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Review Article

Natural Excipients Applications in Conventional Pharmaceutical Formulations –Part I

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ABSTRACT

The form in which drugs are prepared is considered as an important determinant of their bioavailability. In pharmaceutical formulations, excipients offer add-on characteristic properties as integrity, stability, solubility, andpatient compliance to those intrinsic properties exhibited by the Active Pharmaceutical Ingredients (APIs). Naturalexcipients are nowadays gaining a global interest compared to the synthetic ones being nontoxic, biocompatible, lessexpensive and widely available. This review describes the major conventional pharmaceutical applications of natural excipients.

Keywords: Natural excipients; Conventional formulations; Pharmaceutical industry; Stability; Gums

INTRODUCTION

Nature has provided us with a variety of products that contribute directly or indirectly in improving and sustaining the safety of all human beings [1-3]. Excipients are substances or compounds other than the active pharmaceutical component and packaging elements, often influencing the quality of the final product. In recent years natural excipients gained high interest due to their diverse pharmaceutical applications. For example, natural polysaccharide polymers are used in the processing of the drug dosage forms during development and manufacture. They protect, support or enhance stability and bioavailability or patient acceptability. Also, assist in product identification, or enhance any other attribute of the overall safety, effectiveness and/or delivery of the drug during storage and use [4]. Several pharmaceutical excipients of plant origin, like starch, agar, alginates, carrageenan, guar gum, xanthan gum, gelatin, pectin, acacia, tragacanth, and cellulose find applications in the pharmaceutical industry as binding agents, disintegrants, sustaining agents, protective, thickening agents/ gelling agents, bases in suppositories, stabilizers, and/or coating materials [5]. As from plant origin, such excipients are renewable and can be cultivated and harvested in sustainable manner for constant availability of raw materials, such characteristics are other reasons for increase in demand of herbal material as excipients [6]. However, substances from plant origin pose several potential challenges such as being synthesized in small quantities and in mixtures that are structurally complex, which may result in a slow and expensive isolation and purification process with a yield which vary according to the differences in region, species, climate conditions and collection season. During production, they may exposed to external environment and hence possibility of microbial and heavy metal contamination [7,8]. Another issue that has become increasingly important is that of intellectual property rights [9,10]. The specific application of plant-derived polymers in pharmaceutical formulations include their use in the manufacture of conventional and novel drug delivery systems. They are used in solid monolithic matrix systems, implants, films, beads, microparticles/nanoparticles, inhalable and injectable systems as well as viscous liquid formulations [11-13]. The ability to produce a wide range use of excipients is based on their properties and molecular weight; natural polymers become a thrust area in majority of investigations in drug manufacture [14,15]. Present day consumers believe that natural ingredients in food, drugs, and cosmetics are more safe and devoid of side effects. This review gives an insight of applications of natural excipients in the design of conventional dosage forms.

LITERATURE REVIEW

From application viewpoint, pharmaceutical excipients can be categorized into two major classes: (a) Excipients for conventional dosage forms and (b) Excipients for novel drug delivery application. Generally, oral solid dosage forms such as tablets and capsules are the most desired administration route for many drugs, due to its several advantages over other formulations. It is the most commonly used

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route due to its greater stability, ease of administration, high patient compliance, accuracy of doses, cost effectiveness, and flexibility of dosage form design. In tablets formulations, the commonly used mixture of excipients comprising at least one disintegrant (1-15%), a diluent (10-85%), a binder (1-10%), a lubricant, and optionally, a swelling agent, a permeability enhancing agents, sweeteners, and flavoring agents to achieve the effectiveness of the formulation [16-18]. Table 1 includes some examples of natural excipients used as excipients in conventional pharmaceutical formulations, and then each category will be discussed individually.

Emulsifiers and suspending agents

Gums are the dried gluey exudate from different species of Astragalus, Acacia... etc. Most of the gums contain Ca^{2+} and K^{+} salts of bassoric acid, referred to as bassorin and reportedly used as suspending/emulsifying agents in oral and topical pharmaceutical formulations [19,20]. Principally, the mechanisms by which gums stabilize the emulsions are slowing down the thermodynamically favored breakdown and discouraging the crystallization by means of increasing the viscosity of the medium. The other probable factors behind stabilizing property of gums in emulsion include (a) the structural heterogenicity of gums, which may lead to self-aggregation (b) the presence of protein impurity, which may undergo electrostatic interaction with the gum (polyelectrolyte) [21]. Both these factors lead to the formation of colloidal system capable of increasing the miscibility of oils and water by reducing the interfacial tension between them. However, in case of suspensions, it is believed that natural gum increases the tensile strength of the hydration layer formed around the suspended particles by H-bonding and molecular interactions. Since these agents do not reduce the surface and interfacial tension, they function best in the presence of wetting agents [22,23].

Disintegrants

Disintegrating agents constitute substances in tablets and certain formulations of rigid capsules used to make it easier for dissolution in fluid to penetrate moisture and disperse dosage forms. An oral solid form of dosage should ideally be dispersed into the core particles from which it was made of [24]. Examples of some natural excipients used as disintegrants include Karaya Gum of the genus *Sterculia*, (Sterculiaceae), Guar gum *Cyamopsis tetragonaloba* (L) (Leguminosae), *Plantago ovata* seed mucilage (Plantaginaceae), *Lepidium sativum* mucilage (Brassicaceae), Chitin and chitosan (crab and shrimp shells) Polysaccharides [25]. Modified Karaya gum disintegrated quickly in the tablets [26]. Guar gum is used as a colloid, a binding agent and a disintegrating agent in formulations of pills [27]. Mimosa seed mucilage *Mimosa pudica* (Mimosaceae) and Fenugreek seeds mucilage *Trigonella Foenum-graceum*, (leguminosae) hydrate and swell rapidly on coming in contact with water. Earlier the seed mucilage was evaluated for binding and disintegrating properties [28,29].

Binders

Binders are the excipients that are used to bind or hold all ingredients used in preparation of dosage forms together. Binders are mixed in formulation to convey plasticity or to increase the bonding strength between the particles [30]. The griping of ingredients in tablets and granules which enhanced by binders is very important to ensure that the formulations are manufactured according to required physical strength and quantity. Binders are used either in a solution or in a dry form depending on the ingredients in the formulation and the method of preparation of dosage form. Generally, binders are used in solid or semi- solid formulations [31]. Examples of dosage forms in which binders are used are tablets, pills, pallets, granules, pastes etc. Natural binders are widely used in pharmaceuticals and food industry as excipients for their known merits over synthetic one. Moreover, they enhance stability, improve the texture and prevent the breakage of the manufactured forms [32]. However, synthetic binders can lead the processing difficulties like rapid over

Table 1: Pharmaceutical applications of some natural excipients.

Uses	Name of Excipients
Emulsifiers and Suspending agents	Agar, Ghatti gum, Tragacanth gum, Bavchi mucilage, Acacia gum, Neem gum, Asario mucilage, Cashew gum, Xanthan gum, Hibiscus mucilage, Guar gum, Karaya gum, Leucaena seed gum, Ispagol mucilage, Ocimum seed mucilage, Pectin, Sodium alginate, Tamarind seed polysaccharide, Ski waxes, Tea saponins [18-26].
Disintegrants	Agar, Gellan gum, Silicone, Guar gum, Leucaena seed gum, Starch, Mimosa pudica [7,19,25,27, 28].
Binding agents	Ghatti gum, Albizia gum, Cassia tora, Acacia gum, Khaya gum, Satavari mucilage, Tamarind seed, Alginic Acid, Corn Starch, Alginate, polymers, Abelmoschus mucilage, Ispagol mucilage, Fenugreek mucilage, Guar gum, Leucaena seed gum, Ocimum seed mucilage, Mimosa pudica [7,20,23-26,28-33].
Thickening, Viscosity imparting and Gelling agents	Tragacanth, Neem gum, Pectin, Agar, Aloe mucilage, Carrageenan, Fenugreek mucilage, Gelatin, Aloe mucilage, Gums, Tragacanth, Carrageenan, Xanthan[7, 19, 21, 24-28].
Fillers and Diluents	Plant Cellulose, Gelatin, Lactose, Mannitol, Sucrose, Glucose [25].
Coating agents	Gelatin, Arabi, Natural polymers, [25] Sodium alginate. [7]
Lubricants/ Glidants	Castor oil, Mineral oil, Paraffin oil [25], Ispagol mucilage [7], Vitamin D, Talc [25].
Preservatives/Antioxidents and Chelating agents	Clove oil, Cumin seeds, Neem oil, Cayenne pepper, Turmeric, Cinnamon, Clove oil, Cocca Onions, Garlics, Chlorella, Brazil nuts [25,34].
Flavoring agents/Perfumery and Fragrant agents	Ginger, Raspberry, Lemon, Orange, Peppermint, Menthol, Jasmine oil, Cardamom oil, Musk, Sandal Wood Oil, Rose oil [25].
Coloring agents	Caramel, Chlorophylls, Carotenoids, Red beetroot, Turmeric, Saffron [25].
Sweating agents	Glucose, Lactose, Honey [25].
Demulcents/Emollient in cosmetics	Tragacanth gum, Acacia gum, Fenugreek mucilage, Ispagol mucilage [7,21,23].
Solvents	Purified water, oils [25].
Stabilizers	Carrageenan, Xanthan gum, Sodium alginate, Curdlan and Scleroglucan [7,28].

granulation, hardness of formulation and reduction in dissolution properties of formulations. When synthetic binders are used in formulations, the mixing of a strong disintegrants is required during process. Yet the use of synthetic binders is normally of high cost and show negative effects on formulation stability and film coating appearance. Examples of some natural excipients used as binders are Gum Ghatti *Anogeissus latifolia*, (Combretaceae), Albizia gum *Albizia zygia*, (Leguminosae), Cassia tora (Leguminosae), Gum acacia *Acacia arabica*, (Combretaceae), Khaya gum *Khaya grandifola*, (Labiatae), Satavari mucilage *Asparagus racemosus*, (Apocynaceae), Tamarind seed *Tamarindus indica*, (Leguminosae), Abelmoschus mucilage *Abelmoschus esculentus*, (Malvaceae), Fenugreek mucilage, *Mangifera indica* gum (Anacardiaceae) and Mucilage of *Artocarpus heterophyllus* (Moraceae) [25,33,34]. Microcrystalline cellulose is commonly considered the best binding diluent and is one of the recommended binders when direct compression is used [35]. Moreover, Okra *Abelmoschus esculentus*, (Malvaceae) and Ocimum gums *Ocimum tenuiflorum* (Lamiaceae) have been evaluated as binders [36-39]. Cashew gum which is the exudate from the stem bark of *Anacardium occidentale* (Anarcardiaceae) has recently been utilized as a binder in paracetamol tablet formulations where the gum imparted better mechanical properties to the tablets than povidone or gelatin [40]. Neem gum activity as a binder in paracetamol tablet dosage form improved the balance between binding and disintegration properties of paracetamol tablets [41]. *Irvingia* gum *Irvingia gabonensis* is commonly known as 'African mango' or 'bush mango. Its mucilage from the kernel has been used as binding agent in tablet formulation. The potential of *irvingia* gum and its binding effects on metronidazole tablets has been evaluated [42]. Psyllium mucilage obtained from the seed coat of *Plantago ovata* (Plantaginaceae) has been evaluated for its tablet binding properties [43,44].

Thickening, viscosity imparting and gelling agents

Natural thickeners are polymers that absorb water to expand and increase viscosity to regulate water and to operate as adhesives, foam stabilizers and impart different specific properties. Thickeners could be employed in any formula that contains a high level of water. Polyose derivatives like Hydroxyethyl cellulose are often employed in products like shampoo or body washes. Gelatin and gums such as Algarroba Bean Gum and Xanthan Gum are other examples of naturally derived thickener [23]. Gum Tragacanth (GT) swells readily with cold or warm water to form highly viscous semi-gel, even at 1% (w/v). This gum has clarity, good biofilm–forming properties that make stable suspension for the excellent gelling property. It reduces syneresis when blended in combination.

Fillers and diluents

Fillers and Diluents are those excipients, which are used to enhance the bulk of any solid formulation or to dilute any liquid formulation. Hence, they provide a structural form, fill the size of dosage form, and make them suitable for administration by enhancing the bulk volume. Fillers are inert in nature and easily compatible with all ingredients in a formulation [23,45]. Nowadays, Natural fillers and diluents are used in many pharmaceutical industries, exhibiting characteristic merits over synthetic ones [46]. Examples of dosage forms in which fillers and diluents used are tablets, pills, pallets, paste, solutions, suspensions, emulsions etc.. Examples of some natural excipients used as fillers and diluents include cellulose, lactose, sucrose, glucose, and gelatin [47]. Microcrystalline cellulose is most frequently used as a filler, binder and disintegrant in concentrations of 10-30 percent. Lactose is another used diluent in many pharmaceutical formulations (including tablets, capsules and inhalers) due to its low price and biological acceptability. A number of starches are recognized for pharmaceutical use. These include maize (*Zea mays*), rice (*Oryza sativa*), wheat (*Triticum aestivum*), and potato (*Solanum tuberosum*) [48]. Starch 1500 has been also tested as a wonderful binder, producing a granulation that was compressible and likewise do the amorphous form of lactose [49-51].

Coating agents

Coating agents are used to coat or to make a film over the dosage form. Coating techniques enhance the drug protection and also modified the drug release. They ensure the product safety from outer environments and so enhance the product effectiveness and attractiveness [52,53]. According to the specific site of drug release coating agents are used such as to avoid the stomach and to absorb the drug from the intestines (enteric coating). Examples of dosage forms in which coating agents are used include tablets, pills, capsules etc. Natural coats do not show any toxic effect to the human beings as well as environment and they easily biodegradable, easily digested and excreted from body [54]. However, synthetic coating agents show bitter taste therefore various sweetening and flavoring agents are used to hide their bitter taste. Examples of some natural excipients used as natural coating agents include Gelatin, Xanthan gum, Guar gum and Pectin [55,56]. Locust bean gum also called carob gum, is derived from the seeds of the leguminous plant carob *Ceratonia siliqua Linn* (Caesalpiniaceae). *In vitro* drug release studies and *in vivo* studies revealed that the locust bean gum and chitosan as a coating material applied over the core tablet was capable of protecting the drug from being released in the physiological environment of stomach and small intestine and was susceptible to colonic bacterial enzymatic actions with resultant drug release in the colon [57]. Okra gum was used as a film coating [58]. *Irvingia* gum, the mucilage from its kernel has been used as a component of film coating operation [59]. Amylose-rich maize starch has been investigated in tablet film coating [60]. Grewia gum was extracted from the inner stem bark of *Grewia mollis*, fractions of the gum obtained by centrifugation successively at 4500 rpm for 30 minutes with average molecular weights between 230 and 235 kDa showed improved aqueous solubility that was useful in delivering more solids to the substrate when used as a film coating agent [61]. Neem gum is accomplished natural, cheap, biodegradable and ecofriendly film former for aqueous film coating of tablets, moisture sensitive drug or particularly for bitter taste [62]. Rosin occurs naturally in oleoresins of pine tree *Pinus soxburghi* and *Pinus toeda*, (Pinaceae), also known as colophony, its glycerol, sorbitol and mannitol esters are reported to have excellent film forming properties and can be used for enteric coating and delayed release of drugs [63].

Lubricants/Glidants

The purpose of lubrication means making the process smooth by applying some substances. Lubricants are used for preventing the clumping of ingredients used in formulation during process. They decrease the friction between the particles and processing equipment and maintain the stickiness of formulation. They are added in small quantities to formulation like solid dosage forms [64]. Lubricants enhance product flow by reducing inter particulate friction. There are generally two types of lubricants; first those

hydrophilic in natures which generally have poor lubrication properties and do not show anti-adherent property. The second types are those hydrophobic in natures which are most widely used in pharmaceutical industries and they are used in low volume because of their high lubricating property [65]. Examples of dosage forms in which lubricants used are tablets, capsules, pills, pastes, suppositories, pallets etc. Natural lubricants are used for their merits over those synthetics. Examples of some excipients used as natural lubricants include: stearic acid, sodium stearyl fumarate, castor oils, sodium chloride, and paraffin oil. The use of stearic acid and its derivatives, such as magnesium stearate and sodium stearyl fumarates, as lubricants of choice in the production of solid dosage forms is generally considered safe and used for pharmaceuticals in small amounts (usually less than 5%). Stearic acid has the highest lubrication efficiency, as the surface area rise can provide more covering on the surface. Stearic acid is usually added at around 2.5 % by weight. *Irvingia* gum containing lipids has been also employed in tableting as lubricant [66,67].

Preservatives/antioxidants and chelating agents

Preservatives are chemical substances that are generally used in all pharmaceuticals cosmetics and food industries to prevent the decomposition of products by microbial growth. They also stop the undesirable chemical changes. Commonly preservatives are of anti- microbial/anti-oxidant activities [68]. Preservation is a very ancient technique such as pickling and adding honey to prevent microbial growth and hence increases the shelf life of products. Anti-microbial preservatives work by denaturation of enzymes and protein constituents of microbes, by hydrolyzing the microbes, by modifying microbial membrane permeability and/or by oxidizing the cellular constituents of microorganisms [69,70]. Anti- oxidant preservatives are widely used in various industries. The oxidation process damages most of pharmaceuticals as well as food materials especially those which contain large amount of fatty acids. The functioning of antioxidants is done by blocking the oxidation chain reactions/acting as reducing agents [71]. Examples of dosage forms in which preservatives are used include solid, liquid, semi-solid dosage forms. Nowadays natural preservatives used in various formulations being non-toxic compared to synthetic preservatives [72,73]. Examples of some natural excipients used as natural preservatives are Clove oil from Buds of *Myrtaceae syzygium*, (Myrataceae), Neem oil from fruits of *Azadirachata indica*, (Meliaceae), Cumin seeds from seeds of *Cuminum cyminum*, (Apiaceae), pepper oil from fruits of *Piper nigrum*, (Piperaceae), Turmeric, roots of *Curcuma longa*, (Zingiberaceae), Cinnamon bark of *Cinnamomum verum*, (Lauraceae).

Flavoring, perfumery and fragrant agents

Many pharmaceutical industries use flavors in many formulations like: cough syrups, sedatives, anti-malarial and antibiotics. Flavors are also widely used in food industries. Flavors are used as taste masking agents which hide the unpleasant taste or order of a dosage form. A flavor enhances the likelihood of medicines and makes them more compatible for patient's administration. Due to the use of flavors in dosage forms children take medicines without any problem [74]. Flavoring agents may be artificial or natural. Artificial flavoring agents are synthesized in laboratories while natural flavoring agents are extracted from plants. Aromatic oils (volatile oils) types of flavors are extracted from various flowers and plants by using specific separation techniques. Sweetening agents obtained from plants and/or manufactured synthetically are considered as a group of masking agents [75]. Example of dosage form in which flavoring agents used are tablets, pills, pellets, capsules, pastes, syrups, emulsions, suspensions, mouth washes etc. Natural flavoring agents are used widely today in pharmaceuticals and food industries because, they give the realistic flavor with good order and have no negative effect on human as well as environment, in spite of their high cost compared to synthetics [76,77]. Examples of some natural excipients used as natural flavoring agents include Lemon peel of *Citrus limon*, (Rutaceae), Orange peel of *Citrus sinensis*, (Rutaceae), Raspberry fruit of *Rubusrosi folius*, (Rosaceae), Peppermint leaf of *Mentha spicata*, (Lamiaceae), Ginger roots of *Zingiber officinale*, (Zingiberaceae). The principal flavors employed in the dental merchandise area unit are peppermint, spearmint, and wintergreen oils. All of which changed with other different essential oils of anise, clove, caraway, pimento, eucalyptus and citrus fruits, menthol, nutmeg and thyme or cinnamon [78-80].

Coloring agents

Coloring agents promotes the appearance of pharmaceutical formulations. They give the attractiveness to the dosage form [81]. They could be used for differentiation of dosage forms or for easy identification. Due to the use of coloring agents in dosage forms, psychologically patients are attracted towards them. Coloring agents are also used as dyes and widely used in cosmetics and food industries. All coloring agents used in pharmaceuticals must be approved or certified by health authorities [82]. Examples of dosage forms in which coloring agents used are tablets, pills, pallets, capsules, pastes, ointments, syrups, emulsions, suspensions etc. Manufactures use natural colors more than synthetic because they are easily degradable, maintains stability and ecofriendly [83]. However, synthetic coloring agents show allergies-like-symptoms on use, and show toxic effects on human health. They could cause teratogenic effects on chronic use due to the presence of azo groups or aromatic rings in their chemical structures. According to the research report of WHO, synthetic dyes and coloring agents could also cause many problem like immune system problems [84]. Examples of some natural excipients used as coloring agents: brown/black color from bark of *Acacia catechu*, yellow color from leaf of *Adhato davasica*, red color from whole plant of *Aloe barbadensis*, orange/red color from seeds of *Bisca orellena* and *Hibiscus*, blue color from leaf of *Indigo ferotinctoria*, brown color from bark of *Azadirachta indica*, orange color from leaf of *Lowsonia* species. Turmeric and henna are also considered as good sources of colors [85,86].

Stabilizers

Pectin, a non-starch, linear polysaccharides extracted from the plant cell walls are commonly used as stabilizers [87] [98]. Combinations of alginate and pectin polymers used to improve stability of folic acid. The blend matrix increased the folic acid encapsulation efficiency and reduced leakage from the capsules as compared to those made with alginate alone; they showed higher folic acid retention after freeze drying and storage [88]. Alginates are natural polysaccharide polymers isolated from the brown sea weed (Phaeophyceae). Alginic acid can be converted into its salts, of which sodium alginate is the major form currently used. Alginates offer various applications in drug delivery, such as in matrix type

alginate gel beads, in liposomes, in modulating gastrointestinal transit time, for local applications and to deliver the bio molecules in tissue engineering applications [89]. Gellan gum which secreted from *Sphingomonas elodea*, was investigated as matrices for modified oral release, using model molecules with different steric hindrance, can be proposed as carriers for the delivery of high molecular weight drugs such as proteins [90,91]. Cellulose derivatives have gained immense popularity as stabilizers for amorphous solid dispersion owing to their diverse physicochemical properties. More than 20 amorphous solid dispersion- based products that have been approved for marketing consist of cellulose derivatives as stabilizers, thus highlighting their importance in generation of amorphous solid dispersions. These polymers offer numerous advantages like drug solubilization, crystallization inhibition and improvement in release patterns of drugs [92]. Tamarind Seed Polysaccharide possesses properties like high viscosity, broad pH tolerance and adhesively accepted. This led to its application as stabilizer, thickener, gelling agent and binder in food and pharmaceutical industries [93-122].

Some natural excipients used in different formulations

Table 2 below includes some examples for each category of natural excipients used in different formulations.

Some marketed pharmaceutical brands containing natural excipients

Table 3 below describes some pharmaceutical brands containing

Table 2: List of some natural excipients used in different formulations.

Excipient type	Example	Formulation	Reference
Emulsifier	Gum Acacia	Sweet almond oil emulsion Castor oil emulsion	[105] [106]
	Tamarind gum	Castor oil emulsion	[106]
Suspending Agent	Tamarind gum	Paracetamol suspension	[107]
	Grewia gum	Ibuprofen suspension	[108]
Disintegrant/ Superdisintegrant	Karaya gum and locust bean gum	Olanzapine tablets	[109]
	Modified karaya gum and Hibiscus rosa-sinensis mucilage	Amlodipine besylate tablets	[110]
	Chitosan-alginate complex and chitin	Ondansetron HCl fast disintegrating tablets	[111]
	Gellan gum	Metronidazole tablets	[112]
Binder	Okra gum	Paracetamol tablets	[113]
	Khaya gum	Paracetamol tablets	[114]
	Hibiscus rosasinesis mucilage	Paracetamol tablets	[115]
Gelling agents	Gum tragacanth	Prednisolone hydrogels	[116]
	Xanthan gum	Prednisolone hydrogels	[117]
Coating agent	Okra gum	Film-coated paracetamol tablets	[118]
Lubricant	Xanthan gum	Sunflower oil and triglyceride stabilized W/O emulsion	[119]
Stabilizer	Xanthan gum	Doxorubicin hydrochloride gold NP	[120]
	Gum Acacia	Flaxseed protein and soybean protein emulsion	[121]
	Gelatine-acacia coacervation	Tolnaftate microsphere	[122]

Table 3: Examples of some marketed pharmaceutical brands containing natural excipients.

Brand name (company)	Dosage form	Pharmacological/ cosmetic use	Natural excipient (Purpose)
Motilium® (Janssen) 	Film coated tablets	Nausia and vomiting	Lactose, Maize starch and Potato starch (filler/ disintegrant)

Alphapress® (Midpharma) 	Tablets	Benign prostatic hyperplasia (BPH) Antihypertensive	Lactose, Starch and Cellulose (Filler/ disintegrant)
Exforge HCT® (Novartis) 	Film coated tablets	Antihypertensive	Talc, Silica and Cellulose MC (Filler/ Lubricant/ Disintegrant)
Azimax® (Amipharma) 	Capsule	Antibiotic	Lactose and Maize starch (Filler/ Disintegrant)
Clavox® (SPIMACO) 	Suspension	Antibiotic	Xanthan gum, Rasberry and orange flavor (Suspending agent/ Flavouring agent)
Balsam® (Sigma) 	Syrup	Cough syrup	Honey (Sweetener)
Mycosat® (API) 	Oral Suspension	Antifungal	Succrose, Glycerol, Peppermint oil and Orange oil. (Sweetener/ Cosolvent/ Flavouring agent)
Pevisone® (Janssen) 	Cream	Antifungal/ Anti- inflammatory	Liquid paraffin/ Purified water (Base)
Elica® (Jamjoom) 	Ointment	Anti-inflammatory	Liquid paraffin (Base)
Ponds Mineral Clay Face Cleanser® (Ponds) 	Mask	Facial brightening and cleanser	Palmitic acid (Smoothing agent)

Neutrogena Skin Detox® (Neutrogena) 	Scrub	Facial cleanser	Xanthan gum, Citric acid and Glycerol (Viscosity modifier/ Flavoring agent and preservative/ Moisturizing agent)

natural excipients. Selected brands marketed in Sudan from different manufacturers including local, regional and multinational manufacturing companies are listed.

CONCLUSION

In pharmaceutical formulations, the use of excipients offers add-on characteristic properties as integrity, stability, solubility, and patient compliance to those intrinsic properties exhibited by the Active Pharmaceutical Ingredients (APIs). Using natural excipients, drug dosage forms could be developed to address challenges of drug formulations in pharmaceutical industry.

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