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A SYSTEMIC REVIEW ON DEVELOPMENT OF NOVEL DRUG DELIVERY SYSTEMS FOR AYURVEDIC MEDICINES

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ABSTRACT

The limitations of the conventional drug delivery methods are addressed by the innovative drug delivery system, which is a novel method of drug administration. Our nation possesses a wealth of Ayurvedic knowledge, but only recently has its full potential been recognized. If the cutting-edge medication delivery technology is used in Ayurvedic medicine, it might improve the effectiveness and lessen the negative effects of different herbs and Ayurvedic compounds. Lack of scientific support and processing challenges, such as standardization, extraction, and identification of specific pharmacological components in complex polyhedral systems, led to the development of innovative formulations. pharmacokinetics, place of action, mechanism of action, necessary precise dosage, etc.) Incorporating Ayurvedic medicines into cutting-edge drug delivery systems such nanoparticles, microemulsions, matrix systems, solid dispersions, liposomes, solid lipid nanoparticles, and others. The way a medicine is administered can significantly affect how effective it is. Some medications have an ideal concentration range where the most benefit is obtained; dosages outside or inside of this range might be hazardous or have no therapeutic effect at all.

KEYWORDS - drug delivery system, Ayurvedic drugs, delivery methods, etc.

INTRODUCTION

Due to its significant therapeutic effects, aesthetic appeal, and increased patient compliance, the use of herbal medicines has drawn interest from all over the world. Information on these plants' ethnobotanical uses and their protection in indigenous societies is important for preserving biodiversity and advancing health care systems. In the entire planet, there are countless varieties of these plants. Several examples of these plants are Withania somnifera, Aloe vera, Azadirachta indica, Murraya Koenigii, Carica papaya, and Allium sativum.[1]

Various drug delivery and drug targeting systems are now being developed to reduce drug degradation and loss, to prevent negative side effects, to boost medication bioavailability, and to raise the percentage of the drug accumulating in the necessary zone. A new method of medication delivery is called a novel drug delivery system. It makes the drug's effects .stronger and longer-lasting.[2]

NOVEL DRUG DELIVERY SYSTEM

Ayurvedic formulations are dosage forms made up of one or more herbs or processed herbs in precise amounts to offer certain nutritional, cosmetic, and other advantages. They are used to diagnose, treat, or modify the physiology or structure of people or other animals. Whole plants, chopped or fragmented plants, or plant parts are treated via extraction, distillation, expression fractionation, purification, concentration, or fermentation to create Ayurvedic medicines.[3]

This comprises extracts made from comminuted or powdered botanical compounds. expressed juices, essential oils, etc. Due to their low lipid solubility, inappropriate molecular size, or both, many Ayurvedic medicines and Ayurvedic extracts exhibit minimal or no in vivo activities despite their exceptional potential in-vitro findings. This eventually leads to poor absorption and poor bioavailability. There is a great interest and medical need for the improvement of the bioavailability of many Ayurvedic drugs and plant extracts that are poorly lipid soluble and therefore are less bioavailable. Phytochemical and phytopharmacological studies have long established the overall health-boosting capacities of various plant products.[4]

METHODOLOGY

This data of novel drug delivery system has been collected from different articles, like PubMed, NCBI, etc.

AYURVEDIC NOVEL DRUG DELIVERY SYSTEM

Numerous researchers are working to create novel Ayurvedic drug delivery systems, such as mouth-dissolving tablets, formulations for sustained and extended release, mucoadhesive systems, transdermal dosage forms, microparticles, microcapsules, nanoparticles, implants, etc. Some of them are still in the testing phase, while others have advanced to the market.[5]

POPULARITY OF AYURVEDIC MEDICINES

- Concerns about the dependability and safety of medications are developing.
- Many of the most prevalent medical conditions cannot be properly treated by modern medicine.
- Several natural remedies have been proven to be more effective than medicines or surgery without the negative side effects.

Since ancient times, Ayurvedic medicines have been used extensively around the world. Both doctors and patients now realize their superior therapeutic value due to the fact that they have less side effects than contemporary medications. To maximize patient compliance and prevent repetitive administration, phototherapeutics requires a systematic way to administer the components over time. Designing innovative drug delivery systems for Ayurvedic ingredients can help achieve this. Novel Drug Delivery System serve to boost the therapeutic value by lowering toxicity and enhancing bioavailability, which reduces the need for repeated administration to overcome non-compliance. In order to combat additional chronic diseases including asthma, diabetes, cancer, and others, it is crucial to include nanocarriers as a Novel Drug Delivery System into the traditional medical system.[6]

AYURVEDIC DRUG USED AS CARRIER NANO MOLECULES IN NOVEL DELIVERY SYSTEM

- Although they might not be appropriate for delivery as such, effective extracts made from acetone, chloroform, petrol, and methanol are available.

- Since these medications are in bulk, dosage reduction is aimed.
- Target specificity for diverse chronic illnesses is lacking in formulations currently on the market.
- The formulations that are now on the market come with some additional adverse effects.
- Patient non-compliance since the formulations available are less effective and need high dosages.

SIGNIFICANCE OF DRUG DELIVERY SYSTEM IN AYURVEDIC DRUGS

The limitations of conventional drug delivery systems are addressed by innovative drug delivery systems, which are a fresh method to drug delivery. Our nation possesses a wealth of Ayurvedic knowledge, but only recently has its full potential been recognized. However, the conventional and antiquated medication administration method utilized to give the patient the Ayurvedic medicine causes a reduction in the drug's effectiveness. If the cutting-edge medication delivery technology is used in Ayurvedic medicine, it might improve the effectiveness and lessen the negative effects of different herbs and Ayurvedic compounds. This is the fundamental rationale underlying the use of innovative medication delivery systems in Ayurvedic medicines.[7]

Due to a lack of scientific support and processing challenges, such as standardization, extraction, and identification of specific medicinal components in complex poly-ayurvedic systems, Ayurvedic medicines were long ignored for development as innovative formulations. Modern phytopharmaceutical research, on the other hand, can address the scientific requirements for Ayurvedic medicines to be included in novel drug delivery systems, such as nanoparticles, microemulsions, matrix systems, solid dispersions, liposomes, solid lipid nanoparticles, and so on (such as determination of Pharmacokinetics, mechanism of action, site of action, accurate dose required, etc.).[8]

NOVEL DRUG DELIVERY SYSTEM BASED AYURVEDIC DRUG FORMULATIONS

The use of Ayurvedic medicines to treat a range of ailments with less hazardous side effects and greater therapeutic results is growing in popularity in the modern world. Developing nano dosage forms (polymeric nanoparticles and nano-capsules, liposomes, solid lipid

nanoparticles, Phytosomes, and nano-emulsion, for example) has a number of benefits for Ayurvedic drugs, including improving solubility and bioavailability, protecting from toxicity, enhancing pharmacological activity, improving stability, improving tissue macrophage distribution, sustained delivery, and protecting from physical and chemical degradation. Thus, innovative nanosized drug delivery technologies for Ayurvedic medicines may one day be used to improve activity and address issues with plant-based therapies. Ayurvedic remedies are made by putting whole, chopped, or fragmented plants through processes including purification, distillation, expression fractionation, extraction, and fermentation.[9]

THE METHODS FREQUENTLY EMPLOYED FOR FORMULATION ARE

HIGH-PRESSURE HOMOGENIZATION METHOD

The lipid is subjected to a high shear stress and high pressure (100 to 2000 bar) in this process, which causes disruption of particles down to the sub-micrometer or nanometer range. For the mass manufacture of SLNs, parenteral emulsions, lipid drug conjugates, and nanostructured lipid carriers, high-pressure homogenization process is a very effective and dependable technology.

COMPLEX COACERVATION METHOD

This is a naturally occurring phase separation of two liquid phases in a colloidal system caused by the interaction of two polyelectrolytes with opposing charges when they are mixed in an aqueous solution.

NANOPRECIPITATION METHOD

This method is based on the interfacial deposition of a polymer following displacement of a semipolar solvent miscible with water from a lipophilic solution, resulting in a decrease in the interfacial tension between the two phases, increasing the surface area, and subsequently forming tiny droplets of organic solvent even without mechanical stirring.[10]

SOLVENT EMULSIFICATION–DIFFUSION METHOD

An oil phase including oil and polymer in an organic solvent is used to create an o/w emulsion, which is subsequently emulsified with an aqueous phase containing stabilizer in a

high shear mixer. The organic solvent is subsequently made to disperse by the addition of water, which results in the creation of nanoparticles.[12]

SUPERCRITICAL FLUID METHODS

Formulations that are sub-micrometer and nanometer sized can be prepared using this technique. A supercritical fluid is one that is utilized above its thermodynamic critical point of temperature and pressure and can either be a liquid or a gas. Carbon dioxide and water are the most often utilized supercritical fluids.[13]

PHYTOSOMAL AYURVEDIC DRUG FORMULATIONS

Formulations	Active ingredients	Applications of Phytosomal formulations	Biological activity	Method of preparation	Dose	Route of administration
Ginkgo biloba phytosomes	Flavonoids	Flavonoids of GBP stabilize the ROS	Cardio-protective, antioxidant activity	Phospholipids complexation	100 mg and 200 mg/kg	Subcutaneous
Silybin phytosome	Flavonoids	Absorption of silybin phytosome from silybin is approximately seven times greater	Hepatoprotective, antioxidant for liver and skin	Silybin-phospholipid complexation	120 mg	Oral
Ginseng phytosome	Ginsenosides	Increase absorption	Nutraceutical, immunomodulator	Phospholipids complexation	150 mg	Oral
Curcumin phytosomes	Curcumin	Increase bioavailability	Antioxidant, anticancer	Curcumin–phospholipid complexation	360 mg/kg	Oral
Grapeseed lipid-based systems	Epigallo-catechin	Increases absorption	systemic antioxidant	Phospholipid complexation	50-100 mg	Oral
Hawthorn lipid based systems	Procynidins	The blood TRAPn significantly elevated	Cardio-protective and anti-	Phospholipid complexation	100 mg	Oral

			hypertansive			
Ybin Phytosome	Flavonoids	Absorption of silybin phytosome from silybin is approximately seven times greater	Hepatoprotective, antioxidant forliver and skin	Silybinphospholipid complexation	-	Oral
Quercetin Phytosomes	Quercetin	Exerted better therapeutic Efficacy	Antioxidant, Anticancer	Quercetin–phospholipid complexation		Oral
Naringenin Phytosomes	Naringenin	Prolonged duration of action	Antioxidant Activity	Naringenin–phospholipid complex		Oral

[Ref- Kharat Amol and Pawar Pratibha, Novel Drug Delivery System in Herbal's, International Journal of Pharmaceutical, Chemical And Biological Sciences. Ijpcbs 2014, 4(4), 910-930, Issn: 2249-9504]

LIPOSOMAL AYURVEDIC DRUG FORMULATION

Formulations	Active ingredients	Applications of liposome formulations	Biological activity	Method of preparation	% Entrapment efficiency	Route of administration
Liposomes encapsulated silymarin	Silymarin	Improve bioavailability	Hepatoprotective	Reverse evaporation technique	69.22 ± 0.6%	Buccal
Ampelopsin liposome	Ampelopsin	Increase efficiency	Anticancer	Film-ultrasound method	62.30 %	In vitro
Curcumin liposome	Curcumin	Long Circulating with high entrapment efficiency	Anticancer	Ethanol injection method	88.27 ±2.16 %	In vitro
Garlicin liposome	Garlicin	Increase efficiency	Lungs	Reverse- phase evaporative method	90.77 % –	

[Ref- Kharat Amol and Pawar Pratibha, Novel Drug Delivery System in Herbal's, International Journal of Pharmaceutical, Chemical and Biological Sciences. Ijpcbs 2014, 4(4), 910-930, Issn: 2249-9504]

EMULSION BASED AYURVEDIC FORMULATIONS

Formulations	Active ingredients	Applications of emulsion formulations	Biological activity	Method of preparation	Droplet size	Drug loading	Route of administration
Berberine nanoemulsion	Berberine	Improve residence time and absorption	Anticancer	Drawing ternary phase diagram	56.80 nm	0.50%	Oral
Quercetin micro-emulsion	Quercetin	epidermis	Antioxidant	High speed Homogenization method	10–100 nm	0.3% solution	Topical

[Ref- Kharat Amol and Pawar Pratibha, Novel Drug Delivery System in Herbal's, International Journal of Pharmaceutical, Chemical and Biological Sciences. Ijpcbs 2014, 4(4), 910-930, Issn: 2249-9504]

MICROSPHERES ENCAPSULATED AYURVEDIC DRUG FORMULATIONS

Formulations	Active ingredients	Applications of formulations	Biological activity	Method of preparation	Size in µm	Route of administration
Zedoary oil microsphere	Zedoary oil	Sustained release and Higher bioavailability	Hepatoprotective	Quasi-emulsion–solvent diffusion method	100–600	Oral
Quercetin microspheres	Quercetin	Significantly decreases the dose size	Anticancer	Solvent evaporation	6	In vitro
Cynara scolymus microspheres	Cynara scolymus extract	Controlled release of neutraceuticals	Nutritional supplement	Spray-drying technique	6–7	Oral

[Ref- Kharat Amol and Pawar Pratibha, Novel Drug Delivery System in Herbal's, International Journal of Pharmaceutical, Chemical and Biological Sciences. Ijpcbs 2014, 4(4), 910-930, Issn: 2249-9504]

SOME AYURVEDIC DRUG NANOPARTICLES

Formulations	Active ingredients	Biological activity	Method of preparation
Artemisinin nano capsules	Artemisinin	Anticancer	Self-assembly procedure.
Berberine-loaded nanoparticles	Berberine	Anticancer	Ionic gelation method.
Curcuminoids solid lipid nanoparticles	Curcuminoids	Anticancer and antioxidant	Micro-emulsion technique.

[Ref- Kharat Amol and Pawar Pratibha, Novel Drug Delivery System in Herbal's, International Journal of Pharmaceutical, Chemical and Biological Sciences. Ijpcbs 2014, 4(4), 910-930, Issn: 2249-9504]

RECENT PATENTS ON MEDICINAL DRUG CONTROLLED RELEASE FORMULATIONS

US patent No.	Active ingredients	Novel system incorporate
US 6340478 B1	Ginsenosides	Microencapsulated and controlled release formulations
US6896898 B1	Alkaloids of aconitum species	Transdermal delivery system
US patent 2005/0142232 A	Oleaginous oil of *Sesamum indicum* and alcoholic extract of *Centella asiatica*	Brain tonic
US patent 2007/0042062 A1	Glycine max containing 7s globulin protein extract,curcumin, *Zingiber officinalis*	Ayurvedic tablet dosage form
US patent 7569236132	Flavonoids (such as quercetin) and terpenes (ginkgolide A, B, C and J)	Microgranules

[Ref- Kharat Amol and Pawar Pratibha, Novel Drug Delivery System in Herbal's, International Journal of Pharmaceutical, Chemical and Biological Sciences. Ijpcbs 2014, 4(4), 910-930, Issn: 2249-9504]

UTILIZATION OF AYURVEDIC DRUG DELIVERY SYSTEM FOR FORMULATIONS

Significant progress has been achieved in the creation of innovative drug delivery systems for plant actives and extracts during the past several years. Numerous innovative Ayurvedic formulations containing bioactive and plant extracts have been described, including polymeric nanoparticles, nano-capsules, liposomes, Phytosomes, nano-emulsions, microspheres, transferosomes, and ethosomes. The novel formulations are said to have notable advantages over traditional formulations of plant actives and extracts, including improved solubility, bioavailability, protection from toxicity, protection from physical and chemical degradation, enhanced pharmacological activity, enhanced stability, improved tissue macrophage distribution, sustained delivery, and enhanced pharmacological activity.[14]

EXAMPLES-

HAIR GROWTH MEDICINAL DRUG SPRAY

Genuine traditional Chinese medicine is included in the medicinal drug spray for hair development, along with extracts of Polygonum multiflorum, Chinese angelica, and ginseng. It is created with an effective active ingredient that was extracted using cutting-edge super-critical fluid extraction (SFE) technology and high-tech CO 2 super-critical fluid. The TCM booster Angelica naphtha is present in pure, natural hair-growth Ayurvedic spray.

MEDICINAL DRUG TREATMENT FOR FROZEN SHOULDER

Three separate stages of frozen shoulder, also known as adhesive capsulitis, each span a few weeks or months. The initial stage, known as "freezing," is characterized by the beginning of discomfort and a slipping away of shoulder and arm mobility. The second stage, known as the "frozen" stage, sees a decrease in pain but an increase in stiffness. The "thawing" commences in the latter weeks or months. To effectively manage the first discomfort, herbal treatment might be used.

SOME EXAMPLES OF COMPANY BASED MARKETED NOVEL DRUG DELIVERY FORMULATIONS OF MEDICINAL PLANT ACTIVE AND EXTRACTS

S.No	Brand name	Plant active/extracts	Type of NDDS	Company name
1	White tea liposome Herbasec	Camellia sinensis extract	Liposome	Cosmetochem
2	Green tea liposome Herbasec	Camellia sinensis Extract	Liposome	Cosmetochem
3	White hibiscus liposome Herbasec	White hibiscus extract	Liposome	Cosmetochem
4	Aloe vera liposome Herbasec	Aloe vera Extract	Liposome	Cosmetochem
5	Guarana liposome Herbasec	Guarana extract	Liposome	Cosmetochem
6	Centella Phytosome	Triterpenes from Centella asiatica leaf	Phytosome	Indena
7	Crataegus Phytosome	Vitexin-2″-O-rhamnoside from Hawthorn flower	Phytosome	Indena
8	Escin ß-sitosterol Phytosome	Escin ß-sitosterol from horse chestnut fruit	Phytosome	Indena
9	Ginkgo select Phytosome	Ginkgoflavonglucosides, ginkgolides, bilobalide from Ginkgo biloba leaf	Phytosome	Indena
10	Ginselect	Ginsenosides from Panax ginseng rhizome	Phytosome	Indena

	Phytosome			
11	Ginkgo biloba terpenes Phytosome	Ginkgolides and bilobalide from Ginkgo biloba leaf	Phytosome	Indena
12	Ginkgo bilobadimeric flavonoids Phytosome	Dimeric flavonoids from Ginkgo bilobaleaf	Phytosome	Indena
13	Green select Phytosome	Polyphenols from green tea leaf	Phytosome	Indena
14	Meriva	Curcuminoids from turmeric rhizome	Phytosome	Indena
15	PA2 Phytosome	Proanthocyanidin A2 from horse chestnut bark	Phytosome	Indena
16	Sericoside Phytosome	Sericoside from Terminalia sericea bark root	Phytosome	Indena
17	Siliphos	Silybin from milk thistle seed	Phytosome	Indena
18	Silymarin Phytosome	Silymarin from milk thistle seed	Phytosome	Indena
19	Virtiva	Ginkgoflavonglucosides, ginkgolides, bilobalide from *Ginkgo biloba* leaf	Phytosome	Indena
20	18ßglycyrrhetinic acid Phytosome	18ß-glycyrrhetinic acid from licorice rhizome	Phytosome	Indena

[Ref- Kharat Amol and Pawar Pratibha, Novel Drug Delivery System in Herbal's, International Journal of Pharmaceutical, Chemical And Biological Sciences. Ijpcbs 2014, 4(4), 910-930, Issn: 2249-9504]

DISCUSSION

With the exception of Allopathy, Ayurvedic medicines make up a large portion of all the officially recognized health systems in India, including Ayurveda, Yoga, Unani, Siddha, Homeopathy, and Naturopathy. These non-allopathic medical systems are still used by more than 70% of India's 1.2 billion people. The Indian medications Act does not currently have a specific category for Ayurvedic medications or nutritional supplements. For many natural medications, however, there is a sizable body of experience evidence.[15]

Information regarding Ayurvedic drug pharmaceuticals utilized, their forms, formulations, and current market status of novel drug delivery technology in Ayurvedic medicines is provided in this review. This knowledge may be used as a foundation for future research projects, the separation of chemical components from novel Ayurvedic drug delivery systems, and the development of novel Ayurvedic drug delivery systems.[16]

There is a lot of research being done on new medicine delivery and targeting methods for plant actives and extracts. However, exploratory research is currently being done in this field. It is necessary to find solutions to several issues in research, manufacturing, and application. Additionally, greater focus should be placed on the study of carrier substances in order to create better carriers that can lessen the toxicity of medications, increase their activity, and boost the general effectiveness of the agents. The huge therapeutic potential of herbal medications should be investigated using certain value-added drug delivery technologies. The primary barriers for medication molecules to penetrate the cellular membrane and be systemically absorbed after oral or topical administration are lipid solubility and molecular size. Numerous plant extracts and Phyto molecules, although having great bio-activity in vitro, exhibit low absorption and poor bioavailability due to their poor lipid solubility, incorrect molecular size, or both.[17]

ADVANTAGES OF AYURVEDIC DRUGS

Minimal Side Effects

Most herbal medications are well accepted by patients, have less side effects and unforeseen consequences than conventional medications, and may be safer to use.

Effectiveness

Long-standing health issues that don't respond well to conventional therapy are better treated with Ayurvedic medications. The use of Ayurvedic medicines and therapies to treat arthritis is one instance. A well-known prescription medication for treating arthritis called Vioxx was withdrawn owing to an elevated risk of cardiovascular problems. On the other hand, Ayurvedic therapies for arthritis have very less adverse effects. These therapies involve dietary adjustments such introducing simple Ayurvedic medicines, avoiding nightshade vegetables, and consuming less white sugar.

Cost Effectiveness

Ayurvedic medicines cost substantially less than pharmaceutical medicines. The cost of prescription medications is significantly increased by research, testing, and marketing. Compared to medicines, Ayurvedic medicines are typically more affordable.

Extensive Availability

Herbs can be purchased over-the-counter. You may grow simple Ayurvedic medicines at home, such chamomile and peppermint.

LIMITATIONS OF AYURVEDIC DRUGS

Lack of Standardization of Drug and Doses

Risk considerations for self-treatment with Ayurvedic medicines might be numerous. Additionally, improper dosage administration might result in an overdose. Example -in covid 19 situation many people’s self-advice to intake improper doses the Ayush Kwath or Kada in day.

Poisonous Effect Associated with Wild Medicinal Plant

Consuming Ayurvedic medicines without correctly identifying the plant, or using the improper section of the plant, might result in poisoning.

Lack of Regulation and Amendments

Since there are no tight regulations for Ayurvedic Medicines, customers may purchase subpar Ayurvedic Medicines. Ayurvedic Medicines quality might differ between batches, brands, or producers. This can make recommending the right dosage of a plant considerably more challenging. Not all Medicinal plants medications are safe; some might be harmful or trigger allergic responses.

Longer Course of Therapy

Compared to traditional Ayurvedic medicine, the healing period is typically lengthier. While receiving herbal medicine, much patience is required.

CONCLUSION

The Ayurvedic medications can be included in novel drug delivery system, allowing us to deliver the right dosage to the target place. Therefore, it can be concluded that novel drug delivery system for Ayurvedic medications will be a ground-breaking application in the traditional Ayurvedic formulations that will save preparation time and boost patient compliance. There are a number of benefits to using novel drug delivery methods for Ayurvedic medications over traditional formulations. The right dosage of the medication is given to the patient so that it reaches the specific site of action and has a therapeutic impact. Some medications have an ideal concentration window within which the most benefit is obtained; dosages outside of this window might be hazardous or have no therapeutic value at all.

CONFLICT OF INTEREST -NIL

SOURCE OF SUPPORT -NONE

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