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Novel Drug Delivery Systems for Delivery of Herbal Medicine

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Abstract: *New types of plant-based formulations such as polymer nanoparticles, nanocapsules, liposomes, phytosomes, animations, microspheres, transposons and ethosomes have been reported using active and vegetative propagation methods. The new formulations are described as having significant advantages over conventional formulations of active ingredients and plant extracts, including improved solubility, bioavailability and protection. antitoxicity, improved pharmacological potency, improved stability, improved distribution of tissue macrophages, prolonged use and protection against toxicity. physical and chemical degradation. Phytosomes are a proprietary technology developed by a leading pharmaceutical and pharmaceutical manufacturer that combines standard plant extracts or water-soluble plant ingredients into phospholipids to form complexes. lipid-compatible molecules. Herbal medicines can be used in a more straightforward course with increased effectiveness by incorporating them into modern dosage forms. This can be done by designing new drug delivery systems for herbal ingredients. This review highlights the current state of development of new herbal formulations and summarizes the type of active ingredient, bioactivity, and application of the new formulations. New drug delivery systems are new approaches to drug delivery that address the limitations of conventional drug delivery systems. Our country has a vast knowledge base of Ayurveda, the potential of which has only been realized in recent years. outdated and thus reduce the effectiveness of the drug. Applied in herbal medicine, new drug deliverytechniques can help improve the efficacy and reduce side effects of various herbal and herbal compounds. This is the basic idea behind integrating new drug delivery methods into herbal medicine. Therefore, it is important to integrate new drug delivery systems with Indian Ayurvedic medicines to combat more serious diseases. Herbal medicines have long been discouraged due to lack of scientific evidence and difficulty in treatment. Standardization, extraction and identification of individual drug components in complex diverse systems are not intended to be developed as new formulations. However, modern plant protection research is limited to determining the scientific requirements (pharmacokinetics, mechanismof action, site of action, exact dosage required, etc.) plants to introduce new drug delivery systems such as nanoparticles, microemulsions. and matrix. . etc) can be resolved. system, solid dispersion, liposomes, solid lipid nanoparticles, etc. This article summarizes the different drug delivery techniques that can be used in plants, along with some examples.*

Keywords: Herbal Medicine; Novel Drug Delivery System; Natural Products.

I. INTRODUCTION

In the past few decades, considerable attention has been focused on the development of the new drug delivery system "NDDS"; for medicinal plants. Conventional dosage forms, including extended-release formulations, are not able to satisfy both the maintenance of the drug composition at a marked rate required by the body, during the duration of treatment, nor directing the botanical components to the desired target site to achieve an optimal therapeutic response. . In phytopharmaceutical research, the development of nano-sized dosage forms (polymer nanoparticles and nanocapsule, liposomes, solid lipid nanoparticles, phytosomes and nanoemulsions) has several advantages over herbal medicines. pharmacokinetics, including improved solubility and bioavailability, protection against toxicity, improved pharmacology. activity, improved stability, improved tissue distribution of macrophages, sustained management, and

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protected against physical and chemical degradation. Therefore, nanoscale NDDS of medicinal plants has potential in the future to improve the activity and overcome the problems associated with medicinal plants. Liposomes, which are biodegradable and essentially non-toxic media, can encapsulate both hydrophilic and hydrophobic materials.[1] The future of medicine is rooted in the past, before chemists began to synthesize synthetic magic bullets for all these diseases, and before pharmaceuticalcompanies forced the collective health of We're in a multi-billion dollar wagon. In the past, most drugs came from plants. Plants have long been the only human chemists. Herbs are experiencing a resurgence and an herbal "renaissance" istaking place around the world, with more and more people turning to herbal remedies to treat various ailments instead. common medicine. There are three main reasons why herbal remedies are gaining popularity.

1. There are growing concerns about the reliability and safety of drugs and surgeries.
2. Modern medicine fails to effectively treat many of the most common health problems.
3. Many natural remedies have been shown to give better results than drugs or surgery without side effects.[90]

There is also growing evidence that many current medications simply suppress symptoms and ignore the underlying disease process. In contrast, many natural products appear to address the underlying causes of many ailments and produce excellent clinical outcomes. Unfortunately, most doctors and patients are unaware that these natural alternatives exist. No, but research in this area is a never-ending process [91]. How a drug is administered can have a significant impact on its effectiveness. Some drugs have an optimal concentration range for maximum benefit, and concentrations above or below this range may be toxic or have no therapeutic effect. On the other hand, the very slow progress in therapeutic efficacy in severe diseases suggests a growing need for multidisciplinary approaches to deliver therapeutics to tissue targets. This has given rise to new ideas for controlling pharmacokinetics, pharmacodynamics, nonspecific toxicity, immunogenicity, biorecognition, and drug efficacy. These new strategies, often referred to as drug delivery systems (DDS), are based on interdisciplinary approaches that combine polymer science, pharmacology, bioconjugate chemistry and molecular biology.[92] Novel drug delivery systems are new approaches to drug delivery that address the limitations of conventional drug delivery systems. modern medicine treats specific diseases in a targeted manner. Delivery of drugs precisely to the affected parts and areas of the patient's body. A drug delivery system is a method of administering the optimal amount of the drug in question to the patient so that it reaches precisely the 'site of action' where it exerts its effect. New drug delivery systems seek to eliminate all drawbacks associated with traditional drug delivery systems. There are several approaches that can achieve 5 novel drug delivery can be achieved.[93,94]

II. NEW TYPES OF DRUG DISTRIBUTION SYSTEM

Some approaches in the case of novel herbal drug delivery systems include different expression types such as oral soluble tablets, liposomes, phytosomes, pharmacosomes, museums, nanoparticles, microspheres, transfersomes, ethosomes, the "TDDS" and proniosome transdermal drug delivery system are discussed.

III. MOUTH DISSOLVING TABLETS

Ahsoka Life Sciences Limited launches Res-Q, the world's first polyherbal orally dissolving tablet, an oral medicine that dissolves rapidly in the mouth. It induces new drug delivery systems that result in increased potency. In the Ayurvedic medicine segment, this is the first attempt to make medicines more effective in treating chronic diseases. therapy. This unique oral soluble drug delivery system ensures immediate drug delivery to the bloodstream, bypassing first-pass metabolism. It dissolves when mixed with saliva and absorbed in the mouth. This Res-Q relieves shortness of breath within 15 minutes. As such, this product closely resembles the efficacy of sorbitrate, an innovative mouth-dissolving drug used to treat heart disease.[7]

IV. CONTROLLED-RELEASE FORMULATIONS

A patent describes a formulation that can be used orally for controlled release or stable storage of granular herbs, including granular herbs and carriers, a formulation that releases 75% of the active ingredient. calculated between 4 and 18 hours after administration. The active factors selected from the pool included hypericin, hyperforin, and echinacoside. The present invention is intended to provide improved herbal preparations which provide a convenient

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oral dosage form of the herb to provide optimal plasma concentrations of bioactive compounds that help Easy user compliance. A controlled-release and stable-release oral dosageform of herbal granules available in dosage forms such as matrix tablets or in multi-granular dosage forms such as microcapsules placed in two-part capsules manufactured to contain drug delivery system, which will ensure a steady supply of the active ingredients over a long period of time.[8] Another US patent is a new stable herbal formulation in extended-release microparticle form containing G. biloba extract and its manufacturing method. Plant extracts have poor flow and compression properties. Therefore, the expression of such extracts in extended- release tablet form is difficult, as it requires a homogeneous mixture of the extract with the pharmaceutical excipient in all compression belts. Microparticles can be removed by a number of different operations, for example, extrusion- spheronization, liquefied gas bed processes or cutting methods. Extrusion-spheronization is suitable for pellets with high active ingredient content, but requires more equipment. For the production of pellets of the present invention, the excision method is preferred, as it requires only simple equipment and processes.[9]

Liposomes These are microparticulate or colloidal carriers, generally zero.05–5.zero µm in diameter which paperwork spontaneously whencertain lipids are hydrated in aqueous media.[10] The liposomes are round debris that encapsulate a fragment of the solvent, wherein they openly byskip round or go with the flow into their interior. They can deliver one, several, or more than one concentric membranes. Liposomes are built of polar lipids, that are characterised through having a lipophilic and hydrophilic institution of the identical molecules. On interplay with water, polar lipids self-layup and shape self-prepared colloidal debris.[3] Liposome-primarily based totally drug shipping structures provide the ability to elevate the healing index of anticancer agents, through growing the drug awareness in tumor cells or through lessening the publicity in regular tissues exploiting greater permeability and retention impact phenomenon or through making use of focused on strategies.[11] The number one benefits of the usage of liposomes include (i) the excessive biocompatibility, (ii) the easiness of preparation, (iii) the chemical versatility that permits the loading of hydrophilic, amphiphilic, and lipophilic compounds, and (iv) the easy modulation in their pharmacokinetic houses through various the chemical composition of the participant components. Few examples of natural formulations in liposomal drug shipping structures had been given in **Table 1**.[12]

Table 1: Herbal Formulations In Liposomal Drug Delivery Systems

Plants/constituents	Therapeutic category	Applications with respect to liposomal technology	Reference
Ampelopsin	Anticancer	Improved therapeutic efficacy	[13]
Capsaicin	Analgesic	Prolong action, permeation enhancement	[14]
Curcumin	Anticancer	Long systemic residence time and high entrapment efficiency	[15]
Paclitaxel	Anticancer	pH sensitivity and improved entrapment efficiency	[16]
Usnic acid	Antimycobacterial	Prolong action and solubility enhancement	[17]
Wogonin	Anticancer	Prolong duration of action	[18]
Quercetin and rutin	Hemoglobin	Enhancement of Hemoglobin binding	[19]
Garlicin	Lungs	Increase efficiency	[20]
Catechins	Antioxidant and chemopreventive	Increased permeation through skin [21]	
Breviscapin	Cardiovascular	Sustained delivery of breviscapine [22]	

PHYTOSOMES

Most of the bioactive components of herbal medicines are flavonoids, which have poor bioavailability when taken orally. Water-soluble plant constituent molecules (mainly polyphenols) can be converted into lipid-compatible molecular complexes called phytosomes. Phytosomes are more bioavailable than simple plant extracts due to their enhanced mental ability to jump across lipid-rich biofilms and eventually reach the origin. The lipid diluents used to make the plant ingredients lipid compatible are soy phospholipids, mainly phosphatidylcholine. [23] Several herbal formulations in the Phytosomal drug delivery system have been listed in **Table 2.**

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Table 2: Herbal Formulations In Phytosomal Drug Delivery Systems

Plants/constituents	Therapeutic category	Applications Wrt Phytosomal technology	Reference
Ginkgo biloba	Cardioprotective, antioxidant activity	Flavonoids of GBP stabilize the ROS	[24]
Ginsenosides	Nutraceutical, immunomodulator	Increase absorption	[25]
Curcumin	Anticancer, antioxidant	Increase antioxidant activity and increase bioavailability	[26]
Quercetin	Antioxidant, anticancer	Exerted better therapeutic efficacy	[27]
Epigallocatechin	Nutraceutical, systemic antioxidant, anticancer	Increase absorption	[28]
Naringenin	Antioxidant activity	Prolong duration of action	[29]
Silybin and skin	Hepatoprotective, antioxidant for liver	Absorption of silybin phytosome from silybin is approximately 7 times greater	[30]

Phytosomal complexes were first investigated for cosmetic applications, but growing evidence for drug delivery capabilities has accumulated in recent years, with beneficial activity in the fields of cardiovascular, anti-inflammatory, hepatoprotective and anti-cancer.[31] Phytosome complexes exhibit better pharmacokinetics and therapeutic profiles than their uncomplicated plant extracts. Phytosome technology has significantly improved the bioavailability of several phytochemicals.[32] Nanoparticles Nanoparticles are efficient delivery systems for hydrophilic and hydrophobic drug delivery. Nanoparticles are submicron-sized particles, ranging from 10 to 1000 mm.[4] The main goal of designing nanoparticles as a delivery arrangement is to control the particle size, surface properties and release of pharmacologically active agents to achieve the site- specific effects of the drug. at the optimal treatment rate and dosage regimen.[33] In recent years, biodegradable polymeric nanoparticles have attracted considerable attention as potential drug delivery devices.[3] Nanotubes have a matrix-like structure in which the active ingredient is dispersed everywhere (molecules), while nanocapsules have a polymeric membrane and an active core. The nanochemical process has many advantages such as increasing the solubility of compounds, reducing the drug dosage, and improving the absorption of herbal drugs compared with the corresponding crude drug preparations.[34] Examples of several Naoarticulate herbal drug delivery systems are given in Table 3.

Table 3: Herbal Naoparticulate Drug Delivery Systems NIOSOME

Plants/constituents	Therapeutic category	Applications Wrt Nanotechnology	Reference
Triptolide nanoparticle	Anti-inflammatory	Enhance the penetration of drugs through the stratum corneum by increased hydration	[35]
Artemisinin nanocapsules	Anticancer	Sustained drug release	[36]
Taxel nanoparticle	Anticancer	Enhance the bioavailability and sustained drug release	[37]
Berberine nanoparticle	Anticancer	Sustained drug release	[38]
Curcuminoids solid lipid nanoparticle	Anticancer and Antioxidant	Prolonged release of the curcuminoids	[39]
Camptothecin encapsulated nanoparticle	Anticancer	Prolonged blood circulation and high accumulation in tumors	[40]
Naringenin nanoparticle	Hepatoprotective	Improved the release of NAR and improved its solubility	[41]
Breviscapine nanoparticle	Cardiovascular and cerebrovascular	Prolong the half-life and decrease RES uptake	[42]
Tetrandrine nanoparticle	Lung	Sustained drug release	[43]
Glycyrrhizic acid nanoparticle	Anti-inflammatory, antihypertensive	Improve the bioavailability	[44]

Niosomes are multilamellar vesicles formed from nonionic surfactants of the alkyl or dialkyl polyglycerol ether class and cholesterol. Previous studies conducted in collaboration with L'Oreal have shown that niosomes generally have similar properties to liposomes as potential drug carriers.[45] Niosomes are superior to liposomes. They differ from liposomes in that they offer additional benefits. Liposomes face the following problems. B. High cost, chemical instability due to oxidative degradation of components such as phospholipids, special storage and handling requirements, and inconsistent purity of natural phospholipids. Niosomes do not have these problems. [46]

PRONIOSOME

The proniosome gel system is a step toward niosomes that can be used for a varietyof site-delivery applications.[47] Proniosome gels are formulations that convert to niosomes upon in situ hydration with water from the skin. [48]

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Proniosomes are surfactant-coated water-soluble carrier particles that can be hydrated to form a niosome dispersion by brief stirring in a hot aqueous medium just prior to use.[49]. Some examples of proniosome formulations are shown in **Table 4**. [50]

Table 4: Proniosomes In Drug Delivery Systems

Drug	Application	Therapeutic category
Levonorgestrel	Proniosomes(gel, patch	Contraceptive agent
Indomethacin	Proniosomes (oral)	NSAID
Piroxicam	Proniosomes (gel and patch)	NSAID
Estradiol	Proniosomes (gel and patch)	Female hormone
Tenoxicam	Proniosomes (gel)	NSAID
Chlorpheniraminemaleate	Proniosomes (gel and patch)	Antihistamie
Exemestane	Proniosomes (oral)	Anticancer
Aceclofenac	Proniosomes	NSAID
Captopril	Proniosomes(gel and patch)	Antihypertensive
Vinpocetine	Proniosomes (gel)	Cerebrovascular and cerebral degenerative

V. TRANSDERMAL DRUG SHIPPING DEVICE

TDDS has been an expanded stake withinside the drug management through the pores and skin for each neighborhood healing consequences on diseased pores and skin (topical shipping) as effectively as for systemic shipping of tablets.[51] However, they did now no longer have had such anticipated fulfillment with different tablets. But, great capability lies in transdermal drug as destiny clever drug shipping devices.[2] Transdermal shipping device offers the gain of managed drug shipping, more advantageous bioavailability, discount in facet consequences, and clean application. Formulation of transdermal movies incorporating natural drug additives inclusive of boswellic acid (Boswellia serrata) and curcumin (Curcuma longa) is one of the first few tries to make use of Ayurvedic tablets via TDDS, which makes use of pores and skin as a website for non-stop drug management into the systemic circulation. Thus, this shipping device avoids the first by skip metabolism of the drug with out the annoyance related to injection; moreover, the scheme gives a extended drug shipping with rare dosing through zero order kinetics and the remedy may be without difficulty fired at any time. Useof turmeric in TDDS for the neighborhood movement of the drug on the webweb page of management also can be appeared as a younger model of Ayurvedic turmeric poultice or leap.[52]

MICROSPHERE

Microspheres are individual spherical particles with an average particle size between 1 and 50 microns. [52] Microparticle drug delivery systems have been investigated and are believed to be reliable in delivering drugs specifically to target sites to achieve desired concentrations in desired situations without adverse effects. Microencapsulation is a useful technique that significantly extends the duration of drug action and improves patient compliance. Finally, constant plasma concentrations are maintained, thus reducing overall dosage and side effects.[53] To date, rutin, camptothecin, zedoary oil, tetrandrine, quercetin, cinnarus colimus extract, etc. Many herbal active ingredients are processed into microbeads. In recent years, there have been many reports on immunomicroscopy and magnetic microscopy. Immunogenic microspheres possess immunity due to antibodies and antigens coated or adsorbed onto polymeric microspheres. Some herbal microspheres developed for drug delivery systems are shown in **Table 5.**

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Table 5: Herbal Microspheres As Drug Delivery Systems			
Plants/constituents	**Therapeutic category**	**Applications Wrt nanotechnology**	**Reference**
Rutin-alginate-chitosan microcapsules	Cardiovascular and Cerebrovasculardiseases	Targeting into cardiovascular and cerebrovascular region	[55] [56]
Zedoary oil microsphere	Hepatoprotective	Sustained release and Higher bioavailability	[81,57]
Camptothesin loaded microspheres	Anticancer	Prolonged release of camptothecin	[58]
Quercetin microspheres	Anticancer	Significantly decreases the dose size	[59]
Cynara scolymus microspheres	Nutritional supplement	Controlled release of neutraceuticals	

EMULSION

Emulsion refers to a heterogeneous dispersion system consisting of two insoluble liquids, one of which is dispersed in the other liquid in the form of droplets. Generally speaking, emulsions consist of an oil phase, an aqueous phase, surfactants, and sub-surfactants. Its appearance is a translucent to clear liquid. Emulsions can be classified as normal emulsions (0.1-100 μm), microemulsions (10-100 NM), sub-microemulsions (100-600 NM), etc. Of these, microemulsions are also called nanoemulsions, and submicroemulsions are also called lipid emulsions. As a drug delivery system, emulsions are distributed to target areas in vivo due to their affinity for lymph. Furthermore, the drug is packaged in the internal phase and kept out of direct contact with bodily and tissue fluids, allowing drug release over an extended period of time [61].

Subsequently, during the processing of oily or lipophilic drugs into O/W or O/W/O emulsions, the oil droplets are phagocytosed by macrophages, reaching high concentrations in the liver, spleen, and kidney. It's really hard to break down dissolved drugs. Water- soluble drugs, prepared as W/O or W/O/W emulsions, can be sufficiently contracted in the lymphatic system by intramuscular or subcutaneous injection. Emulsion particle size affects its target distribution. Apart from targeted sustained release, the preparation of herbal medicines in emulsion can enhance the stability of hydrolyzed materials, improve the penetration of medicines into skin and mucous membranes, and reduce the irritation of medicines to tissues. mitigate. So far, several types of herbal medicines such as camptothecin, brucea javanica oil, koisenolide oil, and banyan oil have been processed into emulsions. [61] investigated the effects of aluminum emulsion on the human lung adenocarcinoma cell line A549 and protein formulations. The results showed that aluminum emulsion significantly inhibited the growth and proliferation of A549 in vitro, showing a time- and dose-dependent relationship. Elemenum Emulsion is a class of new anticancer agents with great potential for application. In addition, there isno myelosuppression and no susceptibility or damage to the liver. Some examples of herbal emulsions are shown in **Table 6.**

Table 6: Herbal Emulsions As Drug Delivery Systems

Plants/constituents	Applications category	Therapeutic Wrt Nanotechnology	Reference
Self-nanoemulsifying Zedoary essential oil	Hepatoprotection anticancer and antibacterial	Improved aqueous dispersibility, stability and oral dispersibility, bioavailability	[62]
Triptolide microemulsion	Anti-inflammatory	Enhance the penetration of drugs through the stratum corneum by increased hydration	[63]
Docetaxel submicron Emulsion	Anticancer	Improve residence time	[64]
Berberine nanoemulsion	Anticancer	Improve residence time and absorption	[65]
Silybin nanoemulsion	Hepatoprotective	Sustained release formulation	[66]
Quercetin microemulsion	Antioxidant	Enhance penetration into stratum corneum and epidermis	[67]

ETHOSOMES

New advances in patch technology have led to the development of the ethosome patch, which includes a drug in the ethosome. The ethosome system consists of soy phosphatidylcholine, ethanol, and water. They can form multi-membrane vesicles and are highly capable of trapping particles with different hygrophilic properties. Elastomer and transferable vesicles have also been used as drug carriers for a wide range of small molecules, peptides, proteins and vaccines.[68] Ethosomes have high deformability and trapping efficiency, and can penetrate completely through the

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skin and improve drug delivery through the skin. Compared with other liposomes, the physical and chemical properties of ethosomes enable efficient delivery of drugs through the stratum corneum into deeper skin layers or even into the bloodstream.[69] This property is important as both a local drug carrier and a transdermal delivery system. In addition, ethosome support can also provide efficient intracellular transport for both hydrophilic and lipophilic drugs, [70] the transdermal absorption capacity of the herbal anti-inflammatory drug matrine is increased, [71]] it also allows antimicrobial peptides to enter fibroblasts easily.[72] From the literature review, it was found that only three clinical trials were conducted on human ethosoma systems in volunteers. Horwitz et al. conducted a randomized, double-blind, pilot clinical study to compare the efficacy of a generic acyclovir preparation and a commercially available acyclovir cream (Zovirax®) in the treatment of recurrent cold sores in 40 people volunteer. Results showed thatthe ethosoma acyclovir preparation was more effective than Zovirax cream and showed significant improvement in all evaluated clinical parameters, such as time to scab formation, disappearance, and pain parameters. Gel treatment twice a day for 8 weeks. Volunteers treated with ethosomal gel showed significant improvement in acne status, reduction in the number of acne, pustules, and total lesions compared with placebo. The ethosoma modulation of prostaglandin E1 wasevaluated in a pilot clinical study in patients with erectile dysfunction. It was observed that 12 of the 15 tested patients had improved systolic peak rate and penile stiffness. Erection time is 10 to 60 minutes. No treatment-related skin side effects were reported in any of the above clinical trials. [73] **Table 7** shows clinical data for ethosomes.[74]

Table 7: Clinical Data Of Ethosomes

Drug/agent	Dosage forms/type	Volunteers	Clinical trial type
Acyclovir	Not mentioned	40	Pilot clinicaltrial
CLSA	Ethosomal gel	40	
Combination		15	Pilot clinicaltrial
PGE1	Not mentioned		
			Pilot clinicaltrial

TRANSFEREOSOMES

Transfersomes are specifically optimized debris or vesicles which can reply to an outside strain through speedy and energetically inexpensive, formtransformations.[75] The improvement ofnovel techniques inclusive of transfersomes have immensely contributed in overcoming trouble confronted through transdermal drug shipping inclusive of not able to move large molecules, penetration thru the stratum corneum is the price proscribing step, physicochemicalhouses of medication avert their very own shipping thru pores and skin. These elastic vesicles can squeeze themselves thru pores and skin pores often smaller than their very own length and may shipping large molecules.[76] Transfersomes are carried out in a nonoccluded approach to the pores and skin, which permeate thru the stratum corneum lipid lamellar areas because of the hydration or osmotic pressure withinside the pores and skin. It may be relevant as drug providers for a orbit of small molecules, peptides, proteins and natural elements. Transfersomes can penetrate the stratum corneum and deliver the nutrients, regionally to hold its capabilities ensuing upkeep of pores and skin[77] Transfersomes are a shape of elastic or deformable vesicle, whichwerefirstintroducedintheearly1990sandtheirelasticity is generated through incorporation of an aspect activator withinside the lipidbilayer structure.[78] In thisconnection the transfersomes of Capsaicin has been made through Xiao‐Ying et al.[79] which suggests the higher topical absorption in evaluation to natural capsaicin. Examples of natural Transfersomes and Ethosomes as drug shipping structures had been proven in **Table 8.**

Table 8: Herbal Transfersomes And Ethosomes As Drug Delivery Systems

Plants/constituents	Applications category	Therapeutic Wrt Nanotechnology	Reference
Capsaicin transfersomes	Analgesic	Increase skin penetration	[79]
Colchicine transfersomes	Antigout	Increase skin penetration	[74,80]
Vincristine transfersomes	Anticancer	Increase entrapment efficiency and skin	[73]
Matrine ethosome	Anti‐inflammatory	Improve the percutaneous permeation	[81]
Ammonium glycyrrhizinate ethosomes	Anti‐inflammatory	Increase of the *in vitro* percutaneous permeation	[82]

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VI. OTHER NEW ACCESSORIES

In a study by Ma et al., the effects and mechanism of Shuanghua Aerosol (SHA) were investigated for upper respiratory tract infections in children aged 3-14 years. SHA includes Flos Chrysanthemum Indicum, Flos Lonicera, Herba Douttuynia, Radix Bupleurum and mint. The control treatment was Shuanghuanglian aerosols, including Flos Lonicera, Fructus Forsythia and Radix Scutellaria. The authors concluded that SHA has obvious anti-inflammatory and antiviral effects and has a good curative effect in the treatment of upper respiratory tract infections in children.[83] Gugulipid is a standardized extract prepared from the gum resin of Commiphora wightii oleo that has been clinically shown to reduce harmful serum lipid levels in the blood.

Gugulipid microparticles have been prepared by different techniques using chitosan, egg albumin, sodium alginate, ethylcellulose, cellulose acetate, gelatin and beeswax. The microparticles were evaluated for their physicochemical properties. High-performance liquid chromatography (HPLC) profiling showed a clear separation of Guggulsterone-Eand-Z, confirming the trapping of Gugulipid in the prepared microparticles.[84] Microcapsule containing water-soluble extracts of psyllium, Plantago major and Calendula officinalis L. (PCE) are prepared by layer- by-layer adsorption of carrageenan and oligochitosan onto calcium carbonate microparticles and then dissolving them after treatment with ethylenediaminetetraacetic acid. Trapping of PCE was achieved using adsorption and co-precipitation techniques. Co-precipitation provides better PCE trapping in the carbonate matrix than adsorption. In vitro release kinetics were studied using artificial gastric juice. Applying a mouse acetate ulcer model, PCE released from microcapsules has been shown to accelerate gastric tissue repair.[85]

Traditional Chinese herbal medicine (TCH) nanoparticles are useful to improve their absorption and distribution in the body, and thus improve their effectiveness. TCH consists of peach seed, safflower, angelica root, szechwanlovagerhizome, rhubarb root, red peony root, leeches, dragonflies, earthworms and beetles mixed and prepared by drying,[86] cutting Small, extracted, ground into liquid particles by ultrasonic waves, filtered and nanometerized into nanoparticles with nanometerCollider. TCH nanoparticles showed significant thrombolytic effects, leading to rapid recovery from arterial embolization and reduced thrombosis. The thrombolytic effect of TCH nanoparticles is much stronger than that of their non- nanoparticle form. There is also a study on the integrative evaluation, pharmacokinetics, and pharmacological activity of oral extended-release formulations by the specialty of traditional Chinese medicine.[86]

A novel herbal extract extended-release implant using chitosan has proven to be very useful. Danshen Extract (Radix Salvia miltiorrhiza), an herbal medicine, was developed with CS gelatin as an implant to promote junction and healing of muscleand tissue at the site of organic incision in the abdominal cavity. Measurements were made based on sustained release of tanshinone IIa, a tracer component, from the material in vitro. The dissolution medium was analyzed by HPLC method. Biodegradation studies of this material have also been conducted both in vitro and in vivo. The film made of this material exhibits a sustainable release effect. The release profile is consistent with the Higuchi equation. At most about 20% of the combined drug was released in CS gelatin over 15 days (1:

2) matrix. Drug release was effectively controlled by the amount of drug loaded into the matrix. Enhanced membrane (CS/gelatin1 ratio:[87] Arthri Blend-SR is amarketed formulation containing botanical extracts and nutrients to support healthy joints and connective tissue in the body. It is a patented blend of clinically proven natural active ingredients for joint care applications. This preparation has the added benefit of time-release technology, helping to further manage arthritis symptoms. A blend containing glucosamine sulfate, boswellin (extracted from B. serrata) and curcumin complex C3 (curcuminoids from C. longa), ingredients that work synergistically to aid in the control of inflammatory conditions such as arthritis. It will provide a slow release profile of 80% to 90% of the releasing ingredient, over a period of 8 hours. The advantage of the extended-release formulation is particularly related to the bioavailability of glucosamine.[88]

VII. FORMULA FOR DELIVERY IN THE MARKET OF NEW HERBAL DRUGS

The two companies that dominate the market for these systems are Cosmetochem and Indena. To provide herbal medicines, Cosmetochem launches Herbasec® technology on the market which are essentially liposomal preparations of various herbal ingredients such as white tea extract, green tea, white hibiscus, gurana and aloe festival. These extracts are used in cosmetics for their antioxidant effects to prevent aging. Indena has patented the Phytosome®

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technology and markets many products under this name with various therapeutic benefits. Indena markets the ingredients/plant extracts of licorice (18ß-glycyrrhetinic acid), Ammi visnaga (visnadine), Centella asiatica (triterpenes), G. biloba (ginkgoflavonglucosides, ginkgolides, bilobalide), hawthorn flower (vitexin‑2″‑O‑rhamnoside), milk thistle (silymarin and silybin), horse chestnut (ß‑sitosterol escin), Terminalia sericea (sericoside), Panax ginseng (ginsenosides), grape seeds (polyphenols), green tea (polyphenols), etc.[89]

VIII. NOVEL DRUG DELIVERY APPROACHES

Various drug delivery and drug targeting systems have been developed to minimize drug degradation and loss, prevent adverse side effects, and increase drug bioavailability and the proportion of drug that accumulates in the zone of need. Soluble polymers, microparticles of insoluble or biodegradable natural and synthetic polymers, microcapsules, cells, cell ghosts, lipoproteins, liposomes and micelles should be mentioned as active substance carriers. Carriers can be slowly degradable, stimuli-responsive (e.g., pH or temperature sensitive), and can be targeted (e.g., by conjugation with specific antibodies directed against particular characteristic components of the region of interest). You can also. Targeting is the ability to direct a drug-loaded system to a desired site. Two main mechanisms can be distinguished for targeting the desired site of drug release.

1) Passive targeting and

2) Active targeting.

An example of passive targeting is the preferential accumulation of chemotherapeutic agents in solid tumors due to the increased vascular permeability of tumor tissues compared with healthy tissues. One possible strategy that enables active targeting involves surface functionalization of drug transporters with ligands that are selectively recognized by receptorson the surface of cells of interest. As ligand-receptor interactions can be highly selective, this may allow for more precise targeting of the site of interest. Controlled release of the drug and its subsequent biodegradation are essential for successful formulation development. Thepossible release mechanisms are:

1. Desorption of adsorbed/surface bound drugs;
2. Diffusion through the support matrix.
3. Diffusion through the supporting wall (for nanocapsules);
4. Erosion of the support matrix; and
5. Combined erosion/diffusion process.

The route of administration can make the difference between the success and failure of adrug, as drug choice is often influenced by route of administration.[95] Prolonged (or continuous) drug release consists of polymers that release the drug at a controlled rate by either diffusing out of the polymer or degrading the polymer over time. Pulse release is often the preferred method of drug delivery because it mimics the body's natural way of producing hormones such as insulin. This is achieved through the use of drug-carrying polymers that respond to specific stimuli (eg, exposure to light, changes in pH or temperature).[96] For more than two decades, researchers have appreciated the potential benefits of nanotechnology. Nanotechnology greatly improves drug delivery and drug targeting. Improved delivery technologies that minimize toxicity and increase efficacy offer significant potential patient benefits and open up new markets for pharmaceuticals and drug delivery companies. Other approaches to drug delivery focus on overcoming specific physical barriers such as: B. the blood-brain barrier to better target drugs and improve their efficacy; or seeking alternative acceptable routes for the delivery of protein drugs outside the gastrointestinal tract where degradation can ooccur.[97] Currently, new drug delivery systems are widely used only for symptomatic therapy, but they have their own limitations, which makes turning to safe, effective and proven Ayurvedic herbal formulations the preferred option.

IX. POTENTIAL OF NOVEL DRUG DELIVERY FOR HERBAL DRUGS

Our country has a vast knowledge base of Ayurveda, the potential of which has only been realized in recent years. However, the drug delivery systems used to administer drugs to patients are traditional are outdated and, as a result, reduce the efficacy of the drug. In herbal extracts, many compounds are more likely to be destroyed by the highly acidic pH of the stomach. Others are metabolized in the liver before reaching the blood. As a result, the required amount of the drug may not enter the blood. If the drug does not reach the bloodstream at a minimum concentration known as the

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'minimum effective concentration', no therapeutic effect occurs. Botanicals are medicines that use traditional compounds made from plant compounds instead of chemicals. Natural ingredients are more easily and quickly metabolized in the body. Therefore, fewer, if any, side effects occur, and absorption into the bloodstream is increased, resulting in more thorough and effective treatment. Drugs made from chemical compounds are prone to unwanted side effects. . The human body tends to reject certain compounds that do not exist in nature. These denials come in the form of side effects. Some can be as mild as a mild headache, while others can be so severe that they can be fatal. Herbal medicines have few or no side effects, but chemical interactions with other prescription drugs can occur. In addition, because they are single, purified compounds, they are easier to standardize and easier to integrate into modern drug delivery systems compared to herbs.[98]

Lipid-based drug delivery systems have been investigated in various studies, demonstrating their potential for controlled and targeted drug delivery. Pharmacosomes are amphipathic phospholipid complexes of drugs that contain active hydrogens and bind to phospholipids. They give drugs excellent biopharmaceutical properties and improve their bioavailability. Phytosomes are novel compounds composed of lipophilic complexes of plant-derived components such as Silybum Marianum, Ginkgo Biloba and Ginseng with phospholipids.[99] They are also called plant lipid delivery systems. They are highly lipophilic and have enhanced bioavailability and therapeutic properties. They are an advanced form of herbal extracts with improved pharmacokinetic and pharmacological parameters, so that they can be used advantageously in the treatment of acute liver diseases of metabolic or infectious origin. Phytosomes are produced through a patented process in which individual components of herbal extracts, such as flavonolignans and terpenoids, are attached at the molecular level to phospholipids such as phosphatidylcholine via their polar ends. Phytosomes are used as medicines and have a wide range of applications in the cosmetic field. Many fields of phytosomes are expected to be used in medicine in the future. Phytosomes form a bridge between convective and novel delivery systems.[100] The benefits of both can be enjoyed when the herb itself, or purified phytopharmaceuticals or phytosomes are integrated into new drug delivery systems. Therefore, it is important to integrate new drug delivery systems with Indian Ayurvedic medicines to combat serious diseases.

X. HERBAL NOVEL DRUG DELIVERY SYSTEMS

Due to the many possibilities for new plant-based drug delivery systems, several researchers have proposed orally disintegrating tablets, sustained release formulations, sustained release formulations, mucoadhesive systems, transdermal dosage forms, microparticles, We are working on the development of new drug delivery systems such as microcapsules, nanoparticles and implants. Herbs such as. Some of them are in the experimental stage and some have reached the marked stage. Some of the research done in this area is summarized below.

Ashoka Life Science Limited launched Res-Q, the world's first orally dissolving polyherbal tablet, a drug that dissolves rapidly in the mouth. It has a novel drug delivery system that imparts increased effi cacy. In Ayurvedic medicine segment, this is the fi rst attempt to make medicines more effective in managing chronic ailments. Res-Q is a poly-herbal medicine highly effective for lung problems and other respiratory ailments like asthma. This unique mouth dissolving drug delivery system ensures that the drug reaches the blood directly and the fi rst pass metabolism is bypassed. It dissolves in mouth by mixing with the saliva and get absorbed. This Res-Q relieves shortness of breath within 15 minutes. In this way, the drug dissolves in the mouth and resembles the efficacy of sorbitrate, a revolutionary drug used for heart disease.[101] A patent describes an orally administrable formulation for the controlled release or stable storage of a granulated herb comprising a granulated herb and a carrier, wherein the formulation releases the active ingredient between 4 and 18 hours after administration. Emit 75%. The active ingredient is selected from the group consisting of hypericin, hyperforin, and echinacoside. The present invention seeks to provide an improved herbal preparation that provides a convenient oral dosage form of the herb and provides optimal plasma concentrations of the biologically active compounds to facilitate user compliance. is. The controlled and stable release oral dosage forms of granulated herbs are either matrix formulations such as matrix tablets or multiparticulate formulations such as microcapsules, which are manufactured into two-piece capsules to obtain drug delivery systems. are placed. longer period.[102]

Another US patented invention is a new stable herbal formulation in the form of sustained release microparticles containing ginkgo biloba extract and a process for its preparation. Plant extracts are less fluid and compressible.

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Therefore, formulating such extracts in the form of sustained-release tablets is difficult. This is because a homogeneous mixture of extract and pharmaceutical excipients is required during all compression steps. Microbeads can be made by a number of different processes, such as extrusion-spheronization, fluidized airbed processes, or coating pan processes. Extrusion spheronization is suitable for high potency pellets but requires more equipment. The coating pan method is preferred for the production of the granules of the invention.[103]

Studies of palatal mucoadhesive tablets containing herbal formulations have demonstrated the sustained release capability of buccal adhesive tablets containing mucoadhesive polymers. Ingredients of Herbal Preparations, i. H. sage, echinacea, lavender and mastic gum have previously shown antibacterial activity. Incorporated into tablets. Results showed that adhesive tablets containing herbal preparations were effective in reducing bad breath and VSC leadhesiv[104] Studies on the formulation of transdermal films containing herbal active ingredients such as boswellia serrata and curcumin (Curcuma longa) are among the first attempts to deliver Ayurvedic medicines via the transdermal drug delivery system 'TDDS'. One. using the skin as the site of continuous drug delivery into the systemic circulation. Thus, this delivery system avoids first-pass metabolism of the drug without the pain associated with injection. Furthermore, the system provides sustained drug delivery with low frequency dosing via zero-order kinetics, and treatment can be easily terminated at any time. The use of turmeric in TDDS for the local action of the drug at the site of administration can also be viewed as a new version of the Ayurvedic turmeric pack or lepa.[105] The formulations selected for oral retention were from the group consisting of gels, pastes, and chewing gums. Herbal ingredients are selected and formulated to provide an effective composition for causing darkening of the human scalp and facial hair, reducing scalp hair loss, and promoting hair growth after repeated use over a period of time increase.[106] A study by Ma and her colleagues examined the effects and mechanisms of Shuanghua Aerosol (SHA) on upper respiratory tract infections in children aged 3 to her 14 years. Shuanghua Aerosol consists of Flos Chrysanthemum Indicum, Flos Lonicera, Herba Doutuynia, Radix Bupleurum and Menthen. The control treatment was his Shuanghuanglian Aerosol (SHLA) consisting of Flos Lonicera, Fructus Forsythia and Radix Scutellaria. The authors conclude that SHA has clear anti-inflammatory and antiviral properties and has good therapeutic efficacy in treating upper respiratory tract infections in infants.[107] Gugulipid isa standardized extract made from the oleo-gum resin of Commiphora wightii that has been shown to reduce the levels of harmful serum lipids in the bloodstream. Gugulipid microparticles were formulated by different techniques using chitosan, egg albumin, sodium alginate, ethylcellulose, cellulose acetate, gelatin, and beeswax. Microparticles were evaluated for their physicochemical properties. The HPLC profile showed clear separation of guggulsterone-E and -Z. It was confirmed that gugulipid was contained in the prepared microparticles.[108]

Psyllium A microcapsule encapsulating a water-soluble herbal extract from psyllium psyllium and marigold calendula L.. (PCE) was prepared by layer-by-layer adsorption of carrageenan and oligochitosan onto calcium carbonate microparticles and dissolution after treatment with EDTA. PCE trapping was performed using adsorption and co-precipitation techniques. Coprecipitation provided better confinement of His PCE in the carbonate matrix compared to adsorption. In vitro release kinetics were studied using simulated gastric juice. Using a rat acetic acid ulcer model, PCE released from microcapsules was shown to promote gastric tissue repair.[109] Nanoparticles of TCH (traditional Chinese herb) help improve absorption and distribution in the body, enhancing efficacy. , horseflies, earthworms, ground beetles, etc. are mixed into liquid particles by drying, crushing, extracting, and ultrasonically crushing, then filtered and nanometered into liquid nanoparticles using a Nanometer Collider. Nanoparticles of TCH exhibited a significant thrombolytic effect, leading to rapid recovery from arterial embolism and reduction of thrombus. The thrombolytic effect of nanoparticlesof TCH is much stronger than the non-nanoparticle form. There are also several studies on integrated evaluation, pharmacokinetics and pharmacological activity of oral sustained- release formulations of herbal medicines.[110]

A new implant with delayed release of herbal extracts using chitosan has proven to be very useful. Facilitates anastomosis and healing of muscle and tissue at the intraperitoneal organ incision site. Measurements of the sustained release of the marker component tanshinone IIa from the material in vitro were performed. The elution medium was tested using a high performance liquid chromatography method. Biodegradation studies of the material were also performed both in vitro and in vivo. Films made from this material showed a delayed release effect. The emission profile conforms to the Higuchi formula. CS gelatin (1:2) Matrix. Drug release has been found to be effectively

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controlled by the amount of drug loaded into the matrix. Improved film (CS/gelatin ratio 1:16) is hydrolyzed by lysozyme in vitro in 4 days. This 0.5 cm 2 film was implanted in rats and was completely degraded in 28 days, and the animal's abdominal incision healed well.[111]

ArthriBlend-SR is an over-the-counter formulation containing herbal extracts and nutrients that support healthy joints and connective tissue in the body. This is a clinically validated proprietary blend of natural active ingredients for joint care. This composition has the added advantage of sustained release technology, which benefits the continued management of arthritis symptoms. This blend includes Glucosamine Sulfate, Boswellin (Boswellia serrata extract), and Curcumin C3 Complex (curcuminoids from Curcuma longa), ingredients that work synergistically to treat inflammatory conditions such as arthritis. It provides a sustained release profile of 80-90% drug release over 8 hours. The benefits of sustained release formulations are specifically related to glucosamine bioavailability.[112]

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XI. CONCLUSION

Herbal medicines have been widely used all over the world since ancient times and have been recognized by doctors and patients for their better therapeutic value because they cause fewer side effects than conventional medicines. modern medicine. Ayurvedic medicines can be used more frankly with increased effectiveness by incorporating them into modern dosage forms. However, herbal medicine needs a scientific approach to render ingredients in a new way to enhance patient compliance and avoid repeat use. This can be done by designing the NDDS for herbal ingredients. NDDS not only reduces repeat use to correct non-adherence, but also enhances treatment value by reducing toxicity and increasing bioavailability, etc. Recently, pharmaceutical scientists have focused on designing a drug delivery system for herbal medicines using the scientific method. New research can also help capture and sustain the market. But there are many challenges for herbal medicines that need to be overcome, such as the difficulty of conducting clinical research on herbal medicines, the development of simple bioassays for biological standardization, the development of methods of pharmacological and toxicological evaluation, study of their absorption. location, the poisonous plant being used, the discovery of different animal models for toxicity and safety assessment, legal and regulatory aspects of herbal medicine, etc. Medicines of Ayurvedic origin can be used in a better and more effective way by incorporating them into modern dosage forms. A scientific approach is needed to deliver the ingredients in a method. This can be achieved through the development of new drug delivery systems of herbal ingredients. New drug delivery systems not only reduce repeated dosing to overcome non-compliance, but also help increase therapeutic value, such as by reducing toxicity and increasing bioavailability. Recently, pharmaceutical scientists have shifted their focus to developing drug delivery systems for herbal medicines using scientific approaches. New research can also help you compete and stay in the market. However, herbal medicines have many challenges to overcome, including use, discovery of different animal models for toxicity and safety evaluation, and legal and regulatory aspects of herbal medicines.

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