

Functional Properties of *Pulicaria odora* L. Leaves Pre-coated in gel based *Ziziphus jujuba* Mill. Peel Powder

Adiba Benahmed Djilali^{a,b,*}, Abdelouahab Benseddik^c, Khelifa Bouacem^a, Karim Allaf^d, Mohamed Nabiev^e

^aFaculty of Biological and Agricultural Sciences, Mouloud Mammeri University of Tizi-Ouzou,, 15000, Algeria.

^bResearch Unit Laboratory, Materials, Processes & Environment (UR-MPE) in M'Hamed Bougara University of Boumerdes 35000, Algeria.

^cResearch Unit for Renewable Energies, URAER, Center for the Development of Renewable Energies, CDER, 47133, Ghardaia, Algeria

^dLaboratory of Engineering Science for Environment LaSIE-UMR-7356CNRS, University of La Rochelle.

^eLaboratory of Petrochemical Synthesis FHC, M'Hamed Bougara University of Boumerdes, 35000, Algeria

*Corresponding author: adiba.benahmed@yahoo.fr

Graphical Abstract



Uncoated leaf



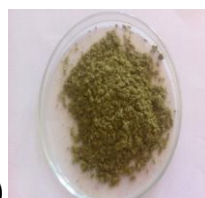
Leaf coated in carrageenan gel



Leaf coated in gel based of carrageenan and *Z. jujuba* Mill peel powder



a)



b)



c)

Fig.1. Appearance of powders obtained from open air drying of *Pulicaria odora* L. leaf coated and uncoated in functional gels

Abstract

The main objective of the present work was to study the aptitude to drying of *Pulicaria odora* L. leaves pre-coated in functional gels. This involves drying in the open air leaves of *P. odora* pre-coated in a carrageenan gel, a carrageenan-based gel added to *Z. jujuba* Mill peel powder. In addition, the evaluation of certain properties (physicochemical, rheological and biological) of the obtained powders was carried out.

The obtained results show that coating has a very positive effect on the rheological properties of *P. odora* leaves powder (small grain size, good flow, and little swelling). It also promotes the conservation and release of bioactive substances (polyphenols and flavonoids). Indeed, the best extraction rates were obtained for the powder from the leaves coated in carrageenan gel based *Z. jujuba* Mill peel powder with levels of 1099.996 ± 8.545 mg

EAG /g d.b and 141.336 ± 0.89 mg quercetin / g d.b) respectively for total polyphenols and flavonoids. Finally, the test for the antimicrobial activity of the total polyphenol extracts of the obtained powders reveals that they are effective against Gram-positive bacteria (*S.aureus* ATCC 25923) and Gram-negative bacteria (*E.coli* ATCC 25322) and yeast (*C.albicans*). The ethanolic extract of the powder from the leaves coated in the carrageenan gel based *Z.jujuba* Mill peel powder has an inhibition diameter of 24.5 ± 0.15 mm with respect to *C.albicans*.

Key words: *Pulicaria odora*, *Zizyphus jujuba* Mill, coating, powder, phenolic compounds.

1.Introduction

Pulicaria odora L. is a medicinal plant widely used by the Algerian population. It is thought to have very interesting biological and medicinal properties, such as antibacterial [1], antioxidant [2] and healing [3] activities. According to traditional pharmacopoeia and our ethno-botanic study, *P.odora* L. is classically used by the local populations of Tizi-Ouzou and Tipaza (northern Algeria). The survey we conducted in these two areas has revealed that its leaves and roots have various traditional uses, such as the treatment of stomach ulcers (with a frequency of use of 40%) and the treatment of wounds (with a frequency of use of 22%). It has also revealed that 18 % of the populations use the leaves to treat gastric disorders and abdominal pain. The mode of use (decoction of leaves in olive oil) is recommended by the population surveyed with low application frequency (<10%) to relieve headache.

Zizyphus jujuba Mill, called 'anneb' in Arabic, is a fruit from China. It is consumed fresh or dry. This fruit is highly replicated in the Mediterranean area (South of France, Morocco, Tunisia and northern Algeria, especially in the regions of Tlemcen, Annaba and Tipaza), but people are reluctant to cultivate it despite its beneficial properties. This dry fruit is a veritable concentrate of sugars and essential nutrients, such as fiber, vitamins B, B-carotene, iron, potassium and phosphorus [4], and polyphenols (flavonoids) [5]. Yet, the cultivation of this fruit is very limited, and its nutritional and therapeutic properties are unknown by the Algerian consumer.

Packaging materials as polysaccharides, alginate, carrageen and pectin are preferred because of their high film forming ability [6]. A variety of polysaccharides and their derivatives reduce fat absorption oxygen, and carbon dioxide permeability is also reduced. Besides, microbial proliferation in particular *Listeria* growth can be reduced by coating fish products with a formulation of hydrocolloids, organic acids or antimicrobial compounds [7].

As for the present work, it aims at studying the effect of a conservation matrix (functional gels) applied on the leaves of *P. odora* L. dried in open air, as well as at evaluating certain physicochemical, rheological and biological properties of the obtained powders.

2. Material and methods

2.1. Plant material

Pulicaria odora L. leaves were harvested manually in April 2017 in the area of Tizirt, a small coastal town situated some 30 km north of the city of Tizi-Ouzou.

The fruit of *Zizyphus jujuba* Mill came from the region of Tipaza (some 65 k, from Algiers), harvested during the period running from September to December 2016. The fruits were dried at the open air and kept in a ventilated room until the moment of their use.

As for the Carrageenans, they are of Danish origin, imported by the Safara company unit of Blida.

2.2. Biological material

Two bacteria (*Staphylococcus aureus* ATCC 25923 and *Escherichia coli* ATCC 25322) and a mold *Candida albicans* were used for the antimicrobial activity test of *P. odora* L. leaves extracts. These strains were provided by the Microbiology Laboratory of the University of Tizi-Ouzou.

2.3. Methods of analysis

2.3.1. Preparation of functional gels

The choice of proportions of carrageenan and *Z. jujuba* Mill peel powder to prepare gels of desired viscosity was optimized on the basis of the blending plan method (experimental design).

At the end, two carrageenan gels were selected. The first was prepared from the *Z. jujuba* Mill peel powder, and the second without this powder. These gels were prepared at a rate of 3% of carrageenan and *Z. jujuba* Mill peel powder was added at a rate of 4%.

The gels were well mixed in order to avoid the formation of lumps. Then, their pH was adjusted to 6. After that, the prepared gels were sterilized by tyndallization at 65°C for one hour. Once cooled, they were stored in the refrigerator for further analysis.

The leaves of *P. odora* L. underwent characterization analyzes, namely: a phytochemical analysis was performed according to standard phytochemical screening methods [8, 9]; the total polyphenols were determined spectrophotometrically following the Folin-Ciocalteu method [10]; the antimicrobial activity of the powder extracts was carried out according to the method described by [11].

2.3.2. Drying process

Just after being harvested, the *P. odora* L. leaves pre-coated and uncoated in functional gels were dried at conventional air. Three samples from the drying process were ground with a grinder (Mammolex, 242 W) into powders, and then were sieved (The sieve type: Euromatest-Sintoo, NFX11-501). Then the final powders were kept into hermetically sealed bags. The particle size distribution of powders was investigated by means of a Malvern laser diffraction granulometer (Mastersizer 2000). This part of the research work was carried out at the Research Laboratory of Material Sciences at M'Hamed Bougara University of Boumerdes.

3. Results and Discussion

The quantitative analysis of the total polyphenols and flavonoids of the (ethanolic and aqueous) extracts of the obtained powders shows that the ethanolic extracts have higher levels of these compound in comparison with the aqueous extracts. In addition, coating has a very positive effect on the rheological properties (small grain size, good flow, and little swelling). It also promotes the conservation and release of bioactive substances (polyphenols and flavonoids). Indeed, the best rates were obtained with the use of the leaf powder coated in carrageenan gel based *Z. jujuba* Mill peel powder with levels of 1099.996 ± 8.545 mg EAG / g d.b and 141.336 ± 0.89 mg quercetin / g d.b), respectively for total polyphenols and flavonoids.

The analysis of the particle size reveals that the two powders resulting from the coated leaves and dried at open air (Fig. 1, b, c) have the same percentages of grain majority of size (316.228 μ m). As for the powder resulting from drying uncoated leaf, it is characterized by a majority particle size of 363.078 μ m (Fig. 2, a). It should be noted that the powder obtained from the drying of uncoated leaf has two different parts: one is composed of light particles (wool part), and the other consists of large particles.

Finally, the antimicrobial activity results showed that the total polyphenol extracts of the obtained powders are effective against Gram-positive bacteria (*S. aureus* ATCC 25923) and Gram-negative bacteria (*E. coli* ATCC 25322) and yeast (*C. albicans*). The best zones of inhibition have been observed using ethanolic

extract of the powder obtained from the leaf coated in the carrageenan gel based *Z.Jujuba* Mill peel powder with an inhibition diameter of 24.5 ± 0.15 mm with respect to *C.albicans*.

4. Conclusion

One can conclude that the coating method has a very interesting effect in terms of flow (pharmacodynamic property). It promotes the fractionation of particles (obtaining less woolly powders of small grain size), thus allowing a better release of bioactive substances.

4. References

- [1] Hanbali, F. E.L.; Akssira, M.; Ezoubeiri, A.; Gadhi, C.E. A.; Mellouki, F.; Benherraf, A.; Blazquez, A.M.; Boira, H. Chemical composition and antibacterial activity of essential oil of *Pulicaria odora* L. *J. Ethnopharmacol*, **2005**, 99, 399–401. doi:10.1016/j.jep.2005.01.012
- [2] Touati, N.; Casas, L.; Mantell, C.; Martínez De La Ossa E.; and Bedjou, F. Green extraction methods of antioxidants from *Pulicaria odora*. GPE – 4th International Congress on Green Pro. Eng. **2014**, Seville (Espagne).
- [3] Meddour, R.; Mella, A.; Meddour-Sahar, O.; and Derridj, A. Medicinal flora and its current uses in Kabylia (Wilaya of Tizi-Ouzou, Algeria): some results of an Ethnobotanical study, *Review of arid regions*, **2009**, 181-201.
- [4] Azam-Ali, S. (2006). Ber and other jujubes. ED South ampton Center for the Underutilized Corps, pp 18-23.
- [5] Benahmed Djilali, A.; Nabiev, M.; Gelicus, A.; Benamara, S.; Allaf, K. Evaluation of Physical-Chemical, Pharmacodynamic and Pharmacological Attributes of Hot Air Dried and Swell Dried Jujube Powders. *J. Food. Pro. Eng*, **2016** Issn 1745–4530. <https://doi.org/10.1111/jfpe.12364>
- [6] Rao, Kanatt, Chawlaet Shama (2010). Chitosan and gum composite films: Preparation, physical, mechanical and antimicrobial properties. *Carbohydr Polym* 82: 1243-1247.
- [7] Sensidoni and Peressini, (1997). Edible films. Potential innovation for fish products. *Ind Alimentt-Italy*, 36:129-133.
- [8] Dohou, N. et al., (2003). Phytochemical screening of an endemic Ibero-Moroccan Thyme laealythroides. *Bulletin of the Pharmacy Society of Bordeaux*, 142, 61-78.
- [9] Kumar, U. et al., (2010). Phytochemical investigation and comparison of antimicrobial screening of clove and cadamom. *International Journal of Pharmaceutical Sciences and Research*, 1,138-147
- [10] Singleton, V.L. et al, (1999). Analysis of total phenols and otheroxidationssubstrates and antioxidants by means of Folin Ciocalteure agent. *Method.Enzymol.*, 299,152-178
- [11] Benjelali, B et al. (1986). Methods of studying the antiseptic properties of essential oils by direct contact in agar medium. *Medicinal plants and Phytotherapy*, 20,155-167.