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Original Article

Phytochemical and biological potential of Prickly pear (*Opuntia ficus-indica*) extracts from M'sila (Algeria)

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ABSTRACT

The cladodes juice and seeds oil obtained from the prickly pear (*Opuntia ficus-indca*) grown in M'sila, Algeria are investigated in this work. The objective of the present study was to evaluate their physicochemical composition, polyphenols and flavonoid content, antioxidant potential by DPPH test and antibacterial activities. The results of this experimental study showed that leaf bud juice presented the highest yield of 79.02%. Leaf juice was rich in polyphenols (4.6 g/100 g) and flavonoids (38.35 mg/100 g). While, the study revealed that the seeds oil extracts presented a weak yield of 5%. Leafy sap from spiny species shows high antioxidant activity and an antibacterial effect on: *S. aurous*, *E. coli*, *S. typhimirum*, *S. marcesscens*. Whereas, the antibacterial activities were as follows: for leafy sap from spiny species *E. coli*, *P. aeruginosa*, *S. typhimirum* and *K. pneumoniae* strains were relatively resistant to oil, *E. coli* and *S. marcescens* strains were relatively resistant to cold-pressed oil. The three oil varieties cold, 90°, and 160° pressed oil, were the most proven oils to be effective against *E. coli*, *P. aeruginosa*, *S. typhimirum and K. pneumonia.*

1. Introduction

The prickly pear is a succulent plant belonging to the cactus family, more specifically the genus *Opuntia*. It grows in various parts of the world, mainly in arid and semi-arid climates with a low annual rainfall rate such as the Mediterranean and Central America [1, 2]. The genus *Opuntia* includes about 300 species, many of which produce very tender and edible stems and fruits [3]. One of these species is *opuntia ficus indica* (single or thornless), commonly called prickly pear. A greater interest has been observed into its cultivation around other continents in the last decades due to its major thanks to its drought resistance, desertification resistance and high water-use efficiency [4, 5]. The cells of this succulent plant can withstand greater fluctuations in water content than other "normal" plants [6]. *Ficus indica* belongs to the Cactaceae family, which includes about 1600 species, with the greatest center of diversity in Mexico, where 669 species are native [7]. In Algeria, the introduction of cactus is like Morocco and Tunisia in the 17th century [8]. In the Mediterranean regions specially in ALGERIA, prickly pear is cultivated principally for fresh fruit consumption, in the food industry, pharmaceutical and cosmetic industries or as

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basic ingredient in the diet of local inhabitants [9-14]. *Opuntia ficus-indica* is among the cacti that have the greatest agronomic importance, both for its edible fruit and for the rackets that could be used as fodder or as vegetables it has miraculous benefits on human and animal health and the environment [9]. Cactus pear fruit and stem are traditionally recommended for medicinal purpose such as; non-insulin dependent diabetes mellitus, as their consumption improves glycemic control and reduces blood cholesterol levels in the patients [15]. Infusions of fruit, cladodes and flowers are traditionally used to treat and soothe ulcers, allergies [16], and as anti-uric acid and diuretic by its effective effect on hypertension [17]. The juice extracted by pressing from the cladodes is recommended for the treatment of liver, rheumatism, scurvy and kidney disease.
[18, 19]. In the form of powder in capsules, cladodes are currently used to stabilize weight [20].
To valorize the cultivation and extend the knowledge concerning this plant in Algeria, current study has been established to report the physicochemical composition, phytochemical screening, TPC, flavonoid content, antioxidant and antibacterial activities of the prickly pear cactus *Opuntia ficus indca* grown at tow area (M'sila and Ain Defla, ALGERIA).

2. Materials and Methods

2.1. Material and Samples preparation

All experiments were carried out on prickly pear cladodes pertaining to the cultivar grow in the Daira of Ain El Hadjel which is located in Wilaya of M'sila, Algeria. Rain is the only source of water for these plants and they receive no chemical treatment. Prickly pear seeds were harvested in summer.

The cladodes were water washed and blended. After centrifugation at 5600 rpm for 20 minutes, the supernatant was recovered and stored at 4° C before analysis.

After ridding, the prickly pear seeds of the pulp, they were washed and dried at room temperature, and subsequently grinded and sieved. Virgin seeds oil extracted by cold pressing.

The juice yield of prickly pear cladodes could be expressed, by the relationship:

$$Y\,(\%) = \left[\frac{m1 - m2}{m1}\right] \times 100 \qquad (02)$$

Y : yield ; m1, m2: mass of cladodes (g); m2: the mass of the juice (g).
m1: mass of cladodes (g) m2: the mass of the juice (g). For the determination of antibacterial activity diftrents strains had been prepared to CLSI Standards (CLSI) by agar plate.
The oil extraction from prickly pear seeds was performed in soxhlet extractor using a mix solvant of hexane and diethyl ether.

2.2. Physico- and biochemical analyses

The water content was determined by drying the samples to 105° C for 24 h. The ash content was determined by oven at 550° C for 3 h. The total acidity was determined on 25 mL of juice by measuring the volume of 0,25 N NaOH necessary to take the sample to pH 8.1.

2.3. Total phenolic and flavonoids contents

The total phenolic contents of prickly pear juice were determined using a modified Folin-Ciocalteu method. It was expressed as gallic acid equivalents in mg per g of dry extract (GAE /g DE) [21].

The content of flavonoids was determined according to Biesaga et al. [22] by the Aluminum chloride chromatography method with slight modifications.

2.4. Antioxydant activity

Free radicals scavenging activity of extracts was assayed by DPPH assay using the method of Bursal and Gulcin [23]. The scavenging activity was calculated using the formula:

$$DPPH\,(\%) = \left[\frac{A517c - A517s}{A517c}\right] \times 100 \qquad (01)$$

A517 c, A517 s: absorbance of the controle and the sample at 517nm respectively.

3. Results and Discussion

3.1. Prickly pear juice

a) Physico- and biochemical analyses results

Basic physico-chemical analysis on cladode juice: yield, water content, ash, pH and titrable acidity investigated in this study are given in table 1.

Table 1. Physico-chemical analyzes of *Opuntia ficus-indica* cladodes juice.

Yield %	79.02 %
Water content	9.1 g/10 g (91%)
Ash content	0.95 g/10 g (9.5%)
pH	4.8

Titratable acidity	3.9

The water content in the cladodes juice is 91%. Generally, the water content of cactus is between 88 and 95% [24]. The ash content in the extract is 0.95 g/10 g, and it exceeds the ash content of orange juice, which (0.37 ± 0.01 g/10 g [25]. Regarding the pH and titratable acidity results, the cladodes juice has a pH of 4.8 ±0.01, so the average acidity of the juice exceeds the pH of the other juices, such as, grapefruit juice which has a pH of 3.67 ± 0.01 [26] and orange juice has a pH of 3.52 ± 0.01 [27]. The titratable acidity of cladodes juice was 3.9 ± 0.01, comparing to other juices, it is lower than lemon juice with 0.94 ± 0.02 EAC (g/L) [26], which can be explained by a high citric acid content.

b) Total phenolic content

The phenolic content in the prickly pear was also checked, the amount of total phenolic was calculated to be 46 mg/100 g of extract. the results appear to be similar to those show in previous study reported in Arris (Batna-Est Algeria) with 45.70 mg/ 100 g [8].

d) Flavonoids content

The flavonoids content in the prickly pear juice was counted to be 38.35 mg/100g. The value was higher than that reported by Haddadi (2005) for fruit and vegetable flavonoids: orange, grapefruit, apple and strawberry, at 3.22, 7.12, 2.10 and 17.53 mg/100 g, respectively.

e) Antioxidant activity

The free radical DPPH was assayed to check the ability of the prickly pear juice extract to donate hydrogen, by which antioxidants inhibit lipid peroxidation. The necessary amount of the prickly pear juice extract to decrease the initial DPPH• concentration by 50% (IC_{50}) was used in the antioxidant activity measurement. A lower value of IC_{50} indicates a higher antioxidant activity. It was noticed from the results presented in the Table 2, and with the comparison of the IC_{50} of our extract with the blank value, it could be concluded that the juice of *Opuntia ficus indica* has a high antioxidant activity.

Table 2. Absorption and inhibition of the juice of *Opuntia ficus-indica L.*

[C](mg/mL)	**Absorption. (nm)**	**inhibition**
1- 0.1	0.281	**68.0%**
2- 0.05	0.413	**54.4%**
3- 0.0125	0.642	**30.8%**
4- 0.0062	0.760	**18.6%**
5- 0.0015	0.780	**16.5%**
Blank	0.976	
IC_{50}	**0.450**	

This activity exhibited by the juicy extracts, could be attributed to total phenol content [28].

f) Antibacterial activity

The antibacterial activities of the prickly pear juice were estimated *in vitro* on 08 different pathogens. The results were given in table 3.

Table 3. The results of antibacterial activity of the prickly pear juice.

Strains	I zone	Sensibility
Staphylococtus aurous G+	11mm	Sensitive
Escherichia coli G-	07 mm	Sensitive
Pseudomonas aeroginosa G-	06 mm	Resistant
Salmonella typhimirum G-	14 mm	Sensitive
Serratia marcesscens G-	6.5 mm	Sensitive
Proteus mirabilis G-	06 mm	Resistant

G+: Gram positive; G-: Gram negative.

The sap extracted from the cladodes of the prickly pear showed antibacterial activity against some of the bacteria tested, such as: *Staphylococtus aurous*, *Escherichia coli*, *Salmonella typhimirum*, *Serratia marcesscens*. The reading was made by measuring the diameters of the inhibition halos around the discs using graph paper. The results are expressed by the diameter of the inhibition zone (I zone).

3.1. Prickly pear seeds oil

A) Antimicrobial activity

Chemically, it has been found that prickly pear presented a weak yield of 5%.

Looking for the sensitivity of the strains to seeds oil, different extracted methods had been used on various bacterial strains. The table 4 reports the zones of inhibition by (mm) reached with the various strains studied; 6 mm is disc diameter.

Table 4. The results of antibacterial activity of the prickly pear seeds oil.

Strains	I zone of extracted oil types (mm)			
	Soxhlet	Cold pressed	Pressed 90°	pressed at 160°
S. aurous G+	06	06	06	06
E. coli G-	06	06	13	11
P. aeroginosa G-	06	18	19	16
S. typhimirum G-	06	14	12	06
S. marcesscens G-	16	06	06	06
P. mirabilis G-	06	06	06	06
K. pneumoniae G-	06	11	13	13

G+: Gram positive; G-: Gram negative.

The results show that all the oily extracts of *Opuntia* seeds proved to be inactive against *S. aureus* and *P. mirabilis* (6 mm); these bacteria have a very high resistance potential, compared to the results of Benattia [29] her oily extracts of the same species is inactive against more to the two bacteria that we mentioned previously, plus to *E. coli*, *P. aeruginosa*, *K. pneumoniae*, and *M. luteus*. The optimal effectiveness of an extract may not relate to a main active constituent, but to the synergy action of different compounds of the extract [30].

On the other hand, the strain of *E. coli*, *P. aeruginosa*, S. *typhimirum* and *K. pneumoniae* showed relative resistance to soxlhet oil, the same for the strain *E. coli* and *S. marcescens* against cold press oil. Several studies have highlighted the high sensitivity of Gram (+) bacteria compared to Gram (-) [31, 32], this can be attributed to the difference in the outer layers of Gram (-) and Gram (+) bacteria. These works are in agreement with our results.

Cold pressed oil, pressed oil at 90° and pressed oil at 160° are the most oils have proven their strength against *E. coli*, *P. aeruginosa*, S. *typhimirum* and *K. pneumoniae*

b) Antifungal activity

The results of the antifungal activity of the oils showed that the extract had no significant effect on the fungus: *Aspergillus Niger*. The results presented below (figure 1) support the findings described above regarding antifungal activity; where we see a rapid and terrible spread of *Aspergillus Niger* in the detriment of the studied oil extracts.

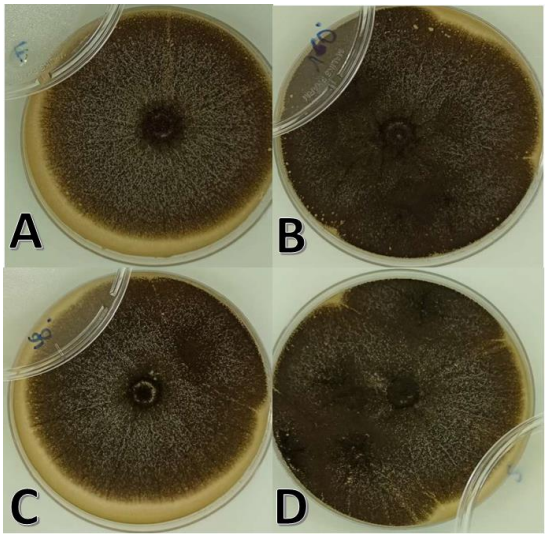

Figure 1. Effects of Opuntia seed oils against the fungus *Aspergillus Niger* after 7 days (A: Cold pressed oil; B: Pressed oil at 90°; C: Pressed oil at 90°; D: Soxlhet oil).

4. Conclusion

Opuntia ficus indica, which is the subject of this work, revealed to be a good source of various components with marked antioxidant activity, witch becoming increasingly important in the medical and cosmetic fields.

The preackly pear juice showed a considerable amount of phenolic compounds witch can be considered as an industrial by-product that has the potential to provide human an additive for food supplements and functional foods. Furthermore, the good antimicrobial activity against the selected bacterial strains by the extracted juice sample make him a suitable ingredient in the food and medical fields.

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Conflict of Interest

The authors declare that they have no conflict of interest

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