Review Article

Lipid Nanocarriers: Promising Approach for Oral Drug Delivery System

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ABSTRACT

Background: A suitable drug delivery system has been work on the strategy to enable safe and effective therapeutic efficacy. Drug discovery program, it has huge number of drug molecules are lipophilic as poor aqueous soluble. Oral drug delivery system is a safe, convenient and easy route for drug administration. Bioavailability is a major issue. Drug administrated with low bioavailability may lead to an ineffective therapeutic efficacy and several adverse effects. However, there are several reasons which may be responsible for poor bioavailability such as constraints of aqueous solubility, poor dissolution rate and permeability, hepatic first-pass metabolism and efflux. These hindrances are the massive challenges of poorly aqueous soluble drugs. Although, conventional approaches have troubles to succeed efficacious therapeutic efficacy of drug. **Materials and Methods:** Lipid nanocarriers have been promising and attractive approach and widely used in formulation development to improve the therapeutic efficacy of drugs. These nanocarriers have made the drug in pre-dissolved form with high durability **Results:** Lipid nanocarriers are more biodegradable, safe and bio-friendly with the biological system. Lipid nanocarriers have potentially overcome such hindrances thus improve the therapeutic efficacy to the drugs. Recently, lipid nanocarriers including it generations have widely preferred in formulation development due to its high durability and uniformity. **Conclusion:** Therefore, lipid nanocarriers have been considered as safe, prominent and robust strategy for improving the therapeutic efficacy of poorly aqueous soluble drugs.

Key words: Lymphatic system, Liposome, Solid lipid nanoparticle, Self-nanoemulsifying, Nanostructural lipid carrier.

INTRODUCTION

For efficacious therapeutic efficacy, the admired drug must prerequisite at the targeted site. Drug discovery program has revealed that huge number of drug molecules are lipophilic in nature. In pharmaceutical science, it has major challenges to design and develop a suitable approach for poorly aqueous soluble drugs.[1,2] Oral drug delivery system is a safe, suitable and more acceptable route of drug administration. Oral route has prestigious advantages such as easy to use, easy for transport, highly patient safety, accurate dose and not required sterile condition and trained person for administration as compared to others route of drug administration. Bioavailability of drug is a major concern of this route. Poorly aqueous soluble drug have inadequate dissolution rate, limited permeability thereby partial drug absorbed through the biological system into the systemic circulation thus, poor therapeutic efficacy. However, conventional approaches of oral system have failed to succeed the desired therapeutic efficacy due to lack of ideal properties of drug delivery system.[3,4] Although, there are several indiscriminate reasons for poor bioavailability of oral route as shown in Figure 1. The first and most important reason is associated with the physicochemical properties of drug molecules as high lipophilic. The second reason is related to the biological system of the particular route of drug administration, due to numerous obstacles such as physiological variations, efflux mechanism, permeability and stability which may alter

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the therapeutic efficacy. The third region is related to approach or carrier system, which must be safe, compatible, non-toxic, high stability and ability to lead the drug at the target site. Although, these hindrances must be overcome thereby, can succeed safe and efficacious therapeutic efficacy. Overall, consider all these circumstances, which require to design and develop of robust drug delivery system which can combat these challenges and anticipates the desired therapeutic efficacy.[5-8]

The most important and fundamental fact of novel drug delivery system, it should be standing with the respective principles including high stability with adequate pharmacokinetics, pharmacodynamics activity. Among numerous strategy, lipid drug delivery system has considered a prodigious strategy for improving the therapeutic efficacy of drugs.[9,10] Oral drug delivery system, lipid nanocarrier have been to considerd as promising strategy due to positive effects on solubility and absorption and also avoid hepatic first-pass metabolism, protect the drug from degradation, high compatible with the biological system and high stability. In lipid nanocarrier based drug delivery system, the lymphatic system has plays an important role in drug absorption.[11-13]

ADVANTAGES AND DISADVANTAGES OF LIPID NANOCARRIERS

Several advantages and disadvantages of lipid nanocarriers are tabulated in the Table 1.

LYMPHATIC SYSTEM

The lymphatic system is the high circulation system of white blood cell through the body. Generally, drug absorption process occurs either blood capillary (Portal route) or lymph capillary (intestinal lymph rout) into the systemic circulation as shown in Figure 2. Absorption of drugs through the portal vein may lead to poor bioavailability because of hepatic first-pass metabolism within the liver, drug degradation and inadequate absorption, thereby poor efficacy. Through the lymphatic system, an adequate drug reached into the systemic circulation. However, the lymphatic system and absorption mechanism of lipid drug delivery have extremely comprehensive.[14-16] Although, the other

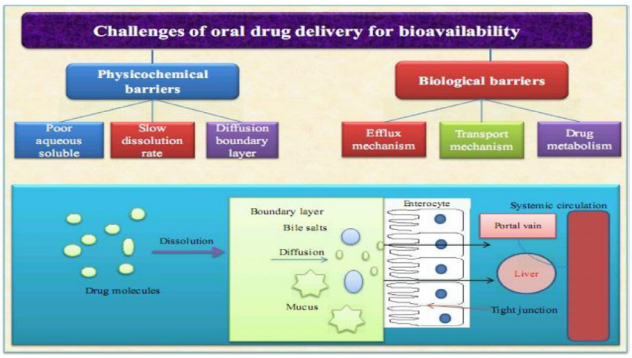

Figure 1: Schematic represents the basic obstacles of oral drug delivery system.

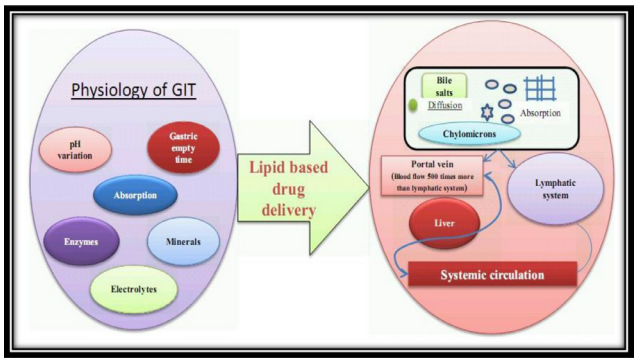

Figure 2: Schematic represents the drug absorption process via portal and lymphatic system.

Table 1: Represent the advantages and disadvantages of lipid nanocarriers.

Formulation	Advantages	Disadvantages	References
Liposome	Suitable for both lipophilic and hydrophobic drugs, well established scale-up techniques, avoiding hydrolysis of encapsulated drugs, control and/ target drug release.	Solubility variations, poor stability, poor loading capacity, drug leakage, low, in process variation.	40, 41,
Solid lipid nanoparticles	A suitable approach for all routes and dosage form, Ease to preparation process and scale-up with low-cost, Control and/or target drug release.	The major disadvantages are low drug loading, leakage of drug during storage and along with stability problem.	57, 58
Self-nanoemulsifying drug delivery system	Most suitable for lipophilic drugs along with hydrophilic, highly *iv-vivo* activity, techniques, good scale-up technique and considerable cost, biodegradable and safe.	Drug precipitation, low drug loading, used of high amount of surfactant cause gastric irritation.	58

important role of the lymphatic system is to the maintains the water balance of body and return by retribution of extracellular fluid to systemic circulation along with transport through immune cells to the lymph nodes. The lymphatic system has an effective used for treatment for and human immune deficiency virus and cancer lead through the lymphatic system.[17-19] It additionally plays an important role in the absorption of several components includes triglycerides, cholesterol esters, long chain fatty acids xenobiotics and macromolecule soluble vitamins. Consequently, the process of uptake and absorption through the lymphatic system, the lipid formulation depend on several aspects including morphology of particle, zeta potential, comparative molecular weight and hydrophobicity. Lymphatic drug delivery system which may be involves in numerous three processes.[20,21] Primarily, the lymphatic capillaries composed of single stratified cells, not fenestrated endothelial cells. These cells are organized with the gap and overlapped approach to create a porous wall in the body vasculature fluid, that facility of the substances to the lymphatic system.[22,23] Therefore, hydrophilic substances and macro conjugates have enhanced the absorption through the paracellular route. Second, gut-associated lymphoid tissue contains either isolated or collective fluid follicles through payer's patches, through it the drug enter into the lymphatic system. Finally, lipid transport is passing through the several processes includes transcellular absorption, paracellular transport, P-glycoprotein and cytochrome P-450 inhibition through the intestinal walls. However, the process of lymphatic transport and chylomicrons plays key role in the delivery of lipophilic compounds into the lymphatic system.[24] Whereas, chylomicrons promotes the drug into the mesenteric lymph duct and move to the thoracic duct and enter into the systemic circulation at the junction of the left jugular and also left subclavian veins. Although, absorption occurs through the lymphatic system, an appropriate drug reached into the systemic circulation. The efficacy of lipid drug delivery also depends on the physicochemical properties of lipids in the process of digestion and absorption processes associated through the lymphatic system. Example, halofantrine (anti-malarial) (log P 8.5 and TG solubility >50 mg/ml), had delivered through the lymphatic system.[25] However, lipidic substances have passed through the enteral lymphatic usually through the lipoprotein biosynthesis. Therefore, lipid drug delivery system can be considered as a safe, effective and robust strategy of drug delivery system.[26]

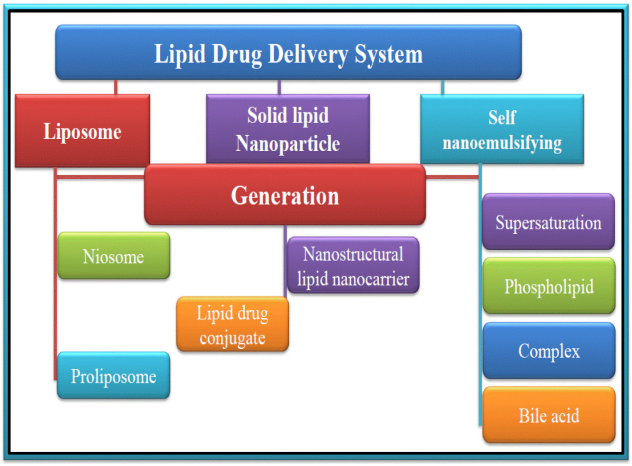

Figure 3: Schematic represents the lipid nanocarriers and its generation.

STRATEGY OF LIPID NANOCARRIERS

Lipid nanocarriers have been considered as safe and robust drug delivery system which produces the effective therapeutic efficacy of drugs as mentioned in Figure 3. These systems are more biodegradable, non-toxic and highly biocompatible with the biological system.[27,28] Although, lipid nanocarriers have been widely used for treatment or diagnosis of the numerous diseases like cancer, infection, diabetes, arthritis etc. Although available of several marketed products based on the strategy represent is significance. The conventional drug delivery systems have complained could not produce desired therapeutic efficacy and also lead to the numerous adverse effects therefore poor patient compliance. Therefore, need to design the robust strategy of drug delivery system.[29,30] Solubility and permeability are highly liable for poor bioavailability for numerous drugs.[31,32] The design of robust strategy, the several features such as solubility, compatibility of formulation and *in vitro* and *vivo* release profile, transport mechanism, cytotoxicity and stability have must be considered as an important tool for robust drug delivery system.[33-35]

LIPOSOME

Liposome is the phospholipids drug delivery system as derived from natural and synthetic sources. It forms single or multi lipid bilayers of hydrous phospholipids as a referred liposome. Prof. Alec D. Bangham of the United Kingdom has first described liposome in 1965. It is derivative from Greek words lipo-fat and soma-body. Phospholipids are the key ingredient of this drug delivery system along with cholesterol act as the backbone to maintain the uniformity and stability of the system as mentioned in Table 2. However, due to aqueous

Table 2: Liposome components.

Components		Example
Phospholipid	Natural	Phospholipid (known phosphatidylcholine (PC), lecithin), Egg lecithin, Hydrogenated soybean lecithin, Soybean lecithin Egg PG
	Synthetic	Dimyristoyl phosphatidylcholine (DMPC)
		Dimyristoyl phosphatidylglycerol (DMPG)
		Dioleoyl phosphatidylcholine(DOPC)
		Distearoyl phosphatidyl glycerol (DSPG)
		Dimyristoyl phosphatidylethanolamine(DMPE)
		Dioleoyl phosphatidyl glycerol (DOPG)
		Dimyristoyl phosphatidylserine (DMPS)
		Dioleoyl phosphatidyl serine (DOPS)
		Hydrogenated soybean phosphatidylcholine (HSPC)
		Soybean phosphatidylcholine (SPC)
		Dipalmitoyl phosphatidylglycerol (DPPG)
		Egg sphingomyelin (ESM)
		Egg phosphatidylcholine EPC
Cholesterol		Cholesterol

and lipid organizations structure of phospholipid lead to more feasible for encapsulate both hydrophobic and hydrophilic drugs. Hydrophobic drug encapsulate in lipid phase while hydrophilic drugs encapsulate in aqueous phase through the process of liposome formulation.[36,37] In liposome, hydrophobic phosphates groups of the phospholipids and water molecules have interacted to accomplish the spontaneous liposomes forms due to the amphiphilic nature of phospholipids which self-associate into bilayers.[38] Generally, liposome has classified into different types according to the size and range of lipid bilayers such as small unilamellar vesicles (SUVs), with single lipid layer, large unilamellar vesicles (LUVs) as several clusters of vesicles and multilamellar vesicles (MLVs) an associated to the numerous layers.[39] However, several marketed products are available on liposome formulation and several formulations have been in process and in clinical trials. Recently, It has been reported some drawback of liposome formulation such as low drug loading, variations in batch-to-batch manufacturing process and stability lacking (transition of phase, hydrolysis and oxidation etc.) for few drugs. Therefore, numerous research investigations have been in pipeline to overcome such types of drawbacks and should develop the robust liposome drug delivery system. However, several strategies have developed as new approached which considered as the next generation of the liposome. The new generations of liposome have been in processing to improve efficacy and stability of drugs. One the most suitable approach is proliposome. It is a dry and free-flowing granular carrier with the addition of water converted to multilamellar liposomal suspensions.[40,41]

New generation of liposome

Although, using phospholipids in the drug delivery system has referred to liposome. However, due to leakage of drugs, low drug loading, heterogeneous size distributions and stability issues lead to poor potency and efficacy of liposome of various drugs. So, consider all these challenges, the scientists have forever to the next steps for liposome strategy. These strategies have been addressed as new formulations to overcome limitations of liposome which are as considered as advanced/novel/new generations of liposome as mentioned in Table 2.[42,43]

SOLID LIPID NANOPARTICLE

The strategy of solid lipid nanoparticle was introduced in 1991 as an alternative drug delivery system to improve the efficacy of therapeutic substances. Solid lipid nanoparticle has been a promising and robust drug delivery system to improve the efficacy of drugs. Solid lipid nanoparticle has addressed the prospective role in drug delivery system such as controlled drug release, targeted drug delivery along with flexible system mentioned in Table 3. In this system, the solid lipid component has solid at room temperature and melt at the body temperature. The particle size system

Table 3: New generation of liposome.

New generation of liposome	Basic components	Description
Niosome	Nanoionic surfactant + Cholesterol or its derivatives	Cheaper and high drug loading and good stable,
Proliposome	Phospholipid+ cholesterol + Organic solvent or solvent mixture like ethanol, methanol)	Good stability, high drug loading, non-toxic

may be in the range of 10–1000 nm. SLN is compose of solid lipid along with other important component such as surfactant which acts as stabilizers and maintain consistency of the system. The components of solid lipid nanoparticle have approved as "Generally Recognized as Safe."[44] Generally, the lipid components of this system have been derived from numerous sources such as fatty acids, monoglycerides, diglycerides, triglycerides, waxes and fatty acids etc. as mentioned in Table 4.[45] Whereas, several methods have been developed to prepare the solid lipid nanoparticle such as high pressure homogenization method, spray drying method, cold homogenization technique, solvent emulsification - diffusion methodology, solvent evaporation/emulsification technique, ultra-sonication or high Speed homogenization, microemulsion based technique, precipitation technique, double emulsion method and supercritical fluid (SCF) method. Although, solid lipid nanoparticle has been a useful strategy for several categories of drugs and succeeded in the desired therapeutic efficacy including methotrexate, etoposide and idarubicin etc.[46] Solid lipid nanoparticle has almost suitable for all route of drug administration such as oral, parenteral, dermal, ocular, pulmonary and rectal drug delivery system. Moreover, recently solid lipid nanoparticle have the recognized as low drug loading (lacking of the drug solubility) along with stability issues. However, the new generation as nanostructure lipid carriers has a strategic approach to improve the drug loading capacity and improve the efficacy. Although, nanostructured lipid carriers is an additional use of liquid lipid as modified to overcome the obstacle of solid lipid nanoparticle.[47]

Table 4: Basic components of Solid lipid nanoparticle.

Components	Example	Components	Brand name
Lipid	Synthetic monoacid triglycerides	Trilaurin (Glyceryl trilaurate)	Dynasan 112
		Trimyristin (Glyceryl trimyristate)	Dynasan 114
		Tripalmitin (Glyceryl tripalmitate)	Dynasan 116
		Tristearin (Glyceryl tristearate)	Dynasan 118
	Triglyceride mixtures/ partial glycerides (Diglycerides)	Glyceryl behenate	Compritol ® 888 ATO
		Glyceryl palmitosteratate	Precirol® ATO 5
	Monoglycerides	Glyceryl monostearate (Other- Glyceryl monostearate Glyceryl hydroxystearate)	(Imwitor®900)
	Hydrogenated vegetable Glycerides (hard fats)	Hard fat	Witepsol H35
			Witepsol H42
			WitepsolW35
			Witepsol E85
			Softisan 100
			Softisan 142
			Softisan 154
	Waxes	Cetyl palmitate	
		Carnauba wax	
		Beeswax	
	Fatty acids	Stearic acid	
		Behenic acid	
		Palmitic acid Decanoic acid, Myristic acid	
Emulsifiers/coemulsifiers/Surfactants		Soybean lecithin	Lipoid® S 75, Lipoid® S 100
Egg lecithin		(Lipoid® E 80	
Phosphatidylcholine		Epikuron® 170,Epikuron 200	
Poly ethylene oxide Poly propylene oxide		Poloxamer 407	
Poly ethylene oxide Poly propylene oxide		Poloxamine 908	
Poly ethylene oxide Poly propylene oxide		Poloxamer 188	
Sodium cholate			
Sodium glycocholate			
Dioctyl sodium sulfosuccinate			

SELF-NANOEMULSIFYING DRUG DELIVERY SYSTEM (SNEDDS)

Self-Nanoemulsifying drug delivery system is one of the strategic and attractive strategies of lipid drug delivery system. However, available of several marketed products includes sandimumun®, Norvir®, Fortovase®etc. have signify it efficacy and potency. However, development of new chemical entities and available of marketed drug products have been addressed high lipophilic in nature.[48,49] Self-nanoemulsifying drug delivery system has considered as a suitable carrier for poorly aqueous soluble drugs to improve the therapeutic efficacy.[50] It is an anhydrous form of emulsion which spontaneously forms emulsion as nanoemulsions (nanosize) when contact with aqueous media or fluid on mild agitation is referred to as self-nanoemulsifying drug delivery system. The most prestigious and territory properties of this approach is that drug present insolubilize form throughout the gastrointestinal transition. It makes it more innovative and unique drug delivery system. Self-nanoemulsifying drug delivery system has numerous advantages in oral approach such as enhance the dissolution rate, avoidance of hepatic first-pass metabolism, c) protect drug from degradation, d) less *in vivo* fluctuations and, e) dose easy manufacture.[51,52] In this strategy, the formulation released into the gut lumen and diffuse to form the fine nanoemulsions sizes, so the remains drug in solution in the gut, evade the dissolution steps that are usually restrictions the rate of absorption of hydrophobic drugs from the crystalline state.[53,54] Self-nanoemulsifying drug delivery system is composed drug, oil/lipid (natural oil or synthetic oil), surfactant and cosolvent which come in contact with fluids spontaneously form tiny nanoemulsions as mentioned in Table 5. The oil/lipid component has usually acts to solubilize the drug, while surfactant acts as an emulsifier which reduces the interfacial tension between two immiscible phases and cosurfactant (cosolvent) promote the solubilization efficacy of the formulation. The potency of the system is depends on the specific properties such as size of globules and stability of the formulation. Self-nanoemulsifying system is clear solution and globule sizes may be in the range of 20-200 nm but less than 100 nm is more effective. Selection of lipid excipients in self-nanoemulsifying system approaches based on the solubility and Hydrophilic-Lipophilic Balance (HLB) value range such as oil for 2-10 (prefer 4-8) HLB, a surfactant for 9-18 (prefer 11-16) HLB and cosolvent/co-surfactant as nontoxic.[55,56] Recent, numerous novel strategies of self-nanoemulsifying drug delivery system have been developed to overcome the obstacles of convention self-nanoemulsifying system.[57]

Table 5: Basic components of self-nanoemulsifying drug delivery system.

Lipid components		Example
Oil	Long chain triglycerides	Corn oil, cotton seed oil, soybean oil, cinnamon oil etc.
	Medium chain triglycerides	Captex® 300, Miglyol® (810,812), Neobee® M-5 etc.
	Synthetic lipid	Capryol 90, Labrafill M 2125 CS, Labrafill M 1944 CS, Peceol™, Maisine 35 etc.
	Fatty acid	Oleic acid, Steric acid, Myristic acid
Surfactant	Span®	Span(20,40,60,85)
	Tween®	Tween (20, 40,60,80)
	Polymeric surfactant	Poloxamer (188, 407), Gelucire® (44/14, 50/13),
	Others	Cremophor® (EL,RH), Capmul® MCM, Capmul® GMO, Myrj® 52
Co-surfactant		Transcutol (P and HP), polyethylene glycols (200, 400, 600), ethanol etc.

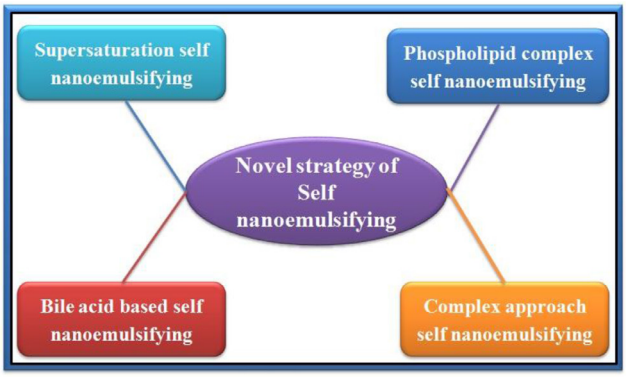

Figure 4: Represent the novel strategies of self-nanoemulsifying system.

Novel strategy of self nanoemulasifying drug delivery system

However, conventional self-nanoemulsifying drug delivery system has solubilized the drug but not able to maintain to the drug in solution after dilution which leads to drug precipitates along with low drug loading for numerous drugs which pharmaceutically and clinically unsuccessful. Therefore, numerous novel strategies have been developed to overcome such obstacles and which would anticipate the effective therapeutic efficacy as shown in Figure 4.[58]

NANOSTRUCTURED LIPID CARRIER

Nanostructured lipid carrier (NLC) is the promising approach and introduced as a new generation or second generation of solid lipid nanoparticle to overcome the challenges associated with solid lipid nanoparticle. Nanostructured lipid carrier has great advantages includes higher drug loading capacity, prolong release profile and good stability. Nanostructured lipid carrier usually developed through using solid and liquid lipid components together as mentioned in Table 6.[59,60] Although, it similar to solid lipid nanoparticle, but modified liquid phase which complex form of solid and liquid as fat and oil substances. This strategy is showing more energetic and innovative system because liquid lipid and solid lipid to formed complex form which improves the drug loading efficacy and uniformity of the formulation therefore, lead to effective therapeutic efficacy. Generally, the nanostructured lipid carrier has proposed in 3 models. The 1st model, refer as imperfect type NLC and developed through the particles spatial lipid mixture (glycerides) composed of numerous fatty acids. It produces the larger distances between the fatty acid chains of glycerides and general inadequacy of the crystal lattice. Therefore, it creates a large space for loading the guest substances in amorphous form. Therefore, higher drug loading efficacy and also prevent drug expulsion or precipitation from the lipid matrix during storage because of distortion of the crystal lattice. The 2nd model is referred to as multiple types of NLC where oil produce the higher drug solubility oppose to solid lipid along with high stability. It is like w/o/w multiple emulsions where oil-in-solid lipid-in-water dispersions. The 3rd model considered as amorphous type NLC which protect the drug from expulsion caused by crystallization or transformation of the solid lipid. In this model the particle forms solid thereby using special lipids such, hydroxyl stearate, isopropyl myristate etc. to avoid the crystallization.[61,62] Recently, simvastatin as antihyperlipidemic drug loaded with nanostructure lipid carrier through emulsification-solvent evaporation method followed by ultrasonication using stearic acid, oleic acid, lecithin and pluronic F-68 as the surfactant. The optimized formulation has revealed the specified parameters like particle size (< 200 nm), zeta potential (-35-40 mV), greater entrapment efficiency (> 75%) along with the sustained release. Overall, an assessment of all corresponding parameters can consider a suitable strategy.[63]

APPLICATION OF LIPID NANOCARRIERS IN NUMEROUS DISEASES

However, lipid nanocarriers have been continuously used in formulation development in pharmaceutical industries to develop the safe and robust formulation

Table 6: Basic components of Nanostructured lipid carrier.

Components	Chemical name	Brand name	Melting/Boiling range(°C)/ Boiling point	HLB
Solid Lipid	Glyceryl palmitostearate (powder)	Precitol ATO® 5	50-60	2
	Glyceryl dibehenate (powder)	Compritol® 888 ATO	65-77	2
	Cetyl palmitate (White solid)	Crodamol™ CP		8
	Stearic acid		69.3°C	15
Liquid lipid	Lauroyl Polyoxylglycerides	Gelucire® 44/14	44	14
	Soy lecithin	Epikuron™200	-	-
	Caprylic/Capric triglycerides (C8/C10)	Miglyol® 812 and 810, Labrafac™, Softison 378	-	-
	Monoacylglycerols	Myverol 18-99K	-	-
	Squalene	-	-	-
Surfactant	Polysorbates	Tween® 20, Tween® 80	>100°C – boiling point	16.7, 15
	Poly (ethylene oxide) (PEO)– poly (propylene oxide) (PPO) copolymers	Poloxamers (188, 407) Lutrol®, F68, Lutrol®, F127	52°C, 56°C	>24, 18-23
	Macrogol-15-hydroxystearate	Solutol®HS 15, Kolliphor®HS 15	-	14–16
	Polyoxiethylene stearate	Myrj 52	47°C	16.9
	Polyoxyl castor oil	Cremophor EL	-	14

Not available

of the prospective drug and objective of drug delivery system. However, drugs which are preferred in the perspective diseases have lack of appropriate therapeutic efficacy. Few of them discuss following;

Diabetes

Diabetes is the metabolic disorder and 95 % of people suffer from type II diabetes and 5-10% type I diabetes. Although, lipid-based systems is a promising approach to improve the efficacy of diabetes drugs.[64]

Anti-cancer

Cancer is one of the most leading diseases in the world. However, due to poor aqueous solubility, inadequate absorption, hepatic first-pass metabolism and high efflux may lead to the poor therapeutic efficacy. Lipid-based strategy has a strategic approach to enhance the therapeutic efficacy of anticancer drugs.[65]

Vaccine

Most of the vaccine administrated via the injection. Due to challenges of needle drug delivery system, most of the researchers focus on the oral drug delivery system. Therefore, lipid drug delivery system in the future can be considered as the strategic approach for oral drug delivery system.[66]

Antifungal

Several antifungal drugs are used in the treatment of fungal infections and parasitic diseases. But most of these are not able to produce the desired therapeutic efficacy due to constrained of poor aqueous solubility results poor bioavailability. However, lipid carriers have been great opportunity great opportunity to improve oral bioavailability.[67]

Antipsychotic

In the treatment of the psychotic condition, an effective concentration of drug must be reached at the targeted site via across the blood-brain barrier. Although, most drugs have failed to the admired drug reach at the target site. However, partial drug present in drug into systemic circulation as well as constrained to across the blood-brain barrier are identified as the main issues. Therefore, lipids nanocarriers have been accomplished as safe and effective carrier to improve oral bioavailability of such class drugs which having poorly aqueous soluble.[68]

FUTURE PROSPECTS

Lipid nanocarriers are safe, biocompatibility and energetic drug delivery system therefore can be considered as suitable approach for insulin, gene and vaccine which would be anticipating the efficacious therapeutic efficacy. Overall, for the future prospects could be considered in numerous fields like biotechnology, cosmetics, contracting agent, phyto drug delivery etc.

CONCLUSION

Lipid nanocarriers are safe, suitable and attractive carriers in oral drug delivery system and playing an adorable role for improving therapeutic efficacy of poorly aqueous soluble drugs. However, the majority of lipophilic drugs are high, which need select an appropriate formulation strategy. However, selection of suitable nanocarrier to the prospective drug has massively preliminary and important step. The current research works on lipid nanocarriers have revealed should be understood inter and intra molecular level interaction of both drug and excipients which would provide ideal information to select an appropriate drug delivery system. As lipid nanocarriers have been fulfilled of idea drug delivery systems which have great opportunity to succeed an appropriate therapeutic efficacy of poorly aqueous soluble drugs. Finally, can conclude that lipid nanocarriers are the suitable approach and could anticipate the desired therapeutic efficacy of those drug molecules which having poor aqueous soluble.

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CONFLICT OF INTEREST

The authors have no conflict of interest.

ABBREVIATIONS

SLN: Solid Lipid Nanoparticle; **NLC:** Nanostructured lipid carrier; **SNEDDS:** Self-Nanoemulsifying drug delivery system; **HLB:** Hydrophilic-Lipophilic Balance; **NM:** Nanometer; **TG:** Triglyceride

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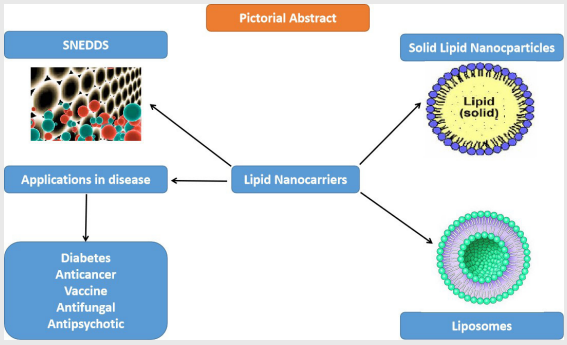
PICTORIAL ABSTRACT



SUMMARY

- Lipid nanocarriers are the safe and robust approach of drug delivery system.
- The lipid components of systems are highly biocompatible with the biologic membranes as compared to the polymeric substances.
- The selection of lipid nanocarrier is extremely important to the perspective drug as based on the principle of drug delivery.
- Lipid nanocarriers have been considered as suitable and efficacious approach for the oral route to succeed the desired therapeutic efficacy.

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