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Review on Herbal Excipients Used as Coating Material

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Abstract

In recent years, the usage of herbal excipients in medicinal preparations has gained increasing attention due to their biocompatibility, non-toxic nature, and availability from natural sources. As coating materials, herbal excipients provide an eco-friendly alternative to synthetic polymers. These natural materials, derived from plants, are often less expensive, easily accessible, and have minimal environmental impact. The primary role of coating in drug formulations is to protect active pharmaceutical ingredients (APIs) from degradation, mask unpleasant taste, and ensure controlled drug release. Herbal excipients such as gums, resins, mucilage, and essential oils are being explored for their film-forming properties, mechanical strength, and biodegradability. In medicinal coatings, herbal excipients have become a viable and biocompatible substitute for synthetic materials. These plant-based natural coatings are applied to capsules, tablets, and other dosage forms, providing functional advantages such improved stability, controlled medication release, and protecting the environment. Gums (like gum acacia and guar gum), mucilages (like plantago and fenugreek), and resins (like shellac and rosin) are common herbal excipients that that have good film-forming, sticky, and protecting qualities. They are desirable for use in drug delivery systems due to their low toxicity, the biodegradability and combination with active medicinal components. Additionally, herbal excipients can be customized for particular uses, such prolonged release or enteric coatings, which make them adaptable to a range of pharmaceutical needs.

Keywords – Herbal excipients, Natural Coating agent, Plant based excipients, Natural colorants, Natural Preservatives, Natural Binders.

INTRODUCTION

The definition of the excipient is "the substance used as a medium for giving a medicament" [1]. A range of plant-based pharmaceutical excipients are used as bases in coating materials, suppositories, stabilisers, protecting agents, thickening agents, gelling agents, colloids, and stabilizing agents in the pharmaceutical industry [2]. Starch, cellulose, agar, acacia gum tragacanth, gum of guar, gum xanthan, pectin, or alginates, and carrageenan. Plant sources can be produced or harvested to provide a steady supply of the raw supplies due to their regenerative nature and sustainable. Herbal extracts can be made using food industry waste as a basic material. These provide additional justifications for the growing demand for herbal ingredients as excipients. [3] Particular applications for plant-derived polymers include the manufacture of implants, microparticles, viscosity fluid formulations, films, beads, rigid monolithic polymer processes, injected and inhalable processes, and for medicinal usage [4]. Natural polysaccharide polymers are specifically used in drug delivery system processing [5]. Simply expressed, pharmaceutical excipients are inert materials that are mixed with molecules that are medicinally active to create dosage forms [6]. Several plant-based pharmaceutical excipients are used in the pharmaceutical industry as bases in suppositories, coating materials, stabilizers, colloids, thickening agents, protectives, disintegrates, and sustaining agents [7].

The World Health Organization defines excipients as inert components they have been expertly evaluated to toxicity and added to a mechanism for delivering drugs [8]

Handling funding for the creation of the drug delivery system.

Maintain support and improve patient compliance, steadiness, and bioavailability.

Facilitates the recognition of substances

Support any other component of the general security of the medication and efficacy throughout preparation or use.

Substances or molecules that are not part of the active pharmaceutical ingredient and packaging are known as excipients. They can occasionally result in a virtually full formulation and affect how well the final result turns out. Nature has provided us with a vast array of benefits that either directly or indirectly assist or improve everyone's safety when they work as natural excipients [9]. Excipients greatly increase API efficiency while guaranteeing the finished product's efficacy and safety [10].

Figure 1*: *Herbal Medicines

Ideal Properties of herbal excipients

It should be practical to use.

It must be safe, causing no toxicity or irritation.

It should not evaporate easily

It should not evaporate easily.

It needs to be stable and unaffected by heat, light, or moisture.

It should be easy to find and affordable.

It should be clear, have no smell, and no taste.

It must dissolve in both water and oils.

It should work well with the active ingredient in the product.

It shouldn't have each pharmacological impact in the formulation.

Benefits of using medicinal excipients:

Biodegradable

Herbal Excipient(s) come from substances in nature. Polymers produced by living Organisms, which decompose without causing harm to humans or the surroundings.

Harmless or ecologically friendly

Most plant-derived excipients are made of carbohydrates, primarily composed of repeating monosaccharide units, making them non-toxic and safe for use

Cost-effective

These natural materials are generally more affordable, with lower Production costs compared to synthetic alternatives.

Safe with Minimal Side Effects

Being sourced from nature, herbal excipients are safe for Human use and typically come with fewer or no side effects.

Widely Available

Due to their demand across various industries, herbal excipients are Produced and readily available in many countries.

Disadvantages of herbal excipient

Bacteria contamination

Organic polymers an get exposing the outside world while being produced, increasing the risk of microbial contamination.

Variation

Unlike synthetic manufacturing, which uses fixed quantities of ingredients, natural polymer production depends on environmental and physical factors, leading to variations.

Uncontrolled hydration rate

Due to differences in the collection time, Animals, the environment, area, and the proportion of chemical elements in natural materials can vary.

Slow production

The frequency at which polymers that are naturally are produced is influenced by the surroundings and additional elements, so it cannot be easily sped use

Heavy metal contamination:

Natural polymers can be contaminated with heavy metals, a risk often associated with herbal excipients.

Classification of herbal excipients

Excipients are categorized based on their use and role in drug products [11]

Binders and Diluents

Help hold ingredients together or increase volume.

Lubricants, Glidants, and Disintegrants

Aid in manufacturing and ensure the tablet breaks down properly.

Polishing agents, Film formers, and Coating agents

Used to coat and protect the tablet.

Plasticizers and Colourings

Improve flexibility and add colour.

Suspending agents, Preservatives, and Antioxidants

Stabilize the product and extend shelf life.

Flavourings, Sweeteners, and Taste enhancers

Improve taste.

Printing inks, Dispersing agents, and Gums

Used for labeling and to ensure consistency in texture.

Excipients can also be classified based on their sources

Source	Example
Animal Sources	Bees, Wax, Cochineal, Honey, etc.
Vegetable Sources	Pectin, Starch, Cardamom, Vanilla, etc.
Mineral Sources	Bentonite, Kaolin, Paraffin, etc.
Marine Sources	Agar, Chitin, Alginates, etc.
Synthetic Products	PEG's, Povidone, etc [12]

Table 1*: *Classification of Herbal excipients based on sources

Classification based on Chemical Nature [13]

Chemical nature	Role	Example
Alcohols	Compliance with Alcohols for Patient	Volatile oils, Lanolin, Polyphenolic compounds
Esters, Ethers, Aldehydes, Carboxylic acids	For dose precision and accuracy	Fixed oil, Citric acid. Vanillin
Glycerides and Waxes	To enhance stability	Beeswax, Lanolin

Table 2*: *Classification based on Chemical Nature

Classification according to application of excipients [14]

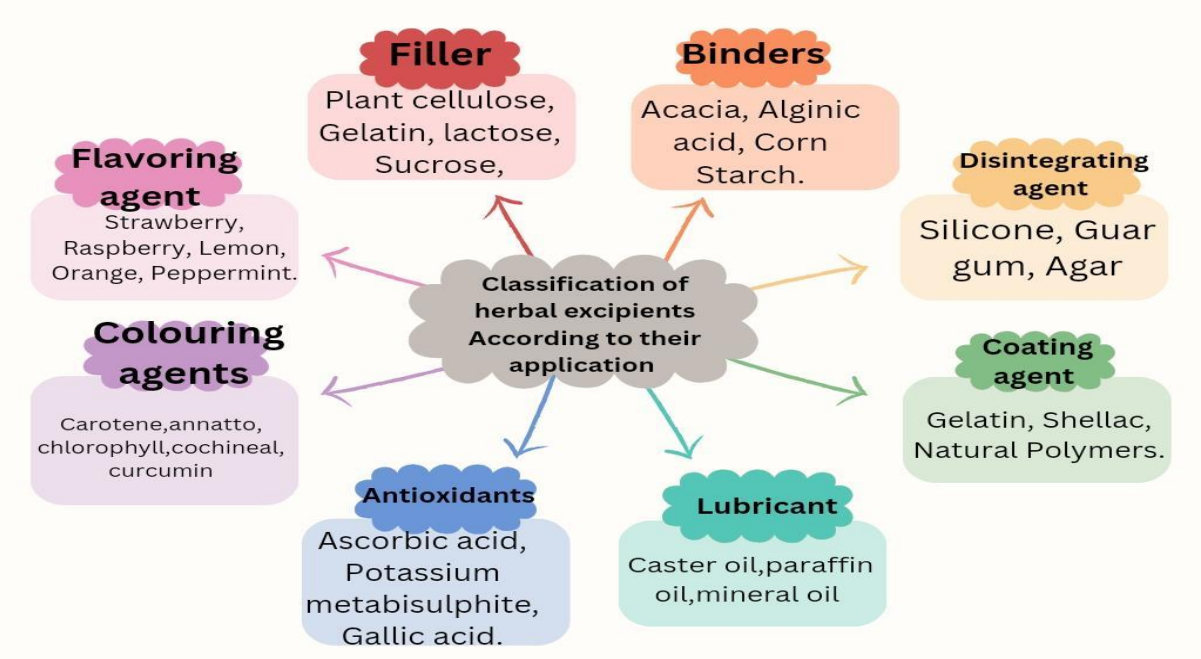

Figure 2*: *Excipients are categorized based on their intended use

Various kinds of natural excipients include

Natural(s) Colourant

Three fundamental questions need to be answered in order to comprehend the ideas behind natural dyes and plants that produce dyes: Why can only some plants produce dyes? What advantages does the plant receive from making dyes? What is the evolutionary theory behind dye production? Two more questions, "Why do plants have so many different colors?" and "What purpose might they serve for the plant?" can be used to support the answers to the first two questions. The color green is perhaps the most common in plants' leaves.[15].

Names of Plants	Title in botany	Chemical constituents	Application
Henna	Lawsonia inermis Lythraceae	Lawsone, Coumarins, Xanthene	Hair dye and other cosmetics
Turmeric	Curcuma Longalinn Zingibetaceae	Curcuminoids, Curcumin.	Colourants, Cosmetics and Food Products.
Annato	Bixa orellana Bixaceae	Bixin	Colouring and Coating agents.
Indigo	Indigo tinctoria Leguminosae	Indigo, rotenol	Colourant and food industry

Table 3*: *Some Natural Excipients used as Natural Colourant

Natural Sweeteners

The human species is characterized by a preference for sweet Flavors in a variety of intensities. By the sixteenth week of pregnancy, taste receptors begin to develop in the foetus, and the newborn baby might react well to sweetened solutions. The natural sweetener sugar has four calories per gram. It is known that consuming too much sugar increases calorie consumption, which can result in weight gain and chronic illnesses linked to obesity and dental cavities. Thus, sugar alternatives are required, as they can aid in calorie restriction, especially for those who are overweight [16].

The plant's naming	Constituents	Sweetness Potency
Stevia rebaudiana Compositae	Stevioside, Rebaudioside A	200-250
Glycyrrhiza glabra Leguminosae	Glycyrrhizin	100

Table 4*: *Some Natural Excipients used as Natural sweeteners

Natural binder

Excipients are additions that are utilized to change pharmaceutical active components into a dose form that may be administered to patients [17]. In order to give the tablet formulation flexibility and strengthen the interparticulate bonding within the tablet, binder is added [18]. Granule and also lowers the propensity for brittle fracture during tableting while raising the degree of consolidation or compactions.Selecting an appropriate binder for a tablet formulation necessitates a thorough understanding of the binder's properties in order to improve the tablet's strength and the way the different materials that make up the tablet interact.

Examples	Uses
Acacia	Natural binders for tablets, Thickener, Suspending agent and emulsifying
Tragacanth	Binder and diluents in tablets
Gelatin	Binder and thickener in tablets [19]

Table 5*: *Several Natural excipients used in natural sweetener

Natural Diluents

Natural diluents are compounds that come from natural sources and have the ability to lower a solute's or chemical compound's concentration. They are frequently used to lessen the potency or strength of an active ingredient without affecting the main properties of a variety of goods, including paints, medicines, and essential oils. [20-21].

Product	Use
Mannitol	Tablets and capsules diluent; sweetener agent; the tonicity agent; thickening agent for lyophilized formulations
Calcium	Diluent for. tablets and capsules; medicinal ingredient

Table 6*: *Several natural excipients used as natural diluents

Natural Lubricants

Excipients known as lubricants are used to make processes run more smoothly by putting certain compounds in them. When the preparation method, lubrication are employed to prevent components from sticking too. Lubricants preserve the stickiness of the formulation while reducing friction between the particles and processing machinery. Lubricant(s) like a solid dose type, may added to formulations in tiny amounts18. Additionally, lubricating are qualities like Ant adherent(s). Lubricants also improve movement of products in the reduction of friction between particles.[22].

Name of excipient(s)	Source
Steric acid	Animal
Caster fats	Caster pods

Table 7*: *Some Natural Excipients used as Natural Lubricants

Natural perfumes and Flavouring agent

The combined Varieties are sensory perceptions that include texture, smell, taste, or sights.Technology is being used by the flavoring businesses to create a wide variety of fake flavors these days. Flavors are used in a wide range of medications, such as medicines for coughing, sedatives, antibiotics of some kind and malaria prevention. Flavors are also widely used in the food manufacturing business. The flavoring compounds can be artificial or biological. While natural flavoring compounds are generated from plants themselves synthetic flavoring agents are produced in laboratories. There are several different kinds of flavoring agents, including ordering agents, sweeteners [23].

Name of excipients	Source (Plant)	Family
Lemon	Peel of Citrus lemon	Rutaceae
Orange	Peel of citrus sinensis	Rutaceae
Davana oil	Artemisia pallens	Asteraceae
Lavender oil	Lavandula latifolia	Lamiaceae

Table 8: *Some Natural Excipients used as Natural perfumes and Flavouring partum*

Natural preservatives

Chemicals called Preservation agents can be employed in the fields of products such as food, and medicine. They are used in the manufacturing to stop microbiological expansion to breaking down the items. They help to stop the undesirable changes in chemicals. Preservatives often fall into Antioxidant compounds and antimicrobial preservers are both separate groups.

Name of excipients	Source	Family
Clove oil	Buds by Myrtaceae syzygium	Myrtaceae
Neem oil	Fruits of Azadira chtaindica	Meliaceae
Cumin seeds	Seeds of Cuminum cyminum	Apiaceae
Turmeric	Roots of Curcuma longa	Zingiberaceae [24]

Table 9*: *Some Natural Excipients used as Natural Preservatives

Coating Agent

Pharmaceutical solid dosage forms and humans both benefit from coating agents in different ways. The dosage form is coated or covered with a film using coating agents. For example, they can be used to prevent the drug from entering the stomach or to help it absorb from the intestines [25]. Coating agents improve the efficacy of the product and guarantee its safety from external factors. Coating agents improve a formulation's appeal [26]. Tablets, pills, capsules, and other dosage forms are a few examples of how coating agents are utilized.

Name of excipients	Source
Gelatin	Animals
Xanthan gum	Secreted from bacterium Xanthomona scampestris
Guar gum	Seeds of Cyamopsistetra gonolobus L.Taub

Table 10*: *Some Natural Excipients used as Natural Coating agent

Extraction Technique of Herbal Excipients [27]

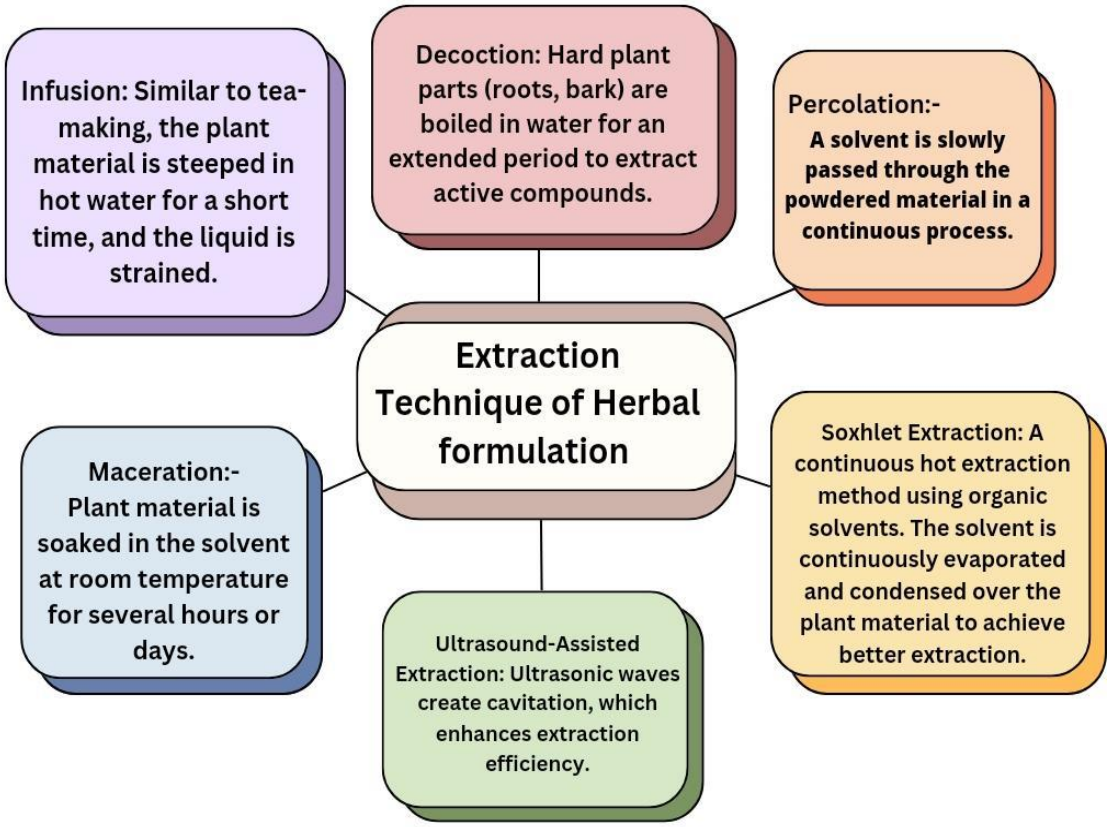

***Figure 3*:** *Extraction technique of Herbal Formulation*

The Use of Plant-Based Excipients

Tamarind gum

Sativa tamarindo, plant of the twenty-one perpetually green, families of trees, yields tamarind xyloglucan from the endosperm of its seeds. The seed is used to extract Tamarind Gum, sometimes called Tamarind Kernel Powder (TKP), which forms microspheres that range in size from 230 to 460 µm. TSP-containing Diclofenac sodium matrix tablets were examined in a different investigation. The wet granulation method used to manufacture the tablets was assessed for drug release [29].

Guar gum

The berries of the guar crop, Cyamopsis tetragonoloba, are the source of guar gum, a naturally occurring, liquid-soluble polymer. Because of its thickening and stabilizing qualities, it is utilized in a wide range of sectors, including food, medicines, beauty products, and fabrics. Additionally, guar gum is taken as a nutritional product to treat a number of ailments [30].

Starch

The starches, degraded carbs, as well as partly pre-gelatinized starches are examples of naturally occurring diluting agents. Aqueous milk sugar, lactose the monohydrate form, and alcohols made from sugar including emollient xylitol, and mannitol are examples of prevalent diluents. Greater tablets qualities, including increased cohesiveness or movement, are provided by diluent.

Honey locust gum

It belongs to the Leguminosea order and specifically the Mimoseae suborder and is known botanically as Gleditsia triacanthos. The seeds are where the gum is found.

Khaya gum

One source of Khaya gum is the tree Khaya grandifoliola (family Meliaceae), whose trunk has been cut.

Potential in creating a medication gum application has also been sparked by its availability in nature, affordability, and lack of toxicity. Research has also demonstrated that it may be used to produce controlled release tablets with a matrix of data that can be immediately compressed.

Aloe mucilage

Barbadensis vera It is made from millet stems. The main polysaccharide in the gel has been determined by some researchers to be partially acetylated mannan, or acemannan, whereas other researchers have determined that the primary carbohydrate is pectic substance [31]

Hakea gum

A dehydrated secretion from the Proteaceae family plant Hakea gibbosa is called hakea gum. Acidic arabimogalactone gums (type A). Molar ratios (%) of ingredients that contain sugar Galactose, Xylose, Mannose, Glucuronic Acid, and Arabinose are 12:43:32:5:8.

Pectin

Serves as a thickening and as a gelling agent in formulations with prolonged release. It is frequently included in chewy lozenges and table

Acacia

Applications for Acacia (Gum Arabic) include stabilizing emulsions and serving as a binder in tablet formulations. Additionally, it serves as a thickening agent in syrups. [32]

CONCLUSION

Herbal excipients have gained attention as promising alternatives to synthetic materials for pharmaceutical coatings due to their biocompatibility, biodegradability, and non-toxicity. Derived from natural sources, these excipients offer several advantages, including improved patient acceptability, minimal side effects, and eco-friendliness. Common herbal materials like gum arabic, guar gum, chitosan, cellulose derivatives, and aloe vera have been explored for use as coating agents in tablets, capsules, and other formulations. These excipients serve various purposes such as controlling drug release, protecting active ingredients from environmental factors (light, oxygen, and moisture), and masking unpleasant tastes. Despite its benefits, issues such inadequate standardized protocols, batch-to-batch variation and possible contamination by microbes must be resolved to guarantee reliable safety and performance. Technological developments in formulation, extraction, and purification could lessen these difficulties and increase the range of uses for them. All things considered, herbal excipients have a lot of promise for ecologically friendly pharmaceutical practices that follow the global trend toward natural and eco-friendly substitutes.

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