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Scientific Research

Investigating the extraction of pectin from the melon skin of winter and Mashhad (Qasri) cultivars using microwave pretreatment

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ABSTRACT

This research was carried out in order to extract valuable and widely used materials in food and pharmaceutical industries from the waste of agricultural products. In this research, with the aim of extracting pectin from the melon skin of winter and Mashhad (Qasri) cultivars, it was carried out by acidic method using microwave pretreatment. Pectin was extracted under microwave conditions (fixed power of 900 watt), irradiation time (1 and 3 minutes) and the ratio of extraction solvent to raw material 15:1 weight / volume and at a constant pH of 1.5. The results showed that the highest extraction efficiency of Mashhad melon in the extraction conditions (power 900 watts and duration 3 minutes) was equal to 13.5% and with the increase of duration from 1 to 3 minutes, the extraction efficiency of pectin in both Melon variety increased. Also, the pectin obtained from all the treatments had a favorable degree of purity (with galacturonic acid content above 65%). Checking the degree of esterification revealed that the pectins obtained from all treatments of winter and Mashhad melons are among pectins with low esterification. The highest equivalent weight was related to the pectin obtained from Mashhad melon in the extraction conditions (power 900 watts and duration 3 minutes), which was equal to 890 mg. The emulsifying activity of pectins obtained from both melon varieties was also low. Also, the amount of water retention capacity of pectins obtained from all treatments of winter and Mashhad melons was at the optimal level and showed that the pectins obtained from this research can be used to preserve water in some food systems. From all of the above, it can be concluded that the melon skin of winter and Mashhad varieties, which is considered as agricultural waste, can be used as a promising source for pectin production.

1. Introduction

Pectin is an important component of the cell wall of all plants on earth and about 4-5 grams are consumed in a normal diet every day. The annual consumption of pectin around the world is estimated at 45 thousand tons, while its production is 20-25 thousand tons per year. Considering the increasing need for pectin with different functional characteristics to be used in different food products and the usefulness of this combination for human health, the research to find raw materials containing pectin and the production of pectin with desirable technological properties continues [1].

Waste from apple and citrus juice factories is the most important source for pectin production on a commercial scale. Due to the wide application and use of pectin in the food industry, today researchers are looking for other sources to extract pectin, among which, the use of food waste has been given a lot of attention, because the disposal of waste and waste from food factories it is one of the major challenges of food product manufacturers, because it leads to increased costs, pollution of factory space and environment. This is despite the fact that most of the waste materials are rich in compounds that can be used in the formulation of food products due to their suitable nutritional and technological properties[2].

Pectin is complex mixture of polysaccharides found in the cell wall of all plants, most of which are galacturonic acid and natural sugars such as rhamnose, arabinose and galactose [3]. Among the most important properties of pectin, we can mention very good flavor release, good processing properties and stability at low pH. Today, in addition to being used as a gelling agent, pectin is also used as a thickener, stabilizing agent, and food coating. Pectin is used in various products such as jellies and jams, bakery products, dairy products, medicines, milk drinks and as dietary fiber and confectionery products. Also, pectin is used a lot in pharmaceuticals [4].

Microwave- assisted extraction has increased the characteristics of capillary porosity and water absorption capacity of plant materials, and these changes provide an opportunity to improve the extraction performance of target molecules from plant materials[5]. The use of microwaves also has other advantages such as short process time, less solvent consumption, higher production efficiency and better quality of the manufactured product with lower production cost [3].

Microwaves are basically waves with a short wavelength and a very high number of oscillations. Microwaves with wavelengths between 0/001-1 meters and a frequency of 300-300000 megahertz are part of the electromagnetic spectrum. All microwave devices operate at 2450 megahertz and heat is produced inside the food [6].

In this research, which was conducted with the aim of extracting pectin from the skin of winter and Mashhad (Qasri) melons by acid method and using microwave pretreatment, an important step has been taken in order to prevent the wastage of food waste. In this regard, extraction of pectin from pulp of some fruits has been done so far. Rezaei et al. (2020) in the extraction of pectin from unriped grape pomace using citric acid stated that the resulting pectin under optimal conditions has a high degree of esterification and favorable emulsifying properties [7]. Also, in a research that extracted pectin from blackberry pomace by Mosayebi et al. (2017), the results showed that pectin obtained from blackberry pomace has a low to medium degree of esterification [8]. Hosseini et al. (2015) also extracted pectin from the skin of Pineapple, Samsuri and Galia melons with the help of microwaves and reported that the pectin obtained from all three products has a good yield and purity and all three waste products can be used as a source of pectin [9]. Zafiris and Oreopoulos (1992) also reported the percentage of galacturonic acid to be 68/5 to 75% in the extraction of pectin from orange pomace by nitric acid [10]. Therefore, the use of fruit waste and pomace for pectin production, in addition to producing a valuable product from the by-products of juice factories, also reduces the problems related to waste disposal.

2- Materials and methods

2-1- Materials

First, melons of Winter and Mashhad (Qasri) cultivars were procured from reputable stores in Neyshabur city, Razavi Khorasan province. Then, chemicals such as citric acid, sodium hydroxide, hydrochloric acid, phenolphthalein reagent, sulfuric acid, ethanol, sodium tetraborate, and sodium azide were purchased from Merck, Germany, and metahydroxydiphenyl and digalacturonic acid reagents were purchased from Sigma, Germany. Oila oil was also provided from Iran Oila company.

2-2- Pectin extraction from melon skin

The skin of the fruit was separated from the place attached to its flesh, and after washing with water and cutting, it was dried on stainless steel trays in the oven until reaching a constant weight. Then the skin was dried, ground and sieved through mesh number 60. The prepared powder was stored in black polyethylene bags in a dry environment for further tests. The method of Li et al. (2012) with a slight modification was used to extract pectin from melon skin using microwaves. Extraction of pectin using a microwave device (DEVOO model) under microwave conditions (constant power 900 watt), irradiation time 1 and 3 minutes, pH equal to 1/5 (citric acid was used to adjust pH) and extraction solvent ratio (distilled water) Deionization) was done to raw material 1:15 weight/volume of melon peel. After the extraction process, suspended particles and insoluble impurities were separated by centrifugation at 10000g for 20 minutes. 96% medical alcohol was used to separate pectin from acidic solution. Alcohol was added to the acidic solution in a ratio of one to one and then kept at 4 degrees Celsius for 24 hours. After this period, the pectin in the solution became cloudy and the solution was centrifuged using a centrifuge at 10000g for 15 minutes. Then, after washing twice with 96% alcohol (in order to separate mono and disaccharides), the separated liquid phase and extracted pectin were dried in the oven until reaching a constant weight, and after desiccating and reaching a constant weight, the yield of pectin production was calculated [11].

The treatments used are listed in Table (1):

Table 1. Treatments investigated in the research.

Extraction times	Melon varieties
1 minute	Winter melon
	Mashhad (Qasri) melon
3 minutes	Winter melon
	Mashhad (Qasri) melon

2- 3- Exams

2-3-1- Assessment of extraction efficiency

The extraction efficiency of pectin from two varieties of Mashhad and Winter melons was calculated with equation (1).

Equation(1):

extraction efficiency = (pure pectin(gram) / primary dry powder)) * 100

2-3-2- Measurement of galacturonic acid

Galacturonic acid content was measured using the method of Hosseini et al. (2015). 6 milliliter of 0/0125 Molar solution of sodium tetraborate in sulfuric acid was added to the test tubes containing one milliliter of sample (200 µg/ml). Then the tubes were placed in an ice-water bath to cool down. After mixing, the samples were placed in a boiling water bath for 6 minutes. After cooling the samples in an ice-water bath, 1 milliliter of methahydroxydiphenyl reagent was added to each of the test tubes and mixed. Then, the absorbance of the samples was read using a spectrophotometer at a wavelength of 520 nanometer. By comparing the read absorption value with the standard curve, the amount of galacturonic acid was calculated. To draw the standard curve of galacturonic acid, different dilutions were prepared from the solution of D-galacturonic acid in deionized distilled water (200 µg/ml) and the absorbance of each of them was read at a wavelength of 520 nanometer. Then the graph of absorption versus concentration was drawn [9].

2-3-3- Measuring the degree of esterification

The degree of esterification of the samples was measured by the method of Santus et al. (2013) with a slight change. 0/1 gram of dry pectin was poured into a 100milliliter beaker and then mixed with 3 milliliter 0f 96% ethanol. In the next step, 20milliliter of distilled water was added to it and stirred on a heater equipped with a magnetic stirrer at a temperature of 40 degrees Celsius until the pectin was completely dissolved. 5 drops of phenolphthalein reagent were added to it and titrated with 0/1 Molar sodium hydroxide until a pale pink color appeared (initial volume). Then 10 milliliter of 0/1 Molar sodium hydroxide was added and stirred for 15 minutes on a magnetic stirrer for hydrolysis. In the next step, 10 milliliter of 0/1 Molar hydrochloric acid was added and stirred until the complete disappearance of the pink color, and then the remaining hydrochloric acid was titrated with 0/1 Molar sodium hydroxide until the pink color appeared (secondary volume). The degree of esterification was calculated according to equation (2) [12]:

Equation (2):

Degree of esterification (percentage) = (secondary volume/ (primary volume + secondary volume))*100

2-3-4- Equivalent weight test

The equivalent weight test was performed using the method of Jamshidian et al. (2021). 0/5 gram of pectin was mixed with 100 milliliter of distilled water and stirred at 25 degrees Celsius for 2 hours, and after adding 1 gram of NaCl, it was titrated with 0/1 normal NaOH in the presence of phenolphthalein reagent (5 drops). The equivalent weight was calculated from equation (3) [13]:

Equation (3):

Eq.w = (gram weight of pectin * 1000)/(ml NaOH consumed * normality of NaOH consumed)

2-3-5- Measurement of emulsion properties

This test was performed based on the method of Darvishi et al. (2021). Emulsion was prepared by adding 3milliliter of edible oil to 3 milliliter of pectin solution (0/5% w/v) containing 0/02% sodium azide to prevent the growth of bacteria. Then it was homogenized using a 10000g homogenizer for 4 minutes at room temperature. Then, the samples were centrifuged in a 4000g centrifuge for 5 minutes at a temperature of 23 degrees Celsius. After centrifugation, the emulsion activity was calculated by calculating the ratio of the volume of the remaining emulsion layer divided by the volume of the initial emulsion layer multiplied by 100 [14].

2-3-6- Determination of water storage capacity

For this purpose, the method of Betancur-Ancona et al. (2004) was used. To measure the water holding capacity, one gram of pectin was weighed inside a 15milliliter test tube and 10milliliter of deionized distilled water was added to it. Then the mixture was vortexed at high intensity for 1 minutes. In the next step, the mixture was centrifuged at 2300*g for 30 minutes. In the next step, the upper liquid was discarded and the test tube was placed upside down on filter paper for 15 minutes to completely remove the excess and unbound water. The remaining contents were weighed and subtracted from the initial weight of the test tube and the initial weight of pectin (1 gram), and the remaining number was recorded as the weight of the amount of water absorbed by one gram of pectin [15].

2-3-7- Statistical Analysis

To check the results, a factorial statistical design was used in the framework of a completely random design. The data was analyzed using SPSS statistical software and comparison of averages with each other was done using Duncan's test at alpha probability level of 0/05 with the same software. Also, Microsoft Excel software was used to draw graphs [10].

3- Results and discussion

3-1- Pectin extraction efficiency

Figure (1) shows the effect of melon variety treatment on extraction efficiency. As can be seen, the highest extraction efficiency of Mashhad melon in extraction conditions (power of 900 watts and duration of 3 minutes) is equal to the value of 13/5% and the lowest extraction efficiency of winter melon in extraction conditions (power of 900 watts and duration of 1 minute)) which is equal to 12/3 percent. The results showed that by increasing the time from 1 minute to 3 minutes, the extraction efficiency increased in both melon cultivars. Irradiation time is one of the important and effective factors on pectin extraction efficiency. Increasing the irradiation time has a positive effect on the extraction efficiency. This result, which has been confirmed by many researchers, may be related to increasing the penetration of the solvent into the matrix of the solid substance as a result of increasing the time and thus creating enough time for the pectin to dissolve in the extraction solvent [16].

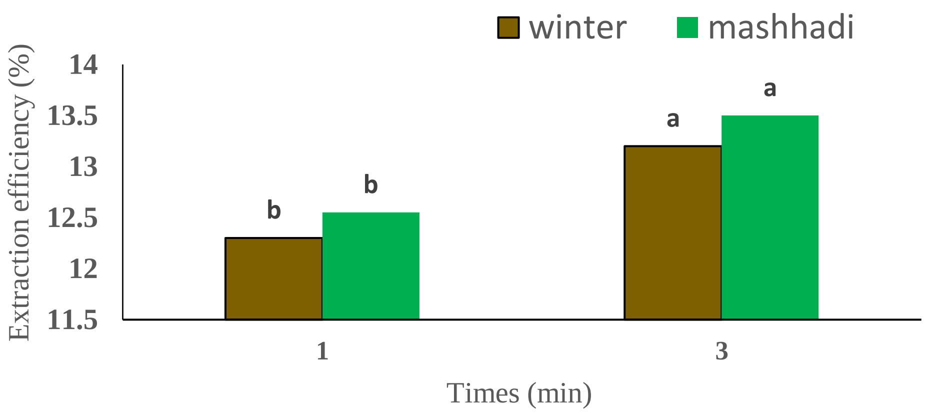

Fig 1. The effect of melon variety treatment on pectin extraction efficiency.

The reason for the increase in yield with the increase in the extraction time can be due to the increase in the time required for the complete release of pectin into the acidic solution [17]. Also, the results showed that the efficiency of extracting pectin from the skin of Mashhad melon is higher compared to the winter variety. Bagherian et al. (2011) obtained similar results in the field of pectin extraction from grapefruit and Li et al. (2012) also obtained similar results in the field of pectin extraction from sugar beet pulp [18 & 11]. Bahramipour et al. (2018) also obtained similar results in the extraction of pectin from pea pods, in which the extraction efficiency increased by increasing the extraction time from 1 minute to 4 minutes. So that in optimal conditions (power 600 watts, time 4 minutes and pH equal to 1), the extraction efficiency was predicted to be around 17/1 [3].

By comparing the results of this research with other researches, it can be said that the production efficiency of pectin obtained from the peel of Winter and Mashhad melon is significantly lower than the pectin obtained from the peel of watermelon (as another member of the pumpkin family), because the results of Maran et al.'s research (2014) who extracted pectin from watermelon skin using microwaves, show that the efficiency of extracting pectin from this product under conditions of microwave power extraction of 477 watts, irradiation time of 128 seconds, ratio of liquid to the solid is 20 to 3 by weight / volume and the pH is equal to 1/52, about 25/53% [19].

3-2- Galacturonic acid content

Figure (2) shows the effect of melon variety treatment on the amount of galacturonic acid. As can be seen, the highest content of galacturonic acid related to Mashhad melon in extraction conditions (power of 900 watts and duration of 3 minutes) is equal to 72/3% and the lowest amount of galacturonic acid related to Winter melon in extraction conditions (power of 900 watts and duration of 1 minute) is equal to the value of 68/1%.

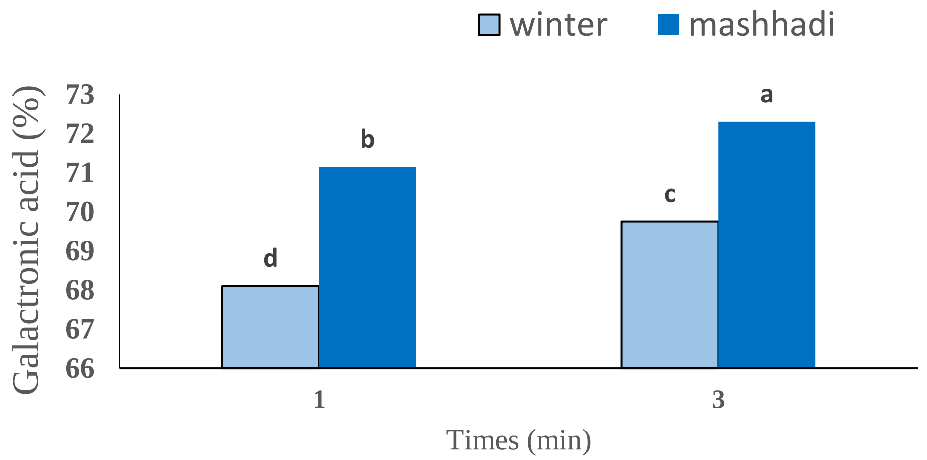

Fig 2. The effect of melon variety treatment on the amount of galacturonic acid.

According to the results, the amount of galacturonic acid has increased with the increase of extraction time in both Winter and Mashhad melon varieties. In fact, the reason why the galacturonic acid content of pectin extract increases with time is related to the separation of non- pectin compounds, because other cell wall polysaccharides such as cellulose, hemicellulose, araban and galactans are also extracted. Another reason for the increase in galacturonic acid content of pectin extract over time is the increase in the hydrolysis of the side chains of neutral sugars belonging to the structure of pectin. These side chains, which are a part of the pectin structure and are covalently connected to its linear chain, are mainly composed of arabinan and galactan in the rhamnogalacturonan 1 region, and 4 side chains with 11 different types of sugars are attached to the rhamnogalacturonan 2 region, including Opium has been replaced. As the extraction time increases, these side chains are further separated [8].

Nateghi (2020) obtained similar results in the extraction of pectin from aloe vera leaves. Various factors are effective on the content of galacturonic acid, the most important of which is the source of pectin and extraction conditions. In the conditions of extraction using the usual method (temperature, time and pH), at low pH, high temperatures and long times, a higher percentage of galacturonic acid is obtained [20]. Pectins are all characterized by a high amount of galacturonic acid, and according to the Food and Agriculture

Organization of the United Nations (FAO) and the European Union (EU), pectin should contain at least 65% galacturonic acid [21].

By examining the results of the galacturonic acid content, it can be stated that the galacturonic acid percentage of all pectins extracted from the skin of Winter and Mashhad melons is higher than 65%, so the pectins obtained are in accordance with the statutes of the Food and Agriculture Organization of the United Nations (FAO) and European Union (EU) conform. Also, by comparing the results of this research with commercial sources of pectin, it can be said that the galacturonic acid content of pectin extracted from Winter and Mashhad melon treatments was almost similar to sugar beet pomace (60/2- 77/8%) and apple (about 73/8%) [22].

Hosseini et al. (2015) also obtained similar results in the extraction of pectin from the peel of pineapple, samsuri and galia melons using microwaves. Based on the results of this research, the content of galacturonic acid in the skin of pineapple, samsuri and galia was found to be 66/53, 75/07 and 69/89%, respectively, and all of them had more than 65% of galacturonic acid [9].

3-3- Degree of esterification

Figure (3) shows the effect of melon variety treatment on the degree of esterification. As can be seen, with the increase of extraction time in both melon varieties, the degree of esterification has decreased. The highest degree of esterification is related to Winter melon in extraction conditions (power of 900 watts and duration of 1 minute) and the lowest degree of esterification is related to Mashhad melon in extraction conditions (power of 900 watts and duration of 3 minutes), which is the reason for the decrease in degree of esterification due to the increase in the extraction time is due to the separation of the ester (de-esterification) from the galacturonic acid chains [23].

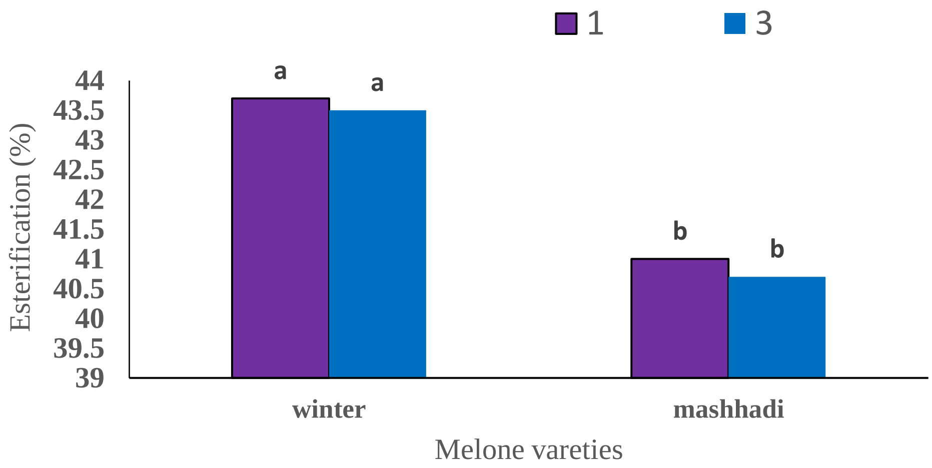

Fig 3. The effect of melon variety treatment on the degree of esterification.

The degree of esterification is one of the most important parameters determining the use of pectin. Pectins are divided into two categories: low ester with less than 50% esterification and high ester with high esterification [24]. The results showed that the degree of esterification of pectins obtained from the treatment of Winter and Mashhad melon skin is less than 50% and these treatments are classified as low ester pectins. Therefore, these pectins create a gel without the presence of sugar or in the presence of a small amount of sugar and in a wide range of pH (2-6), but the presence of divalent ions, such as calcium, is necessary for this purpose. Habibpour et al. (2021) also reached similar results in the extraction of pectin from bean pods, that with the increase in the extraction time, the degree of esterification decreased and according to the results, bean pod pectin was placed in the low ester category, which can be used in low- calorie products such as diet gels, low-calorie jams and jelly milk products [25]. Emaga et al. (2008), in extracting pectin from banana skin, concluded that in addition to the effect of pH and temperature, increasing the extraction time also decreases the amount of methoxyl pectin [26].

In another study, Liu et al. (2010) who investigated the degree of esterification of pectin obtained from the skin of mulberry branches (as a non-commercial source of pectin), reported that the pectin obtained from the skin of mulberry branches with epidermis had a degree of esterification of less than 50% (about 24/27%) and similar to the results obtained from the skin of Winter and Mashhad melon, it is classified in the group of low ester pectins [27].

3-4- Equivalent weight

Figure (4) shows the effect of melon variety treatment on dextrose equivalent weight. As can be seen, the highest equivalent weight of pectin obtained from Mashhad melon in the extraction conditions (power of 900 watts and duration of 3 minutes) is 890 mg, and the lowest equivalent weight of the pectin of Winter melon in the extraction conditions (power of 900 watts and duration of 1 minute) is 830 mg.

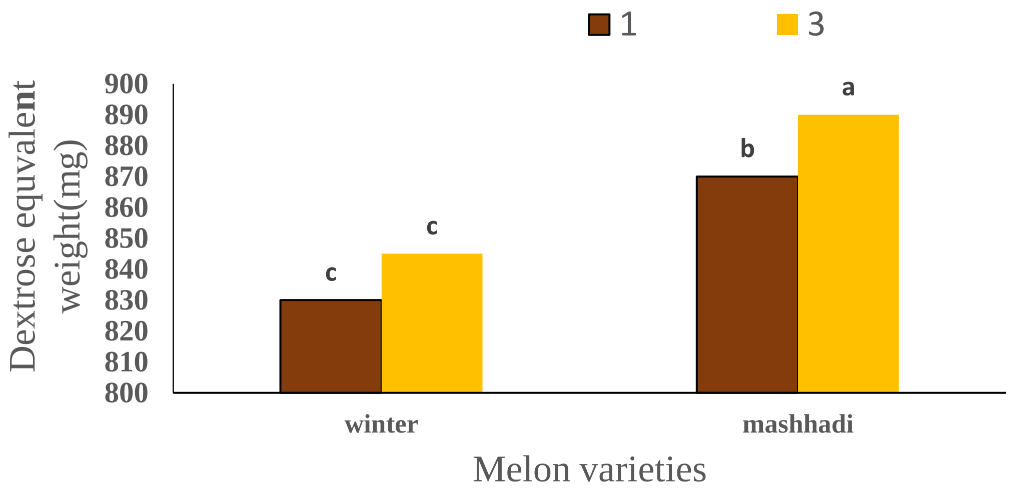

Fig 4. Effect of melon variety treatment on dextrose equivalent weight.

Jamshidian et al. (2021) obtained similar results in the extraction of pectin from apple waste, and the equivalent weight of dextrose in this study was 909 mg [13]. Siddiqui et al. (2021) also reached similar results in extracting pectin from sweet lime peel and declared the dextrose equivalent weight to be 740/3 mg [28]. Jibon Kumar et al. (2022) also reported similar results in extracting pectin from mango skin, and in this study, the equivalent weight varied from 450/45 to 1324/24 mg [29].

3-5- Emulsifying activity

Figure (5) shows the effect of melon variety treatment on the amount of emulsifying activity. As can be seen, the highest amount of emulsifying activity in the treatments of the Winter variety was related to pectin extracted in 3 minutes, which is equal to 11/48%. Also, the highest amount of emulsifying activity in the treatments of Mashhad variety is related to pectin extracted in 3 minutes, which was equal to 18/25%.

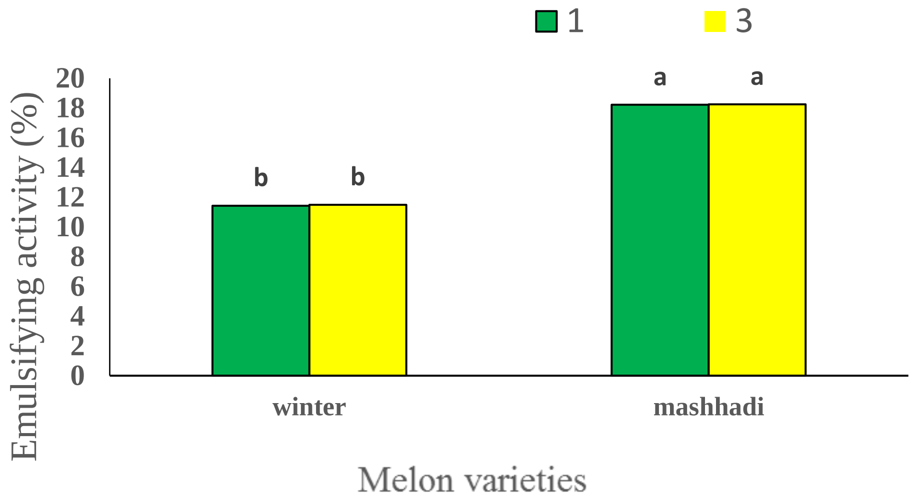

Fig 5. The effect of melon variety treatment on emulsifying activity

Oil and water are two immiscible liquids, emulsifier compounds are used to create a homogeneous emulsion of these two liquids. If the interfacial tension between oil and water is high, a stable emulsion is difficult to form. By reducing the interfacial tension, emulsifiers prevent the accumulation and cohesion of dispersed phase particles and lead to an increase in the stability of the emulsion system [30].

By adsorbing at the interface of the phases around the dispersed particles, pectin forms a coating and leads to electrostatic repulsion, or by increasing the viscosity of the aqueous phase, it stabilizes the emulsion. Many factors are effective in the emulsifying activity of pectin, low molecular weight is one of the most important factors, this factor is also affected by extraction conditions such as temperature and extraction time [31].

Hosseini et al. (2015) reported similar results in the extraction of pectin from the peel of pineapple, samsuri, and galia melons, and in this study, the emulsifying activity was 8/17, 11/67 and 35/67%, respectively. According to the obtained results, the pectin obtained from Mashhad melon treatments is similar to samsuri melon in the terms of emulsifying activity [9]. Hoa et al. (2019) also reached similar results in the extraction of pectin from Vietnamese mango skin, and in this research, the amount of emulsifying activity was 11/8 to 34/2% [32].

3-6- Water storage capacity

Figure (6) shows the effect of melon variety treatment on water holding capacity. As can be seen, the highest amount of water holding capacity related to pectin extracted from Mashhad melon in extraction conditions (power 900 watts and duration 3 minutes) is equal to 7/01 grams and the lowest amount of water holding capacity related to pectin extracted from Winter melon is in extraction conditions (power 900 watts and duration 1 minute), which is equal to the amount of 4 grams.

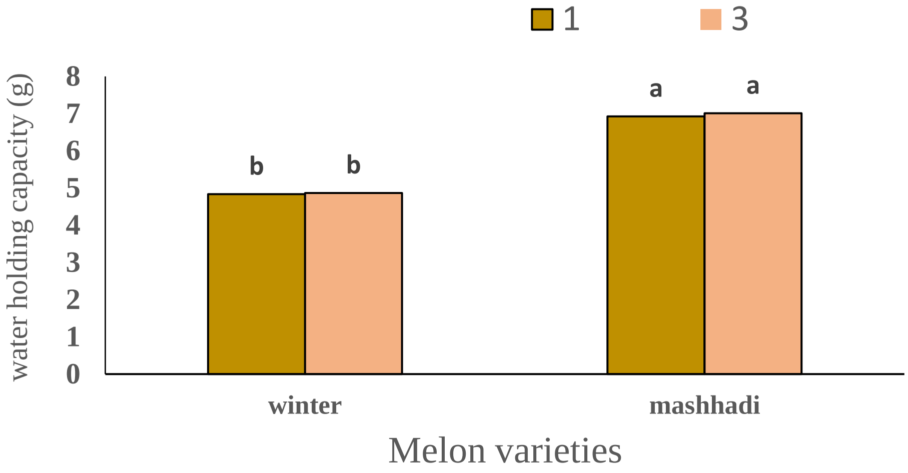

Fig 6. The effect of melon cultivar treatment on water retention capacity.

Various external and internal factors such as the amount of free hydroxyl groups in the chemical structure, pectin porosity, extraction method and pH can affect the water holding capacity [33].

In fact, pectin with higher water holding capacity can be used to retain water and improve sensory properties in food systems (such as yogurt) [7]. Akbari Adergani et al. (2020), in the extraction of pectin from pomegranate peel, reached similar results that in this research, the water retention capacity of pomegranate peel was 3/86 grams per gram of extracted pectin [34]. Rezaei et al. (2020) also reported similar results in the extraction of pectin from unriped grape pomace using citric acid and declared the water holding capacity to be 6/7 ± 0/2 (gram water/gram pectin). According to this result, the water retention capacity of unriped grape pomace is similar to the result obtained from Mashhad melon pectin [7].

4- Total resulting

According to the results of this research, the highest extraction efficiency of Mashhad melon was obtained in a period of 3 minutes, equal to 13/5%. Investigations showed that by increasing the time from 1 minute to 3 minutes, the extraction efficiency increased in both melon cultivars, and the extraction efficiency of pectin from the skin of Mashhad melon was higher compared to the Winter cultivar. The galacturonic acid content of all the treatments extracted from the skin of Winter and Mashhad melon was also higher than 65%, which indicates the high degree of purity of the extracted pectins.

The degree of esterification of all treatments was less than 50%. Therefore, all pectins extracted from Winter and Mashhad varieties are in the low ester category, and they can be used to produce low-sugar products such as jellies and low-calorie gams. The highest equivalent weight was related to the pectin obtained from Mashhad melon treatments during 3 and 1 minutes, which were 890 and 870 mg, respectively. Among the treatments, the highest emulsifying activity was related to pectin obtained from Mashhadi melon in a period of 3 minutes (18/25%). In general, the emulsifying activity of the pectins obtained from the treatments of the Mashhad variety was higher compared to the Winter variety. Also the highest amount of water retention capacity was related to pectin obtained from Mashhad melon, which was obtained in 3 minutes equal to the amount of 7/01 grams. According to the results, the pectin obtained from the treatments of the Mashhad cultivar had a higher water holding capacity than the Winter cultivar. In general, all the pectins obtained from this research can be used to preserve water in some food systems such as yogurt.

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بررسی استخراج پکتین از پوست خربزه رقم‌های زمستانه و مشهدی(قصری) با استفاده از پیش تیمار مایکروویو

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چکیده

این پژوهش به منظور استخراج مواد با ارزش و پر کاربرد در صنایع غذایی و دارویی از ضایعات محصولات کشاورزی انجام شد. در این پژوهش که با هدف استخراج پکتین از پوست خربزه رقم های زمستانه و مشهدی(قصری) به روش اسیدی با استفاده از پیش تیمار مایکروویو انجام شد، پکتین تحت شرایط مایکروویو (توان ثابت ۹۰۰ وات)، زمان پرتودهی(۱ و ۳ دقیقه) و نسبت حلال استخراج به ماده اولیه ۱۵:۱ وزنی/حجمی و در pH ثابت ۱/۵ ثابت، استخراج شد. نتایج نشان داد که بیشترین راندمان استخراج مربوط به خربزه مشهدی در شرایط استخراج(توان ۹۰۰ وات و مدت زمان ۳ دقیقه) برابر با مقدار ۱۳/۵ درصد بود و با افزایش مدت زمان از ۱ به ۳ دقیقه، راندمان استخراج پکتین، در هر دو رقم خربزه افزایش یافت. همچنین پکتین حاصل از تمامی تیمارها، دارای درجه خلوص مطلوبی(با محتوی گالاکتورونیک اسید بالای ٦٥ درصد)بود. بررسی درجه استریفیکاسیون مشخص کرد که پکتین حاصل از همه تیمارهای خربزه‌ی زمستانه و مشهدی، جزء پکتین‌های با درجه استری پایین می‌باشند. بیشترین وزن معادل نیز مربوط به پکتین حاصل از خربزه مشهدی در شرایط استخراج(توان ۹۰۰ وات و مدت زمان ۳ دقیقه) بود که برابر با مقدار ۸۹۰ میلی‌گرم به‌دست آمد.فعالیت امولسیفایری پکتین‌های حاصل از هر دو رقم خربزه نیز پایین بود. هم‌چنین میزان ظرفیت نگهداری آب پکتین‌های حاصل از تمام تیمارهای خربزه‌ی زمستانه و مشهدی در حد مطلوبی بود و نشان داد که پکتین‌های حاصل از این پژوهش، می‌تواند جهت حفظ آب در برخی سیستم‌های غذایی، مورد استفاده قرار گیرد. از مجموع موارد فوق می‌توان نتیجه گرفت که از پوست خربزه رقم‌های زمستانه و مشهدی که جزء ضایعات کشاورزی به شمار می‌رود، می‌توان به عنوان یک منبع نوید بخش در تولید پکتین استفاده نمود.