World Applied Sciences Journal 8 (1): 21-24, 2010
ISSN 1818-4952

Extraction of Pectin from Sunflower Head Residues of Selected Iranian Cultivars

[1]J. Mohamadzadeh, [2]A.R. Sadeghi-Mahoonak, [3]M. Yaghbani and [2]M. Aalami

[1]Department of Food Science and Technology,
Ferdowsi University of Mashad, Mashad, I.R. Iran
[2]Department of Food Science and Technology,
Gorgan University of Agricultural Science and Natural Resources, Gorgan, I.R. Iran
[3]Department of Agricultural Engineering Research,
Agricultural and Natural Resources Research Center, Gorgan, I.R. Iran

Abstract: Pectin is a very precious material which has a great role in food and industries because of its ability to produce gel. One of the materials which used for production of pectin is sunflower head residue that is a potential natural source of low methoxyl pectin. In the present study head residue of five sunflower cultivars grown in Golestan province of Iran, including Golshid, Record, Gabor, Azargol and Progress were evaluated for pectin extraction. The pectin was extracted by using 0.75% sodium hexametaphosphate at pH 5, temperature 85°C for 20 min and then extraction yield, galacturonic acid content and the degree of esterification of pectin were evaluated. The results showed that the pectin extracted from Golshid and Record varieties had higher yields compared to other cultivars and their galacturonic acid content was 80.4 and 81.8%, respectively. Extracted pectin was low methoxyl type and esterification degree of pectin varied from 33.2 to 35.1%. However, there were no significant differences between degree of esterification in pectin extracted from different cultivars.

Key words: Sunflower head residue · Pectin extraction · Yield

INTRODUCTION

Pectic substances are complex mixtures of polysaccharides containing units of galacturonic acid as the main chain [1]. In this main chain, α-L-rhamnose units are occasionally inserted through glycosidic linkages and the carboxyl groups are partially esterified by methyl alcohol. These molecules have been isolated and extensively studied from various plant tissues such as grape berries [2], apple [3-5], sugar beet [6], citrus [7], chicory roots [8] and other materials [9, 10]. However, industry traditionally uses citrus peels and apple pomace as raw material for pectin production [11]. These pectins are widely used in the pharmaceutical, cosmetic and food industries [12-14].

Recently, non-traditional pectin sources have been investigated. Pectins have been extracted from various food industry by-products and, considering that food processing is characterised by large amounts of waste material, by this way the extraction process could represent an efficient and environmental friendly matter recovery for the production of functional compounds [15, 16].

Although apple pomace and citrus peels are sources for commercial pectin, sunflower heads could be used for commercial pectin [17]. Sunflower seeds are a major world source of edible oil and as by- product, their residual heads are a potential natural source of low-ester pectin. The total pectin content in sunflower cultivars varies between 15-24% in the heads [17]. The pectin from sunflower heads has good gelling properties, high molecular mass and high viscosity [18, 19]. The extraction process and the sunflower cultivar can affect yield and quality of pectin [18]. In the present study, head residue of five different sunflower cultivars have been investigated as a potential source of pectins.

MATERIALS AND METHODS

Materials: In the present study, five commercially grown sunflower cultivars including Golshid, Azargol, Record, Gabor and Progress were used. These varieties were

Corresponding Author: A.R. Sadeghi Mahoonak, Department of Food Science and Technology, Gorgan University of Agricultural Science and Natural Resources, Gorgan, I.R. Iran

grown at Agricultural Research Station of Golestan, Gorgan, Iran and harvested in the last week of June 2008. After seed separation, the head residues were dried in a cabinet dryer with air circulation at 65°C for 48 h. The samples were ground to 60 mesh in a hammer mill and blended into a bulk sample before processing.

Methods

Proximate Composition: Moisture content was determined by air-oven method. Ash content was measured by incinerating the sample in a muffle furnace at 550°C for 8 h [20].

Pectin Extraction: The dried sunflower head samples were washed with hot water (75°C) for 15 min at a solid:water ratio of 1:25 to remove soluble pectin and pigments. Insoluble pectin were extracted with 0.75% sodium hexametaphosphate solution at 85°C and pH=5 for 20 min and then filtered using filter paper.

Precipitation of Pectin: The clear pectin extracts were cooled to 15°C and precipitated using acidified ethanol (Ethanol: HCL ratio 3:1) at extract: acidified ethanol ratio of 4:1. The mixture were stirred gently for a few minutes to break up the gel and then allowed to stand for 1 h at 10°C [17].

Purification and Drying: The precipitated pectin was washed with 60% ethanol and then washed with HCl (pH 1) to reduce ash content and rewashed again with 60% ethanol. The extracted pectin was dried in a vacuum oven drier at 55°C for 16 h. The samples were weighed and extraction yield for each cultivar were calculated.

Physico-chemical Properties of Pectin: The total pectin content, degree of methylation and Galacturonic acid content were analyzed using AOAC standard methods [20].

Statistical Analysis: The SPSS software package was applied to datasets to perform descriptive multivariate statistical studies.

RESULTS AND DISCUSSION

Pectin contents of the five sunflower head sample were compared and results were presented in Table 1. The Golshid cultivars contained the highest pectin content (19.7% dry weight basis) and progress cultivar had the lowest pectin content (12.4%). Total pectin content in the head residues of different cultivars varied between 14-20% which is in agreement with the reported value of Miyamoto and Chang [17]. The pectin yield produced in our laboratory was this may due to the different cultivars.

Table 1: Pectin content of sunflower head residue in different cultivars*

Cultivar	Pectin content (%)
Golshid	19.7±0.10^{a}
Record	17.4±0.15^{b}
Gabor	17.3±0.13^{b}
AzarGol	14.1±0.20^{c}
Progress	12.4±0.13^{d}

Mean ± SD of three determinations

*Values followed by different letter are significantly different (P<0.05)

Table 2: Extraction yield, Ash and moisture content in pectin extracted from different cultivars*

Cultivar	Extraction Yield	Ash (%)	Moisture (%)
Golshid	5.47±0.06^{a}	2.91±0.02^{a}	4.41±0.05^{a}
Record	5.18±0.05^{a}	3.18±0.03^{b}	4.11±0.04^{a}
Gabor	4.07±0.09^{b}	3.53±0.03^{b}	4.58±0.04^{a}
AzarGol	1.80±0.07^{c}	5.30±0.04^{c}	4.79±0.06^{a}
Progress	2.30±0.05^{c}	7.10±0.03^{d}	4.27±0.04^{a}

Mean ± SD of three determinations

*Values followed by different letters in each column are significantly different (P<0.05)

The extraction yield of pectin from head of five sunflower cultivars was compared (Table 2). Golshid and Record cultivars showed the higher pectin yield compared to the other three cultivars and the Azargol cultivar had the lowest pectin yield. Variations in the pectin yield and the effects of cultivar on extraction yield have been reported by Line *et al.* [18]. It can be seen that the variation in total pectin of each cultivar influences the yield of pectin therefore the Golshid cultivar, which had the highest pectin content (Table1) showed the highest pectin yield (Table 2).

The average of moisture content in all samples (Table 2) was low and did not show any significant differences (p<%5) in different samples. Reduction in moisture content is necessary for safe storage and inhibition of microorganisms' growth, otherwise they may grow and by producing pectinase enzymes influence pectin quality.

The ash content in all pectin samples (Table 2) were well below the quality criteria of %10 which has been established as the maximum limit. Ash content in Golshid, Record and Gabor cultivars were low and did not show any significant differences. However, ash content in

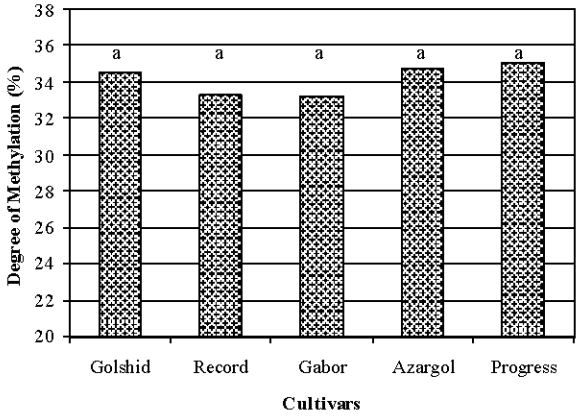

Fig. 1: Degree of methylation of the pectin extracted from different cultivars

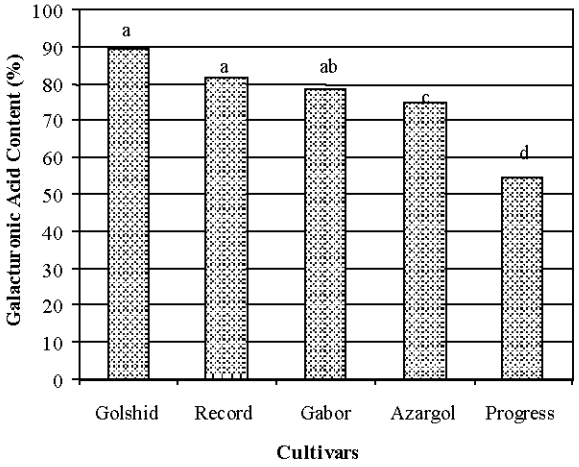

Fig. 2: Galacturonic Acid content of the pectin extracted from different cultivars

progress cultivar was significantly higher than other cultivars. Ash content of pectin is import because it can affect the ability of pectin to produce gel.

Degree of methylation (DM) of the pectin in different sample is presented in Figure 1. The DM of different samples varied from 33 to 35.7% which was in the range of 28.8% to 40.4% of low methoxyl pectin as reported others [17, 18]. The difference between DM of different samples was not significant statistically (P<%5). It is clear that the pectins extracted from sunflower head residue are low methoxyl type (DM<50%).The DM of the pectin is important factor which determine gel firmness.

Galacturonic acid content of pectin isolated from different cultivars is present in (Figure 2). The Golshid cultivar had highest galacturonic acid (89.4%) content which was similar to the 87% value reported by Lin and Sosulski for pectin extracted from sunflower head [18].

Except in Azargol and Progress cultivars, the galaturonic acid contents of the isolated pectin from other three cultivars did not show any significant differences (Figure 2). These data are in close agreement with findings of Miyamoto and Chang who reported that sunflower pectin contained high amount of galacturonic acid [17].

CONCLUSION

The pectin content in head residue of five sunflowers cultivars used in this study was between 19-20%. The Golshid and Record cultivars were the best cultivars for commercial production of pectin. The extracted pectin from head of sunflower contained high amount of galacturonic acid and low methoxyl group (low DM). The ability of sunflower pectin to from jells at low sugar concentration would be useful for producing low- caloric foods. Therefore the pectin extracted from sunflowers head show a high potential for commercial food applications.

REFERENCES

1. Jarvis, M.C., W. Forsyth and H.J. Duncan, 1988. A survey of the pectin content of nonlignified monocot cell walls. Plant Physiol., 88: 309-314.
2. Saulnier, L. and J.F. Thibault, 1987. Extraction and characterization of pectic substances from pulp of grape berries. Carbohydrate Polymers, 7: 329-343.
3. De Vries, J.A., F.M. Rombouts, A.G.J. Voragen and W. Pilnik, 1984. Comparison of the structural features of apple and citrus pectic substances. Carbohydrate Polymers, 4: 89-101.
4. Garna, H., N. Mabon, C. Robert, C. Cornet, K. Nott and H. Legros, *et al.* 2007. Effect of extraction conditions on the yield and purity of apple pomace pectin precipitated but not washed by alcohol. J. Food Sci., 72: 1-9.
5. Renard, C.M.G.C., M.J. Cre´peau and J.F. Thibault, 1995. Structure of the repeating units in the rhamnogalacturonic backbone of apple, beet and citrus pectin. Carbohydrate Res., 275: 155-165.
6. Guillon, F., J.F. Thibault, F.M. Rombouts, A.G.J. Voragen and W. Pilnik, 1989. Enzymic hydrolysis of the ‘‘hairy” fragment of sugar-beet pectins. Carbohydrate Res., 190: 97-108.
7. Renard, C.M.G.C., M.J. Cre´peau and J.F. Thibault, 1995. Structure of the repeating units in the rhamnogalacturonic backbone of apple, beet and citrus pectin. Carbohydrate Res., 275: 155-165.

8. Robert, C., T. Devillers, B. Wathelet, Van J.C. Herck and M. Paquot, 2006. Use of a Plackett-Burman experimental design to examine the impact of extraction parameters on yields and compositions of pectins extracted from chicory roots (Chicorium intybus L). J. Agricultural and Food Chemistry, 54: 7167-7174.
9. Huisman, M.M., H.A. Schols and A.G.J. Voragen, 1999. Enzymatic degradation of cell wall polysaccharides from soybean meal. Carbohydrate Polymers, 38: 299-307.
10. Polle, A.Y., R.G. Ovodova, A.S. Shashkov and S. Ovodov Yu, 2002. Some structural features of pectic polysaccharide from tansy, Tanacetum vulgare L. Carbohydrate Polymers, 49: 337-344.
11. Voragen, A.G.J., W. Pilnik, J.F. Thibault, M.A.V. Axelos and C.M.G.C. Renard, 1995. In A.M. Stephen and Y. Dea (Eds.), Food polysaccharides and their application London: Marcel Dekker, pp: 287-339.
12. Kiyohara, H., M. Hirano, X.G. Wen, T. Matsumoto, X.B. Sun and H. Yamada, 1994. Characterization of an anti-ulcer pectic polysaccharide from leaves of Panax ginseng C.A. meyer. Carbohydrate Res., 263: 89-101.
13. Pilnik, W., 1990. Gums and stabilizers for the food industry. London:Oxford University Press.
14. Platt, D. and A. Raz, 1992. Modulation of the lung colonization of B 16-F1 melanoma cells by citrus pectin. J. National Cancer Institute, 84: 438-442.
15. Kroyer, G.T., 1995. Impact of Food Processing on the environment - An overview. Lebensmittel-Wissenschaft und-Technologie, 28: 547-552.
16. Schieber, A., F.C. Stintzing and R. Carle, 2001. By-products of plant food processing as a source of functional compounds - Recent developments. Food Science and Technol., 12: 401-413.
17. Miyamoto, A. and K.C. Chang, 1992. Extraction and physic- chemical characterization of pectin from Sunflower head residues. J. Food. Sci., 57: 1439-1443.
18. Lin, M.J. and F.W. Sosulski, 1978. Acidic Isolation of Sunflower pectin. Can. Inst. Sci. Tech. J., 11: 75-78.
19. Dhurandar, N. and K. Chang, 1994. Processing methods affect yield and quality of Sunflower pectin J. Food. Sci., 59: 602-605.
20. Association of Official Analytical Chemists, 2002. Association of Official Analytical Chemists, In Official Methods of Analysis of AOAC International, AOAC International, Arlington.