

## A Brief Review of Herbal Excipients

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### Abstract

Natural or herbal excipients are significantly more advantageous than their synthetic equivalents because they are readily available, non-toxic, and less expensive. The pharmaceutical industries are becoming more interested in using these herbal excipients – mainly polymers of natural origin – in formulation development because of growing knowledge of them. The purpose of this study is to provide light on the possibility of using natural excipients, which are biocompatible and able to provide additional nutrition to the produced dosage form, as a diluent, binder, disintegrant, and lubricant in various formulation types. An overview of natural excipients used in both novel and conventional drug delivery methods is provided in this article. Medical science is developing at an extremely rapid rate these days. Different kinds of formulations are found to be effective for treating certain diseases. Given that a dosage form is made up of an active pharmaceutical ingredient (API) and an excipient, it follows that an excipient is required for the formulation of all pharmacological dosage forms. Natural excipients derived from plant sources, such as gums, mucilages, starches, and cellulose have demonstrated promising functional properties, including swelling, gel formation, and mucoadhesion, which enhance drug delivery and therapeutic efficacy. Their biodegradability and minimal side effects make them suitable for long-term use and safer for patients with sensitivity to synthetic additives. Moreover, the eco-friendly nature of herbal excipients aligns with the increasing global demand for sustainable pharmaceutical practices. Current research also focuses on modifying natural polymers to improve their physicochemical characteristics, enabling their application in advanced drug delivery systems like nanoparticles, transdermal patches, and controlled-release formulations for enhanced patient compliance.

**Keywords:** Natural, herbal, nanoparticles, polymer, pharmaceuticals, excipients

### INTRODUCTION

Excipients, as defined by the World Health Organization, are substances other than active ingredients

that have undergone appropriate safety evaluation and/or are added into drug delivery systems to:

- Assist in processing drug delivery system during its manufacture,
- Protect, support and improve stability, bioavailability or patient acceptability,
- Assist in product identification. Improve any additional features that contribute to the drug delivery system's general efficacy and safety during usage or storage [1].

Excipients were originally used in drug formulations as an inert vehicle to provide the proper weight, consistency, and volume required for the active component to be administered correctly, but in more recent pharmaceutical dosage forms. They frequently play multiple roles,

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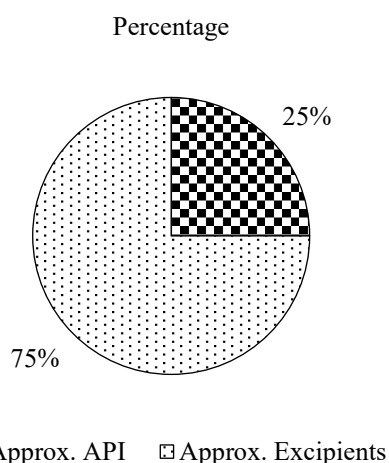
including modifying release, enhancing patient acceptance, improving the stability and bioavailability of the active ingredient, and maintaining ease of manufacture [2].

Excipients are typically used in the same older indefinite quantity forms as sweeteners, diluents, binders, disintegrates, adhesives, and glidants, among other forms like tablet, capsule [3].

Researchers studying flavoring excipients are becoming more interested in the subject since the institution of toxicity and approval from limited authorities warn of significant problems with artificial excipients [4].

### PHARMACEUTICAL EXCIPIENTS

To manufacture medicines, non-active substances known as “Pharmaceutical excipients” are combined with one or more therapeutically active compounds. An ingredient is considered an excipient if it is not an active ingredient (Figure 1) [5].



**Figure 1.** Percentage of excipients & API in dosage form.

### Natural Excipients

Natural excipients are substances used in formulations that are derived from a variety of natural sources, including minerals, plants, and animals. Because they are less poisonous, have less side effects, and have lower dosages, natural excipients are often employed [6].

### Ideal Properties of Excipients

- They have useful applications.
- They should not be harmful or irritating in any way.
- They ought to be of a non-volatile type.
- They should not be affected by hydrolysis, light, or temperature.
- They must be easily available and economically priced [7].

### Classification of Excipients

- Binders, Diluents.
- Lubricants, Glidants, Disintegrates.
- Polishing Film formers and coatings agents.
- Plasticizers, Colorings.
- Suspending agents Preservatives, antioxidants.
- Flavoring, Sweeteners, Taste improving agents.
- Printing inks Dispersing agent gums (Table 1) [8].

**Table 1.** Classification of excipients.

S.N.	Excipients	Examples
1.	Colorants	Henna, indigo, caramel, chlorophyll, amaranth
2.	Sweeteners	Glycyrrhiza, honey, starch
3.	Binding agents	Acacia, gelatine, tragacanth, starch
4.	Viscosity enhancer	Pectin, tragacanth, cellulose, guar gum
5.	Diluents	Lactose, starch, mannitol, sucrose
6.	Disintegrating agent	Starch, isabgol husk, CMC
7.	Ointment bases	Lanolin, bees wax
8.	Emulsifying agent	Acacia, agar, guar gum
9.	Flavoring agent	Cardamom, vanilla, lemon oil, orange oil
10.	Perfumes	Rose, lavender, sandal wood

### CLASSIFICATION OF EXCIPIENTS BASED ON SOURCE

- *Products From Animal Sources:* e.g., Beeswax, Cochineal, Gelatine, Honey, Spermaceti, Lanolin, etc.
- *Products From Vegetable Sources:* e.g., Kokum Butter, Pectin, Starch, Peppermint oil, Cardamom, Vanilla, etc.
- *Products From Mineral Sources:* e.g., Bentonite, Kieselghur, Kaolin, Paraffin, Talc, fullers earth, etc.
- *Synthetic Products:* e.g., PEGs, Polysorbates, Povidone [9].

Classification of excipients based on their chemical nature depicts in Table 2 & the classification of excipients based on their applications depicts in Table 3.

**Table 2.** Classification of excipients based on their chemical nature [10].

S.N.	Chemical Name	Role	Examples
1.	Alcohol	For patient compliance.	Volatile oil, Lanolin, polyphenolic compounds.
2.	Esters, Ethers, Aldehydes, Carboxylic acids.	For dose precision and accuracy.	Fixed oil, citric acid, lanolin.
3.	Glycerides and waxes	To enhance stability.	Bees wax. Lanolin.
4.	Carbohydrates	Assist in the manufacturing process.	Gums and mucilage,
5.	Hydrocarbons and halogen derivatives	Drug tolerance.	Drug tolerance.
6.	Polymers (Natural and synthetic)	To avoid drug disaggregation.	Cellulose, pectin.
7.	Minerals	Help with drug dissolution.	Bentonite, talc, calamine.
8.	Proteins	Preparing controlled release formulation.	Gelatine, soybean.
9.	Preservatives, dyes, sweeteners, surfactants	To enhance absorption, to preserve, to make bitter taste and color.	Stevia, honey, henna, cochineal, antioxidants, Polysorbates, emulsifying waxes.

### ADVANTAGES OF HERBAL EXCIPIENTS

- *Biodegradable:* Naturally occurring polymers produced by all living organisms. They show No adverse effects on the environment or human being.
- *Biocompatible and Non-Toxic:* Chemically, nearly all these plant materials are Carbohydrates in nature and are composed of Repeating Monosaccharide units. Hence, they are non-toxic.
- *Low-Cost:* Natural sources are always more affordable to use. In addition, the cost of manufacture is significantly less than that of synthetic materials. India, along with many other emerging nations,

depends heavily on agriculture.

- *Environmental-Friendly Processing*: Because the production methods involved are simple, gums and mucilage's from various sources can be easily collected in different seasons in large amounts (Figure 2) [11].

**Table 3.** Classification of excipients based on their applications [10].

S.N.	Category	Examples
1.	Fillers	Plant cellulose, Gelatine, lactose, Sucrose, Glucose.
2.	Binders	Acacia, Alginic acid, Corn Starch.
3.	Disintegrating agents	Silicone, Guar gum, Agar.
4.	Coating agents	Gelatine, Shellac, Natural Polymers.
5.	Lubricants	Castor oil, Mineral oil, Paraffin oil.
6.	Antioxidants	Ascorbic acid, Potassium metabisulphite, Sodium metabisulphite, Gallic acid.
7.	Coloring agents	Annatto, Carotene, Chlorophyll, Cochineal, Curcumin.
8.	Flavoring agents	Strawberry, Raspberry, Lemon, Orange, Peppermint.
9.	Solvent	Purified water, Oils.
10.	Chelating agents	Onions, Garlic, Chlorella, Brazil nuts.
11.	Buffering agents	Lemon.
12.	Surface active agents	Waxes, Saponins.
13.	Viscosity builders or emulsifiers	Gelatine, Mucilage of Aloe, Gums.



**Figure 2.** Advantages of herbal excipients.

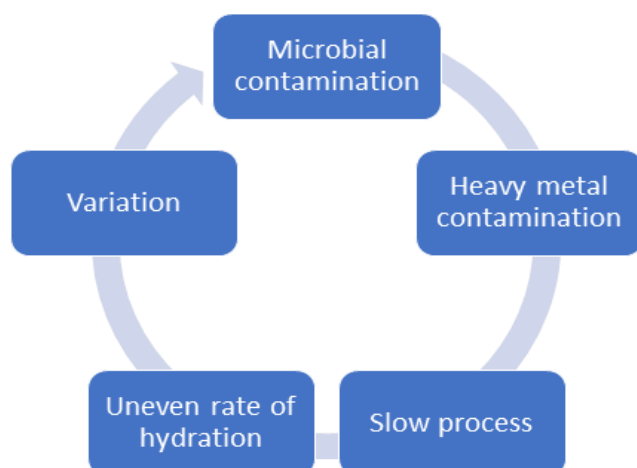
### DISADVANTAGES OF HERBAL EXCIPIENTS

- *Microbial Contamination*: During production, they are exposed to an external environment and hence, there are chances of microbial contamination.
- *Variation*: Synthetic manufacturing is a controlled procedure with fixed quantities of ingredients while production of natural polymers is dependent on environment and various physical factors.
- *The Uncontrolled Rate of Hydration*: Due to Differences in the collection of natural Materials at different times, as well as Differences in region, species & climate Conditions the percentage of chemical Constituents present in each material may vary (Figure 3) [11, 12].

### FUNCTIONS OF EXCIPIENTS

- Add bulk to the formulation.
- During manufacturing it helps to handle Active Pharmaceutical Ingredients.

- Assist in drug administration.
- Enhance patient compliance.
- Various herbal excipients with their sources and uses have been depicted in Table 3 [13].
- Enhance drug solubility and bioavailability of Active Pharmaceutical Ingredients [10]. Various Herbal Excipients with their sources depicts in Table 4.



**Figure 3.** Disadvantages of herbal excipients.

**Table 4.** Various herbal excipients with their source and uses.

S.N.	Name of Excipients	Source	Category/Uses
1.	Agar	<i>Gelidium amansii</i> (Gelidaceae)	Laxative, suspending agent, emulsifying agent, gelling agent in suppositories, surgical lubricant, tablet disintegrations, medium for bacterial culture.
2.	Gum ghatti	<i>Anogeissus latifolia</i> (Combretaceae)	Binder, emulsifier, suspending agent.
3.	Agarcanth	<i>Astragalus gummifer</i> (Leguminosae)	Thickening agent, demulcent, Suspending agent, emulsifying agent, emollient in cosmetics and sustained release agent.
4.	Albizia gum	<i>Albizia zygia</i> (Leguminosae)	Binder agent.
5.	Aloe mucilage	Aloe species (Liliaceae)	Gelling agent, sustained release agent.
6.	Bavchi mucilage	<i>Ocimum canum</i> (Gigarginaceae)	Suspending agent, emulsifying agent.
7.	Senna tora	<i>Cassia tora</i> Linn (Leguminosae)	Binding agent.
8.	Gum acacia	<i>Acacia arabica</i> (Combretaceae)	Suspending agent, emulsifying agent, binder in tablets, demulcent and emollient in cosmetics.
9.	Khaya gum	<i>Khaya grandifolia</i> (Labiatae)	Binding agent.
10.	Shatavari mucilage	<i>Asparagus racemosus</i> (Aapocynaceae)	Binding agent and sustaining agent in tablet.
11.	Tamarind seed	<i>Tamarindus indica</i> (Leguminosae)	Binding agent, emulsifier.
12.	Gellan gum	<i>Pseudomonas elodea</i> (Leguminosae)	Disintegrating agent.

## DIFFERENT TYPES OF NATURAL EXCIPIENTS

### Natural Binders

Excipients are substances that are used to transform active pharmaceutical components into dosage forms that can be administered to patients [14]. To give the tablet formulation flexibility and

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enhance the interparticulate bonding within the tablet, a binder is added. Granule and reduces the risk for brittle fracture during tableting while raising the degree of consolidation or compactions. Selecting an appropriate binder for a tablet formulation requires a thorough understanding of the binder's properties to maximize the tablet's strength and the interaction of the many materials that make up the tablet [15].

#### **Advantages of Natural Binders**

- They are more affordable, readily available, biodegradable, and less toxic.
- They may have an impact on the drug's release, which may then have an impact on the drug's absorption and bioavailability.
- They enhance the dosage form's accuracy, precision, and stability.
- To improve patient compliance, they improve the drugs' organoleptic qualities.

#### **Disadvantages of Synthetic Binders**

- Sometimes, they lead to the hardening of tablets, which in turn reduces their dissolving performance.
- Strong disintegrants, including super disintegrants, must be added if polymer binders are used. These additives are expensive and have an adverse effect on the final product's film coating look as well as product stability [13].

#### **Natural Diluents and Fillers**

The pharmaceutical business today frequently uses natural fillers and diluents due to their advantages over synthetic ones. Doses that incorporate fillers and diluents include tablets, pills, pellets, paste, solutions, suspensions, emulsions, and other types of dosage administration. Natural excipients are used as diluents and fillers, such as cellulose [16].

#### **Advantages of Natural Fillers and Diluents**

- Biodegradable.
- Does not have adverse effects.
- Possess no toxicity.
- Available at ease.
- Economic.
- No environmental detrimental effects.

#### **Disadvantages of Synthetic Fillers and Diluents**

- They were expensive.
- may have an impact on the environment.
- possibly adverse effects.
- Does not work well with some additives [10].

#### **Natural Colorants**

In India, there are more than 450 plants that can yield dyes. In addition to their dye-yielding characteristics, some of these plants also possess medicinal value. Natural dyes are environmentally friendly for example, turmeric, the brightest of naturally occurring yellow dyes is a powerful antiseptic which revitalizes the skin, while indigo gives a cooling sensation [17].

#### **Advantages of Natural Colorants**

- Natural colorants have a calming, glossy, and gentle quality.
- There are numerous color options.
- Since natural dyes are typically renewable, there is no disposal issue.
- Stable and environmentally friendly.

- Not harmful to people's health.
- Display a few health-related qualities.

#### **Disadvantages of Synthetic Colorants**

- Able to cause allergic reactions.
- Possibly hazardous in nature.
- It has the capacity to cause teratogenic and toxic effects.
- As per WHO report, Synthetic colorants have been linked to several health issues, including impulsivity, low temperature, ADHA, immune system issues, and frustration [10].

#### **Natural Flavoring Agents**

Flavoring substances that are frequently employed as pharmacological aids can be synthetic or naturally occurring. Numerous pharmacological dosage forms, including tablets, syrups, emulsions, suspensions, and other oral dosage forms, contain these flavoring agents. They are mostly used to cover up the formulation's unpleasant taste or odor without producing chemical or physical incompatibility [18].

#### **Advantages of Natural Flavoring Agents**

- The realistic flavor is provided by natural flavorings or fragrances.
- Not harmful to the environment and non-toxic.
- They are more stable and less expensive.
- Readily available.

#### **Disadvantages of Natural Flavoring Agents**

- Their nature is poisonous.
- Since they are difficult to biodegrade, they can have an impact on the environment.
- Costly.
- Extremely concentrated and must be applied lightly [10].

#### **Disintegrants**

Disintegrants are substances that are added to tablets, capsules, and some encapsulated formulations to facilitate their disintegration into smaller pieces in an aqueous environment. Disintegrants thereby facilitate the quick release of medication particles by increasing the surface area that is available. The three mechanisms and factors influencing tablet disintegration are swelling, porosity and capillary action, and deformation.

#### **Advantages of Natural Disintegrants**

- Even at low concentrations, they still work.
- They have less impact on the powder's or granules' compressibility and flowability.
- The intragranular form of them works better.

#### **Disadvantages of Natural Disintegrants**

- Since they are more hygroscopic, medications that are sensitive to moisture cannot be used with them.
- Since some of them are anionic, they may only weakly bind to cationic medications in vitro (which will not cause an issue in vivo) [13].

#### **APPLICATIONS FOR HERBAL EXCIPIENTS**

Natural medications, such as agitate, baati, Bhasma, and so on are used before the produced mixes arrive. Owing to the substantial negative effects or symptoms of produced enhancers, they are used under special regulations in a limited area. To increase the strength of mixtures, researchers these days

also prefer to use semi-manufactured mixtures or as many regular excipients as is reasonably possible. Most therapeutically active mixes are either naturally occurring or are created by corporations employing naturally occurring dynamic mixtures. Additionally, consumers use more typical or natural products because of their less or non-poisonous [19].

### **Tamarind Gum**

Studies examining the effectiveness of tamarind seed polyose as a binder for tablet dosage forms were conducted using both weight granulation and direct compression techniques. The outcomes suggested that polyose from tamarind seeds could be used as a binder for tableting techniques that involve weight granulation and direct compression [20].

### **Guar Gum**

Guar gum is utilized in pill formulations as a dissolving, binding, and colloid; it also lowers blood sugar concentrations in diabetics and serum levels in hyperlipidemia patients. It is also used in bulk laxatives as an appetite suppressant. This stabilizer for emulsions is quite helpful. It is not affected by the pH, moisture content, or solubility of the tablet matrix. It is not usually perfectly white; on sometimes, its color varies from off-white to brown, and it tends to discolor in alkaline environments [21].

### **Pectin (Stabilizer)**

Plant cell walls contain a non-starch linear polymer called pectin, which is frequently employed as a stabilizer. Alginate and pectin polymer combinations are utilized to increase folic acid stability. When compared to capsules produced mainly of alginate, the mix matrix improved the folic acid encapsulation efficiency and decreased leakage from the capsules; after freezing drying and storage, the blend matrix demonstrated greater folic acid retention [22].

### **Alginates**

Naturally occurring alginate polymers are widely used as food additives and are known to be non-toxic; they provide great potential for use in medication development. Alginates can be customized to meet the needs of applicants in the biomedical and pharmaceutical industries. This set of polymers has several attributes that make it helpful as a formulation aid, particularly as a tool for polymeric-controlled drug administration and as a traditional excipient [23].

### **Xanthan Gum**

Because of its remarkable qualities, including prolonged emulsion stability in acidic, alkaline, and saline media, thermal stability, and pseudoplasticity, xanthan gum is said to have significant applications in many industries. It is widely employed in the chemical industry, wherein products, like deodorant gels, are made using xanthan and locust bean gum [24].

### **Aloe Mucilage**

Aloe barbadense Miller leaves are used to make aloe mucilage. In addition to the various carbohydrates, it has been demonstrated that the aloe parenchyma tissue or pulp contains proteins, lipids, amino acids, vitamins, enzymes, inorganic chemicals, and tiny organic molecules [25].

### **Locust Bean Gum**

Carob gum, sometimes referred to as locust bean gum (LBG), is obtained from the refined endosperm of seeds derived from the *Ceretonia siliqua* L. carob tree. This tree belongs to the family Legume and is evergreen. The procedure of extracting and preparing the endosperm from carob tree seeds yields carob bean gum [26].

### **Gum Acacia**

It is obtained from stems of tree *Acacia Arabica*. It dissolves in water and forms a thick gel. In research it was indicated that gum acacia might be utilized as a binder in tablets. Gum acacia can be used as an encapsulating ingredient in conjunction with gelatine to prepare microspheres [27].

### Starches

One of the most important pharmaceutical excipients in the formulation of pharmaceutical tablets and capsules is starch, whether it is in its original or modified form. It can be used as a disintegrant, bulking agent, binder, or to help transport drugs. Microcapsules containing a protein and a proteinase inhibitor were produced to deliver proteins or peptides medicines orally [28].

### Karaya Gum

Karaya gum is widely used as bulk laxative. Pharmaceutically, it is used as a Suspending agent, emulsifying agent, stabilizing and thickening agent. dental adhesive, matrix forming agent in sustain release tablets and it has also been used in food, paper and textile industries [28].

### CONCLUSIONS

The objective of this review was to collect information about various natural excipients used in pharmaceuticals that come from natural sources, including microbes, plants, animals, and minerals. Natural excipients can interact chemically with other excipients in a medication delivery system because they are biodegradable substances. Furthermore, natural excipients are less expensive (economic) than synthetic chemicals, readily available, and non-toxic. Natural excipients are essential for the food, cosmetics, and pharmaceutical industries. These are developing into excellent components for pharmaceutical delivery systems.

Excipient, a partner of the API in a dosage form meanwhile has major share in a formulation sometimes and showing their unique pharmacokinetics and pharmacodynamics apart from Active Pharmaceutical Ingredients to complete the motive of medicine. Human, a creation of nature is well supplied with natural materials that were used as medicament too since thousands year even in many traditional medical sciences including Ayurveda in India. In this regard, these natural excipients used in Ayurvedic pharmaceutics may play a major role as advance nurture for Ayurvedic medicament as well as modern medicament to fulfil the requirement of time demanding dosage form with quality, safety and efficacy along with cost effectiveness and serve the creation of nature by its natural nurture and medicament.

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