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NATURAL POLYSACCHARIDES OF MULBERRY LEAVES ACTING AS PHARMACEUTICAL EXCIPIENTS

K.VINOD KUMAR[1], B.V.D.BRAMARAMBIKA[2], M.BLESSY[2], MD.JAFIRA[2], NABIHA.SK[2], P.NEERAJA SAI[2]

[1]*Professor, Department of Pharmaceutics, St.Ann's College of Pharmacy, Chirala*
[2] *Department of Pharmaceutics, St.Ann's college of Pharmacy, Chirala*

Corresponding Author
K.Vinod Kumar

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ABSTRACT
Mulberry (Morus spp.) leaves are traditionally recognized as a source of nutrients, antioxidants, flavonoids, and bioactive phytoconstituents. However, their natural polysaccharides are increasingly investigated as pharmaceutical excipients. Because of their biodegradability, biocompatibility and low toxicity. mulberry leaf polysaccharides (MLPs) have attracted considerable attention because of their antioxidant, hypoglycaemic, and anti-inflammatory properties. Recent reviews indicate that MLPs are predominantly heterogeneous polysaccharides containing glucose, galactose, arabinose, and galacturonic acid, From a pharmaceutical-material perspective, these structural characteristics suggest potential applications as binders, viscosity modifiers, film-forming polymers, suspending/stabilizing agents, mucoadhesive materials, Thus, MLPs should currently be regarded as promising candidate multifunctional excipients rather than established compendial pharmaceutical excipients. Overall, this article explores the pharmaceutical-excipient potential of mulberryleaf polysaccharides, structural characteristics including their application in tablets, oral films, suspensions, microsystems, hydrogels, and advanced drug-delivery platforms and future development pathways.

Keywords: *Mulberry leaves, Morus alba, polysaccharides, natural excipients, pharmaceutical excipients, binding agent, film former, mucoadhesion, controlled release, drug delivery.*

INTRODUCTION

Mulberry (Morus alba L.) leaves are widely recognized as a valuable source of biologically active compounds, including proteins, flavonoids, phenolic compounds, minerals and naturally occurring polysaccharides. These polysaccharides are isolated from the leaves of Morus alba L.commonly referred to as mulberry leaf polysaccharides (MLPs) these are complex carbohydrates composed mainly of different monosaccharides such as glucose, arabinose, rhamnose, xylose, etc. and may contain Antioxidant, Antidiabetic, Anti-inflammatory activities. the (MLPs) are gaining profound attraction as multifunctional pharmaceutical excipients, these are inactive ingredients incorporated into dosage forms to improve manufacturing, stability, drug release and patient acceptability. The conventional excipients include starch, cellulose derivatives, synthetic polymers, gums and inorganic materials [1]. pharmaceutical excipients may constitute a major fraction of finished dosage form making their quality and functionality critically important. plant derived polysaccharides are particularly attractive because they are biodegradable, relatively inexpensive, and capable of providing functions ranging from viscosity enhancement to controlled drug release [2].

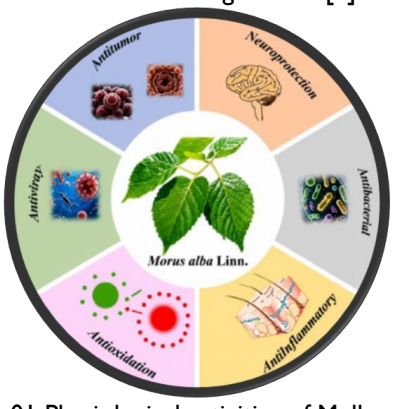

Figure: 01 Physiological activities of Mulberry leaf

The polysaccharides of Mulberry leaves are interesting because of their macromolecular structure can also be modified to obtain desired swelling, absorption, gel-formation and interaction with active pharmaceutical ingredients these properties may allow them to function as natural binders, disintegrants, suspending (or) thickening agents for controlled drug delivery [4].

Figure 02: Detail Mulberry Leaves

In pharmaceutical formulation polysaccharides are important because of their biocompatibility, biodegradability, water holding capacity, film forming ability and ability to modify the drug release. They are increasingly being investigated as alternatives to synthetic and semisynthetic excipients in the formulation of modern pharmaceutical dosage forms, polysaccharides can provide important physicochemical properties such as binding, thickening, mucoadhesion and stabilization. the above following characteristics allow them to function as pharmaceutical excipients in tablets, capsules, suspension, gels, films, microspheres and advanced drug delivery systems. However, Mulberry leaves have traditionally been studied mainly for their nutritional (or)and pharmacological properties their polysaccharides can be considered from a different perspective as functional pharmaceutical excipient materials [5].

TYPES OF POLYSACCHARIDES IN MULBERRY LEAVES ACTING AS PHARMACEUTICAL EXCIPIENTS

Mulberry leaves (Morus alba L.) contain several naturally occurring polysaccharides that can be explored as pharmaceutical excipients. The polysaccharide fraction is mainly associated with the plant cell wall and includes cellulose, hemicellulose, pectic polysaccharides, and water-soluble heteropolysaccharides [6].

1.Cellulose: It is a major structural polysaccharide of plant cell walls which is mainly composed of β-(1→4)-linked glucose units. In pharmaceutical formulations, cellulose and its derivatives are widely used as diluents, binders, disintegrants, and matrix-forming agents. The cellulose fraction of mulberry leaves may therefore provide a useful natural source for developing cellulose-based excipients.

2. Hemicelluloses: Hemicelluloses are branched heteropolysaccharides containing sugars such as xylose, arabinose, glucose, mannose, and galactose. They can exhibit water-binding, swelling, and film-forming properties.

3. Pectic polysaccharides: Pectins are acidic polysaccharides containing substantial amounts of galacturonic acid, together with neutral sugars such as arabinose and galactose. They may be investigated as thickening agents, stabilizers, binders, mucoadhesive materials, and controlled-release matrix formers.

4. Water-soluble heteropolysaccharides: Mulberry leaves also contain water-soluble polysaccharide fractions composed of different monosaccharides, including glucose, galactose, arabinose, mannose, rhamnose, and uronic acids. Their physicochemical characteristics can vary depending on cultivar, geographical origin, maturity, and extraction method. These polysaccharides may provide hydration, viscosity, swelling, and film-forming properties, supporting their investigation as natural excipients.

5. Acidic polysaccharides: Acidic polysaccharides containing uronic acids represent another potentially useful fraction of mulberry leaves. Their ionic and hydrophilic nature can influence water uptake, gel formation, and drug–polymer interactions. Consequently, they may be explored for applications such as controlled drug delivery and mucoadhesive formulations.

An Overview on Mulberry Leaves and Its Polysaccharides

Mulberry (Morus alba L.) is a member of Moraceae family and it is widely distributed in a variety of climates from the tropics to temperate zones especially in Asia. Mulberry leaves are monoecious or dioecious and average sized trees, these are nutrient rich traditional herbs valued for medicine and food, also rich in vitamins, antioxidants and a unique compound called DNJ(1-deoxynojirimycin) it is a natural iminosugar that mimic the structure of glucose. These Mulberry leaves are largely recognised as a valuable source of biologically active compounds including proteins, flavonoids, phenolic compounds, minerals and naturally occurring polysaccharides [7].

Figure 03: Red and Black fruits of Mulberry plant

Polysaccharides represent as an important Macromolecular fraction of Mulberry leaves more than 20 years of Research has identified numerous crude and purified MLPs fraction with different monosaccharides compositions, biological properties current reviews explains about antioxidant, hypoglycaemic, immunomodulatory, anti- inflammatory, anti-coagulant and microbiota-related activities. In the recently ongoing research these mulberry leaf polysaccharides can be considered as pharmaceutical excipients because they possess various useful physicochemical and functional properties and are obtained from a natural plant source. These characteristics may allow their applications as binders, disintegrants, and controlled release matrix materials [8].

CHEMICAL CONSTITUENTS OF MULBERRY LEAVES [9-10]

Table 01: The major chemical constituents of mulberry leaves are presented in the following table.

Class	Important constituents/ examples	Relevance
Polysaccharides	Pectins, cellulose, hemicellulose, arabinogalactans, acidic polysaccharides	Potentially usefull as binders, suspending agents, thickening agents and stabilizers
Flavonoids	Rutin, quercetin, kaempferol, isoquercitrin, astragalin	Antioxidant and pharmacological activity
Phenolic acids	Chlorogenic acid, caffeic acid, ferulic acid, gallic acid	Antioxidant properties
Alkaloids	1-Deoxynojirimycin(DNJ) and related iminosugar	Important bioactive constituents
Proteins & amino acids	Essential and non-essential amino acids	Nutritional and functional components

Applications of Natural Polysaccharides in Mulberry Leaves as Pharmaceutical Excipients [11-15]

1.Binder in tablet formulation: Mulberry leaf polysaccharides contain hydrophilic polymeric components that can contribute to particle adhesion and improve granule formation. Therefore, the purified polysaccharides used as natural tablet binders which helps to improve the tablet hardness.

2.Synergistic therapeutic activity: They offer integrated anti-oxidant, anti-diabetic, and immunomodulatory activities which turns them into active excipients that actively complement the therapeutic goals of the loaded drug mainly in formulations managing the cardiometabolic disorders.

3.Thickening agent and Viscosity-modifying agent: These polysaccharides are widely used to increase the viscosity in pharmaceutical liquids and semisolid preparations therefore, serves as thickening agents in oral liquids, suspensions and topical formulations.

4.Film -forming agent: Mulberry-leaf polysaccharides may consequently have potential as filmforming excipients for coating tablets, capsules, and other dosage forms such films could provide protection from environmental conditions.

5.Disintegrant: Some plant polysaccharides exhibit swelling and water uptake properties, Mulberry -leaf polysaccharides may facilitate the water penetration and matrix swelling, promoting tablet breakup after administration. their disintegration performance would depend on polysaccharide composition, molecular weight and degree of swelling.

6.Suspending and stabilizing agent: Increased polymer-water interaction can helps to reduce sedimentation of dispersed particles. Consequently, mulberry polysaccharides may have potential as suspending or stabilizing excipients in pharmaceutical suspension.

7.Hydrogel-forming material: Polysaccharides are capable of extensive hydration or cross-linking can produce three-dimensional hydrogel networks these mulberry leaf polysaccharides could be investigated for hydrogel-based drug delivery and designed for prolonged drug release.

8.Mucoadhesive excipient: Hydrophilic polysaccharides can interact with mucin through hydrogen bonding and other intermolecular interactions, depending on their structural characteristics mulberry -leaf polysaccharides may have potential as mucoadhesive polymers for buccal, nasal, and gastrointestinal drug-delivery systems.

9.Emulsion stabilizer: Mulberry-leaf polysaccharides could therefore be explored as natural stabilizers in pharmaceutical emulsions, although this application requires experimental validation.

10.Lipid lowering and weight control: They inhibit pancreatic lipase activity, which prevents excessive lipid absorption in the gut. This suppresses fat accumulation in tissue and aids in overall weight management.

CONCLUSION

Mulberry Leaves possess phytochemicals and is being used extensively in Asia. Mulberry leaf polysaccharides (MLPs) represent naturally desired pharmaceutical excipients with considerable potential for the development of multifunctional and sustainable drug delivery systems. They added therapeutic value through inherit anti-oxidant, anti-inflammatory and anti-microbial activities. Their abilities to act as Binders, disintegrants, suspending agents, thickening agents, stabilizers, film-forming agents, and controlled -release materials make them valuable in different pharmaceutical dosage forms.(MLPs) are valuable source of naturally derived polymeric materials as well as their constituents are discussed in this article, It is reported that their antioxidant, antiinflammatory and other bioactive properties offer advantages over conventional pharmaceutical excipients their abundance biocompatibility, biodegradability renewable origin and versatile physicochemical characteristics make them complimentary materials to conventional synthetic and semisynthetic excipients. they provide opportunities for designing of hydrogels, film, novel matrix systems, nanoparticles and other advanced drug delivery platforms. Although further studies are required to standardize their extraction, purity, stability, safety, mulberry-leaf polysaccharides represent promising natural and sustainable alternative to synthetic excipients for future pharmaceutical formulations.

REFERENCES

1. Andallu B, Varadacharyulu NC. Antioxidant role of mulberry (Morus indica L. cv. Anantha) leaves in streptozotocin-diabetic rats. Clin Chim Acta. 2003;338:3-10.
2. Bharani SER, Asad M, Dhamanigi SS, Chandrakala GK. Immunomodulatory activity of methanolic extract of Morus alba Linn. (Mulberry) leaves. Pak J Pharm Sci. 2010;23:63-68.
3. Cui H, Lu T, Wang M, Zou X, Zhang Y, Yang X, Dong Y, Zhou H. Flavonoids from Morus alba L. leaves: optimization of extraction by response surface methodology and comprehensive evaluation of their antioxidant, antimicrobial, and inhibition of α-amylase activities through analytical hierarchy process. Molecules. 2019;24:2398. doi:10.3390/molecules24132398.
4. Katsube T, Imawaka N, Kawano Y, Yamazaki Y, Shiwaku K, Yamane Y. Antioxidant flavonol glycosides in mulberry (Morus alba L.) leaves isolated based on LDL antioxidant activity. Food Chem. 2006;97:25-31.
5. Khan MS, Chen C, Fu X. The effect of geographic variation on chemical composition, antioxidant and hypoglycemic activities of Morus alba L. polysaccharides. J Food Process Preserv. 2019;43:e14206. doi:10.1111/jfpp.14206.
6. Chen C, Mohamad Razali UH, Saikim FH, Mahyudin A, Mohd Noor NQI. Morus alba L. plant: bioactive compounds and potential as a functional food ingredient. Foods. 2021;10(3):689. doi:10.3390/foods10030689.
7. Chen J, Gou Z, Huang Y, Yu Q, Kim AN, Shi W, Zhou Y. Research progress on phytochemicals from mulberry with neuroprotective effects: a review. Pharmaceuticals (Basel). 2025;18(5):695. doi:10.3390/ph18050695.
8. Cho AR, Park WY, Lee HJ, Sim DY, Im E, Park JE, Ahn CH, Shim BS, Kim SH. Antitumor effect of morusin via G1 arrest and antiglycolysis by AMPK activation in hepatocellular cancer. Int J Mol Sci. 2021;22(19):10619. doi:10.3390/ijms221910619.
9. Zhao LJ, Qi FL, Qu XH, Chen YR. Nutrition health protection and comprehensive utilization of mulberry leaf. Food Nutr China. 2004;2:22-25. Chinese with English abstract.
10. Kayo DOI. Studies on the constituents of the leaves of Morus alba L. Chem Pharm Bull (Tokyo). 2001;49:151-153.
11. D'Urso G, Mes JJ, Montoro P, Hall RD, de Vos RCH. Identification of bioactive phytochemicals in mulberries. Metabolites. 2019;10:7. doi:10.3390/metabo10010007.
12. Devi B, Sharma N, Kumar D, Jeet K. Morus alba Linn: a phytopharmacological review. Int J Pharm Pharm Sci. 2013;5:14-18.
13. Shahid I, Umer Y, Chan K, Sarfraz RA, Kamal U. Proximate composition and antioxidant potential of leaves from three varieties of mulberry (Morus sp.): a comparative study. Int J Mol Sci. 2012;13:6651-6664.
14. Wang F, Li JR. Research progress on chemical constituents, physiological function and application of mulberry leaves. J Food Sci. 2005;26:111-117.
15. Zhai K, Tian J, Yan Y. Morus alba L.: bioactive constituents, pharmacological activities, and therapeutic potential. Curr Pharm Des. 2026. doi:10.2174/0113862073469823260410l.