ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 11, Special issue 1, 2018

Online - 2455-3891
Print - 0974-2441

Research Article

DURIAN SEED UTILIZATION AS A BASE MATERIAL OF TOPICAL GEL

NILSYA FEBRIKA ZEBUA[1]*, EFFENDY DE LUX PUTRA[1], URIP HARAHAP[1], JAMARAN KABAN[2]

[1]Department of Pharmacy, Faculty of Pharmacy, Universitas Sumatera Utara, North Sumatera, Indonesia. [2]Department of Chemistry, Faculty of Mathematics and Science, Universitas Sumatera Utara, North Sumatera, Indonesia. Email: urip@usu.ac.id

Received: 25 October 2017, Revised and Accepted: 13 March 2018

ABSTRACT

Objective: This research is aimed to investigate that durian seed gum is potential as an excipient in topical drug delivery. Durian seed gum is isolated from low-cost source and usually discarded.

Methods: A certain amount of durian seed gum was isolated and characterized by scanning electron microscopy energy dispersive X-ray (SEM-EDX) and infrared spectrophotometer. The isolation method is divided into centrifuge and heating method, and the results of both methods are compared in their ability to form a gel and their evaluation.

Results: The infrared spectra of durian seed gum by centrifugal method indicate the presence of -OH, -COOH, -CH groups, and the addition of C=O and ester groups on the heating method, i.e., at wave number 1726.22 cm^{-1}. SEM-EDX shows the form of hollow surface particles, and the elements contained are C, O, K, Cl, and Mg. Durian seed gum of both methods formed a gel with boiling water at a concentration of 5% giving transparent and non-flowing results.

Conclusion: Durian seed gum by the heating method is a low-methoxyl pectin compound because it is extracted at an alkaline pH. Durian seed gum can form a gel and complete the gel evaluation requirements.

Keywords: Gel, Gum, Durian seed, Topical drug delivery.

 DOI: http://dx.doi.org/10.22159/ajpcr.2018.v11s1.26600

INTRODUCTION

Durian is included in the Malvaceae family and is widely found in the tropics which is one of the most popular fruits in Indonesia. Each durian tree can produce 80–100 pieces. Part of durian fruit consumed is the meat while the seeds are removed. Physically, the durian seed is white or yellowish-brown and round-shaped like an egg. Ripe durian seeds contain 51.1% water, 46.2% carbohydrates, 2.5% protein, and 0.2% fat. The high carbohydrate content allows utilization durian seeds as polymer materials in pharmaceutical formulations of drugs [1,2].

The usual dosage of the gel is formulated from hydroxy propyl methyl cellulose or carboxy methyl cellulose, but no one has developed a form of gel preparations from whole durian (*Durio zibethinus*) [3]. Preparation of the gel can be made from gum, where the gum will provide the consistency of viscous when dissolved in water [4]. Gum is found in the seeds of durian (*D. zibethinus*) and is a by-product (waste) from the fruit durian. Durian seeds are obtained from the Gum by means of the addition of ethanol, so hydrated and gum can be obtained in the form of a white powder [1]. Gum has been widely used as a thickener, stabilizer, and emulsion additive in various food industries and pharmaceuticals [5,6]. Durian seed gum extract as an alternative thickening agent as which is a lucrative and readily available source in replacing Xanthan gum in fruit nectar manufacturing process [5]. The utilization of durian (*D. zibethinus* L.) seed gum was an emulsifier in vegan mayonnaise [8].

Gum generally sourced from the seeds of the plant tribe of the Fabaceae or Leguminosae, but no possibility exists in the other family. Because it tastes slightly sweet gum into a coating agent [3]. Several studies have also used the gum raw material such as the manufacture of edible films and coatings applied as edible packing in lieu of plastic [9]. Gum is almost entirely soluble in water to form a solution of thick and gel, and it is being extended in comparison with starch [10].

Gum viscosity rate when dissolved in water depends on the size of the molecule and when added with other polysaccharides such as xanthan then will form a gel [10]. The main advantage of this gum when compared to other polysaccharide is its ability to form a highly viscous solution in low concentrations and is only slightly affected by pH, ionic strength, and warming. The viscosity of gum is very constant in range pH 1-10.5 so it can be used in various pharmaceutical preparations [4].

Utilization of durian seed gum as a basis for the manufacture of pharmaceutical gel is a new concept. Gum can form gels with or without combination with other agents. Gel formation was a result of intramolecular bonds to produce a three-dimensional network, where the water molecules will be caught. These reactions are influenced by the physical properties (pH and temperature) or properties (the addition of an appropriate reagent). Gum has been used as gel-forming agents because it is non-toxic, low-cost, easily obtainable and does not cause environmental pollution [11].

METHODS

The study was conducted at the Pharmaceutical Chemistry Laboratory, Faculty of Pharmacy, Universitas Sumatera Utara. The plant material used in this research is the durian seed which is determined by the Herbarium Medanense of the Biology Department of the Faculty of Mathematics and Natural Sciences. This study has received ethical approval from the ethics committee of the faculty of mathematics and natural sciences.

The materials used are methylparaben, sodium pyrosulfite, and glycerine (Merck). The tools used are skin moisture analyzer (FCM), analytical balance (Sartorius), and centrifuge (Hitachi). Durian seed gum was characterized by scanning electron microscopy (SEM) (Zeiss) and infrared spectrophotometer (Shimadzu).

Isolation gum

Isolation of durian seed gum is done in the following two ways: Durian seed is washed, finely blended with water 1:20, set the pH 12 with the addition NaOH, saved into the refrigerator for 24 h, and centrifuged with speed 8500–9500 rpm during 10–15 min [7]. The result is added

ethanol 1:2 and stored in the refrigerator for 24 h. The aggregate was filtered and stored in a desiccators [1,4]. The centrifuge method was replaced by warming, temperature <50°C in 5, 15, and 30 min in water bath [13].

Gel formulation

Durian seed gum dispersed in boiling water with some concentration (1%, 2.5%, 5%, and 10%) as the Mass I, whereas the Mass II is a mixture of methylparaben 0.2% as a preservative, sodium pyrosulfite 0.1% as an antioxidant, and 10% glycerine as a humectant moisturizing at the same time [14]. Gel formula in this research is presented in Table 1.

Gel evaluation

Evaluation of durian seed gel includes evaluation of physical properties of gel, homogeneity, determination of pH, power spread determination, stability observation, testing skin irritation, and the ability to skin moisturizing [15].

RESULT

Gum characterization

Figs. 1 and 2 show SEM-EDX shows the shape of hollow surface particles, and the elements contained are C, O, K, Cl, and Mg. Figs. 3 and 4 show Infrared spectrum of durian seed gum by centrifugal method shows the presence of -OH, -COOH, -CH, and the addition of C = O and ester groups on the heating method at wave number 1726.22 cm^{-1}. Table 2 shows the durian seed gums from both methods forming a transparent gel with boiling water at a concentration of 5% and Table 3 shows that gel (F3) meets homogeneity requirements, neutral pH, good power deployment and stable 12 week storage.

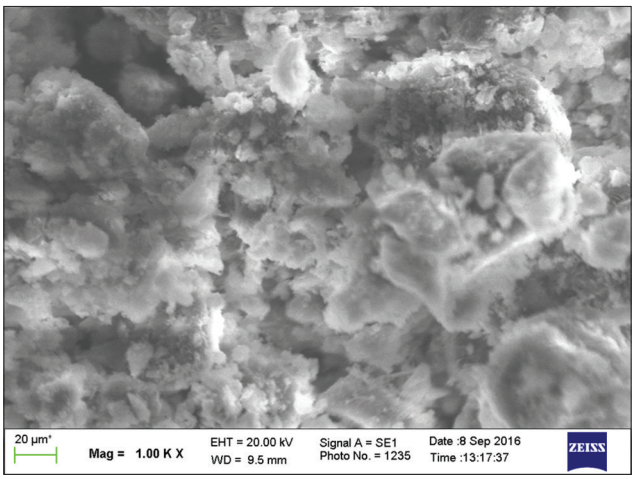

Fig. 1: Surface morphology by scanning electron microscopy magnification ×1000

DISCUSSION

Gum produced from durian is 3.9% (heating method) and 3.7% (sentrifuge method). Durian seed gum is characterized by SEM and energy dispersive X-ray (SEM-EDX) in Fig. 1. Fig. 1 shows the hollow particle shape of the surface. The elements contained in the durian seed gums (Fig. 2) are C, O, K, Cl, and Mg that allow the durian seed gums to form the gel.

Testing the functional groups of the gum can be inspected with infrared spectrophotometry in wavenumbers 4000–2000 cm^{-1}, and the fingerprint spectrum of the gum can be identified in wave number 2000–500 cm^{-1}. The results of a spectrum of Fourier-transform infrared durian seed gum are shown in Fig. 3 at wavenumbers 3379.29 cm^{-1} and Fig. 4 at 3394,72 cm^{-1} indicates the presence of vibration of -OH stretch and widening of peak from 2500 to 4000 cm^{-1} indicates the presence of the -COOH group. The wavenumbers 2927,94 cm^{-1} (Fig.3) and 2924,09 cm^{-1} (Fig. 4) indicates the presence of C-H stretching vibration aliphatic. Fig. 3 at wavenumbers 1728.22 and 1635.64 cm^{-1} and Fig. 4 at 1631,78 cm^{-1} show the presence of bending of the carbonyl group C=O and the COO- ester. Wavenumbers 1539.20 cm^{-1} may indicate the presence of an amide group of proteins. Wavenumbers 1408, 1338, and 1234 cm^{-1} indicate the presence of ester groups and carboxylic groups but with low intensity. Wavenumbers 1200–950 cm^{-1} in 1141.36 and 1033.85 cm^{-1} show the vibration of the glycoside bond and the pyranoid ring [16].

The infrared spectrum indicates that the durian seed gum is not a galactomannan compound. Previous research also explained that durian seed gum is not a galactomannan compound which is probably a protein compound [2]. However, the SEM-EDX results (Fig. 2) do not show any N elements of the protein even though the wave number 1539.20 cm^{-1} gives a sign of the amide group. However, the spectrum in wave number 2000–1000 cm^{-1}, it is very likely that the durian seed gum is a pectin compound. The wavenumber 1728.22 cm^{-1} indicates the presence of a carbonyl group in which the galactomannan spectrum of this wavenumber does not appear [17]. This is also reinforced by the widening of the peak from 3700 to 2500 cm^{-1} which is characteristic of the carboxylate group. The galactomannan infrared spectra provide a sharp peak -OH shape at 3700–3000 cm^{-1}, widening to peak 2500 cm^{-1} indicating carboxylate. It is difficult to determine the compound on the durian seed gum but temporary conclusion by looking at the IR spectrum that durian seed gums belong to the pectin compound. Usually, pectin is extracted with acid, and in this study, the extraction is done with water at pH 12 with addition NaOH. Pectins are classified as low methoxyl or

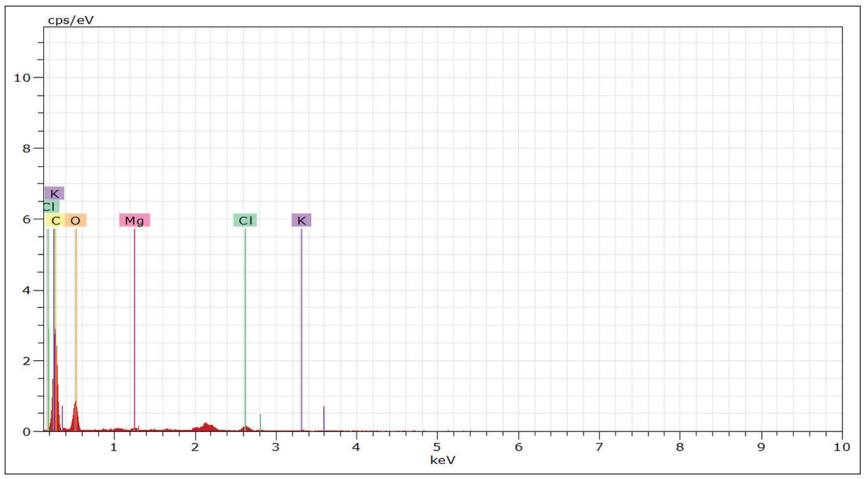

Fig. 2: Elements contained in durian seed gums

Table 1: Arrangement of the gel formula

Formula	Durian seed gum (g)	Methylparaben (g)	Glyserin (g)	Sodium metabisulfite (g)	Water (mL)
Formula I	1	0.2	10	0.1	100
Formula II	2.5	0.2	10	0.1	100
Formula III	5	0.2	10	0.1	100
Formula IV	10	0.2	10	0.1	100
Formula V	20	0.2	10	0.1	100

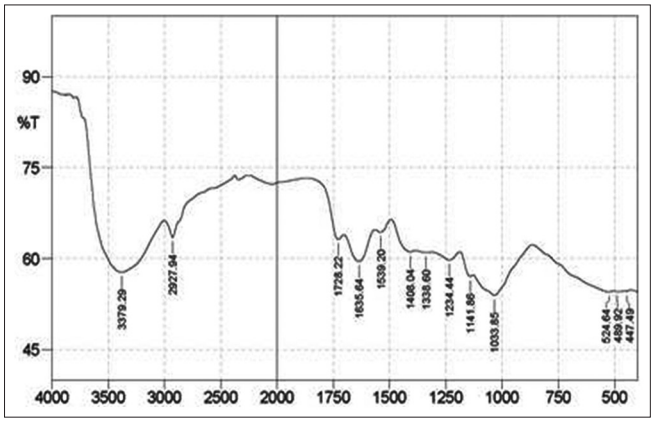

Fig. 3: Infrared spectrum of durian seeds (heating method)

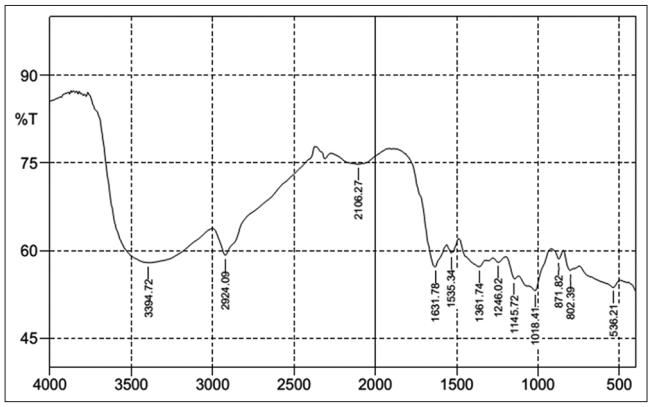

Fig. 4: Infrared spectrum of durian seeds (sentrifuge method)

high methoxyl according to their degree of esterification [18]. As the durian seed gum is obtained at an alkaline pH, the probability of pectin obtained is classified as low methoxyl.

Gel formulation result

Durian seed gums are obtained by two methods: Heating and centrifuge, where the centrifuge method gives the best gel form at 5% concentration. Gel of durian seed gum at this concentration provides a transparent and non-flowing form, whereas at concentrations of 1% and 2.5%, it provides a watery mass and still flowing. Gel with 10% concentration of durian seed gum gives the mass does not flow but is very concentrated and looks cloudy. However, durian seed gums obtained by the heating method give different results Table 3. Gum of seed durian obtained by heating 5 min gives the same gel form with durian seed gum from the centrifuge method. Durian seed gums from longer warming methods (10 and 30 min) are difficult to form gel, where gel is formed only at 20% concentration, but gel is very cloudy.

Homogeneity observation can be done by applying a piece of glass on the preparations, then flattened out, if there is no grain on a piece of glass, the material can be said to be homogeneous [19]. Examination of homogeneity in some gel formulations using durian seed gums gave homogeneous results evidenced by no grain on a piece of glass when applied [19].

The pH value can be determined using pH meter. Experimental results show that the average pH of the entire preparations tested ranged between 6.3 and 6.7 means eligible for material of skin moisturizer because the pH requirements for material of skin moisturizer is 5–8 [19]. There was no significant difference in pH between the formulas using different variations of gum concentration of different seeds.

Power spread test is done to find the easy of deployment preparations gel when used. The results of measurements of the spread of power gel preparations formulated using gum durian seed with different concentration variation show that the power of the average spread throughout the preparations tested ranged between 5.10 and 5.28 cm means a good criteria for material gels because a good spread of power criteria for material of skin is 5–7 [14,20]. There are little visible difference power spread preparations with higher concentrations of gum producing greater spread, although the difference is not very large, and completely still in a good criteria.

Stability tests of some durian seed gel formulas were carried out with storage for up to 12 weeks and observed each week. Damage can be observed by looking at discoloration, odor. Damage to materials due to oxidation can be overcome by the addition of antioxidants such as sodium metabisulfite [20]. Damage can also be caused by fungi or microbes, to cope with it can be done the addition of anti-microbial (preservatives) such as nipagin. Based on the data in Table 3, Formula I and II were unstable at 4 weeks because of higher water content, the formula III, IV and V did not change color and odor up to 12 weeks.

The use of cosmetics that are not good on the skin can cause a range of reactions (side effects). Side effects can be determined by testing skin irritation. Testing is done only on the Formula III as the best formula obtained results as presented in Tables 2 and 3. Against the skin irritation test to know or no side effects, done by cosmetics smeared on the forearm or 6 people behind the ears volunteers, then left on for 24 h and see the changes that occur in the form of redness, itching and rough on the skin [14,15]. This research shows that the invisible presence of side effects in the form of redness, itching, and rough on the skin caused by the material. Then, it can be inferred that the gel preparations formulated using gum durian seeds with 5% concentration are not irritating to the skin.

The ability to moisturize the skin is done by measuring percent of skin moisture using Skin Moisture Analyzer to 6 volunteers who have used cosmetics [14]. The results show that the preparation of the gel that is formulated using the gum with an enormous variety of durian seed concentration showed no difference in the percentage increase in the moisture of the skin which is very significant. Formulas I-V contain the same amount of glycerin that is 10%, but seen data obtained an increase in humidity by increasing the concentration of durian seed gum are used, possibly because the skin pores getting covered with an increased concentration of durian seed gum that is used in the formula so as to reduce the water content evaporate on the skin.

CONCLUSION

The gum can be isolated from durian seeds with the method using a centrifuge and warming 5 min as the best method. Spectrum infrared of durian seed gum shows it's pectin as low methoxyl. The best concentration of gel formula is 5%, which will form transparent gel, the mass does not flow, it feels cool if applied topically on the

Table 2: The influence of gum isolation methods to best gel formulation

Gum concentration (%)	Centrifuge methode	Heating methode		
		5'	10'	30'
1	Dilute, transparent	Dilute, transparent	Dilute	Transparent
2.5	Dilute, transparent	Dilute, transparent	Dilute	Transparent
5	Viscous, transparent	Viscous, transparent	Dilute	Transparent
10	Viscous, cloudy	Viscous, cloudy	Dilute	Transparent
20	Viscous, cloudy	Viscous, cloudy	Viscous	Cloudy

Table 3: Evaluation of durian seed gel

Evaluation of gel	F1	F2	F3	F4	F5
pH measurement	6.7	6.3	6.6	6.5	6.4
Spread power test	5.10	5.28	5.15	5.12	5.18
Stability test					
Newly made	-	-	-	-	-
1 week	-	-	-	-	-
4 weeks	+	+	-	-	-
8 weeks	+	+	-	-	-
12 weeks	+	+	-	-	-
Skin irritation test					
Redness	-	-	-	-	-
Itching	-	-	-	-	-
Rough	-	-	-	-	-
Skin moisture test					
Before	34.03	33.92	34.25	33.75	33.58
After	53.17	53.19	54.55	54.81	55.59
Increasing	56.22	56.83	59.27	62.41	65.53

skin. Concentrations below 5% are unstable stored for 4 weeks and concentrations above 5% provide a thick gel color. The resulting gel formula of durian seed gum meets the requirements of these supplies, Formula gel (F3, F4, and F5) produce a homogeneous gel, neutral pH, good spread of power, and stable in storage for 12 weeks. The increasing concentration of durian seed gum used in formula gel turns increasingly provide increased humidity of the skin.

CONFLICTS OF INTEREST

All author have none to declare.

AUTHOR CONTRIBUTION

Study conception: Putra. Acquisition of data: Harahap. Analysis of data: Zebua. Drafting of manuscript: Zebua. Critical revision: Kaban.

REFERENCES

1. Amid BT, Mirhosseini H. Optimisation of aqueous extraction of gum from durian (*Durio zibethinus*) seed: A potential, low cost source of hydrocolloid. Food Chem 2012;132:1258-68.
2. Amid BT, Mirhosseini H, Kostadinovic S. Chemical composition and molecule structure of polysaccharide-protein biopolymer from *Durio zibethinus* seed: Extraction and purification process. Chem Cent J 2012;6:117.
3. Raymond CR, Sheskey PJ, Quin ME. Handbook of Pharmaceutical Excipien, 6th ed. London: Pharmaceutical Press; 2009.
4. Kok MS, Hill SE, Mitchell JR. Viscosity of galactomannan during high temperature processing, influence of degradation and solubilisation. Food Hydrocoloids 1999;13:535-42.
5. Navaratne SB, Nawarathne NH. Determination of suitability of durian (*Durio zibethinus*) seed gum extract in replacing of *Xanthan gum* in fruit nectar. Int J Sci Eng Res 2014;2:86-9.
6. Mazumder R, Nath LK, Haque A, Maity T, Choudhury PK, Shrestha B, *et al*. Formulation and *in vitro* evaluation of natural polymers based microspheres for colonic drug delivery. Int J Pharm Pharm Sci 2010;2:211-9.
7. Mirhosseini H, Amid BT. Influence of chemical extraction conditions on the physicochemical and functional properties of polysaccharide gum from durian (*Durio zibethinus*) seed. Molecules 2012;17:6465-80.
8. Cornelia M, Siratantri T, Prawita R. The utilization of extract durian (*Durio zibethinus* L.) Seed gum as an emulsifier in vegan mayonnaise. Proc Food Sci 2015;3:1-18.
9. Cerqueira MA, Bourbon AI, Pinheiro AC, Martins JT, Souza BW, Teixeria AJ, *et al*. Galactomannans use in the development of the edible films/coatings for food applications. Food Sci Technol 2011;22:662-71.
10. Silveira JL. Pharmaceutical use of galactomannans. Quim Nova Brasil 2011;34:292-9.
11. Mirhosseini H, Amid BT. A review study on chemical composition and molecular structure of newly plant gum exudates and seed gums. Food Res Int 2012;46:387-98.
12. Bhatia H, Gupta PK, Soni PL. Extraction, purification and characterization of a galactomannan from *Prosopis juliflora* (Sw.) Dc. Seed Polysaccharides. Int J Sci Environ Technol 2013;2:708-24.
13. Tamaki Y, Teruya T, Tako M. The chemical structure of galactomannan isolated from seeds of delonix regia. Biosci Biotechnol Biochem 2010;74:1110-2.
14. Helal DA, El-Rahman DA, Halim SA, El-Nabarawi MA. Formulation and evaluation of fluconazole topical gel. Int J Pharm Pharm Sci 2012;4:176-83.
15. Negi A, Sharma N, Singh MF. Formulation and evaluation of an herbal anti-inflammatory gel containing eupatorium leaves extract. J Pharm Phytochem 2012;1:112-7.
16. Stuart B. Infrared Spectroscopy: Fundamentals and Applications, Analytical Techniques in The Science. Chichester, UK: John Wiley and Sons; 2004. p. 84.
17. Copikova J, Synytsya A, Cerna M, Kaasova J, Novorna M. Application of FT-IR spectroscopy in detection of food hydrocolloids in confectionery jellies and food supplements. Czech J Food Sci 2001;19:51-6.
18. Marcon MV, Carneiro PI, Vosiacki G, Beleski-Cameiro E. Pectins from apple pomace-Characterization by 13C and 1H NMR Spectroscopy. Ann Magn Reson AUREMN 2005;4:56-63.
19. Balsam MS, Gerson SD, Reiger MM, Sagarin E. Cosmetics Science and Technology. United States America: New York; 1972.
20. Garg A, Aggarwal D, Garg S, Sigla AK. Spreading of semisolid formulation: An Update. Pharm Technol 2002;2:84-104.