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Synthesis and comparison of hydrogels based on *Pistacia atlantica* gum

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Key words: Pistacia atlantica gum, hydrogel, superbosrbent polymer, swelling rate.

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Abstract

Pistacia atlantica Gum as a polysaccharide has been chemically modified by graft copolymerizationan various monomers in aqueous medium using ammonium persulfate (APS) as an initiator. The results showed that the hydrogels have capacity of swelling significant, and are sensitive to pH. The structure was confirmed by FT-IR and SEM devices.

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Introduction

Super absorbent polymers are a unique group of polymeric materials which absorb great amounts of water when left in a water medium for long times (Hoffman as 2002).biocompatible and biodegradable hydrogels have a wide application in the field of hygienic products (Anisha S 7 et al. 2010), agriculture (Amulya K.,2010), drug delivery systems (Anisha S 7 et al. 2010) and (Hamidi M. et al, 2009), sealing (Anisha S 7 et al. 2010), coal dewatering , artificial snow, food additives, pharmaceuticals, biomedical applications and tissue engineering and regenerative medicines, diagnostics, wound dressing , separation of biomolecules or cells and barrier materials to regulate biological adhesions, and Biosensor (Ahmed E. M. 2013). Many structural factors (e.g. charge, concentration and pK_a of the ionizable group, degree of ionization, crosslink density and hydrophilicity) influence the degree of swelling of ionic polymers (Askadskii 1990;; Wu *et al* 2001). More ever, the swelling medium properties (such as pH, ionic strength and the counter ion and its valency) affect the swelling characteristics (SINGH A. and et al. 2006).

In recent years, more study were done on synthesis development of hydrogels based on natural materials, biodegradable and biocompatible polymeric materials.

The present research reports the preparation of hydrogel based on Pistacia atlantica **(** Pourreza, M., et al. 2008**)** by graft copolymerization of various monomers in aqueous medium. The spectroscopic (FTIR) characterization of hydrogel, effect of extent of crosslinking and effect of temperature, pH and ionic strength of swelling media on swelling behavior of hydrogels were observed.

Material and methods

Materials

Acrylonitrile (AN), acrylic acid (AA), acrylamide, ammonium persulfate, N,N,-methylene bis acrylamide (NN-MBAAm) from RANKEM company,India were used are received. Pistacia atlantica Gum was prepared in Iran.

Synthesis of hydrogels

Pistacia atlantica gum was dissolved in distilled water and continuously stirring to form mixture with heating at 60–70 °C. ammonium persulfate and N,N,-methylene bis acrylamide and monomers added to solution, for made of one monomer hydrogel was used from AA,tow monomers hydrogel were used AA and AN, three monomers hydrogel were used AA,AN,AAm. The Solution stirred for 15 min and then system keep in heating for 20 min to be completed gel process, then, hydrogel poured in NaOH solution for formation of salt of carboxylic acid groups. the gel membranes in distilled water for 1 h at room temperature and stirred and then dried in oven at 50 °C for 24 h.

Results and discussion

Swelling behavior in distilled water

Hydrogel samples were immersed in distilled water for different times at room temperature. After the excessive surface water was removed with filler paper, the weight of swollen gel was measured at various time intervals. The procedure was repeated for 1h. The percent swelling ratio was determined according to the following equation:

$$ES = \frac{W_t - W_d}{W_d}$$

Where W_t is the weight of the gel after swelling and W_d is the weight of dried gel before swelling.

Table 1. Swelling behavior in distilled water.

Time(min)	one momomer hydrogel	two momomers hydrogel	three momomers hydrogel
0	0.1	0.1	0.1
5	0.995	2.567	2.609
10	2.164	3.95	3.344
15	3.457	4.554	4.069
20	4.621	4.69	4.429

25	5.027	4.944	4.778
30	5.137	5.008	4.958
35	5.181	5.398	5.191
40	5.313	5.625	5.242
45	5.429	5.699	5.347
50	5.668	5.935	5.366
55	5.896	6.007	5.375
60	5.896	6.137	5.556

Table 2. Swelling behavior in buffer solutions.

Buffer solution	onemomomer hydrogel	two momomers hydrogel	three momomers hydrogel
4	1.385	1.207	1.328
5	1.387	1.315	0.961
6	1.287	1.26	1
7	1.142	1.091	0.645
8	1.407	1.504	1.105

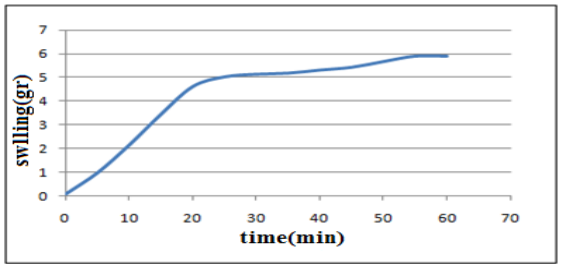

Fig. 1. Curve of one monomer hydrogel in distilled water.

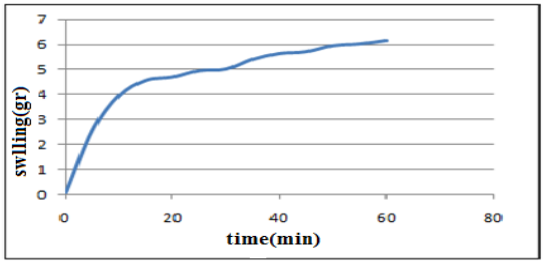

Fig. 2. curve of two monomers hydrogel in distilled water.

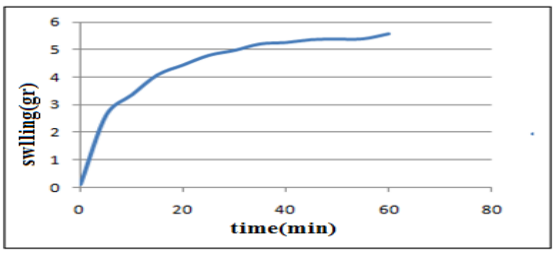

Fig. 3. curve of three monomers hydrogel in distilled water.

Measurement of pH sensitivity

The hydrogel samples poured in buffer solutions with different pH values (4, 5, 6, 7, 8) for constants time(30 min) at room temperature. Then, the weight of swollen gel was measured.

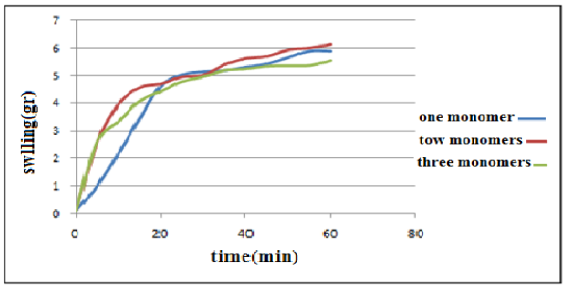

Fig. 4. Comparison of swellingof hydrogels based on monomers.

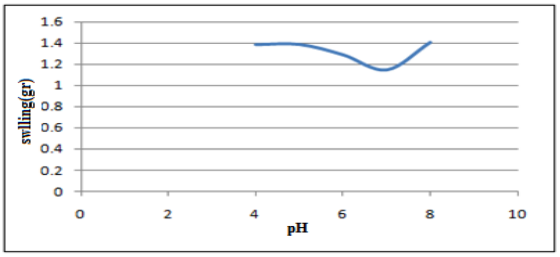

Fig. 5. Curve of One monomer hydrogel in buffer solutions.

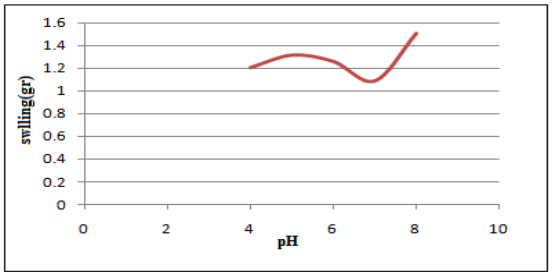

Fig. 6. Curve of two monomer hydrogel in buffer solutions.

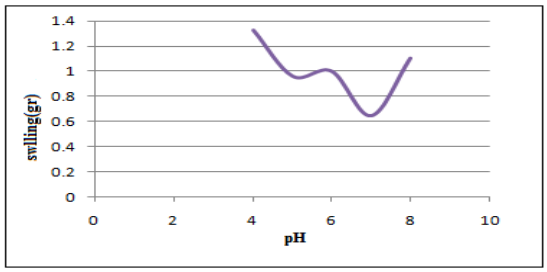

Fig. 7. Curve of three monomer hydrogel in buffer solutions.

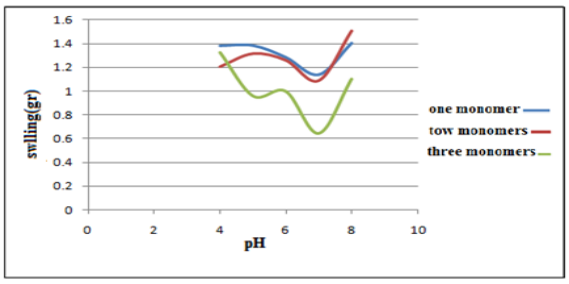

Fig. 8. Comparison of swelling hydrogels based on monomers.

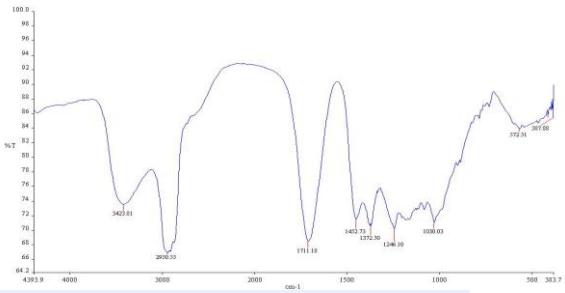

Fig. 9. FT-IR of Gum atlantica pistacia pure.

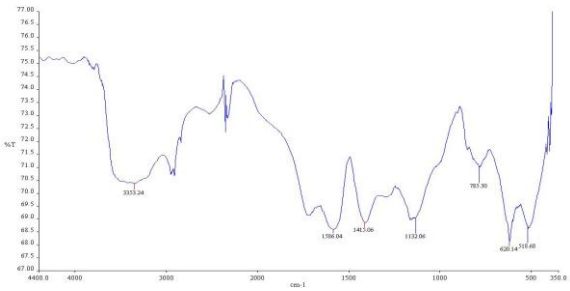

Fig. 10. FT-IR of one momomer hydrogen.

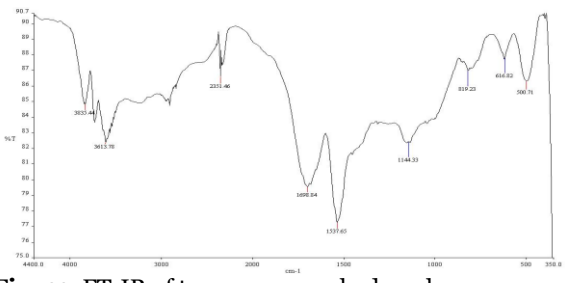

Fig. 11. FT-IR of two momomer hydrogels.

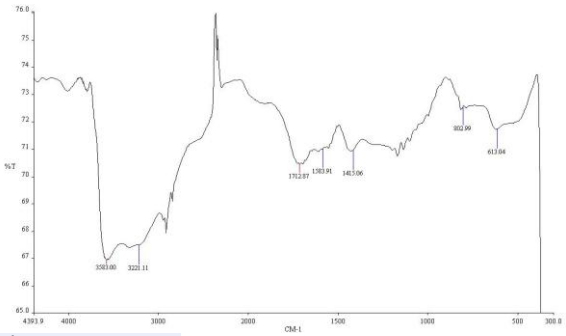

Fig. 12. FT-IR of three momomer hydrogels.

FTIR analysis

Samples for infrared spectroscopy of atlantica pistacia gum and the hydrogels were examined. Figure 9 shows the spectrum of atlantica pistacia gum pure and hydrogels.(Perkin-Elmer-RX1 FTIR).

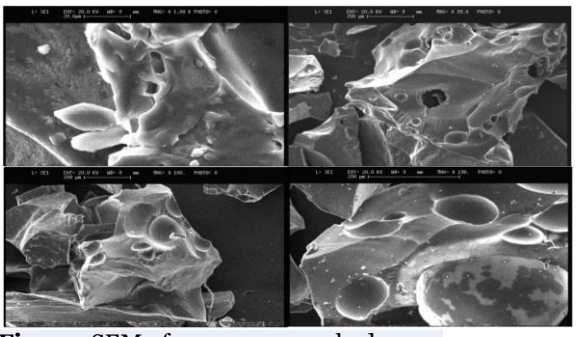

Fig. 13. SEM of one momomer hydrogen.

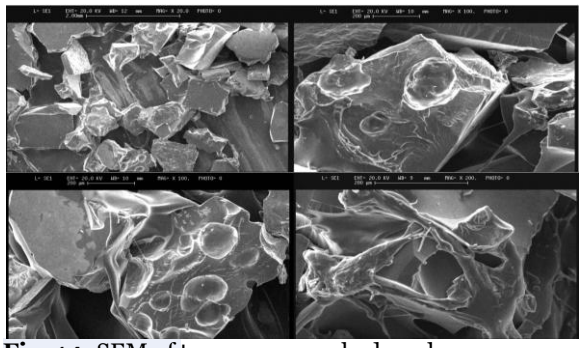

Fig. 14. SEM of two momomer hydrogels.

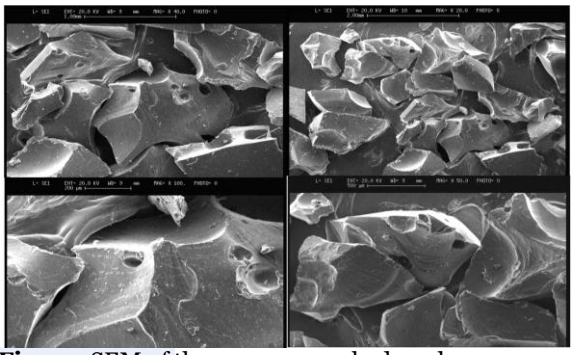

Fig. 15. SEM of three momomer hydrogels.

SEM analyses of the hydrogels

Hydrogel morphology was studied using electron microscopy.

Conclusions

A series of novel hydrogels based on pistacia atlantica gum could be synthesized by grafting polymerization. Comparing to pistacia atlantica gum hydrogels,two monomers hydrogel can provide satisfying properties such as pH-sensitivity and good swelling.

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