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Physicochemical and Biological Characteristics of *Aloe Barbadensis Miller* Gel Extract from Ghardaia, Algeria

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ABSTRACT

Aloe barbadensis Miller, usually referred to Aloe vera, has existed around since the dawn of time. It is a North African plant that has a variety of medicinal properties. This work was a contribution to studying the physico-chemical characteristics, the photochemical content, and the biological properties of *Aloe Barbadensis Miller*, a plant collected from a local garden located in the small town of Berriane (region of Ghardaïa, Algeria). The antioxidant activity was determined utilizing the DPPH method, and the solid medium diffusion method was employed to assess the antimicrobial potential against human pathogenic bacteria a gram positive (*S. aureus*) bacterial strain, two gram negative bacteria (*E. coli* and *P. aeruginosa*), and one yeast (*Candida albicans*) and fungi. The phytochemical analysis demonstrated the existence of different phytochemical substances such as phenol, flavonoid, tannin, alkaloid, saponin, and terpenoid in aloe vera gel extract. Furthermore, the antibacterial test of *Aloe vera* leaf extracts revealed that the gram negative bacteria *E. coli* sensibility compared with the two other bacteria (*S. aureus* and *P. aeruginosa*), which showed resistance, and that this extract showed antifungal efficiency against the fungi. In addition, the *aloe vera* extract was given an antioxidant effect according to the DPPH free radical method. The findings of this study allowed us to confirm that Aloe vera's biological activity is principally due to the existence of various phytochemical compounds with biological activities, like phenolic compounds. According to these obtained results, *A. barbadensis* gel extract can be utilized to treat certain diseases by providing a natural biological active component.

Keywords: *Aloe vera; total polyphenols, flavonoids, antioxidant activity, antimicrobial.*

1. INTRODUCTION

Since ancient times, medicinal plants with ethnobotanical significance have been used as the most important source for finding pharmaceutical substances to cure various diseases and health problems [1]. Aloe is a genus within the Liliaceae family, is found all over the world with almost 500 species, with very different sizes and aspects [2, 3].

The specie *Aloe Barbadensis Miller*, also recognized by the names *Aloe vera Linne*, *Barbados* or *Curaçao Aloe*, is endemic to northern Africa and cultivates in arid and subtropical climates [4]. It's a perennial succulent or xerophyte short stem with elongated and pointed green fleshy leaves that can grow from a few centimeters to more than 2-3 meters high and containing three different layers and storing lots of water. The firs thick membrane is the protective layer for filter air and water and accounts for around 20% to 30% of its total weight, which contains more than 18 cell layers that are interleaved with chloroplasts, which produced the carbohydrates, lipids, and proteins [5,6]. Then there's the cellulose derme layer,

which has laxitive properties and is known as aloe's "blood." Finally, there's the transparent parenchyma, which is the gel that the plant is looking for. The characteristics of this gel are mostly influenced by the soil and environmental conditions [7].

Aloe Barbadensis Miller is the most popular variety and is often employed not just for decoration but also to make a variety of therapeutic compounds to treat skin and digestive problems due to the plant's abundance of bioactive secondary metabolites [8] [9]. Aloe vera is utilized as a supplemental health ingredient and preservative in a wide variety of food products [10] [11]. It serves as an important source of pharmacological ingredients used in a number of medical applications, such as bactericidal [14] [15], antifungal [16], antiviral [17], anti-inflammatory [18, 19], antioxidant [20] anticancer [21], antitumor [22], cytotoxic [23], and so on. It's also been used to treat burn wounds ranging from first to second degree [24] [26], radiation dermatitis [27], and skin problems [28, 29], as well as cure for diabetes diseases due to its antidiabetic proprieties [30], to treat cardiovascular illness and to improve the immune system [31].

The fresh *Aloe vera L.* gel is composed of 99.1% of water and 0.9% dry matter, which includes 16.2% of cell wall, 0.7% of microparticles, and 83.1% of liquid gel [4]. Recent studies reveal that Aloe vera gel contains a wide variety of photochemical compositions like phenolic acids, flavonoids, salicylic acids, stilbenes, anthraquinones, coumarins, phytosterols, saponins, other constituents as amino acids, glycoproteins, enzymes, polysaccharides, vitamins, and minerals [5] [6] [10][13] [31-35].

The purpose of our study is to establish the phytochemical compositions of local *Aleo vera* gel extract and investigate their antioxidant and antimicrobial capacity.

2. MATERIALS AND METHODS

2.1. Preparation of Aloe vera gel extract

On February 28, 2021, *Aloe Barbadensis Miller L*. fresh leaves were harvested by hand, randomly, on the same plant, from a local garden located in Berriane, a small town in the city of Ghardaïa (Algeria) (Fig. 1). This area has a Saharan climate characterized by a cold winter and a hot and dry summer, with temperatures between 0 °C and 50 °C. The selected samples must be large and show no signs of infection and be taken directly to our laboratory to start the experiments.

Figure 1 locations where Aloe Barbadensis Miller L. was collected in the district of Berriane, Ghardaia (Google Mapp, 2021).

The fresh *Aloe vera* leaves were washed many times with cold distilled water to eliminate the dust and impurities and then allowed to dry. After that, we used a knife to fillet and recuperate the mesophyll gel from a middle of the *aloe vera* leaf, which was homogenized for 15 min using a household bender. Finally, the mixture was powdered by drying in an oven at 45 °C for five days.

For preparing an aqueous extract of the gel of Aloe vera leaves, 50 g of obtained Aloe vera dry powder was extracted using the cold maceration method [36] in 150 ml of distilled water with continuous shaking for 24 h. After incubation, the mixture was filtered using Whatmann's filter and then evaporated at 50 °C in a thermostatic water bath to yield the extract.

A methanolic extract of gel from Aloe vera leaves was prepared by extracting 50 g of the dried powder in 150 ml of methanol under constant agitation for 24 hours. After incubation, the mixture was filtered using Whatmann's filter and then evaporated using a rotator vacuum evaporator to eliminate the solvent and process the extract. The two extracts were preserved at 4°C in sterile dark flasks for any further investigation.

2.2. Qualitative and quantitative test of aloe vera L. gel extract

The aqueous and methanolic *Aloe vera L.* gel extract using to determine the qualitative and properties of this plant such as pH, density, water and dry biomass soluble and to investigate the presence of phytochemical compounds including total phenol, flavonoids, alkaloids, saponin, and tannin was calculated. The analyses were carried out using spectrophotometric method according to the standard method with slight modifications [37-39] as stated in table 1.

Table 1. Physicochemical and phytochemical test.

	test	Reference	
Physico-chemical test	pH	with pH-metre	
	density	[40]	
	water	[41]	
	dry biomass	[42]	
Quantitative phytochemical test	Test	Reference	standard solution
	Phenolic mg of GAE/g of extract	[43]	gallic acid
	Flavonoid mg QE/g of dry weight	[44]	Quercetin
	Tannin mg of GAE/g of extract	[45]	gallic acid
	Alkaloid	[46]	/
	Total Saponin	[47]	/
	Terpenoid	[48]	/

2.3. Antioxidant capacity analysis

In this study, we used DPPH free radical scavenging method to examine the antioxidant activity of Aloe vera L. gel extract according the protocol used by Brand-Williams et al. [49]. The results was giving with the percentage inhibition of free radical DPPH (I %) and IC50 value which indicated the concentration of the tested extract that could inhibit 50% of the DPPH radicals. The Lower concentration indicates higher antioxidant activity activity [50].

2.4. Antimicrobial activity Test

By utilising the paper-disc agar diffusion method, the antimicrobial activity of the aqueous extract of Aleo vera gel was examined against one gram positive bacteria (*Staphylococcus aureus* ATCC 25923), two gram negative bacteria (*Pseudomonas aeruginosa* ATCC 27853, *Escherichia coli* ATCC 25922), and one yeast (*Candida albicans* ATCC 10231). The typical antibiotic Gentamycine (10 g /disc) and Nystatine (100 g /disc) were utilized as the reference test against the bacteria and fungi, respectively [51].

3. RESULTS AND DISCUSSION

3.1. Qualititative and quantitative proprieties of Aloe vera gel extract

3.1.1. Physiochemical results

Table 2. physicochemical propriety of *Aloe vera* gel extact

	pH	water content (%)	Dray matter (%)
Aloe vera gel extract	4.97	96.778	3.222

The pH is one of the three parameters used usually for the evaluation and the identification of the commercial gel of aloes. According to table (05), the pH of the gel extract is 4.97 and the high acidity of gel probably because the accumulation of organic acid likes malic acid [53].
As shown in the table 2, the aloe vera gel was very rich with water 96.778 % and the dry matter content was estimated at 3.222%. These results are logical and confirm that the leaf of Aloe vera is composite a high amount of water [5].

3.1.2. Phytochemical compounds of the of Aloe barbadensis gel extract

Table 3. phytochemical propriety of Aloe vera gel extact

Test	Result
Total Phenolic (mg GAE/g)	36.25 ± 0.8
Total Flavonoid (mg QE/g)	63.26±0.62
Tannin (mg GAE/g)	6.29±0.23
Alkaloid (mg /g)	24.89±0.79
Total saponin (mg/g)	8.23±0.65
Terpenoid (mg/g)	14.56±19

Mean value ± Standard error

According the table 2, the result of phytochemical screening test shows that the fresh Aloe vera gel extract obtained by maceration was very rich with bioactive compounds such as phenol, flavonoid, tannin, alkaloid, saponin and terpenoid.

The total flavonoid content is the highest secondary metabolite compound found it the aloe vera gel extract with 63.26±0.62 mg QE/g and this value is very close to the value founding by Taukoorah and Mahomoodally [54].

A. barbadensis gel extract was found to have a good amount of total Phenol to be 36.25 ± 0.8 mg GAE/g. This

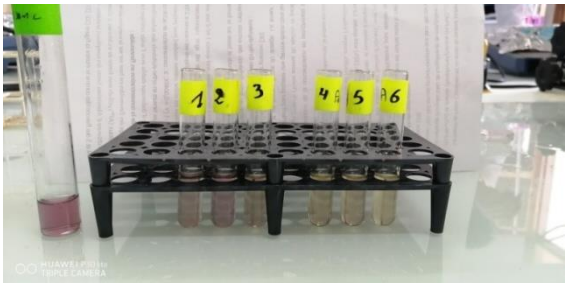
result is in accordance with the recent investigation performed by Kumar et al. [6] where the values the total phenol levels ranging from 32 to 65 mg GAE/ g of dry. [56]

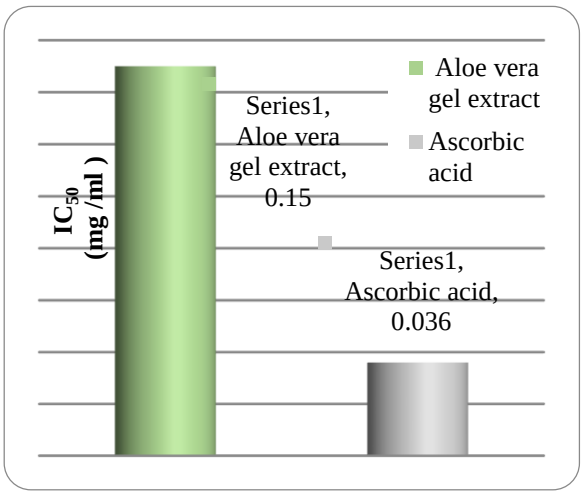
From the data, we can observed that our extract contain a appreciable amounts of alkaloid (24.89±0.79 mg/g) and terpenoid (14.56±19 mg/g), which is near to the values founding by Sonam and Archana to be 23.83 ± 0.28 mg/g and mg/g 13.5 ± 0.86, respectively [57].

This study showed total tannin content in the Aleo gel extract to be 6.29±0.13 mg GAE/g, and this amount is higher than the result founding in the study done by R. Bista et al. to be 1.13±0.19 mg GAE/g [58].

The difference in the amount of secondary metabolites contained in the A. barbadensis gel extract obtained from Ghardaia compared with another country, as reported in an earlier study, depended on the variation of the age of the plant, climatic conditions and environmental factors [59].

3.2. Antioxidant activity





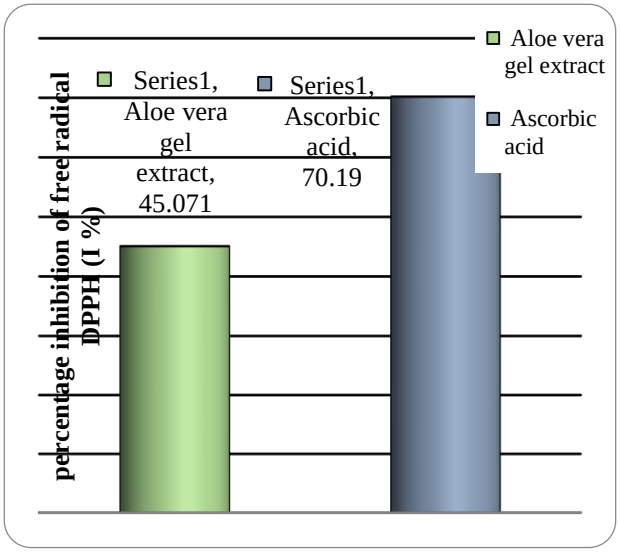


Figure 2 Results of antioxidant capacity of *aloe vera* gel extract.

The antioxidant potential test using DPPH radical method (Fig 2) was determined that our gel extract showed a significant antioxidant activity by reducing 45,071 % of radical DPPH with IC_{50} of 0.15 mg/mL. Furthermore, this extract exhibit a effective antioxidant power but it's was lower compared with standard antioxidant (ascorbic acid).

This antioxidant efficiently can be related to the inclusion of bioactive molecule like flavonoids and phenolic acids [60] [61].

3.3. Antimicrobial activity

The capacity antifungal and antibacterial of the Aloe vera gel extract was evaluated using disc diffusion method technique against different pathogenic microbes' four pathogenic bacteria and one fungi as reported in the table 4.

Table 4. Inhibition zone of tested simple against different strains

	Gram	Aloe-vera gel extract	antibiotic	
			Gentamycine	nystatine
E. coli	-	15±0.15	22±0.12	/
P. aeruginosa	-	-	21±0.2	/
S. aureus	+	8±0.04	25.5±17	/
C. albicans	fungi	6±0.12	33±54	15±0.1

Zone of inhibition=mean Values ± SD (mm),
(-): No zone of inhibition

The extract was showed an inhibitory zone between 6 and 15 nm, and this indicated that the aloe gel extract revealed a highest antibacterial capability against the *E. coli* gram negative bacteria with zone of inhibition around 15±0.15 mm which was lower than Gentamycine the standard antiobiotic. The two other strain *S. aureus* and *P. aeruginosa* showed a resistance to our tested extract, then Aloe vera gel extract can't inhibit the growth of this two bacteria. In the other side, the aloe vera gel extract revealed a weak antifungal activity against *C. albicans*. Same results was reported in the research of Darshan T Dharajiya et al. [62]. This antibacterial ability of Aloe barbadensis gel extract agins *E.coli* could be attributed to the presence of photochemical activity including phenol, flavonoid, alkaloids, saponins and tannins which were reported to prevent several diseases [63].

4. CONCLUSION

The presence of the phytochemical compounds such as phenol, flavonoid, tannin, alkaloid, saponin and terpenoid in the Aloe barbadensis gel extract give this plant significant therapeutic and pharmacology properties as reported in literature before. These phytochemical constituents can be extract and used for the development of drugs with antimicrobial, antiviral, anti-inflammatory, antioxidant anti-cancer activity.

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