that the flavonoid aglycones are insoluble in water whereas glycosylated flavonoids are also readily soluble in water and alcoholic solutions [18], it can be inferred that the two extracts contain glycosylated flavonoids responsible for this activity.

On the antibacterial activity, except *Retama retam* dried in the open air and *Asphodelus tenuifolius* lyophilized having a remarkable inhibition against *Escherichia coli* and *Pseudomonas aeruginosa*, respectively, the other extracts of these plants in different drying methods have low activities or for both bacterial strains [19].

Conclusion

The drying of spontaneous medicinal plants is important to best utilization in traditional medicine. The lyophilization is the best method to preserve the antioxidant activity of *Oudneya africana*. The improvement of this activity suggests the removal of water by sublimation.

In parallel, antibacterial activity of the four bacterial strains studied (*Pseudomonas aeruginosa* and *Escherichia coli*) which are of Gram negative and (*Staphylococcus aureus* and *Micrococcus luteus*) which are Gram positive, exhibit low resistance against *Oudneya africana* extracts dried with a solar dryer, lyophilized.

Finally, we concluded that the better drying methods for medicinal plants are the lyophilization and solar dryer allows a preservation of the biological activities (antioxidant and antibacterial) of *Oudneya africana*.

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Tables

Table I: EC₅₀ of different extracts of plant studied according to drying methods and gallic acid equation of EC₅₀

Plant	Dring methods	Gallic acid equation	EC ₅₀
Oudneya africana	Fresh plant	$y = 34,541x + 14,92$ $R^2 = 0,976$	0,542
	Oven		0,863
	Shade		1,169
	Solar dryer		0,682
	Lyophilization		0,333

Figures

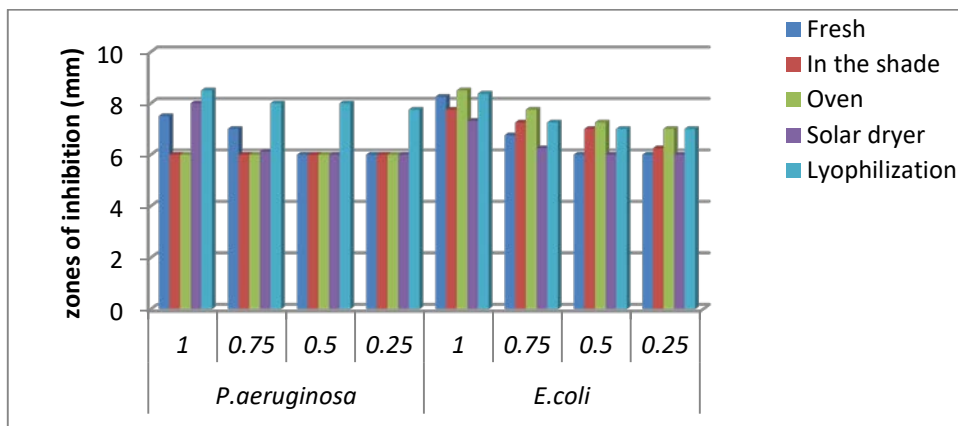


Figure 1: Antibacterial activity (Gram negative)

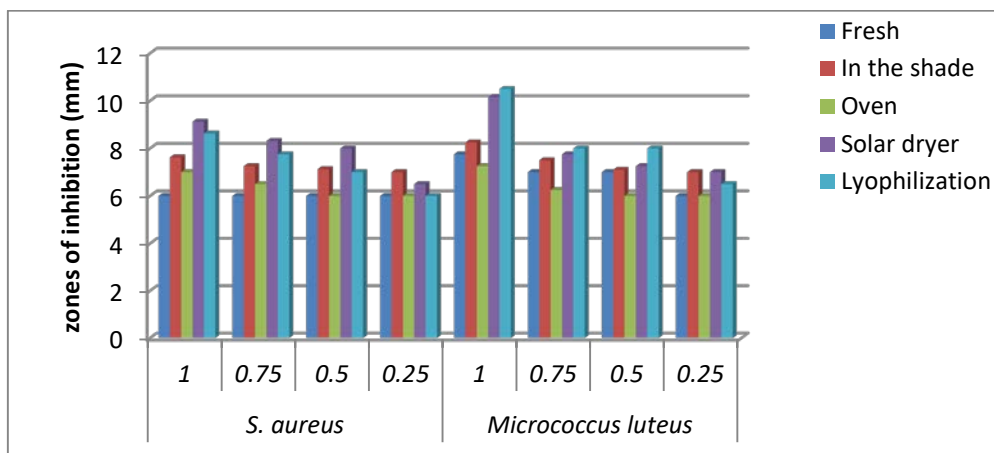


Figure 2: Antibacterial activity (Gram positive)