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Research Article

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Emulsifying effect of pectin from *Opuntia ficus- indica* Cladode

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ABSTRACT

The present study describes the extraction and Emulsifying effect of pectin from Opuntia ficus indica Cladode. The extraction was carried out by hydrolysis in acid aqueous solution with HCL (0.5N) adjusted to ph 1.5 at 81°C for 1h. The solid ratio was 1kg/50L. Concentrated pectin solution was precipitated with aluminum salts (sulfate). Determination of emulsifying activity is based on the ratio of the emulsified layer volume and the whole volume of the solution. Emulsions were prepared by adding 3 ml of vegetable oil to 3 ml of pectin solution (0.5 %, w/w). The yield and the emulsifying activity (EA) of the extracted cladode pectins showed (8.55%) and (67.74 %) respectively.

Keywords: Extraction; Pectin; Cladode; *Opuntia ficus-indica*; Emulsifying properties

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INTRODUCTION

Opuntia ficus-indica (Cactaceae family) is widely cultivated in the semi arid countries in Algeria for its high adaptation to the harsh desert environment. It's used for fruit production for its rich content of vitamin and presents important amount of minerals such as: Ca^{+2}, Mg^{+2}, Na^{+}, K^{+}, and Fe^{+2} and fibers: lignin, cellulose, hemicelluloses and pectin that together with amino acids help to eliminate toxins such as ammonia and free radicals [1,2]. The cladodes of this cactus have proved an excellent nutritional fiber source [3]. These cladodes are used as vegetables; animal food; medicinal plant for diarrhea, hiperlipidemy, anti-inflammatory and cosmetics.

Malainine et al. [4] found carbohydrates as the main constituent of the palm cladodes. Harlay [5], Amim et al. [6] found neutral sugars such as: D-galactose and L-arabinose in the mucilage of Opuntia. Other authors have suggested that the mucilage was acidic containing L-arabinose, D-galactose, L-rhamnose, and D-galacturonic acid [7, 8]. Parikh and Jones [9] have reported that the mucilage of Opuntia fulgida consisted of a backbone of β (1→3)-linked galactose units with branches on carbon C6 containing D-galacturonic acid, D-galactose, D-xylose, L-rhamnose, and L-arabinose units. A preliminary sugar composition of the pectic polysaccharides extracted from the peel of *Opuntia Ficus-Indica* cactus fruits has already been published by Forni et al.[27] They found that these polysaccharides are characterized by high neutral sugar content (rhamnose, arabinose and galactose) and large amounts of galacturonic acid. Habibi et al. [2] have reporter that the pectic polysaccharides from the skin of *Opuntia ficus indica* prickly pear fruits consisted of a disaccharide repeating unit →2)-α-L-Rha*p*-(1 →4)-α-D-Gal*p*A-(1→ backbone, with side chains attached to O-4 of the rhamnosyl residues. The side chains contained highly branched α-(1→5)-linked arabinan and short linear β-(1→4)-linked galactan.

Pectin is present in highest concentration in the middle lamella of plant cell wall as a cementing substance between adjacent cells [10]. It has a very complex structure. Basically, it is a polymer of α-D-galacturonic acid with 1-4 linkages [11]. This ain chain is regularly interrupted by some rhamnogalacturonan segments which combine galacturonic acid residues and α-rhamnopyranose by a 1-2 linkage [12] and β-D-galactopyranose are commonly detected.

Pectin is a high-value functional food ingredient widely used as gelling agent and stabilizer, emulsifier in a variety of food, pharmaceutical, cosmetic products [13,14]. As early as 1927, the use of pectin as an emulsifying agent in various applications such as flavor, mineral and vegetable oils emulsions and mayonnaise, was suggested [15]. Pectic substances have been isolated and extensively studied from various plant tissues such as grape, berries, apple, sugar beet, citrus…There are few studies in the literature concerning *Opuntia ficus-indica* cladodes.

The aim of our study was the extraction, purification and emulsification activity of the extracted pectin and was to compare various pectins, in terms of their emulsifying capacity

EXPERIMENTAL SECTION

Extraction of pectins

The cladodes of *Opuntia ficus-indica* were collected in mars 2014 at Seriana (Batna Algeria). Fresh cladodes (1162.82 g) after spine removal were washed in distilled water and oven dried at 30–40 °C for 24 H. After cutting the cladodes into small pieces, extraction was carried out by hydrolysis in acid aqueous solution with HCl (0.5N) adjusted to pH 1.5 at 81°C for 1H. The solid ratio was 1kg/50L [16**]**. After extraction, the pectin solution was filtered through a fine cloth. Concentrated pectin solution was precipitated with aluminum salts (sulfate). Pectin precipitate was then filtered through a fine cloth and dried in vacuum dryer at 50°C and 40 cm Hg.

Chemical characteristics

Ash content: Ash determined by dry incineration in a Heraeus muffle at 600 °C, 4h according to AOAC [17] method.

Protein content: Protein: The nitrogen content of pectins was measured using the micro-Kjeldahl method [17]. Protein content was calculated by multiplying the nitrogen content by a factor of 6.25

Total carbohydrate: Total sugar content was determined by the phenol–sulfuric acid method using glucose as the standard [18].

Study of the emulsifying activity and emulsion stability of extracted pectin

Emulsifying activity and emulsion stability were assessed using Dalev and Simeonova [19] procedure. Pectin's are able of emulsifying and stabilizing oil-water systems. Determination of emulsifying activity is based on the ratio of the emulsified layer volume and the whole volume of the solution. In graduated tubes, emulsions were prepared by adding 3 ml of vegetable oil to 3 ml of pectin solution (0.5 %, w/w). The mixture was homogenized in a vortex mixer (vortex de Janke et Kunkel) at maximum speed, for 3 min, at room temperature. Samples were then centrifuged at 527 g, for 5 min, at 23°C. After centrifugation, the whole volume of the solution (w_v) and the emulsified layer volume were determined (E_{LV}). Emulsifying activity (E_A) was calculated as:

$$E_A\ (\%) = (E_{LV} / w_v).\ 100$$

Similar emulsion samples were prepared to study the emulsion stability (E_S) after 1 and 30 days of storage at 4 and 23°C. Samples were centrifuged at 524 g, for 5 min, at 4 and 23°C. The initial emulsified layer volumes (V_{Ei}) were measured. After each storage period. Samples were centrifuged and the remaining emulsified layer volumes were measured (V_{Er}). Emulsion stability was calculated using the following relation

$$E_S\ (\%) = (V_{Er} / V_{Ei}).100$$

All experiments were performed in triplicate.

RESULTS AND DISCUSSION

Table 1: Cladodes composition

Moisture content (%)	Ash content(%)	Protein content (%)	Total sugar content (%)	Organic matters (%)	Dry matters (%)
91.9	1.90	0.14	6.05	6.19	8.10

The chemical composition of cladode is shown in Table 1.The moisture content in the fresh cladodes was 91.9% (8.1% dry weight). This value is in agreement with the 91% previously found by Pimienta and E. Sepu´lveda [20,21]. Protein content was extracted from cladode using similar experimental. The ash content in the cladode was

1.9% according to Pimienta and E. Sepu´lveda : the ash content varied between 1% and 12%. Cladode presents low protein content 0.14%, in agreement with all previously published data.

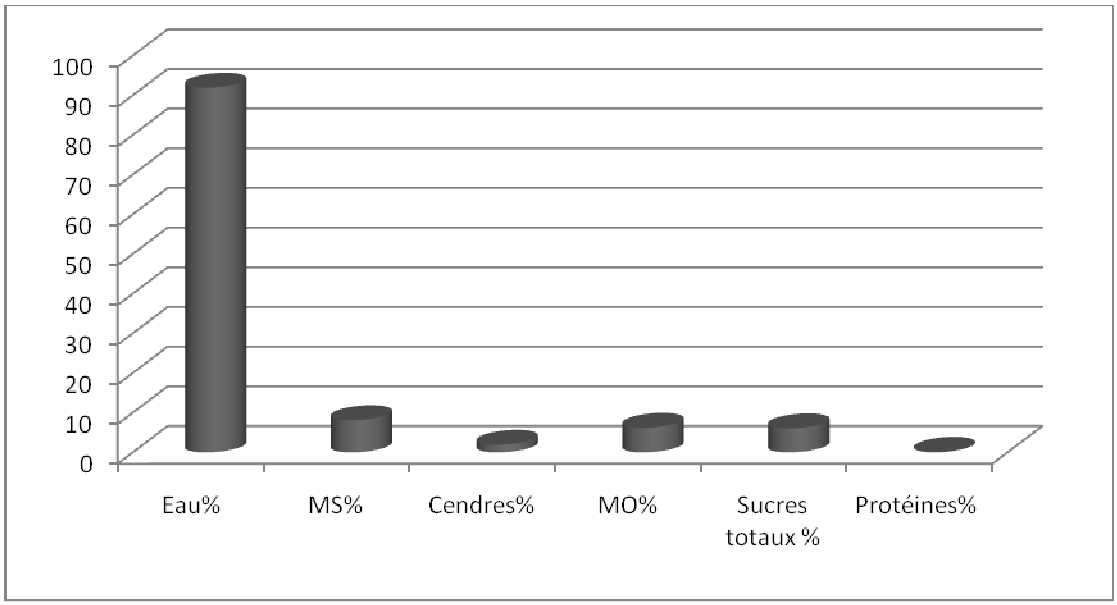

Figure1: Cladodes composition

Table 2: Total sugars of extracted pectin

Pectin	Total sugars
P.D.	74,21 %
P.O.	74,12 %
P.C.	70,11 %
P.I.	88,18 %

P.D: pectin of dates [22]; P.O.: pectin of orange [22]; P.C: pectin of cladodes; P.I: industrial pectin

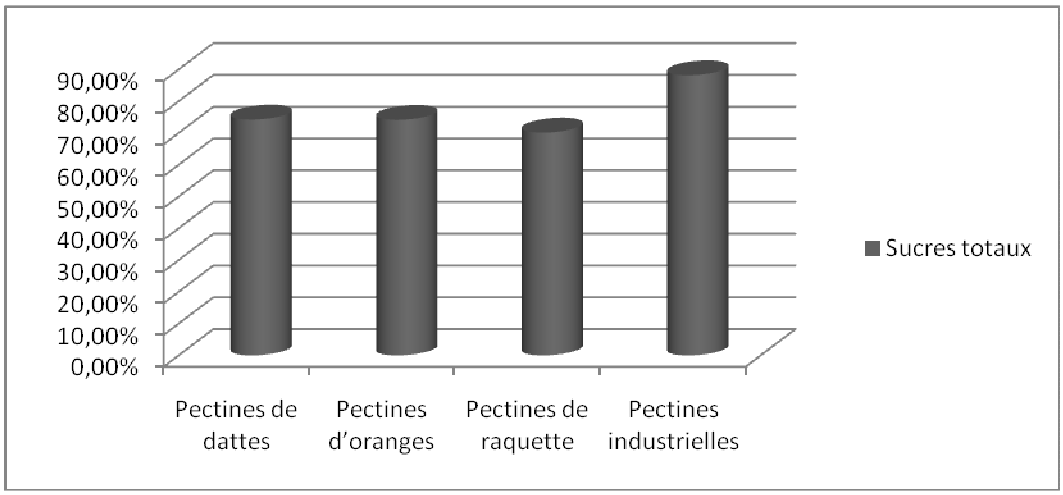

Figure 2. Total sugars of extracted pectin: dates, orange, cladode, industrial

Figure 2 showed total sugars of extracted pectin and industrial pectin. The sugar content in the industrial pectin was 88.18%. The value was higher than the sugars of orange 74.12%, sugar of date 74.21% and sugar of cladode 70.11%. Table3 showed yield of extracted pectin. Pectin content was extracted from cladode, orange palmyra palm, sugar bett , apple, apricot, cacao pod husk and date using similar experimental parameters [16].The cladode pectin yield 8.55% was the medium, it was higher than the dates yield 3.75% and more low than orange yield 35.71% [22]. The emulsifying properties of extracted pectin from cladode and industrial emulsifier Emulgin L (PPG-1-PEG-9 Lauryl Glycol Ether) were studied as well as the possibility to maintain these emulsions stable during storage of 1 day at 4 and 23°C. Results of emulsifying activity (EA) are shown in table 3. Emulsifiying activity of all pectins

varies between 33.50 and 67.74 %. Emulsifying activity of cladode pectins (67.74 %) was the highest but lower than industrial (100%). At 4°C emulsions showed the best stability.

Table 3. Yield of pectin ; Emulsifying (EA) and emulsion-stabilizing (ESA) activities of oil/0.5% (w/w) pectin solutions

Pectines types*	Yield of pectin (%)	EA (%)	Reference	ESA (%) 1 day		ESA (%) 30 days	
				4 °C	23 °C	4°C	23°C
**EmulginL(Emulsifiant industrielle)		100	This study	100	100	100	100
Cladode	8.55	67.74	This study	95.00	89.00	95.0	89.0
Orange	35.71	41.66	A. lekbir[22]	90.00	86.00	86.0	86.0
Date	3.72	39.13	A. lekbir[22]	97.00	87,30	84.2	87.3
Palmyra palm	4.70	58.30	S.Assoi [23]	nd	nd	nd	nd
Apricot	3.40	38.50	Baississe[24]	80.00	73.00	80.0	80.0
Apple	20.06	38.60	Baississe[24]	87.30	80.00	80.0	80.0
Sugar bett	13.50	33.50	Sen Ma[25]	73.90	60.80	73.7	60.5
Cacao Pod Husk	5.40	43.20	B.M.Yapo[26]	78.10	65.50	78.1	65.3

** Pectins was extracted using similar experimental parameters*
*** Emulgin L (PPG-1-PEG-9 Lauryl Glycol Ether)*

CONCLUSION

Cladode pectin showed the better emulsifying activity of natural product but presents the low yield content (8.55%). It would be very interesting to look for a new technique of extraction which will give a bigger yield.

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REFERENCES

[1]C. Saenz et al, *congreso nacional sobre conocimiento y aprovechamiento del nopal. 5.*. **1997**, 302-303.
[2]Y. Habibi; A. Heyraud; M. Mahrouz and M. R. Vignona. *Carbohydrate Research,* **2004,** 339,1119–1127.
[3]E. M. D'Oliveira et al, *Ciênc. Tecnol. Aliment., Campinas*, **2010,** 30(4): 933-939.
[4] M. E. Malainine, et al, *Carbohydrate Polymers*, **2003,**51, 77-83.
[5]V. Harlay, *Journal of Pharmaceutical Chimica*, **1902,** 16 (6), 193-198.
[6]E. S. Amim ; , O. M. Awad.; M. M. EL-Sayed, *Carbohydrate Research*, **1970,**15(1), 159-161.
[7]E. Anderson; L. Sands; N. Sturgis, *American Journal of Pharmacology*, **1925,** 97, 589-592.
[8]L. Sands; R.Klaas, *Journal of American Chemical Society*, **1929,** 51(11), 3441-3446.
[9]V. M. Parikh; J. K. N. Jones, *Journal of Polymer Science*, **1965,** 11(1), 139-148.
[10]W.G.T. Willats, J.P. Knox, J.D. Mikkelsen, *Food Sci. Technol,* **2006,** 17, 97–104.
[11]G. O. Aspinall, Chemistry of cell wall polysaccharides. The Biochemistry of Plants, New York: **1980**. Academic Press
[12]H. A. Schools; A. G. J. Voragen, *Progress in Biotechnology, Amsterdam,* **1996,** 14, 3–19.
[13]J. Leroux; V. Langendorff; G. Schick; V. Vaishnav; J. Mazoyer, *Food Hydrocolloids,* **2003,** 17, 455–462.
[14]B. R. Thakur; R. K. Singh; A.K. Handa, *Critical Reviews in Food Science and Nutrition,* **1997**, 37(1), 47–73.
[15]W. A. Rooker, *The Fruit Products Journal and American Vinegar Industry*,**1927**, 7(1), 11.
[16]M. Kratchanova; E. Pavlova; I. Panchev, *Carbohydrate polymers*, **2004**, 56, 181-185.
[17]AOAC, Officinal methods of analysis (14th ed.), Association of Officinal Analytical Chemists, Washington, DC. **1984**, 122-125.
[18]M. Dubois; K. A. Gilles; J. K. Hamilton, P. A. Rebers; F. Smith, *Analytical Chemistry*, **1956.** 28, 350-356.
[19]P.G. Dalev; L.S. Simeonova, *J. Sc. Food. Agric*., **1995**, 68, 203-206.
[20]E. Pimienta, El Nopal Tunero. Universidad de Guadalajara, Mexico, **1990,** 246.
[21]E. Sepu´lveda, *Journal of Arid Environments* **2007,** 68, 534–545.
[22]A. Lekbir, Thèse de Magistère en Sciences Agronomiques Universté de Batna, 2008.
[23]S. Assoi; K. Konan; T. Lloyd Walker; Ron Holser; N. Georges, *Food Science and Technology,* **2014,**58, 214-221
[24]S. Baississe ; H.Ghannem; D. Fahloul; A. Lekbir, *World Journal of Dairy & Food Sciences*, **20105,** 1, 79–84.
[25]Sen. Maa; S.j.Yua; X.l. Zheng; X.x Wang; Q.d. Bao; X.m. Guoa, *Carbohydrate Polymers* **2013,** 98, 750–753.
[26]B.M. Yapo; C. Robert;I. Etienne; B. Wathelet; M. Paquot, *Food Chemistry*, **2007,** 100, 1356–1364.
[27]E. Forni; M. Penci; A. Polesello, *Carbohydrate Polymers*, **1994,** 23(4), 231-234.