A quick reference to plant gums and mucilages used as a tablet binder

Raghu U, Hindustan Abdul Ahad, Satish P, Siddeshwara S, Dhanalakshmi AC, Tejeshwini H
Department of Industrial Pharmacy, Jawaharlal Nehru Technological University,
Anantapur-OTPRI, Ananthapuramu, India
*Email: abdulhindustan@gmail.com

Abstract

Binders are the ingredients used in tablet granulation process for tablet cohesiveness. This confirms the tablet remains intact after compression. The development of new excipients for potential use as a binding agent in tablet formulations continues to be of interest. Different binding agents are used to achieve mechanical strength and drug release from tablets. Natural polysaccharides area unit wide employed in the pharmaceutical and food business as excipients and additives thanks to their low toxicity, biodegradable, availability and economical compared to synthetic one. Natural binders like different gums and mucilages possess binding capacity as well as some other properties like disintegrant, filler, sustained release and these natural polymers are much safer and economical than synthetic polymers.

Keywords: Excipients, Binding agents, Natural Polysaccharides, economical

INTRODUCTION:

Polymers of plant origin are gaining importance day by day as they have a wide range of pharmaceutical applications viz., diluent, binder, disintegrant, thickening agents, protective, gellingagents, suppository bases, cosmetics. Gums are plants exudates (produced after plant injury) and mucilages are plant products (produced upon metabolism, formed within the cell). Natural gums and mucilage can be modified into semisynthetic/synthetic excipients to meetthe requirements of drug delivery systems.

Binders are excipients added to the tablet formulation to impart plasticity as to increasebonding strength of tablet. The selection of anappropriate binder for a tablet preparation need extensive knowledge of the binder and its interactions with other excipients/drugs[1].The present investigation was aimed to explore the natural gum and mucilage used as binder in tablet formulation till date.

CLASSIFICATION OF GUMS AND MUCILAGES:

Gums and mucilages are abundant in many plants, animals, fungi, seaweeds and microbes. They have different structure and metabolic functions. Various classification systems existing for gums and mucilages are showed in **table 1** [2-7].

Table 1. Classification of plant gums and mucilages

Classification system	Categories	Examples
According to the charge	Non-ionic	Guar, Locust bean, Tamarind
	Anionic	Arabic, Karaya, Tragacanth
	Marine	Agar, Carrageenans, Alginic acid
According to the source	Plant	Gum arabica, Guar gum, Locust bean
	Animal	Chitin, Chitosan, Chondroitin, Hyaluronic acid
	Microbial	Xanthan, Dextran, Curdian
Semi-synthetic	Starch derivatives	Hydroxy Ethyl starch, Starch acetate, Starch, phosphates
	Cellulose derivatives	Carboxymethyl cellulose (CMC),Hydroxy Propyl Methyl Cellulose(HPMC), Methyl Cellulose (MC), Microcrystalline Cellulose (MCC)
According to shape	Linear	Algins, Amylose, Cellulose
	Branched	Xanthan, Xylan, amylopectin
Monomeric Units	Homoglycans	Amylose, Arabinanase, Cellulose, Pectin
	Di-heteroglycans	Algins, Carrageenans, Galactomannans
	Tri-heteroglycans	Arabinoxylans, Gellan, Xanthan
	Tetra-heteroglycans	Gum arabic, Psyllium seed gum
	Penta-heteroglycans	Ghatti gum, Ttragacanth

ADVANTAGES OF NATURAL GUMS AND MUCILAGE:

The merits of natural gums and mucilages are listed below [8]

- Local availability in market/medicinal garden.
- Economical, nontoxic, biocompatible and biodegradable.
- Environmental friendly processing as they do not need harmful solvents for their processing.

DISADVANTAGES OF NATURAL GUMS AND MUCILAGE:

The demerits of natural gums and mucilages are as follows [8]

- Reduced viscosity on storage due to the complex nature of gums and mucilages
- Batch to batch variation as they harvested in different seasons
- Microbial contamination as they retain a small quantity of moisture
- As they collected at different times/region/species/climate conditions the percentage of chemical constituents present in a given material may vary. There is a need to develop suitable monographs on available gums and mucilages.

The plant gums and mucilages used as tablet binders was shown in **table 2 and 3**.

Table 2. List of natural gums used as a tablet binder

Common name	Botanical name	Family
Gum Acacia	*Acacia catechu*	Leguminosae[9]
Gum Albizia	*Albiziazygia*	Leguminoseae[10]
Gum Almond	*Prunuscommunis*	Rosaceae[11]
Gum Ayoyo	*Cochorusolitorius*	Tiliaceae[12]
Gum Badam	*Prunusamygdalus*	Rosaceae[10]
Gum Bihul	*Grewiaoccidentalis*	Malvaceae [13]
Gum Carrageenan	*Chondruscryspus*	Gigartinaceae[14]
Gum Galbanum	*Ferula gummosa*	Apiaceae[10]
Gum Gellan	*Pseudomonas elodea*	Leguminoseae[15]
Gum Ghatti	*Anogeissuslatifolia*	Combretaceae[16]
Gum Grewia	*Grewiamollis*	Malvaceae[10]
Gum Karaya	*Sterculiaurens*	Sterculiaceae[10]
Gum Khaya	*Khayagrandifolia*	Meliaceae[10]
Gum Kondagogu	*Cochlospermumgossypium*	Bixaceae[17]
Gum Moi	*Lanneacoromandelica*	Anacardiaceae[18]
Gum moringa	*Moringaolifera*	Moringaceae[19]
Gum Neem	*Azadiractaindica*	Meliaceae[10]
Gum Odina	*Odinawodier*	Anacardiaceae[20]
Gum of Bael	*Aegle marmelos*	Rutaceae[21]
Gum of Cashew	*Anacardiumoccidentale*	Anacardiaceae[10]
Gum of Cederela	*Cedrelaodorata foliage*	Meliaceae[22]
Gum of Indian Cherry	*Cordial obliqua*	Baraginaceae[23]
Gum of Jack fruit	*Artocarpusheterophyllus*	Moraceae [24]
Gum of Leucaena seed	*Leucaenaleucocephata*	Fabaceae[10]
Gum of Malva nut	*Scaphiumscaphigerum*	Sterculiaceae[10]
Gum of Mangiferaindica	*Mangiferaindica*	Anacardiaceae[25]
Gum Okaro	*Abelmoschusesculentus*	Malvaceae[26]
Gum Olibanum	*Frankincense*	Burseraceae [27]
Gum Prunus	*Prunusdomestica*	Rasaceae[28]
Gum Tamarind	*Tamarindusindica*	Fabaceae[29]
Gum Tawa	*Beilschmiediatawa*	Lauraceae [30]
Gum tragacanth	*Astragalusgummifer*	Leguminosea[31]
Gum Welan	*Alcaligenes species*	Alcaligenaceae[10]
Gum Xanthan	*Xanthomonaslempestris*	Xanthomonadaceae[32]

Table 3. List of natural mucilages used as a tablet binder

Common name	Botanical name	Family
Aloe mucilage	*Aloe species*	Asphodelaceae[33]
Asario mucilage	*Lepidumsativum*	Brassicaceae[34,35]
Banana peel mucilage	*Musa paradisiaca*	Musaceae[10]
Bavchi mucilage	*Ocimumcanum*	Lamiaceae[36]
Bidi leaf mucilage	*Bauhinia racemosa*	Fabaceae[37]
Broom creeper Mucilage	*Cocculus hirsute*	Menispermaceae[38]
Cactus mucilage	*Opuntiaficusindica*	Cactaceae[39]
Chinee apple mucilage	*Zizyphusmauritiana*	Rhamnaceae[40]
Date palm mucilage	*Phoenix dactylifera*	Palmaceae[41]
Dendrophthoe mucilage	*Dendrophthoe falcate*	Loranthaceae[42]
Fenurgreek mucilage	*Trigonellafoenumgraenum*	Leguminosae[10]
Golden shower cassia. mucilage	*Cassia fistula*	Caesalpiniaceae [43]
Hibiscus mucilage	*Hibiscus esculentus*	Malvaceae[44]
Humble plant mucilage	*Mimosa pudica*	Mimosaceae[45]
Ispagol mucilage	*Plantago psyllium*	Plantaginaceae[10]
Naga mucilage	*Brachystegiaeurycoma*	Leguminosae-Caesalpiniodeae[46]
Ocimumseedmuccilage	*Ocimumgratissimum Linn*	Labiatae[10]
Okra mucilage	*Abelmoschusesculentus*	Malvaceae[10]
Orange peel mucilage	*Citrus aurantum*	Rutaceae[10]
Red Cassia mucilage	*Cassia roxburghii*	Fabaceae[47]
Satavari mucilage	*Asparagus racemosus*	Asparagales[48]
Senna tora mucilage	*Cassia tora*	Caesalpiniaceae[49]

CONCLUSION:

There are large numbers of natural polymers have been used in pharmaceutical preparations. Natural substances like gums, mucilages, and also dried fruits can be used as a binding agent. They have been showed good potential as a binding agent as well as they possess some other properties like fillers, disintegrating agent, sustain releasing agent. Natural polymers showed good binding property in wet granulation, granules are stable and less friable in comparison with other binders. Natural binders are non-polluting renewable resources for sustainable supply of cheaper pharmaceutical excipient or product.

ACKNOWLEDGMENT:

We gratefully acknowledge Dr. C. Devanna, Director, JNTUA-OTPRI, for his supervision.

CONFLICT OF INTERST:

None of the authors of this paper has a financial or personal relationship with other people or organizations that could inappropriately influence or bias the content of the paper.

REFERENCES:

[1] A. R. Oyi, O. J. Olayemi, T. S. Allagah. Comparative binding effects of wheat, rice and maize starches in chloroquine phosphate tablet formulations, Res. J. App. Sci. Eng. Tech. 2009, 1: 77-80.
[2] C. K. Kokate, A.P. Purohit, S. B. Gokhale. Text book of Pharmacognosy. 4th Edition, Pune, India: NiraliPrakashan; 2006.
[3] V. D. Rangari. Text book of Pharmacognosy&Phytochemistry. Nashik, India: CareerPublication; 2006.
[4] T. E. Wallis. Text Book of Pharmacognosy. New Delhi, India: C B S Publishers andDistributors;2004.
[5] Mohammed. Text Book of Pharmacognosy. New Delhi, India: C B S Publishersand Distributors; 2005.
[6] S. H. Ansari. Essential of Pharmacognosy. New Delhi, India: Birla Publications Pvt.Ltd.; 2006.
[7] R. E. Venkata. Chemical and biological aspects of selected polysaccharides. IndianJ. Pharm. Sci., 1992, 54: 90-97.
[8] R. B. Rohit, B. Rajendra, A. M. Riyazet al., Natural Gums and Mucilages: A Review on Multifaceted Excipients in Pharmaceutical Science and Research, Int. J. Pharmacog. Phytochem. Res. 2014-15, 6(4); 901-912.
[9] K. G. K. Phani, B. Gangarao, N. S. L. R. Kotha. Isolation and evaluation of tamarind seed polysaccharide being used as a polymer in pharmaceutical dosage forms. Res. J. Pharm. Bio. Chem. Sci. 2001, 2(2): 274-290.
[10] J. Muazu, A. Alpha, G.T. Mahammed. Isolation and release retardant properties of a plant gum obtained from Ayoyo. Carib. J. Sci. Tech.2014, 2: 301-313.
[11] M. T. Patel, K. P. Jitendra, M. U. Umesh. Assessment of various pharmaceutical excipients properties of natural Moringaoleiferagum. Int. J. Pharm. Life sci. 2012, 3(7): 1833- 1847.
[12] S. I. Ofoefule and A. Chukwu. Application of Abelmoschus esculents gum as a minimatri for furosemide diclofenac sodium tablets. Indian J. Pharm. Sci., 2001,63: 532-535.
[13] J. K. Vijay, O. P. Sati, S. Ranjit. A potential natural tablet binder from Grewiaoptiva 2011, 3(3): 120-127.

[14] N. K. Jain, V. K. Dixit. Studies on gums and their derivatives as binding agent.Indian J. Pharm. Sci., 1988, 50: 113-114.
[15] P. J. Antony, N. M. Sanghavi. A new disintegrant for pharmaceutical dosage forms. Drug Dev. Ind. Pharm., 1997; 23:413-415.
[16] S. C. Owen. Gum Tragacanth. In: C. R. Raymond, J. S. Paul, J. W. Paul, ed. Handbook of Pharmaceutical Excipients. The Pharmaceutical Press. 2009.
[17] K. J. Aditya, D. Mousumi, D. E. Arnab, et al., Determination of efficacy of a natural tablet binder: Characterization and invitro release study. Asian J Pharm. Cli. Res. 2014, 7(3): 164-168.
[18] S. K. Singh, R. Gendle, N.R. Sheth, P. Roshan andPhysiologischeUntersuchungenüberBlattschleime. Untersuchungen an Verbascumdensiflorum. Biochemie und Physiologie der Pflanzen, 2010, 177: 671-685.
[19] O. Olayemi, J. Oremeyi. Preliminary evaluation of Brachystegiaeurycoma seed mucilage as tablet binder. Int. J. Pharm. Res. Innovation, 2011, 3(1): 01-06.
[20] Singh. Pharmaceutical characterization of Cassia toraseed mucilage in tablet formulations. Scholar Res. Lib. 2010, 2(5): 54- 61.
[21] M. Levina, C. R. Cunningham. The effect of core design and formulation on the quality of film coated tablets. Pharm. Tech. Europe. 2005, 17: 29- 37.
[22] A. O. Michael, A. O. Babalola, O. A. John. Evaluation of Cederelagum as a binder and bioadhesive component in ibuprofen tablet formulations,Braz. J. Pharm. Sci. 2013, 49 (1): 95-105.
[23] K. Hapgood, H. E. Hartman, C. Kauret al.,Proceedings of the World Congress of Particle Technology. Int. J. Pharm. 2002; 4: 21–25.
[24] S. B. Narkhede, R. B. Atul, G. J. Anil. Isolation and Evaluation of Starch ofArtocarpusheterophyllusas a tablet binder. Pharm.Tech. 2011, 3: 836-840.
[25] K. S. Anoop, K. S. Vipul, R. S. Panner. Evaluation ofMangiferaindica gum as tablet binder. 2010, 2(3): 2098-2100.
[26] O. O. Kunle, D.O. Akin, O.A. Odeku. Effects of pigeon pea and plantain starches on the compressional, mechanical, and disintegration properties of paracetamol tablets. Drug. Dev. Ind. Pharm. 2006, 32(3): 357- 365.
[27] G. Alebiowu. Assessment of Tapioca starches obtained after different steeping periods as binders in a paracetamol tablet formulation, Farmacia. 2010, 58: 341-52.
[28] S. Sarojini, R. Manavalan. Effect of natural almond gum as a binder in the formulation of diclofenac sodium tablets. Int. J. Pharm. Sci. and Res. 2010, 1(3): 55-60.
[29] H. Rahim, M. K. Azam, B. Amin, et al., Evaluation of Prunusdomesticagum as a novel tablet binder. Braz. J. Pharm. Sci. 2014, 50(1): 195-202.
[30] K. Girpunje, A. Kumaran, R. Palet al., A novel binding agent for pharmaceutical formulation from cassia Roxburghiiseeds. Int.J. P. Pharm. Sci. 2009, 1:1-5.
[31] J. K. Girish, S. P. Vipul, J. C. Vineet. Gums and mucilages, Asian J. Pharm. Sci. 2009, 4 (5): 309-323.
[32] V. Dhopeshwarkar, J. L. Zatz. Evaluation of Xanthan gum in the preparation of sustained release matrix tablets. Drug Dev. Ind. Pharm., 1993, 19: 999-1017.
[33] A. A. Hindustan, J. Sreeramulu, V. HimaBindu. Design and evaluation of sustained release matrix tablets of Glimepiride based on combination of natural and synthetic Polymers, Inter. J. Applied Bio. Pharm. Tech. 2010, 1 (3), 770-777.
[34] M. M. Patel, G. M. Chauhan, L. D. Patel. Mucilage of Lepidiumsativum and Ocimumcanum as an emulgents. Indian J. Hosp. Pharm., 1987, 24: 200-202.
[35] M. K. Avachat, A. G. Dhamne. Oral controlled release drug delivery system with husk powder from Lepidiumsativum seeds. Patient No. WO02100438.
[36] B. J. Ahmed, G. Mutasim. Sustained release characteristics of tablets prepared with mixed matrix of sodium carragennan and chitosan: Effect of polymer weight ratio, dissolution media and drug type.Drug Dev. Ind. Pharm. 2005, 31: 241-247.
[37] A. B. Gangurde, S. S. Boraste. Preliminary evaluation of Bauhinia racemeslam and Caesalpinaceae seedmucilage as a tablet binder.Int. J. Pharm. 2012, 2(1): 80-83.
[38] K. M. Rao, K. Gnanaprakash, A. V. Badarinath, Preparation and evaluation of flurbiprofen gel; mucilage of Cocculushirsutus leaf powder as gel base,Int. J. Pharm. Tech. Res. 2010, 2 (2): 1578-1583.
[39] A. Cardenas, I. C. Higuera, F. M. Goycoolea. Rheology and aggregation of Opuntia cactus mucilage in solution. J. PACD. 1997, 2: 152- 159.
[40] V. V. Kale, R. Kasliwal, S. K. Parida. Formulation and release characteristics of guar gum matrix tablet containing Metformin HCl. Int. Pharm. Expt. 2004,45:75-80.
[41] N. C. Ngwuluka, B. A. Idiakhoa, E. I. Nep,et al., Formulation and evaluation of paracetamol tablets manufactured using the dried fruit of Phoenix dactylifera as an excipient, Res. Pharm. Biotech. 2010, 2 (3), 25-32.
[42] S. N. Kothawade, P. B. Shinde, M. R. Agrawal, et al., Preliminary evaluation of Dendropthoefalcata mucilage as tablet binder,Int. J. Pharm. Tech. Res. 2010, 2 (2): 1474-1476.
[43] K. Vekaiah, J.J. Shah, Distribution,development and structure of gum ducts in Lanneacoromandelica, Annals of botany, 1984, 54 (2): 279-284.
[44] S. P. Wahi, V. D. Sharma, V. K. Jain. Studies on emulsifying property of mucilages of Hygrophilaspinosa and Hibiscus esculentus. Indian J. Natural Product, 1985,1: 3.
[45] K. Singh, A. Kumar, N. Langyan,et al., Evaluation of Mimosa pudica seed mucilage as sustained-release excipient, AAPS Pharm. Sci. Tech. 2009, 10 (4), 1121-1127.
[46] R. Valluru, H. G. Shivakumar. Investigation of Kondagogu gum and Ghatti gum as binders in formulating Metaprolol tartrate tablets. Res. J. Pharm. Bio. Chem. Sci. 2013, 4(2): 1110-1121.
[47] K. Hapgood, H. E. Hartman, C. Kaur. Proceedings of the World Congress of Particle Technology. Int. J. Pharm. 2002, 4: 21–25.
[48] G. T. Kulkarni, K. Gowthamrajan, G. Bramaji Rao. Evaluation of bindingproperties of selected natural mucilages.J. Sci. Ind. Res., 2002, 61: 529-532.
[49] S. G. Maru. Natural polymer: Gum and mucilage as good pharmaceutical excipients. Pharm. Tech. Med. 2012, 1(2): 64-74.