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A Review on Herbal Excipients in Pharmaceutical Formulations

Nityanand Tiwari[1*], Vishal Rai[2], Shekhar Singh[3]

[1,2,3]Suyash Institute of Pharmacy, Hakkabad, Gorakhpur, Uttar Pradesh, India

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Corresponding Author
Nityanand Tiwari
Suyash Institute of Pharmacy, Hakkabad, Gorakhpur, Uttar Pradesh, India.

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ABSTRACT

Herbal components derived from natural sources are gradually replacing synthetic materials in the pharmaceutical industry. These components, which originate from herbs, are biocompatible and possess medicinal value. They play essential roles in drug formulations as binders, stabilizers, and other key ingredients. Herbal excipients are highlighted in this review, revealing their uses in pharmaceutical preparations, roles in drug formulations, and advantages over synthetic excipients. We also delve into the challenges and future prospects of herbal excipients in creating sustainable and effective drug delivery system. This review brings to light the uses of herbal excipients in pharmaceutical preparations, their roles in drug formulations, and their advantages over synthetic excipients. The challenges and future prospects of herbal excipients in developing sustainable and effective drug delivery systems are also discussed.

Key Words: *Excipients herbal, drug formulation, biocompatibility pharmaceutical additives.*

INTRODUCTION

Excipients are vital non-active ingredients in drug formulations, playing a significant role in achieving stability, bioavailability, and ease of administration. They are traditionally synthetic or semi-synthetic in nature. The use of herbal excipients derived from natural plant sources has been stimulated in recent years. Interests have shown an upsurge, driven by concerns over safety, biocompatibility, and environmental sustainability of synthetic excipients. The pharmaceutical industry's demand for more natural and green formulations also contributes to this trend[1].

Advantages of herbal excipients over synthetic ones are evident. They are biocompatible and biodegradable. Additionally, they exhibit therapeutic values such as antimicrobial and antioxidant actions, enhancing the overall effectiveness of a drug formulation. Patients welltolerate plant-derived excipients, making them less likely to cause adverse reactions or toxicity due to their generally safer nature. The philosophy of sustainability in the production of pharmaceutical industry is reflected in the use of eco-friendly and renewable products of natural origin[2]. Excipients, in pharmaceutical drug formulations, serve a wide range of functions and include herbal gums, resins, and starches. They act as binders, emulsifiers, stabilizers, and masking agents for taste. Herbal excipients, such as acacia gum, starch from maize, and mucilage from Aloe vera, render themselves suitable for various pharmaceutical applications due to their unique physicochemical properties[3]. However, despite the benefits, the use of herbal excipients also presents several issues. These include issues such as batch-to-batch variability, stability, and a lack of standardization and regulatory approval.

Classification of Herbal Excipients:

In pharmaceutical formulations, herbal excipients attain a prominent role due to their natural origins, biocompatibility, and extra therapeutic benefits. They meet various requirements in drug formulation and can be classified based on their function in the formulation process. The classification of herbal excipients is as follows:

1. **Binders:** Impart cohesiveness to powder ingredients and help form tablets with their aid. Herbal binders, which are typically polysaccharides or mucilage of plant origin, are used in this process.

2. **Herbal dissolution:** Agents cause the disruption of tablets into smaller fragments after ingestion, allowing for drug release and uptake[4]. Their advantages include being non-toxic and biodegradable.

Example:

1. **plant ago Seed Mucilage**: The mucilage of Plant ago ovate is effectively acted upon as a dissolution agent and has a high capacity for absorbing moisture.
2. **Fenugreek Seed Mucilage**: The mucilage of Trigon Ella foenum-graecum is used in the tablet formulation and has been seen to possess good disintegrating properties[5].
3. **.Fillers/Diluents**: Herbal fillers are added to increase the bulk drug formulation when API is in less quantity[6]. They offer advantages due to their low toxicity and natural origin in this process.

Example:

1. **Starches** - Numbers and symbols used to refer to the authors and their publication are typically placed in parentheses at the end of a sentence in the active voice[7]. In the passive voice, they are usually integrated into the sentence in a different way, such as at the beginning or within the sentence.
2. **Microcrystalline Cellulose** - Microcrystalline Cellulose is commonly used as a diluent in tablet formulations due to its excellent compressibility and flow properties[8].
3. **Stabilizers-** Gum Tragacanth stabilizes pharmaceutical formulations, preventing degradation and maintaining their stability and integrity. It is one of the herbal stabilizers used, and it functions as a gum, mucilage, or thickener to improve the formulation's shelf life[9].

1. **Tragacanth** : Tragacanth is obtained from Astragalus species and is used as a stabilizer in the formulation of liquids and semi-solids[10].
2. **Xanthan Gum**: It is a polysaccharide, which is also produced by the fermentation of plant sugars, and widely used in suspension, emulsions as stabilizers.

4. Emulsifier: Herbal emulsifiers prevent the separation of oil and water phases in liquid formulations by stabilizing emulsions[11]. They are preferred due to their non-toxic and biodegradable nature.

Examples include:

1. **Lecithin**: Lecithin is derived from soybean and functions as a natural emulsifier in both topical and oral formulations[12].
2. **Sapiens**: Emulsifiers are used in pharmaceutical formulations with the help of plant-derived sapiens, such as those from Qualia or Yucca species.

5. Lubricants: Herb lubricants are applied in the tablet making process to minimize contamination and help reduce friction, making it easier for tablets to be extracted from the dies and punches[13].

Some examples include:

1. **Castor Oil:** An oil plant extract used for its lubricating properties in many tableted preparations[14].
2. **Rice Bran Oil**: Rice bran oil is used as a lubricant and Guidant in tablet formulations to offer smooth production of tablets[16].

6. Flavoring and Sweetening Agents: Natural agents are applied as flavoring and sweetening agents in herbal excipients for oral drug formulations[17].These agents make the medications more palatable for patients, including those in pediatric formulations[18].

Examples include:

1. Stevia is derived from the Stevia rebaudiana plant and is used as a natural sweetener in drug formulations, serving as an alternative to synthetic sweeteners[19].
2. Menthol is derived from the peppermint plant oil and acts as both a fragrance and a coolant in orals and topical[21].

7. Coating Agents Herbal- based coating agents are biodegradable and get applied on the surface of tablets or capsules to protect the drug, mask unpleasant tastes, and enhance the aesthetic appeal of the dosage form[22].

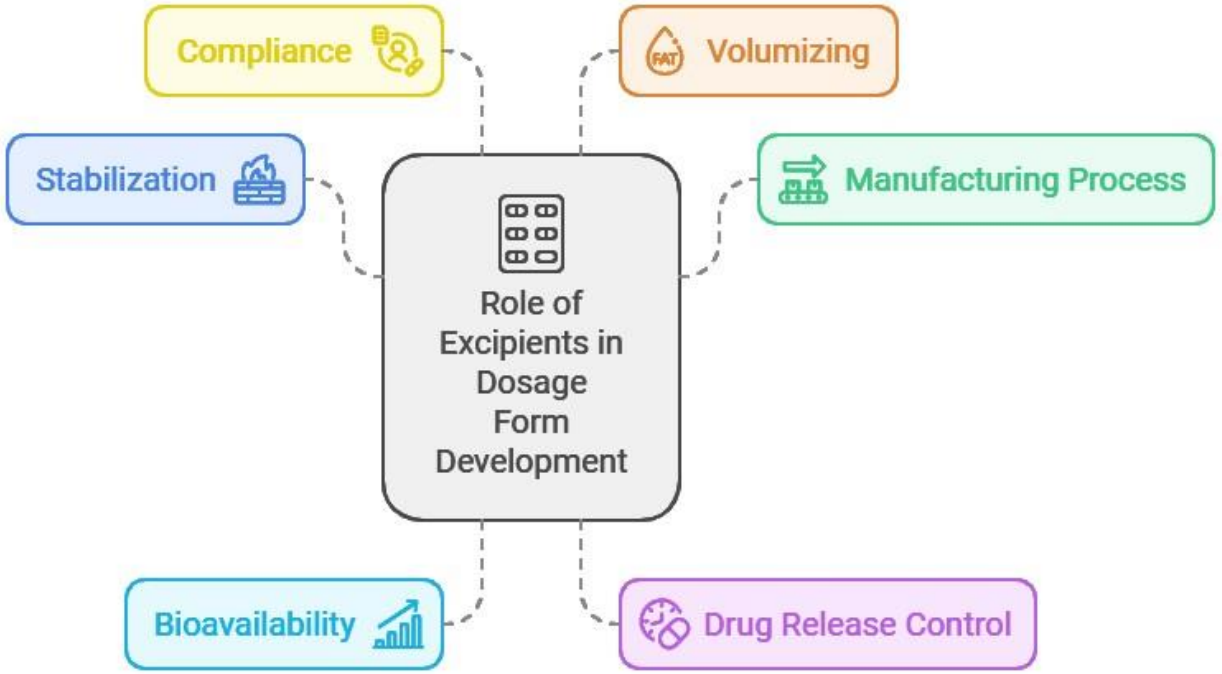
Examples include:

1. **Shellac:** The insect Laccifer lacca produces the exudate shellac, which is used as a natural film-coating agent in pharmaceutical formulations[23].
2. **Chitosan:** Although it comes from shellfish, some of these chitosans can be derived from plants and, in that form, are applied as a coating agent, owing to their film-forming properties[24].

Role of excipient in development of dosage form

Excipients carry out multiple roles during the development of a dosage form, acting as inactive ingredients to support the active pharmaceutical ingredient. They perform several important functions in the formulation process:

1. **Active Ingredient Stabilization:** Antioxidants shield APIs from oxidation, while excipients protect the active pharmaceutical ingredients (API) from environmental factors such as moisture, light, and oxidation[25].
2. **Excipients in the Manufacturing Process**: Excipients like lubricants, binders and fillers will make the process of dosage form manufacturing smooth. These help overcome sticking issues and facilitate tablet compression without impairing flow properties of powders[26].
3. **Improvement of Bioavailability**: Bioavailability of drugs is enhanced by excipients. They function as solubilizes or permeates to boost the API's solubility and permeability in the body[27]. Surfactants, such as cyclodextrins, are among the solubilizing agents used[28].
4. **Control of Drug Release**: Formulations can be made with sustained-release or delayedrelease properties by using polymer and coating agents to control the release of APIs[29].
5. **Satisfaction of Compliance**: Flavoring agents and sweetening agents increase the palatability of drugs whereas for children's preparations they also give a good color to these drugs[30]. In addition, excipients can be used to improve the physical and chemical property of a drug.
6. **Adding Volumoinc**: Excipients ensure a pharmaceutical product's efficacy, safety, stability, and manufacturability by adding bulk to high potency drugs, making it easier to produce tablets or capsules[35]. They contribute to the success of the dosage form in its final form.



Advantages of herbal excipients:-

Herbal excipients are gaining prominence in the pharmaceutical formulation. Derived from plant-based raw materials, they offer several advantages.

1. **Biodegradability**
2. **Biocompatibility and Safety**
3. **Non-toxicity and Hypoallergenic Nature**
4. **Sustainability**

1. Biodegradability:

Herbal excipients are biodegradable in nature, decomposing spontaneously without leaving harmful residues in the environment[34]. This reduces the impact on the environment compared to synthetic excipients.

2. Biocompatibility and Safety:

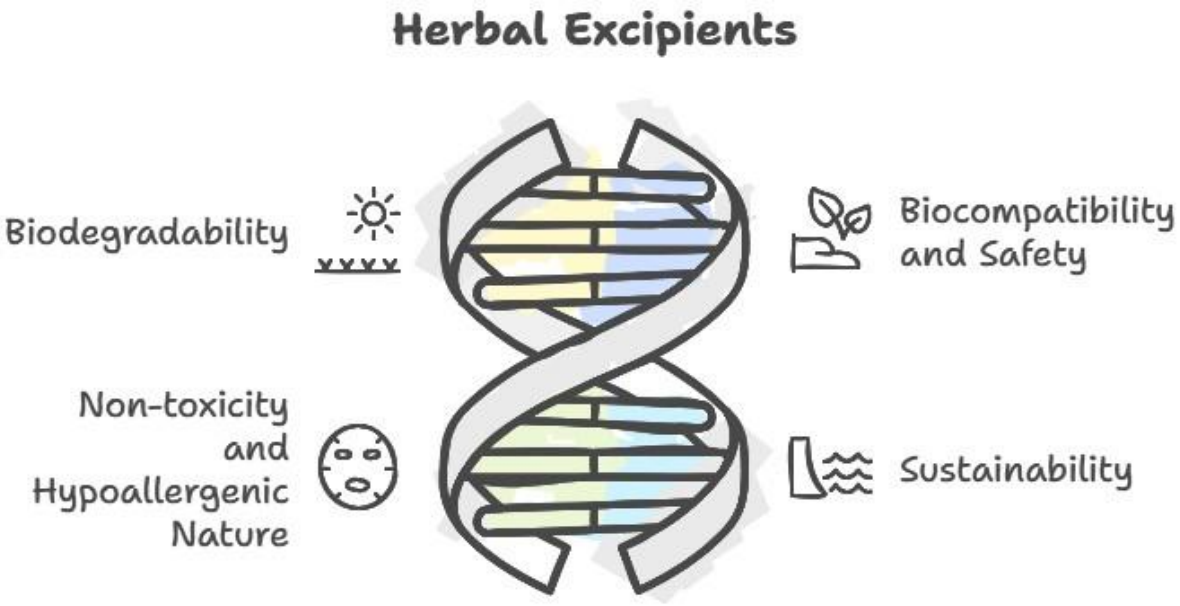
Most herbal excipients are well biocompatible, so less likely to elicit adverse reactions or toxicity, making them safer, especially for long-term use or in sensitive populations, such as children or the elderly[33].

3. Non-toxicity and Hypoallergenic Nature:

Herbal excipients are suitable for use in sensitive patients and those allergic to synthetic chemicals due to their nontoxic and hypo allergic nature, if processed appropriately.

4. Sustainability:

Herbal excipients are renewable resources derived from plants but renewable at the same time[31]. They can be grown and harvested in the environment in a sustainable manner, thus reducing dependence on petrochemical-based synthetic excipients[32].

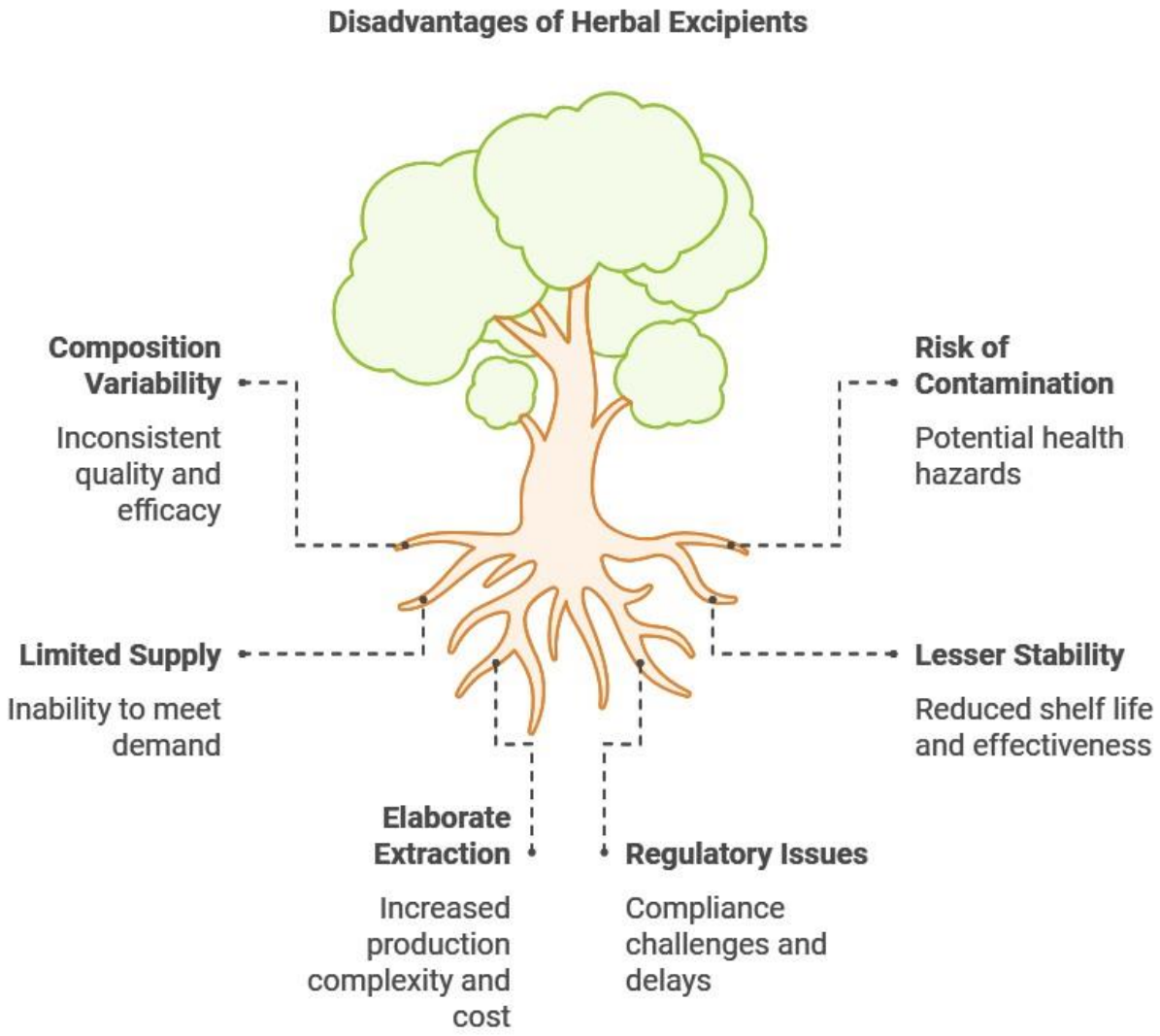


Disadvantages of Herbal Excipients:-

While herbal excipients offer such a huge number of benefits, they do come along with some drawbacks[36]. Here are the major issues involved with herbal excipients:

1. **Composition Variability**
2. **Risk of Contamination**
3. **Limited Supply**
4. **Lesser Stability**
5. **Elaborate Extraction and Purification Processes**
6. **Regulatory Issues**

1. **Variability**: In Content: The chemical content of herbal excipients varies with geography, climate conditions, and harvesting. This results in variability in the final product from batch to batch.
2. **Chances of contamination**: Herbal excipients can be contaminated by microbes, pesticides, or heavy metals during cultivation or process. They thus raise questions of safety, so proper quality control is required.
3. **Limited Supply**: Some herbal excipients may not be available in sufficient amounts or even seasonally, which could cause problems in the supply chains and production plans.
4. **Lower Stability**: The herbal excipients tend to deteriorate at a faster rate than their synthetically prepared counterparts. This is highly prone to degradation when environmental factors such as temperature, light, or moisture are exposed to products, lowering shelf life.
5. **Complex Extraction and Processing**: The process for extracting and purifying the active constituents of herbal excipients is generally more challenging and expensive than that for synthetic excipients, which makes their cost of production higher.
6. **Regulatory Problems**: In some countries or regions, herbal excipients face tougher regulation over several purported allergens or toxic compounds found in some forms of plant material.



Ideal Properties of Excipients

Excipients are the inactive substances mixed with the active ingredient of a drug, and their functional roles vary-from facilitating drug stability and delivery to providing a patient benefit. Exciting properties of excipients include:

1. **Safety and Non-toxicity**
2. **Stability**
3. **Compatibility**
4. **Inertness**
5. **Functionality**
6. **Reproducibility**
7. **Economical**

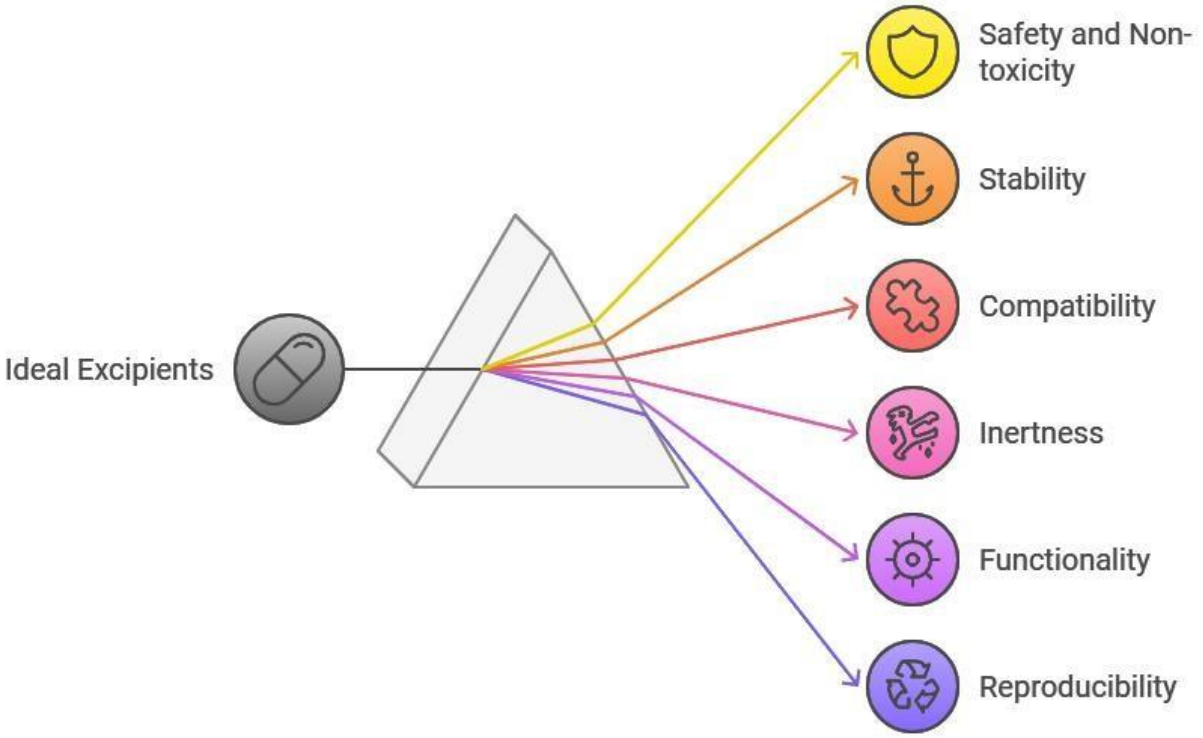
1. **Safety and Non-toxicity:** The excipients should not give adverse reactions or toxic at the concentration used in the formulation.
2. **Stability:** The excipients should be stable with different environmental conditions like temperature, light, and humidity during the manufacturing process, storage, and shelf life[20].
3. **Compatibility:** Compatibility of the excipients with both API and other excipients that is present in the formulation in order to maintain the integrity of the drug.

END.

4. **Inertness:** They should not have some kind of chemical reaction with API or other excipients so that the efficacy, stability, or safety of the drug is not compromised in any manner[15].
5. **Functionality:** They should perform their intended functions during the production process, such as improving the solubility of a drug, providing controlled release, assisting in its disintegration, or improving its taste.

6. Reproducibility: Properties of excipients must be reproducible from one batch to another so as to achieve uniformity within the final product.

7. Economical: The excipient properties have to be the same for each batch and lot in order for uniform end-products



Classification based on source of excipients:

1. Natural Sources

2. Biotechnological Sources

3. Synthetic Sources

1. Natural Sources:

Plant-based Excipients are manufactured from various plant parts, including seeds, leaves, and roots.

Examples are:

Starches, such as corn starch and potato starch, are produced from plant seeds.

Cellulose derivatives, like microcrystalline cellulose and methylcellulose, are derived from plant cellulose.

Acacia, guar gum, and pectin gums are extracted from plant sources.

2. Biotechnological Sources

Biotechnologically manufactured excipients, generated by microbial fermentation or by any other biologic process. Some of these are:

Hyaluronic acid in ophthalmic and dermal drugs

Albumin in some biopharmaceuticals

These type of sources can allow selecting proper excipients for pharmaceutical formulation based on source, functional properties and compatibility with the active ingredients.

3. Synthetic Sources

Excipients derived from modifications of natural materials are known as semi-synthetic.

Three examples of these are:

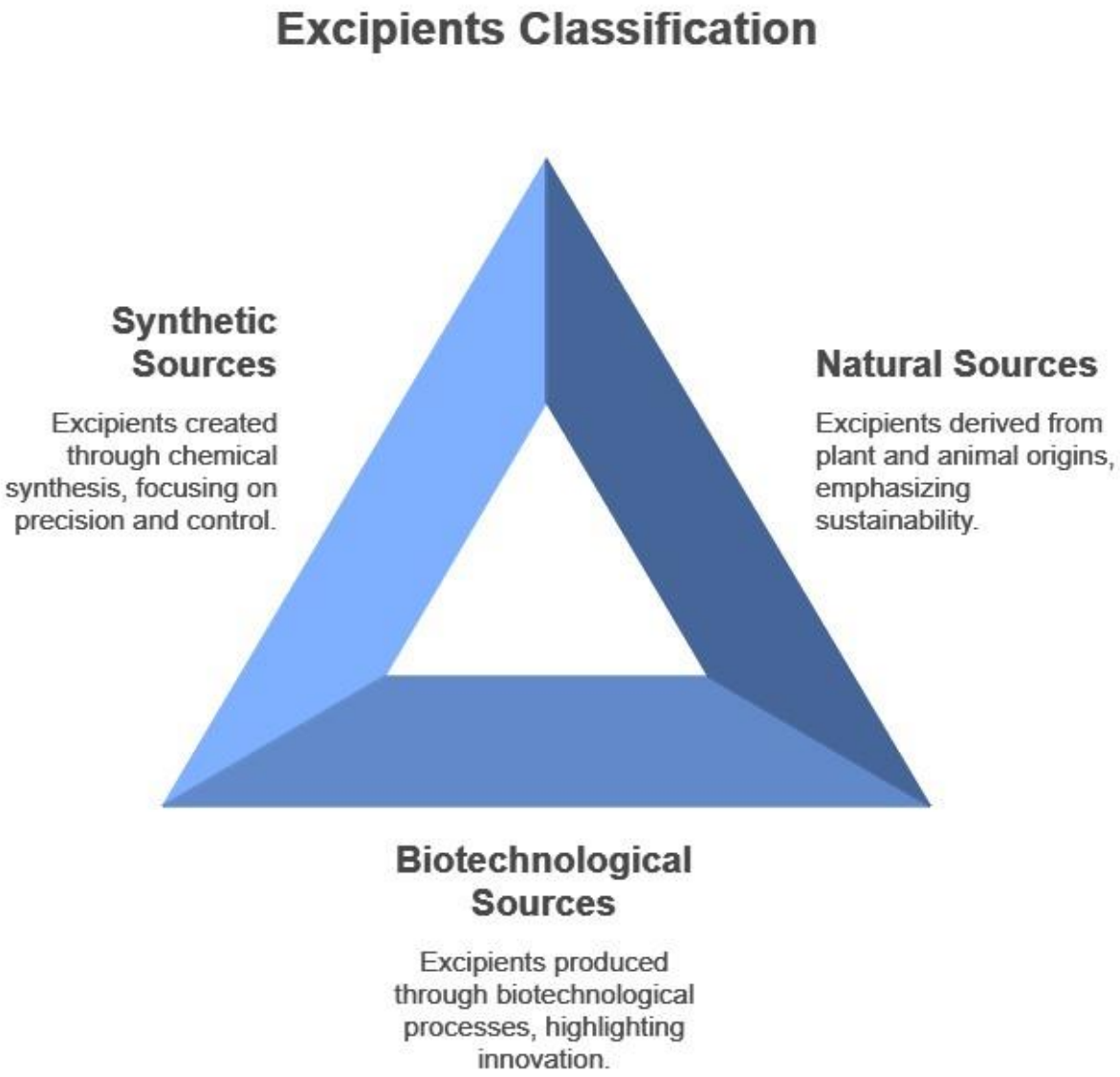
Ethyl cellulose is derived from cellulose, hydroxypropyl methyl cellulose (HPMC) is derived from cellulose with hydroxypropyl and methyl groups added, and carboxymethyl cellulose (CMC) is derived from cellulose with carboxymethyl groups added.

Completely Synthetic Excipients: Chemically synthesized compounds. Examples include:

Polyethylene glycol (PEG)

Polysorbates (emulsifiers)

Polyvinylpyrrolidone (PVP, a binder)



Conclusion: The need and quest for safer drug-delivery systems and more effective results lie in the use of herbal excipients, which holds promising leads for future pharmaceutical formulations. These natural sources enhance drug bioavailability, improve chemical stability, and exert specific therapeutic activity. Necessary is the continuous research and further development for appropriate usage with regulatory compliance in the end. Herbal excipients will be integrated into modern drugs in this manner, achieving the best of traditional and advanced therapeutic strategies. Bringing an important change in patient outcome may prove to be beneficial, contributing to the growing trend of holistic medicine.

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