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SOME VEGETABLE AND FRUIT WASTES AS ADDITIONAL SOURCE OF USED PECTIN IN JELLIES AND JAMS PREPARATION

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ABSTRACT

This study was conducted to evaluate some fresh and dried vegetable and fruit wastes for their pectins. Three different extraction methods of pectins were used. The effect of extracted pectins on jellies and jams characteristics was also studied. The best extractant agent for the pectin extraction from grapefruit peel was 0.05 M HCl, while 0.4% ammonium oxalate was the best extractant agent for watermelon peel and carrot pomace. Yields and recovery of fiber pectin extracted by acidified ethanol were higher than pectins extracted by HCl or ammonium oxalate for all investigated wastes. It was also characterized by the highest moisture, ash and protein contents. Anhydrogalacturonic acid (AGA) and methoxyl content (MC) were found to be lower in fiber pectin than that in classical extracted pectins. A noticeable lower degree of esterification (DE) occurred in extracted pectin from dried watermelon peel. pH value of 0.5% pectin solution prepared from all extracted pectins ranged from 3.0 to 5.1 . The extracted fiber pectins by acidified ethanol of all tested wastes were characterized by higher relative viscosity, specific viscosity, intrinsic viscosity and setting time than those extracted by the other extraction methods. Color of extracted pectins varied from beige for grapefruit and watermelon peels to deep beige for dried carrot pomace. Viscosities of extracted pectins from fresh wastes were higher than those extracted from dried wastes. The jellies prepared by using pectin or fiber pectin from watermelon peels showed lowest values of all investigated organolibtic attributes. The ideal consistency for apricot jam was found by using 0.4 and 0.3% of extracted pectin or fiber pectin from fresh or dried carrot pomace and grapefruit peel, respectively. Viscosity of apricot jam was increased as storage period increased in all investigated pectin samples.

INTRODUCTION

Pectins are used in many food products as stabilizers, thickeners and gelling agents, which nowadays is an indispensable component of a great variety of products in either the food industry, where it is used in the production of jams, jellies, marmalades, preserves, confectionery articles, baked and dairy products or in the nonfood industry such as in cosmetics and pharmaceutics, where pectin has in recent years gained increasingly in importance.

Pectin is a group designation for complex plant polysaccharides in which D-galacturonic acid esterified to various extents with methanol is the main component and coupled by $\alpha(1\text{-}4)$ glucosidic links (Doesburg, 1965). The elaborate structure of pectin is summarized by Rolin and De Vries (1990). The annual worldwide production of purified pectin is approximately 10000 metric tones of which more than the half is produced from citrus wastes (Crandall and Wicker, 1986). Apple pomace (the dried residue of apple after juice extraction) constitutes the second most important source of pectins. The pectin content of citrus peel is usually high , 25-30% of the dried peel mass (Salem, 1964; Huong and Luyen, 1989 and Baker, 1997). An appreciable amounts of pectic substances (10-31%) were reported to be

found in different substances as sugar beet (Phatak *et al.*, 1988); lime (Siliha, 1993); onion (Ismail *et al.*, 1995); carrot, beans and sweet potatoes (Baker, 1997); prickly pear, apple and pomegranate (Laban, 1998). Increasing demands on pectin in the fields of food and pharmaceutical industries, in addition to the extortionate price of the imported types, justified their attain from some available agriculture residues (Braddok and Cadwallader, 1992).

A number of methods for pectin extraction have been reviewed by Doesburg (1965) and Potter (1966) divided the preparation of all pectins into three principal steps : 1) Solubilization and extraction of the pectin by heating in a weak acid solution, 2) Clarification and concentration of the pectin extract, 3) Precipitation, washing, drying and finally standardizing the pectin.

The type of acid and other conditions of temperature time, pH and ratio of water to peel used during extraction step vary greatly among various researchers. Different acids have been used for pectin extraction, such as hydrochloric acid (May, 1990), Sulfuric acid (De Lucca and Joslyn, 1957) and nitric acid (Aravantions Zafiris and Oreoppoulous, 1992). Kausar and Anomura (1980) reported that the most suitable conditions of time, temperature and pH to get maximum pectin yield were pH 1.6 at 95°C for 60 min with a water to pomace ratio of 60:1. A ratio of water to dry orange peel of 70:1 at 90°C for 2 hrs with pH value 1.7 was recommended by El-Nawawi and Shehata (1987). Recently, Ismail *et al.*, (1995) extracted the pectin from some wastes by using a HCl or ammonium oxalate in a ratio 1 waste to 30 water as extracting agent at 90°C for 1.5 hrs with 1.5 pH value. High methoxyl pectins, with a degree of esterification (DE) above 50% can be used as gelling agents in a limited range of products such as jams and jellies, as they require high acidity (below pH3) and low water activity (high soluble solids such as sugar) to form a gel. Commercially low methoxyl pectins, with a DE below 50%, are produced from high methoxyl pectins extracted from citrus peels and apple pomace. These low methoxyl pectins gel in the presence of multivalent cations (usually calcium) at acid and neutral pH and can therefore, be used in a wide range of products (Glicksman, 1979).

The purpose of this study was to characterize some fresh and dry vegetable and fruit wastes as an additional source of pectins and evaluate their effects on the pectin yield and quality as well as on physico-chemical characteristics and technological properties of the extracted pectin. The effect of extracted pectin on jellies and jam organoleptic characteristics was also studied.

MATERIALS AND METHODS

Watermelon (*Citrallus colocynthoides*) peels as by-products during production the seeds were obtained from private farms in Nobaria, Egypt.

(1) Carrot (*Daucus carrota*) pomace in fresh state was obtained from El-Nasr company of preserved food (Kaha, Kalubia, Egypt) .

(2) Grapefruit (*Citrus paradisi*) peels as by-product during production the fresh juice were obtained from Daltex company, Kafr El-Zaiat, Egypt.

Watermelon peels and carrot pomace were exposed to steam blanching for 15 min, to inactivate native pectic enzymes, then dried at 50°C in an fan oven (until ~ 9% moisture content). While, the grapefruit peels were

mashed in a Braun-meat mincer, then subjected to leach hot-water (one part of peel and three parts of water) at 80ºC for 15 min to inactivate native pectic enzymes. The leached mash was cooled by dipping in cold water to remove the soluble solids and flavenoids, allowed to drain and pressed to remove excess water, then dried at 50°C (until ~ 7% moisture content). The dried wastes were ground to fine powder using a hammer mill (Arslan and Togrul, 1996).

Extraction and precipitation of pectin:

Three different extraction methods were used for pectin extraction from fresh and dried used wastes as follow:

(1) The first method is the classical hot-acid hydrolysis.The wastes were extracted by 0.05M *HCl* (the ratio was 1:3 *w/v and 1:30 w/v for fresh and dry* wastes, respectively) and pH value was adjusted to ~ 1.6 with concentrated HCl at 90ºC for 2hours. Then slurry was rapidly filtered through cheese cloth and the pectin was precipitated by using ethanol 96% in a ratio of 1:1 (v/v). Pectins were filtered from the precipitated media through 3 layers of muclin cloth, washed with ethanol 70%, acetone and dried at room temperature *(Huang,* 1973 and Ismail *et al.,* 1995).

(2) The second method of extraction is ammonium oxalate method. The process in this method was done as in the first, but the extracting agent was 0.4% ammonium oxalate instead of 0.05 M HCl. Also, all conditions were as the same first method (Ismail *et al.,* 1995 and El-Zoghbi *et al.,* 1998).

(3) The third method was done by using acidified ethanol as an extraction solution, instead of acidified water. The fresh and dry wastes were extracted by acidified ethanol 96% (the ratio was 1:2 and 1:10 w/v respectively, and pH was adjusted to ~ 1.6 with concentrated HCl) at 60ºC for 2 hours. The slurry was cooled in tap water, incubated for 20 hours at 40ºC and filtered through 3 layers of muclin cloth. The residues were washed with ethanol 70% and acetone, then dried at room temperature. The produced pectin from this method was called fiber pectin (Siliha, 1993). The dry material was milled in a *Moulinex mill to a particle size less than 0.7 mm.*

Pectin yield and recovery :

The yield and recovery of watermelon, carrot and grapefruit pectin extracted by different methods were calculated on dry basis as gm pectin/100 gm dry material using the following formula (Zahran, 1993):

$$\textbf{Pectin yield (\%)} = \frac{Amount\ of\ Produced\ pectin}{Amount\ of\ dry\ waste\ material} X\ 100$$

$$\textbf{Pectin recovery (\%)} = \left[\frac{Amount\ of\ Produced\ pectin}{Pectin\ on\ dry\ waste\ material} X\ 100\right]$$

Analytical Methods :

Moisture, ash and protein contents as well as pH values were *determined according to the methods recommended by the* A.O.A.C. (1990).

Anhydrogalacturonic acid (AGA, Mw: 176) content was determined according to the method of Ahmed and Labavitch (1977). The degree of

esterification (DE), jelly grade, jelly units and setting time were determined according to the method described by Ranganna (1978). Total neutral sugars of extracted pectins were determined according to the method of Smith *et al.*, (1956). Methoxyl content was determined according to the method of Ranganna (1986).

The relative viscosity, specific viscosity, intrinsic viscosity and molecular weight of pectin were calculated as in the following equations according to the described by Owens *et al.*, (1946):

$$\text{Relative viscosity } (\varsigma_r) = \frac{Flow\ rate\ of\ sample}{Flow\ rate\ of\ solvent}$$

Specific viscosity (ς_s) = ς_r -1

$$\text{Intrinsic viscosity } (\varsigma) = \frac{Specific\ viscosity\ (\eta_s)}{Concentration\ of\ pectin\ solution}$$

Intrinsic viscosity (ς)= $1.4 \times 10^{-6}\ Mw^{1.34}$

$$\text{Log Mw} = \frac{Log(\eta) - Log\,1.4 + 6}{1.34}$$

Viscosity measurements were carried out by using a Lab-Line Instruments, Inc., Model 4537 Viscometer (Spindle 3, 60 rpm).

Technological properties :

(1) Jelly preparation :

Sugar was added to apricot juice in a ratio of 45:55 (w/w). Then 0.5% standard pectin (citrus pectin, DE 75%, Copenhagen Pectin Company, Denmark), or extracted pectin, and 0.2% citric acid were added. Pectin was added on mixture weight basis after it was dry-mixed with five times as much sugar, where as citric acid was added on sugar weight basis. Mixture was stirred until dissolved and brought to boiling until a total soluble solids 65% was obtained. Finally, jellies were poured into glass containers and chilled for several hours until set (Hulme, 1970 and Ismail *et al.*, 1995). The overall acceptability of jelly samples prepared from the extracted pectin samples in comparison to a control sample prepared from pure (standard) pectin was evaluated according to the numerical scoring test described by Kramer and Twigg (1962). Ten judges were asked to indicate the best jelly samples according to their quality attributed.

(2) Jam preparation :

One kilogram of fresh destones apricot was added in 3 L preserving pan and one kilogram of sugar was added. The mixture stirred while heating when the temperature reached 60ºC, the pectin with concentration 0.2, 0.3, 0.4 and 0.5% (diluted in 50 ml of mixture) was added. 0.2% citric acid was added as soon as the mixture reached 62-65º Brix. Heating was stopped at 68º Brix and the processed jam was immediately poured in 370 gm jars. The obtained jams after cooling to room temperature had a final pH 3.1 and 68º Brix. The consistency of jams was determined organoleptically according to (Guichard *et al.*, 1991 and Ghazy, 1993).

RESULTS AND DISCUSSION

Yield and recovery of extracted pectin :

Three different pectins were extracted from each waste (fresh or dry). The first pectin preparation was extracted by classical hot-acid hydrolysis from watermelon, carrot and grapefruit wastes. The second type of pectin was extracted by hot-ammonium oxalate hydrolysis from each wastes. The third type of pectin (Fiber pectin) was extracted by acidified ethanol. The data recorded in Table (1) revealed that the efficiency of pectin extraction from the investigated wastes differed according to the kined of waste, extractant agent and drying process.

Data in this table proved that 0.05M HCl was found to have the best extractant agent for grapefruit pectin. Meanwhile, 0.4% ammonium oxalate was the best extractant agent for the pectin extraction from watermelon peel and carrot pomace. From the same table, it could be noticed that the yield and recovery of extracted pectins from fresh and dried grapefruit peels by 0.05M HCl were 25.25 and 86.4% as well as 26.55 and 90.90%, respectively. On the other hand, the yield of extracted pectins from fresh and dried watermelon peel and carrot pomace by 0.4% ammonium oxalate were 21.90 and 21.08% as well as 17.24 and 16.57%, respectively. The recovery for the same wastes were 89.80, 86 40, 79.70 and 76.60%, respectively .

Table (1): Efficiency of investigated extraction methods on pectins extracted from some fresh and dried vegetable and fruit wastes.

Waste Materials		Extraction Methods					
		(1)		(2)		(3)	
		F.S	D.S	F.S	D.S	F.S	D.S
Watermelon peels	A	4.04	3.65	21.90	21.08	55.89	54.05
	B*	16.60	15.00	89.80	86.40	-	-
Carrot pomace	A	10.20	10.05	17.24	16.57	51.85	50.10
	B*	47.20	46.50	79.70	76.60	-	-
Grapefruit peels	A	25.25	26.55	4.21	4.95	58.45	60.40
	B*	86.40	90.90	14.40	16.90	-	-

1- **First method: 0.05 M HCl, pH 1.6, 90°C for 2 hrs.**
F.S.: Fresh state. A: Pectin yield (%).

2- **Second method: 0.4% ammonium oxalate, pH 1.6, 90°C for 2 hrs.**
D.S: Dried state. B: Pectin recovery (%).

3- **Third method: Acidifled ethanol 96%, pH1.6, 60°C for 2hrs (Fiber pectin).**

* **Pectin content in raw wastes was 24.39, 21.63 and 29.22% for watermelon, carrot and grapefruit respectively on dry basis.**

In contrary, yields and recovery of fiber pectin extracted by acidified ethanol were higher than pectins extracted by HCl or ammonium oxalate for all investigated wastes. This may be due to the other dietary fibers i.e. cellulose and hemicellulose were extracted with the pectin (Baker, 1997).

Chemical characteristics of extracted pectin and fiber pectin :

Table(2) represents the composition of the extracted pectin and fiber pectin. Fiber pectin was characterized by the highest moisture, ash and protein content, while the lowest figures were found in pectin extracted by hot- HCl acid or hot-ammonium oxalate methods extracted from dry wastes (Table 2). Anhydrogalacturonic acid (AGA) content and methoxyl content (MC) were found to be lower in fiber pectin than that in classical extracted

pectins. This is due to the fact that fiber pectin contains, in addition to the solubilized pectin, all the fiber material of wastes, such as cellulose and hemicellulose. The results are in accordance with those reported by Siliha (1993) and Laban (1998). The degree of esterification (DE %) of the pectin preparations showed an interesting pattern. Fiber pectin showed the highest DE, being 80.73% in dreid grapefruit peel, while pectin extracted from dried watermelon peel was characterized by the lowest DE, being 19.12%.

Table (2) : Chemical characteristics of pectin and fiber pectin extracted from different fresh and dried wastes.

Chemical characteristics	Waste Materials											
	Watermelon Peels				Carrot Pomace				Grapefruit Peels			
	F.S		D.S		F.S		D.S		F.S		D.S	
	P^a	F.P	P^b	F.P	P^a	F.P	P^a	F.P	P^a	F.P	P^a	FP
Moisture (%)	7.11	8.63	5.70	8.50	8.44	9.10	7.45	8.41	6.02	8.89	5.95	7.85
Ash (%)	1.98	2.96	1.75	2.90	2.78	3.33	2.32	2.89	2.42	3.54	2.31	3.22
Protein (%)	3.39	4.27	2.68	4.01	3.49	4.21	2.75	3.96	3.34	4.49	3.25	4.15
Anhydrogalacturonic acid (AGA) (%)	70.65	34.65	76.30	36.60	68.84	33.50	72 78	35 89	79.25	37.14	78 60	39 45
Methoxyl content (%)	2.54	1.36	2.57	1.37	7.94	4.12	7.97	4.33	10.69	5.12	10.50	5.61
Degree of esterification (%)	20.41	22.28	19.12	21.25	65.48	69.82	62.17	68.50	76.58	78.27	75.84	80.73
Total neutral sugars (%)	15.22	47.59	12.40	46.90	14.65	48.73	12.95	47.11	7.90	44.29	8.58	43.45
pH value *	4.22	4.60	4.44	5.03	4.50	4.90	4.64	5.10	3.00	3.45	3.11	3.70
Yield as 100% AGA	15.50	19.50	16.20	19.80	11.90	17.40	12.10	18.00	20.00	21.70	20.90	23.80

F.S : Fresh state . D.S: Dried state. F.P: Fiber pectin.

(P^a) : Pectin extracted by 0.05M HCl, pH 1.6 at 90°C for 2 hrs.

(P^b) : Pectin extracted by 0.4% ammonium oxalate, pH 1.6 at 90°C for 2 hrs.

*** Measured in 0.5% pectin solution.**

This can be explained by the mild conditions of extraction used during the preparation of fiber pectin (20 hours at 40°C) compared to that employed in hot-acid hydrolysis (2 hours at 90°C). Partial demethylation of pectin molecule occure during acid hydrolysis to convert protopectin into soluble pectin (Potter, 1966). Furthermore, the watermelon pectin was characterized by the lower DE% than that from other investigated wastes (19.12 to 22.28%) followed by carrot pomace pectin (62.17 to 69.82%) and grapefruit peel pectin (75.84 to 80.73%). On the other hand, the methoxyl content was the highest in grapefruit peel pectin, being 10.69 and 10.50% in fresh and dried peel pectin respectively, which found to affect pectin solubility and its jelling properties comparing to those of watermelon wastes (2.54-2.57%). Ranganna (1978) reported that high methoxyl pectin (HMP) contained 10.5% or more MC (DE= 70% or more) while low methoxyl pectin (LMP) contained below 7.0% MC (DE= 50% or below).

The pH value of 0.5% pectin solution prepared from all extracted pectin ranged from 3.0 to 5.1. Specification of commercial consideration refer that pH of pectin (1% solution in distilled water at 20°C) ranged from 4.0-4.6 (OBI Pectinag, 1984). As expected. total neutral sugar content was the highest in fiber pectin due to the high level of cellulose and hemicellulose. These results are agreement with those obtained by El-Zoghbi *et al.*, (1998). Although the highest yield was obtained from fiber pectin (Table 1), it is essential to mention that this is not pure pectin as the other pectin. Therefore, a comparison based on absolute yield between fiber pectin and other pectin

is not justified. When the yield is calculated on the basis of 100% AGA, the highest yield was found in fiber pectin.

Physical characteristics of extracted pectin and fiber pectin:

Some physical characteristics of extracted pectin and fiber pectin are shown in Table (3). From these results it could be noticed that the fiber pectins of all investigated wastes were characterized by higher relative viscosity, specific viscosity, intrinsic viscosity and setting time than those extracted by the other methods. The highest molecular weight (Mw) was found in fiber pectin. Pectin extracted from fresh wastes was characterized by higher Mw than that extracted from dried wastes. This is in accordance with the data obtained by Crandall *et al.*, (1978), who found that pectin solutions made from dried peels had lower viscosity than those made from fresh peels.

Table (3) : Physical characteristics of pectin and fiber pectin extracted from different fresh and dried wastes.

Physical characteristics	Waste Materials											
	Watermelon Peels				Carrot Pomace				Grapefruit Peels			
	F.S		D.S		F.S		D.S		F.S		D.S	
	P^a	F.P	P^a	F.P	P^a	F.P	P^a	F.P	P^a	F.P	P^a	F.P
Relative viscosity *	1.129	1.167	1.097	1.133	1.194	1.233	1.188	1.200	1.355	1.419	1.300	1.378
Specific viscosity *	0.129	0.167	0.097	0.133	0.194	0.233	0.188	0.200	0.355	0.419	0.300	0.387
Intrinsic viscosity *	1.29	1.67	0.97	1.33	1.94	2.33	1.88	2.00	3.55	4.19	3.00	3.87
Molecular weight (Mw)	28255	34258	22840	28906	38312	43925	37425	39193	60142	68061	53042	64143
Jelly grade	120	105	129	110	136	105	145	112	250	140	259	149
Jelly units	26.30	-	27.20	-	23.50	-	24.00	-	63.10	-	68.8	-
Setting time (min)	31.0	33.0	30.0	32.0	30.0	32.0	30.0	31.0	25.0	26.0	23.0	25.0
Color	Beige	Beige	Beige	Beige	Beige	Beige	Deep beige	Deep ege	Beige	Beige	Beige	Beige

* **Measured in 0.1% pectin solution .** **Mw : Dalton.**

F.S : Fresh state. **D.S : Dried state.** **F.P : Fiber pectin.**

(P^a) : Pectin extracted by 0.05M HCl, pH 1.6 at 90°C for 2 hrs.

(P^b) : Pectin extracted by 0.4% ammonium oxalate, pH 1.6 at 90°C for 2 hrs.

Pectins extracted by classical method (hot-acid hydrolysis) were characterized by the highest jelly grade (250-259 for grapefruit peel pectin) while the lowest jelly grade was found in fiber pectin(105-110 for watermelon peel pectin). Jelly unit which is a measure of the amount of sugar that can be jelled by one unit of peel. It was not possible to calculate the jelly units for the fiber pectin because it is not a pure pectin. Grapefruit pectins possessed higher jelly units (63.10-68.8) compared to watermelon and carrot wastes (23.5-27.2). Rouse and Knorr (1970) reported that the numerical value of 60 or more jelly units indicates the commercial feasibility of raw pectic material for the manufacture of pectin. From the same table, it could be noticed that the color of extracted pectins varied from beige for grapefruit and watermelon peels to deep beige for dried carrot pomace.

Relationship between viscosity and concentration of extracted pectin and fiber pectin solutions :

From the results illustrated graphically in figures (1 and 2), it could be observed that aqueous solutions of pectins extracted from fresh and dried grapefruit peels possessed the highest viscosity followed by fresh and dried carrot pomace. Whereas, pectins of fresh and dried watermelon peels

showed the lowest viscosity at the same conditions. The data also showed that viscosity of extracted pectins from fresh wastes were higher than those extracted from dried wastes. Generally, the viscosity significantly increased as pectin concentration increased in all investigated pectin samples. These results were quite similar with the previously reported data of Miyamoto and Chang (1992). From the figures (1 and 2), the fiber pectins extracted from all investigated wastes showed a higher viscosities than those extracted by the classical methods. This due to high molecular weight of fiber pectins. Furthermore, fiber pectins of grapefruit peel and carrot pomace showed higher viscosity than that of watermelon peel. This is may be due to high Mw and DE% are found in the fiber pectins of grapefruit peel and carrot pomace.

Sensory evaluation of jellies prepared from extracted pectin and fiber pectin:

It is obvious from the results in figures 3 and 4 that the favorable jellies with the best quality attributes such as light, clear and uniform in color, better in taste and aroma representing, the natural flavour of fruits species which be used in its preparation (apricot), besides a good texture with sharp and smooth cut surface, were obtained by using pectin extracted from grapefruit peel followed by carrot pomace pectin.

On the contrary, the jellies prepared by using pectin or fiber pectin from watermelon peels showed lowest values of all investigated quality attributes. This may be attributed to the low methoxyl content of such pectin which in the presence of 60 mg Ca^{++}/g pectin, at acid and neutral pH can be used in a wide range of products (Glicksman, 1979). Crystallization was detected in few jelly samples prepared from watermelon peel pectin and fiber pectin. Also, a few jelly samples prepared from fiber pectin in all wastes showed non-smooth cut surface.

Concentration on the consistency of apricot jam:

Extracted pectin and fiber pectin were added at different concentrations (0.2, 0.3, 0.4 and 0.5%) to apricot jam in order to evaluate its consistency (Tables 4 and 5) . From data represented in these tables, it could be noticed that the ideal consistency for apricot jam was found by using 0.4% and 0.3% of extracted pectin or fiber pectin from fresh or dried carrot pomace and grapefruit peel respectively. It was also found that apricot jam showed the lowest consistency by using either pectin or fiber pectin from watermelon peels. This may be due to the low DE% of watermelon pectins.

Changes in viscosity of apricot jam during storage :

Viscosity is one of the important physical properities that affect the quality of jam. The addition pectin improve the texture of the jam. The flow time in seconds of the prepared jam and the changes taking place in such a property during storage is shown in Table (6). From the results in this table, it could be noticed that viscosity of apricot jam was increased as storage period increased in all investigated pectin samples. It was also noted that the addition of grapefruit peel pectins to apricot jam resulted the highest viscosity followed by jam with carrot pomace and watermelon peel pectins.

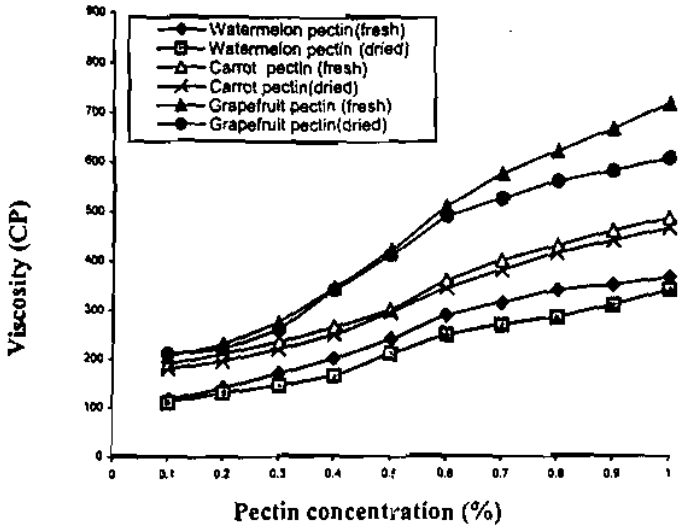

Fig. (1): Relationship between the viscosity and concentration of the extracted pectin solution (Temp.= 90°C , pH 3 and the time of heating =15 min).

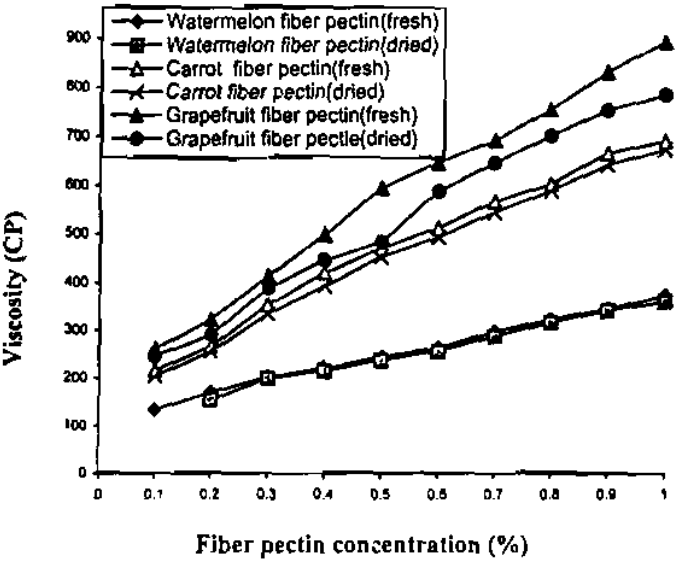

Fig. (2): Relationship between the viscosity and concentration of the extracted fiber pectin solution (Temp.= 90°C , pH 3 and the time of heating =15 min).

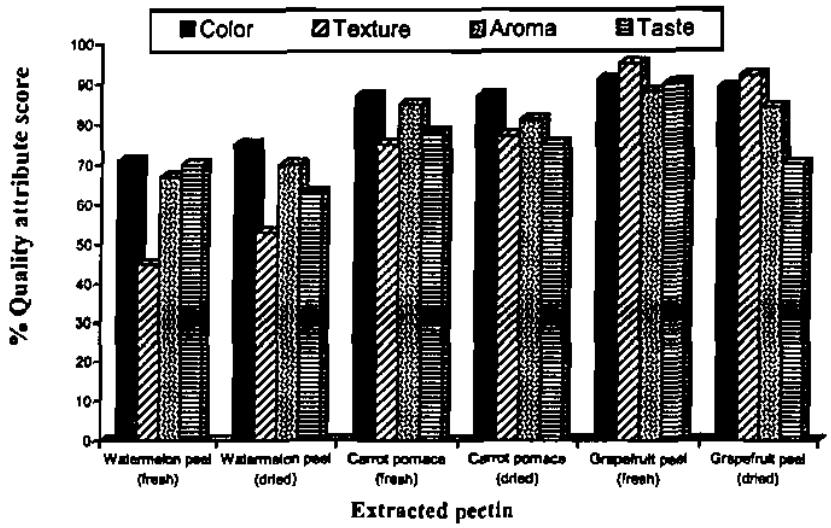

Fig. (3): Organoleptic evaluation of apricot jellies prepared by using 0.5% pectin extracted from wastes (as % of the standard jelly scores which prepared from commercial pectio).

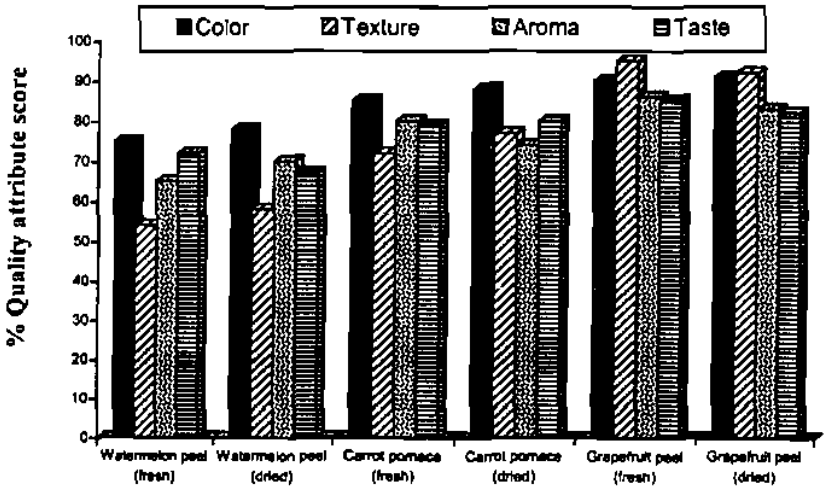

Fig. (4): Organoleptic evaluation of apricot jellies prepared by using 0.5% fiber pectin extracted from wastes (as % of the standard jelly scores which prepared from commercial pectin).

Table (4): Effect of extracted pectin concentration on the consistency of apricot jam.

Samples*	Control	Watermelon Peel						Carrot Pomace						Grapefruit Peel					
		Fresh			Dried			Fresh			Dried			Fresh			Dried		
		Extracted pectin level (%)																	
Texture	0.0	0.2	0.3	0.4	0.5	0.2	0.3	0.4	0.5	0.2	0.3	0.4	0.5	0.2	0.3	0.4	0.5	0.2	0.3	0.4	0.5
Very soft (20¹)	19.0	6.2	5.4	3.8	2.9	5.4	4.3	3.7	2.9	4.3	3.9	3.5	3.1	4.1	3.6	3.1	2.7	3.3	2.9	2.5	1.9	3.1	2.7	2.0	1.7
Just right (20¹)	3.2	11.1	12.9	14.2	13.1	12.5	14.5	14.1	13.0	15.3	16.9	16.9	17.5	14.5	16.2	18.8	16.5	16.9	19.0	18.1	17.0	16.5	18.9	18.0	16.7
Very hard (20¹)	0.6	3.5	4.4	6.2	11.5	3.8	4.5	6.5	12.1	3.0	7.1	9.2	18.0	2.9	7.4	8.1	17.9	4.1	10.4	15.2	19.1	3.9	9.9	14.0	17.4

* Mean scores of 10 panelists

Table (5): Effect of extracted fiber pectin concentration on the consistency of apricot jam.

Samples*	control	Watermelon Peel						Carrot Pomace						Grapefruit Peel					
		Fresh			Dried			Fresh			Dried			Fresh			Dried		
		Extracted pectin level (%)																	
Texture	0.0	0.2	0.3	0.4	0.5	0.2	0.3	0.4	0.5	0.2	0.3	0.4	0.5	0.2	0.3	0.4	0.5	0.2	0.3	0.4	0.5	0.2	0.3	0.4	0.5
Very soft (20¹)	19.1	4.1	3.2	2.8	2.5	5.1	4.0	3.4	2.4	5.0	3.8	3.4	2.8	4.5	3.6	3.1	2.5	2.8	2.2	1.9	1.4	2.5	2.0	1.2	1.0
Just right (20¹)	2.5	11.9	13.5	15.1	15.6	10.4	13.0	14.5	14.9	15.5	17.2	19.1	17.7	15.1	16.8	19.0	17.1	7.2	19.4	18.1	16.9	4.9	19.2	17.0	15.8
Very hard (20¹)	0.7	3.7	5.2	6.9	10.9	3.8	5.0	6.8	13.0	3.3	7.3	9.4	18.4	3.1	7.0	6.5	18.0	5.9	10.1	14.0	17.2	5.4	10.2	14.5	17.6

* Mean scores of 10 panelists

Table (6): Effect of storage period on viscosity (as flow time in seconds) of apricot jam.

Treatments		Watermelon peel						Carrot pomace						Grapefruit peel					
		Storage period in weeks																	
		Zero time	2	4	8	12	20	30	Zero time	2	4	8	12	20	30	Zero time	2	4	8	12	20	30
Commercial pectin		40	47	51	56	60	62	65	40	47	51	56	60	62	65	40	47	51	56	60	62	65
From fresh waste	P	25	33	36	41	46	49	55	30	33	37	40	43	46	51	36	42	46	51	55	57	62
	F P	21	25	28	33	37	40	42	25	31	35	37	41	42	45	28	34	39	42	47	50	54
From dry waste	P	24	32	35	40	44	47	52	28	31	36	39	42	45	49	34	40	44	48	52	53	57
	F P	20	25	27	32	35	39	40	23	29	33	35	40	41	42	27	33	37	41	45	49	50

P: pectin F.P: fiber pectin

This could be due to high DE. It was also noticed that jam prepared by the addition pectin from fresh waste, possessed the highest viscosity when compared with those from dry waste and fiber pectin. A gradual increase in the flow time in all samples during storage was observed. This could be due to some hydrolysis of the pectin and the formation of low methoxyl pectin during storage at room temperature. The above mentioned results were in close agreement with those previously reported by Rouse *et al.*, (1956).

Finally, it could be concluded that the investigated pectin could be used in food industries as thickeners, stabilizers and jelling agents.
Moreover, the recycling of such food industries wastes to produce fiber pectin by simple technology which sharply reduces the production costs especially in developing countries. The major difference between fiber pectin and purified pectin is the high content of fiber. However, health organizations nowadays recommended the consumption of increased amount of dietary fibers.

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بعض مخلفات الخضر والفاكهة كمصدر اضافى للبكتينات المستخدمة فـــى إعـداد الجيلى والمربى

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استهدفت هذه الدراسة تقييم بكتينات بعض مخلفات الخضر والفاكهـة الطازجـة والجافـة. فقـد استخدمت ثلاث طرق لاستخلاص البكتينات. كما درس تأثير هذه البكتينات المستخلصة على صفات الجـودة لكل من الجيلى والمربى. ولقد وجد أن استخدام ٠,٠٥ مولر حمض هيدروكلوريـك كـان أحسـن معـامل لاستخلاص البكتينات من قشور الجريب فروت بينما استخدام ٠,٤% أكسالات الأمونيوم كانت أحسن معـامل لاستخلاصها من قشور البطيخ ومخلفات الجزر. ولقد كانت نسبة الاسترجاع من بكتين الألياف المسـتخلص بالإيثانول المحمض أعلى من البكتين المستخلص بحامض الهيدروكلوريك او أكسالات الأمونيوم بالنسبة لكـل المخلفات المختبرة. كما أنه تميز بارتفاع نسبة الرطوبة والرماد ومحتوى البروتين بينما كان منخفـض فـي حمض الجلاكتيورونيك اللامائى (AGA) ومحتوى الميثوكسيل ودرجة تكوين الجيـل بالنسـبة للبكتينـات المستخلصة بالطرق التقليدية العادية. وقد ظهر انخفاض ملحـوظ فـي درجـة الأسـترة (DE) للبكتينـات المستخلصة من قشور البطيخ الطازج والجاف – وتراوح رقم الحموضة (pH) لمحلول ٠,٥% بكتيـن مـن ٣,٠-٥,١ فى جميع البكتينات المستخلصة.

وقد تميزت بكتينات الألياف المستخلصة بالإيثانول المحمض لجميع المخلفات المختـبرة بارتفـاع اللزوجة النسبية واللزوجة النوعية واللزوجة الحقيقية وفترة تكوين الجيل عنها فـي البكتينـات المسـتخلصة بواسطة الطرق الأخرى. ولقد كانت لزوجة البكتينات المستخلصة من المخلفات الطازجة أعلـى منـها فـي بكتينات المخلفات الجافة – وقد تراوح لون البكتينات المستخلصة مـن قشـور الجريـب فـروت والبطيـخ ومخلفات الجزر الجافة من البيج إلى البيج الغامق .

و قد أدي استخدام البكتين وبكتين الألياف المستخلص من قشور البطيخ فى صناعة جيلى المشمش إلي انخفاض فى جميع صفات الجودة الحسية بالمقارنة بالجيلى المجهز بالأنواع الأخرى. وقد وجد أن أحسـن قوام لمربى المشمش باستخدام ٠,٤، ٠,٣% من البكتين و بكتين الألياف المستخلص مـن مخلفـات الجـزر والجريب فروت الطازج والجاف على التوالى – كما تبين أن لزوجة مربى المشمش زادت مع زيـادة فـترة التخزين بالنسبة لجميع عينات البكتينات المختبرة.