



FULL LENGTH ARTICLE

# Phytochemical study of prickly pear from southern Morocco



Z. Bouzoubaâ<sup>a</sup>, Y. Essoukrati<sup>b</sup>, S. Tahrouch<sup>b</sup>, A. Hatimi<sup>b</sup>, S. Gharby<sup>c</sup>,  
H. Harhar<sup>c,\*</sup>

<sup>a</sup> Laboratoires d'Agrophysiologie et Physiologie de Poste récolte, UR Ressources Naturelles et Produits de Terroirs, INRA-CRRA-Agadir-Morocco, B.P. 124, Inezgane, Morocco

<sup>b</sup> Laboratoires de Biotechnologie Végétale, Université Ibn-Zohr, Faculté des Sciences, Agadir, Morocco

<sup>c</sup> Laboratoire de Chimie des Plantes et de Synthèse Organique et Bioorganique, Faculté des Sciences, Université Mohammed V-Agdal, BP 1014, Rabat, Morocco

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**Abstract** This work concerns the phytochemical study of the prickly pear pulp's fruits of two opuntia cultivars; Achefri and Amouslem widely present in two regions of southern Morocco; Arbaa Sahel and Asgherkis that are different in their altitude and annual rainfall. The results of the phytochemical study show that the levels of antioxidants have a non-significant difference between the fruits of the two sites (comparing Amouslem and Achefri in the same site, on the one hand, for the differences due to the variety or cultivar, on the other hand between Amouslem and Achefri from the two sites to show the site effect).

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## 1. Introduction

*Opuntia cactus* is a native species of Mexico (Mulas et al., 1992). It was one of the food bases for the indigenous populations (Hoffman, 1995). It was introduced in southern Spain after Columbus's first expedition to the New World. Thereafter, it was spread throughout the Mediterranean Basin by the

Spanish conquerors in the 16th and 17th century. The culture of *Opuntia* covers about 200,000 ha in North Africa 30–40% in Tunisia (Le Houérou, 1985). *Opuntia cactus* was introduced in Morocco in the early 17th century from Spain (Schielief et al., 2000). With the exception of the Sahara and mountainous areas, *Opuntia* are widely represented in the Moroccan rural landscape, into plantations more or less regular, around villages or plant closing limiting parcels of crops or orchards (Arba, 1983; Arba et al., 2000; Bouzoubaâ et al., 2014).

The culture of *Opuntia* exists almost in all regions of the country with relatively variable area; it occupies an estimated area with about 54,530 ha, representing 11.07% of the total area of the fruit trees (Boujghagh and Chajja, 2001). Its geographical distribution is quite large since it found both in coastal areas from Sidi Ifni in the South to Tangier in the

\* Corresponding author. Tel.: +212 6 68 79 99 42.

E-mail address: [hichamoo79@yahoo.fr](mailto:hichamoo79@yahoo.fr) (H. Harhar).

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North, as in several continental regions (Boujghagh and Chajia, 2001). The best plantations are located in coastal areas and more specifically in the coastal strip of more than 10 km wide undergoing maritime influence, the plant benefits the night and morning fog, very frequently in this area throughout year (Boujghagh and Chajia, 2001; Bouzoubaa et al., 2014). In Morocco, at the Tiznit province, the culture of *Opuntia* occupies the largest area with about 17,600 ha mainly in the regions of Sidi Ifni and Ait Baamrane accounting for 65% of it (Dehbi and Radwan, 2000). Tensift and the Central regions are among the areas where regular plantations have been installed as part of national operation against erosion. In the region of Moulay Idriss, near Meknes, a cactus plantation for the production of fruits has been a steady expansion. In Beni Smir, near Oued Zem, a cactus collection was established in 1944 on an area of 500 ha (Habibi, 2004).

The cactus has been largely ignored by scientists until the beginning of 1980; this renewed interest is partly attributed to the multifunctionality of prickly pear fruit. Recent studies have revealed their high levels of certain chemical compounds, which can make this fruit an added nutritional value, such as taurine, calcium, magnesium, phenolic compounds and betalains (Piga, 2004; Zine et al., 2013).

Cactus also knows a renewed interest in several countries due to its ecological role, environmental and socio-economic: the fight against erosion and desertification, and fruit production fodder (Bouzoubaa et al., 2014). The prickly pear is also the origin of products and by-products to various industrial uses, medicinal, pharmaceutical and cosmetics (Barbera, 1995).

In Morocco, the new strategy of agricultural development concretized by the Green Morocco Plan (PMV) is a real opportunity for the development of different sectors related to cactus, knowing that the PMV provides the consecration of a million hectares fruit species requiring little water, such as olive, carob or cactus (Bouzoubaa et al., 2014). The area reserved for the latter in each region will experience a remarkable increase, especially in the Guelmim-Smara and Rhamna regions with additional 70,000 and 50,000 ha respectively.

Moroccan cactus has a very high genetic variability, several cultivars exist (Bouzoubaa et al., 2014), and are distinguished by the flowering period (early, late), the flower color (yellow, orange and pink), fruit color and pulp (green, yellow, orange, red and purple), fruit shape (oval, round or oblong), the organoleptic characteristics of fruit (Boujghagh Chajia, 2001), and the antioxidant content (Kuti, 2004; Tesoriere et al., 2005).

The fruits of the prickly pear exhibit both intra-site and inter-site variability in the shape, color, weight, sugar, acids, antioxidants, etc. These parameters vary from one cultivar to another and are strongly influenced by the environment (Parish and Felker, 1997). In this context, we are interested in the study of antioxidants (polyphenols, flavonoids and betalains) of the pulp's fruit of both cultivars in the regions of Tiznit and Ait Baha. These cultivars are locally named Achefri and Amouslem.

## 2. Materials and methods

### 2.1. Sampling sites

The fruit samples were collected from two different sites in their relief and climate; Arbaa Sahel had a maritime influence,

located at 15 km from the sea and 17 km southwest of the Tiznit city and Asgherkis a continental site located at 709 m of altitude, and 57 km in the south of the Ait Baha city (70 km from Agadir) (Fig. 1).

### 2.2. Plant material

The studied fruits were harvested between July and September 2010. Only ripe and healthy fruits were selected, they were immediately stored in a cold room at a temperature of 4 °C. The present plant material in the study sites is composed of two populations:

- a- A population consists of individuals with thorny rackets and small oval fruits, with yellow or red color, and yellow–orange pulp with a thinner crust. This population is locally known as Achefri.
- b- A population consists of individuals with spineless rackets and oval fruits with large caliber, yellow or red color, and orange pulp with a thicker crust. This population is locally known as Amouslem Fig. 2.

### 2.3. Physico-chemical analyses

From the sample kept cold, 30 fruits per cultivar were randomly selected with a view to determine the various physico-chemical parameters. The determination of the color of the bark and the pulp was carried out using a chromameter (KONICA MINOLTA CR-400).

The sugar content of the juice was determined using a refractometer (DIGIT 032), the results are expressed as °Brix. The free acidity, expressed as a percentage of citric acid is determined by titration; 10 ml of the juice of prickly pear was placed in a 100 ml beaker equipped with a magnetic stirrer, 20 ml of distilled water was added and the homogenized mixture is titrated with NaOH (0.1 N) to pH = 8.1 (Medina et al., 2007).

For the determination of dry matter, fruits were washed and peeled, 30 g of the pulp obtained was precisely weighed and placed in clean glass Petri dishes and pre-weighed. Then they were placed in an oven at 100 °C. After 24 h, periodical weighing was continued at intervals of 2 h until a constant weight.

### 2.4. Total polyphenols

The polyphenol content was determined using the Folin–Ciocalteu spectrophotometrically according to the Singleton method (Singleton et al., 1999) using caffeic acid as standard. In an alkaline medium, polyphenols reduce phosphomolybdic acid of Folin–Ciocalteu reagent (Catalano et al., 1999); this reduction is reflected by the appearance of a dark blue color. The color produced, (whose maximum absorption is between 725 and 765 nm) is proportional to the amount of polyphenols present in plant extracts (Ghazi and Sahraoui, 2005).

### 2.5. Total flavonoïdes

The flavonoid in the raw juice has been extracted by the methanol–water mixture (80:20, v/v). After stirring, sonication and

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