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A Review on Application of Plant Based Excipients on Pharmaceutical Formulations.

Chethan Kayara*, J Adlin Jino Nesalin, E.Gopinath, Pooja H, Vineeth Chandy

Department of Pharmaceutics, T John College of Pharmacy,Bangalore, Karnataka, India.

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Address for Correspondence: Chethan Kayara
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Abstract

Plants and their derivatives have made significant contributions to drug research for use as therapeutic agents or as excipients in the creation of novel drug delivery systems. Their usage keeps growing every day. The African sub-region has a lot of potential to become the next worldwide location for supplies of pharmaceutical excipient due to its abundant, untapped vegetation. In this effort, published articles on plants and their derivatives that have so far been used to alter medicine delivery are reviewed. The use of gums and mucilages as plant derivatives in either their native or modified forms for regulated medication administration has been thoroughly studied. Some of them have demonstrated drug release modification abilities comparable to numerous excipients used in medication delivery on a commercial scale. Many plants and plant-derived polymers are widely recognized as being safe, easily cultivable, effective as medicine additions, and capable of being altered to enhance any less desirable characteristics. Utilizing these advantageous aspects will allow for the best possible usage of these naturally occurring medicinal excipients.

Keywords: Binding agent, Excipients, Conventional formulation, Plant origin.

Introduction

The term "excipients" refers to a material that is utilized to deliver a medication[1]. Natural polysaccharide polymers are specifically used in pharmaceutical formulations to support or protect stability, bioavailability, or patient acceptability during manufacturing, support product identification, or improve any other aspect of the overall safety, effectiveness, or delivery of the drug during storage or use[2]. In the pharmaceutical industry, a number of plant-based excipients are used as binding agents, disintegrants, sustaining agents, protectives, colloids, thickening agents, gelling agents, bases in suppositories, stabilizers, and coating materials. These excipients include starch, agar, alginates, carrageenan, guar gum, xanthan gum, gelatin, pectin, acacia, tragacanth etc[3]. Excipients have an increasing number of functional and substantial effects on how well a medication product performs. Active ingredient, excipient, and process variability are clear contributors to product variability[4].

WHO defines excipient as the substance other than active pharmaceutical ingredients which have been appropriately evaluated for safety and or included in a drug delivery system to:

- Helps in manufacturing step of drug delivery system
- Protect, support, and improve stability, bioavailability or patient acceptability.
- Aid in product identification.
- Enhances overall safety and stability of the pharmaceutical formulation during its storage or use[5].

Plants can provide a consistent supply of raw material because they are renewable and can be grown or harvested in a sustainable way. Waste from the food sector can be used as the starting point for the extraction of herbal excipients. These are other causes for the rise in demand for herbal ingredients as excipients[6]. Plant-based drugs do, however, also come with a number of potential drawbacks, such as the need to synthesis them in small amounts from

structurally complicated mixes that can vary depending on the location of the plants as well as other factors like the time of year. As a result, the separation and purification process could be time-consuming and costly. The importance of intellectual property rights is another issue that has risen[7].

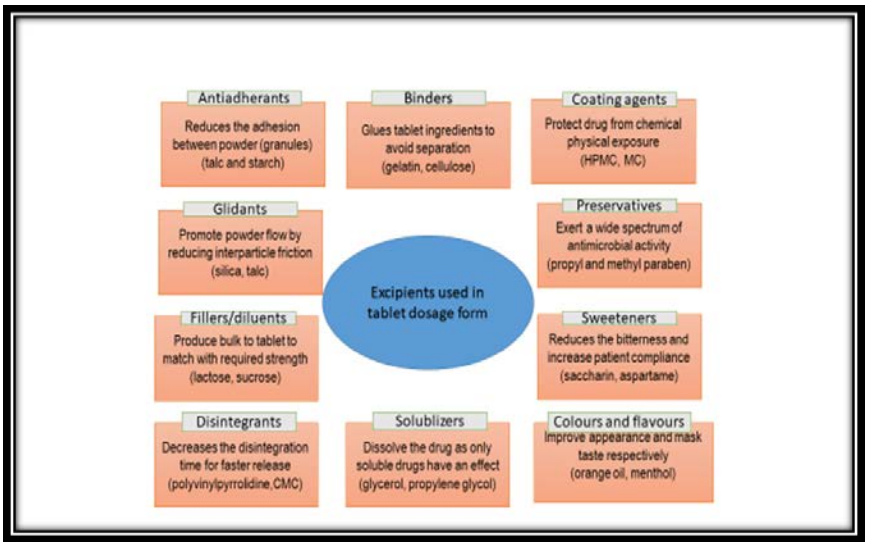

Figure 1: Different excipients used in tablet dosage form

Selection of Ideal Excipients:

The following criteria's are considered during the selection of excipient:

- Physiological inertness.
- Stable from environment and chemically inert.
- Ease of regulatory requirement free from microbial contamination.
- Cost effectiveness.
- Non-volatile in nature[8].

Excipients of Plant Origin:

Excipients that are derived from plant origin of substitution of synthetic excipient in pharmaceutical industry because of various advantages over synthetic excipients. In terms of security, cost, and accessibility, herbal or natural excipients offer a substantial advantage over their synthetic analogues. These herbal excipients, which are primarily polymers of natural origin, are becoming more and more popular among the pharmaceutical sector, and they are increasingly being used in formulation development[9]. Carrageenan, thaumatin, lard, storax, agar, gum acacia, tragacanth, and other naturally occurring plant-derived gums and mucilages satisfy a range of pharmaceutical excipient requirements. They can be preferred for formulation development in comparison to their synthetic equivalents since they are more stable and have less regulatory worries. They can also be easily modified to meet specific needs, making them a potent and economical method of delivering active pharmaceutical ingredients in formulations[10].

Advantages of Herbal Excipients over Synthetic Excipients[11]:

1. **Safe and biodegradable:**
Herbal excipients are natural excipients as they are obtained from the natural resources. Hence, they are claimed to be safe and biodegradable. They do not effect environment.
2. **Nontoxic:**
Herbal excipients are chemically carbohydrates in nature. Hence they are non-toxic compounds.
3. **Cost effective:**
Natural excipients are economical and there manufacturing cost is less than synthetic excipients.
4. **No adverse or side effect:**
Herbal excipients do not show any adverse or side effect on the human beings as they are obtained from natural sources.
5. **Easily available:**
Herbal excipients are easily available from various natural resources.

Classification of Plant Based Excipients[12]:

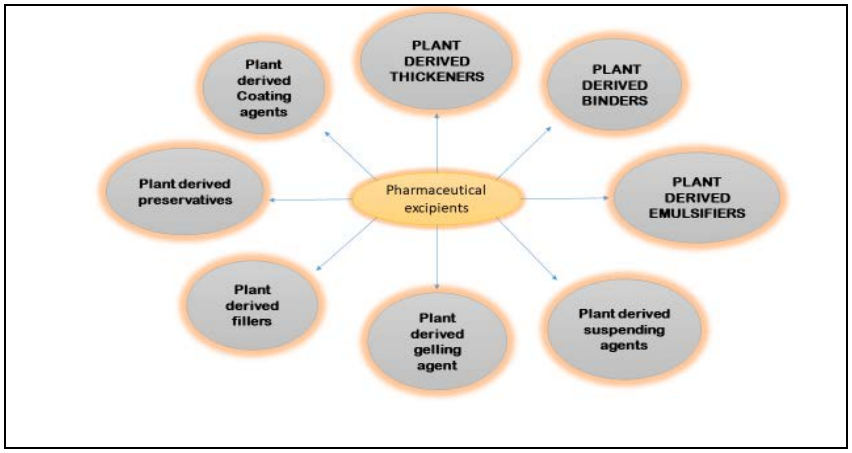

Figure 2: Classification of pharmaceutical excipients.

Plant Derived Thickeners:

Alternatives to common thickeners can be found in nature in the form of several thickeners. Usually polymers, these thickeners absorb water to create the right consistency. Many cosmetic goods, such as shampoo and body washes, use polyose derivatives such hydroxyethyl cellulose. One example of a thickening that is naturally derived is gum. Gelatin, Xanthum gum, and algarroba bean gum are additional. The primary use of plants and other gums is to thicken or gel binary complex systems to control water. Additionally, a thickener can be employed to stabilize adhesive foam, and it can provide the formulation particular qualities[13].

Table 1: List of some excipients used as thickeners:

Sl.no	Excipients	Source	Family
1	Tragacanth	Astragalus gummifer	Leguminosae
2	Konjac mannan	Amorphophallus konjac	Arums
3	Tapioca starch	Cassava root	Spurgus
4	Aloe mucilage	Aloe species	Liliaceae

Plant Derived Binders:

As their name implies, binders are the excipients utilized to bind or hold all of the ingredients in the dosage formulation. Binders are added to the mixture to show plasticity or to increase the likelihood that the formulated particles will bind together. Natural binders have some other qualities in addition to having binding properties, such as mucilage from dehydrated fruit and starch gum. Natural polymers are more cost-effective and secure than manufactured ones. The table below includes some plant-derived binders[14].

Table 2: List of some excipients used as binders:

Sl.no	Excipient	Source	Family
1	Tamarind seeds	Tamarindus indica	Leguminosae
2	Fenugreek mucilage	Trigonella foenum graecum	Leguminosae
3	Mangifera indica gum	Mangifera indica	Anacardiaceae
4	Gum acacia	Acacia Arabica	Combretaceae

Benefits of natural binders[13]:

a. Less harmful.
b. Biodegradable.
c. Effective delivery.
d. Economical.
e. Upgrades strength.

Plant Derived Emulsifiers:

An appropriate emulsifying agent is used to combine two immiscible liquid phases (oil phase and aqueous phase) to form emulsions, which are dispersions. Emulsifiers are the compounds that make the emulsion more kinetically stable. Emulsifiers are categorized according to their method of action and chemical makeup[15].

Table 3: List of some excipients used as emulsifiers:

Sl.no	Excipients	Source	Family
1	Carrageenan	Irish moss	Gigartinaceae
2	Acacia gum	Acacia senegal and Acacia seyal	Fabaceae
3	Lecitin	Soyabean oil	Fabaceae
4	Tragacanth	Astragalus gummifer	Leguminosae

Plant Derived Suspending Agents:

Gums serve as suspending agents. They successfully stabilize the emulsion by surface absorption, which leads to the formation of a condensed film with a high durability and resistance to droplet coalition. They do this by producing stable multimolecular spherical films that stabilize the oil/water emulsion. Therefore, every oil globe slows down the coalition due to the evaporating barrier between the oil and water sections. Gum is the dried, glue-like exudate produced by Astragalus gummifer and other Astragalus species. The gum accumulates in the pith and medullary rays when the stem sustains damage. In general water absorption causes many gums to swell and leak through the wound[15].

Table 4: List of some excipients used as suspending agent[16]:

Sl.No	Excipient	Source	Family
1	Guar gum	Seeds of Cyamopsis tetragonoloba	Leguminosae
2	Acacia	Exudates of Acacia senegal	Fabaceae
3	Agar	Dried gums of Gelidium and Gracilaria	Gelidiaceae

Plant Derived Gelling Agent:

Natural thickeners are polymers that absorb water to expand and enhance viscosity to control water, as well as to function as adhesives, foam stabilisers, and impart various particular qualities. Any formula with a significant amount of water could benefit from the use of thickeners. Shampoo and body cleansers frequently contain polyose derivatives like hydroxyethyl cellulose[17]. Some examples of thickeners made naturally include gelatin and gums like Algarroba Bean Gum and Xanthan Gum. Even at 1% (w/v), gum tragacanth easily swells in cold or warm water to form an extremely viscous semigel. The outstanding gelling capability of this gum is enhanced by the gum's transparency and good biofilm-forming abilities[18].

List of some excipients used as gelling agent[18]:

Table 5: Examples of plant derived excipients used as gelling agent

Sl.No	Excipient	Source	Family
1	Aloe Mucilage	Dried latex of curaco aloe	Liliacea
2	Fenugreek Mucilage	Seeds of Trigonella foenum-graecum L.	Leguminosae
3	Neem gum	Dried leaves of Azadirachta indica	Meliaceae

Plant Derived Fillers And Diluents:

Fillers and diluents are two types of excipients that are used to increase the bulk of solid formulations or thin out liquid ones. So, by increasing the bulk volume, they offer a structural form, fill the size of the dosage form, and make them acceptable for administration. All of the chemicals in a formulation can easily

get along with fillers because of their inert nature. Natural fillers and diluents are now commonly employed in the pharmaceutical industry since they have certain advantages over manufactured ones. Tablets, pills, pallets, paste, solutions, suspensions, emulsions, and other dosage forms are examples of dosage forms that use fillers and diluents. Natural excipients such as cellulose, are utilised as fillers and diluents[19]

Table 6: Examples for plant derived fillers and diluents

Sl.No	Excipient
1	Plant cellulose
2	Agar Agar
3	Mannitol

Plant Derived Preservatives:

Fillers and diluents are two types of excipients that are used to increase the bulk of solid formulations or thin out liquid ones. So, by increasing the bulk volume, they offer a structural form, fill the size of the dosage form, and make them acceptable for administration. All of the chemicals in a formulation can easily get along with fillers because of their inert nature. Natural fillers and diluents are now commonly employed in the pharmaceutical industry since they have certain advantages over manufactured ones[21]. Tablets, pills, pallets, pzaste, solutions, suspensions, emulsions, and other dosage forms are examples of dosage forms that use fillers and diluents. Natural excipients such as cellulose, are utilised as fillers an diluents.Antioxidants function by preventing oxidation chain reactions and acting as reducing agents. Preservatives are sometimes used in dosage forms that are solid, liquid, or semi-solid. Natural preservatives are now employed in many formulations because they are less hazardous than synthetic preservatives[22].

Table 7: List of some excipients used as preservatives:

Sl.No	**Excipients**	**Source**	**Family**
1	Clove oil	Dried flower buds of Eugenia caryophyllus	Mirtaceae
2	Cumin seeds	Obtained from the herb Cuminum cyminum	Apiaceae
3	Neem oil	Fresh or dried leaves and seed oil of Azadirachta indica J	Meliaceae
4	Cayenne pepper	Fruits of Capsicum annuum	Solanaceae
5	Turmeric	Rhizome of Curcuma longa	Zingiberaceae

Plant Derived Coating Agents:

Coating agents are used in a variety of pharmaceutical solid dosage forms and are also advantageous to people. To coat or create a film over the dosage form, coating agents are utilised. Various coating methods modify the drug release while improving drug protection. Coating agents are used depending on the specific site of drug release, such as to avoid the stomach and to absorb the drug from the intestines. Moreover, coating agents make products more effective and protected from the outside environment. Coating agents make the formulation more appealing[23].

Plant Derived Colourants:

Pharmaceutical formulations look better when coloured agents are used. They make the dose form more appealing. These could be utilised for simple identification or to distinguish between dose forms. Patients are psychologically drawn to dose forms because colouring agents are used in them. In the food and cosmetics industries, colouring compounds are frequently utilised in addition to as dyes. Health authorities must approve or certify any colouring agents used in medications[24]. Tablets, pills, pallets, capsules, pastes, ointments, syrups, emulsions, suspensions, and other dosage forms are examples of dosage forms in which colouring compounds are utilised.

Because natural colours are easily degradable, maintain stability, and are environmentally benign, manufacturers prefer using them over synthetic ones.Synthetic colouring compounds, however, have hazardous effects on human health and exhibit allergy-like symptoms when used[25].

Table 8: List of some excipients used as Colourants[25]:

Sl.No	Excipients	Source	Family
1	Red beetroot	Fresh root of Beta vulgaris	Chenopodiaceae
2	Blueberry	Berries with a bluish, purple hue	Ericaceae
3	Saffron	Dried red stigma of Crocus sativus L	Iridaceae
4	Carrot	Root vegetable of Daucus carota L	Apiaceae

Plant Derived Sweetening Agents:

The leaves of the stevia plant contain a variety of very sweet diterpene glycosides known as steviol glycosides.Mogrosides, extracted from monk fruit are a gaggle of\scucurbitane-type triterpenoid glycosides. Glycyrrhizin is an soleanane-type triterpenoid organic compound derived from the sunderground elements of Glycyrrhiza plant. Dates are wonderful sweeteners loaded with K, copper, iron, manganese, metallic element and pyridoxal[26].

Plant Derived Excipients Used As Lubricants/ Glidants

Lubricants are used to keep ingredients from clumping together while the formulation process is being carried out. They keep the formulation's stickiness while reducing friction between the particles and the processing machinery. Like solid dosage forms, they are included into formulations in minute amounts. By decreasing the friction between particles, lubricants improve product flow. There are typically two different kinds of lubricants. The first are those with hydrophilic natures, which typically have poor lubricating qualities and no anti-adherent capabilities. Due to its strong lubricating properties, the second type, which is hydrophobic in nature, is utilised the most frequently in the pharmaceutical industry[27].

Table 9: Plant derived excipients used as Lubricants

Sl. No	Excipient	Source	Family
1	Castor oil	Vegetable oil obtained by pressing the seeds of Ricinus communis L	Euphorbiaceae
2	Ispagol mucilage	Seeds of plant Plantago ovata Forsk	Plantaginaceae

Plant Derived Flavouring Agents:

In many pharmaceutical formulations, including those for cough syrups, sedatives, anti-malarials, and antibiotics, tastes are used. The food industry makes extensive use of flavours as well. When employed as taste masking agents, flavours can cover over an unpleasant dose form's flavour or order. The chance of medicines increases with flavour, which also makes them more palatable for patient administration. Because tastes are used in dose forms, youngsters consume medications without any issues. There are both artificial and natural flavouring agents[28]. While natural flavourings are derived from plants, artificial flavourings are created in laboratories. By employing particular separation processes, aromatic oils (volatile oils) sorts of flavours are produced from a variety of flowers and plants. Sweeteners that come from plants or are synthesised are regarded as a subset of masking agents. Tablets, pills, pellets, capsules, pastes, syrups, emulsions, suspensions, mouthwashes, and other dosage forms are examples of dosage forms in which flavouring compounds are utilised. Despite being more expensive than synthetic flavourings, natural flavouring agents are nevertheless frequently employed in the pharmaceutical and food industries because they provide a realistic flavour with good order and have no adverse effects on humans or the environment[28]. Examples of certain natural

excipients used as natural flavouring agents include Ginger roots from Zingiber officinale, Lemon peel from Citrus limon, Orange peel from Citrus sinensis, Raspberry fruit from Rubusrosi folius, and Mentha spicata from the Lamiaceae family (Zingiberaceae).The three main flavours used in dental products are oils of peppermint, spearmint, and wintergreen. All of which were altered by adding additional essential oils of cinnamon, menthol, nutmeg, clove, caraway, pimento, eucalyptus, and citrus fruits[29].

Application:

The employment of common excipients in many projects illustrates the natural dynamic dynamics that artificial materials have hindered. Normal excipients have the advantages of being of a benign nature, being more cost-effective, and being readily available.The excipients' components directly correlate to the type of the determined item. Excipients are substances other than dynamic compounds with restorative properties that are internal in nature and improve the functionality of dynamic mixes. Every component other than the dynamic substances intentionally blended in with definition of a measuring structure and obtained from the common resources are considered to be relatively regular excipients. Ayurveda, the traditional medical system in India, uses direct plant parts and extracts of many healing herbs to treat a variety of ailments. Due to their considerable side effects or harmfulness, manufactured intensifiers are only permitted to be used in special circumstances. As much as is realistically possible, researchers nowadays also encourage the use of natural excipients or the use of semi-manufactured combinations to increase the concentration of mixtures. All therapeutically useful dynamic mixes may be found in nature or are additionally created utilising naturally occurring dynamic mixtures in laboratories[30].

Conclusion:

Development of natural excipients is now receiving a lot of attention. Carrageenin, alginate, gum arabic, guar gum, gum, and carob gum are a few examples of plant-derived polysaccharides that have demonstrated a number of uses in controlled indefinite quantity forms. Before being added to forms that have been approved for indefinite quantities, excipients must adhere to tight regulatory requirements. Natural excipients, such as flavourings, offer several advantages over artificial ones, including being non-toxic, more affordable, and widely accessible. The pharmaceutical industries are leaning towards using these flavoured excipients in formulation development as a result of the rising awareness around them. The carrageenan, thaumatin, storax, agar, gum tree, and gum plant-derived gums and mucilages from natural sources meet a variety of demands for pharmaceutical excipients. These excipients are stable\sand entail less regulative concerns as compared to their\artificial equivalents. Excipients must be stable and safe because they are a crucial component of health goods. Several stability testing techniques are carried out to prevent the use of incompatible excipients.

Reference:

1. Abrantes CG, Duarte D, Reis CP. An overview of pharmaceutical excipients: safe or not safe.J Pharm Sci . 2016;105(7):2019-26.
2. Pifferi G, Restani P. The safety of pharmaceutical excipients. 20031;58(8):541-50.
3. Singh P, Mahmood T, Shameem A, Bagga P, Ahmad N. A review on Herbal Excipients and their pharmaceutical applications. Sch. Acad. J. Pharm. 2016;5(3):53-7.
4. Chaudhari SP, Patil PS. Pharmaceutical excipients: a review. Int J Adv Pharm Biol Chem. 2012;1(1):21-34.
5. Baldrick P. Pharmaceutical excipient development: the need for preclinical guidance. Regulatory toxicology and pharmacology. 2000;32(2):210-8.
6. Selvadurai S, Divya S, Geetha A, Rohini K, Anbazhagan S. Herbal Excipients-Significance of Substances of Natural Origin as Excipients.
7. Singh P, Mahmood T, Shameem A, Bagga P, Ahmad N. A review on Herbal Excipients and their pharmaceutical applications. Sch. Acad. J. Pharm. 2016;5(3):53-7.
8. Perepelkin KE; Polymeric materials of the future based on renewable plant resources

and biotechnologies; Fibers, films, plastics. Fiber Chem. 2005; 37: 417-30.

9. Singh P, Mahmood T, Shameem A, Bagga P, Ahmad N. A review on Herbal Excipients and their pharmaceutical applications. Sch. Acad. J. Pharm. 2016;5(3):53-7.

10. Evans WC, Trease and Evans: Pharmacognosy. Harcourt Brace & Co., Asia Pvt. Ltd, Singapore. 1996:196-208.

11. Poonam V, Sagar G, Abhishek K, Yuvraj S. Remarkable contribution of natural excipients in finished pharmaceutical products (FPPs). International Journal of Pharmaceutical Sciences and Research. 2018;52(1):7-14.

12. Dharmendra S, Surendra JK, Sujata M, Shweta S. Natural excipients-a review. International Journal of pharmaceutical and biological archives. 2012;3(5):1028-34.

13. Bhardwaj TR, Kanwar M, Lal R, Gupta A. Natural gums and modified natural gums as sustained release carriers. Drug Dev Ind Pharm. 2000;26(10):1025-38.

14. Girish K, Dhiren JP, Shah VD, Prajapati VC. Gums and mucilages: versatile excipients for pharmaceutical formulations Asian J Pharm Sci. 2009;45:309-332.

15. Sarathchandraprakash NK, Mahendra C, Prashanth SJ, Manral K, Babu UV, Gowda DV. Emulsions and emulsifiers. The Asian Journal of Experimental Chemistry. 2013;8:30-45.

16. Alwossabi A, Elamin ES, Ahmed EM, Abdelrahman M. Natural Excipients Applications in Conventional Pharmaceutical Formulations-Part I. Med Aromat Plants. 2021;10:397.

17. Batra V, Bhowmick A, Behera BK, Ray AR. Sustained release of ferrous sulfate from polymer-coated gum arabica pellets. J Pharm Sci. 1994; 83:632-635.

18. Mudgil D, Barak S, Khatkar BS. Guar Gum: Processing, Properties and Food Applications – A review. J Food Sci Tech. 2014; 51:409-418.

19. Patel Dhara B and Patel Madhabhai M. Natural excipients in controlled drug delivery systems. Journal Of Pharmacy Research. 2009;2(5)900-907.

20. Prabakaran L, Sendhil D. Formulation development of patient's friendly dosage form: all in one natural excipients as binders, diluents and disintegrants. International Journal of Pharmacy and Pharmaceutical Sciences. 2011;3:97- 102.

21. Pawar HA, Shenoy AV, Narawade PD, Soni PY, Shanbhag PP, Rajal VA. Preservatives from nature: A review. Int J Pharm Phytopharmacol Res. 2011;1:78-88.

22. Shaikh SM, Doijad RC, Shete AS, Sankpal PS. A Review on: Preservatives used in Pharmaceuticals and impacts on Health. PharmaTutor. 2016 May 1;4(5):25-34.

23. Carien E. Beneke, Alvaro M. Viljoen and Josias H. Hamman. Polymeric Plant-derived Excipients in Drug Delivery. Mdpi / Molecules. 2009; 14:2602-2620.

24. Chengaiah B, Rao KM, Kumar KM, Alagusun MD, Chetty CM. Medicinal importance of natural dyes A-Review. 2010;2:144-154.

25. Šuleková M, Smrčová M, Hudák A, Heželová M, Fedorová M. Organic coloring agents in the pharmaceutical industries. Folia Veterinaria. 2017;61:32-46.

26. Kim NC, Kinghorn AD, Highly sweet compounds of plant origin, Arch pharm Res. 2002; 25:725-46.

27. Wang. J, Wen. H, Desai. D. Lubrication in tablet formulations. Eur. J. Pharm. Biopharm. 2010;75: 1-15.

28. Shalini S, Shaila L. Taste masking technologies: A review. Int J Pharm and Pharm Sci. 2010; 2:6-13.

29. Sen DJ. Esters, terpenes and flavors: Make the mood cheers by three musketeers: WJPR. 2015;4:1-40.

30. Sabne Prachi S, AvalaskarAmruta N, JadhavRashmi, and Sainkar Pooja S. Natural Excipients. Research Journal of Pharmaceutical, Biological and Chemical Sciences; 2013;4(2):1346-1354.