EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 11
Issue: 8
321-329
Year: 2024

FORMULATION AND DEVELOPMENT OF SOLID LIPID NANOPARTICLES CONTAINING COUROUPITA GUIANENSIS EXTRACT

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Article Received on 20/06/2024 **Article Revised on 10/07/2024** **Article Accepted on 30/07/2024**

ABSTRACT

Nanotechnology-based drug delivery systems have increasingly been developed in the last decades and have significantly impacted the pharmaceutical sciences. They play a critical role in delivering hydrophobic drugs, which comprise more than 40% of approved drugs. Formulation was carried out by Solvent evaporation method. Trial batches indicated that polymers are suitable for the Nanoparticles formulation polymer produced good formulations. Compritol and Sodium lauryl sulphate were selected for further studies. Scanning electron micrograph of the prepared solid lipid nanoparticles at 20.00 KX magnification showed that the Nanoparticles were smooth surface morphology and spherical shape. The porous nature of Nanoparticles was clearly observed in the SEM images. Particle size and zeta potential was determined by Malvern Zeta sizer. The particle size analysis confirmed that the prepared sample were in the nanometer range. Average particle size obtained for the all formulations were 146.5 nm to 808.8 nm. Zeta potential values of Solid lipid Nanoparticles indicated that the formulated Solid lipid Nanoparticles is stable (-03. mV to 27.5mV). This is because the newly developed Solid lipid Nanoparticles is believed to exhibit a core shell structure with a core formed. The formulations were optimized on the bases of results of all formulations. Effect of polymer type and extract: polymer ratio on the evaluation parameter of formulated extract loaded solid lipid Nanoparticles on evaluation parameter was studied. Even though the particle size of Solid lipid Nanoparticles F2 formulation is selected as the optimum formulation due to its comparatively better result of all parameter including particle size, zeta potential, antimicrobial and SEM etc.

KEYWORDS: Drug delivery, Nanoparticles, Novel drug Delivery, Solid lipid nanoparticles, Couroupita Guianensis.

INTRODUCTION

Nanoparticles drug delivery system

Nanotechnology-based drug delivery systems have increasingly been developed in the last decades and have significantly impacted the pharmaceutical sciences. They play a critical role in delivering hydrophobic drugs, which comprise more than 40% of approved drugs. The poor water solubility of these hydrophobic drugs is one of the major limiting steps that considerably affect drug release and bioavailability, which can be resolved using nanotechnology-based drug delivery systems. In addition, the incorporation of drugs in Nanoparticles (NPs) increases drug stability, reduces enzyme degradation, prolongs circulation time, and improves the uptake of target cells, which, thereby, enhances the overall effectiveness and safety **(Mitchell *et al.*, 2021).**

According to their chemical compositions and structure, nanotechnology-based drug delivery systems can be classified as inorganic NPs, polymeric NPs, and lipid-based NPs. Inorganic NPs are made up of inorganic materials, such as gold, silver, iron, and silica. Owing to some of the unique properties of the materials, these inorganic NPs may have distinct electrical, physical, optical, or magnetic features, such as the photothermal effects of gold NPs **(Hu *et al.*, 2020)**. superparamagnetic properties of iron oxide NPs. Inorganic NPs have good stability and are potential drug delivery systems in photothermal therapies, imaging, and diagnostics. However, as a result of their low water solubility and toxicity issues, they are not widely used in clinical applications **(Arias *et al.*, 2018).** Polymeric NPs are produced from a wide variety of natural or synthetic polymers. They include dendrimers, polymeric micelles, nanospheres, and polymersomes. Polymeric NPs can incorporate hydrophobic and hydrophilic drugs with different molecular weights, including small molecules, biological macromolecules, and proteins. The advantages of polymeric NPs include biodegradability, biocompatibility, and co-delivery of different drugs. In

addition, they can deliver drugs to targeted tissues with suitable surface modifications. However, polymeric NPs have the disadvantages of toxicity and particle aggregation **(Mitchell *et al.*, 2021).** Lipid-based NPs have been widely investigated in the last decades. They have various advantages, such as biocompatibility, high bioavailability, high drug payloads, formulation simplicity, and self-assembly. Lipid-based NPs include emulsions, liposomes, lipid NPs, and solid lipid Nanoparticles (SLNs). They can be fabricated from biodegradable and non-toxic materials, making them ideal systems for clinical applications **(Lorente *et al.*, 2018).**The second generation of SLNs is sometimes termed nanostructured lipid carriers (NLCs). However, SLNs can be used to mention both SLNs and NLCs.

SLNs were developed in the mid-1990s and have been considered alternative systems to liposomes, emulsions, micelles, and polymeric NPs, due to various advantages. They are produced from physiologically biocompatible and biodegradable lipids as well as other materials that are generally recognized as safe (GRAS), and, therefore, they are safe nanotechnology-based drug delivery systems **(Pardeike *et al.*, 2009).**The solid matrices can protect the drugs incorporated in SLNs, and, thereby, the drug stability is efficiently improved. Both hydrophilic and hydrophobic drugs can be encapsulated in SLNs with higher entrapment efficiencies than liposomes. The drug release from SLNs can be controlled by altering the lipid components. The surface of SLNs can be modified to target specific tissues and enhance stability. SLNs can be produced using non-solvent techniques, such as high-pressure homogenization and high-speed stirring. These advantages enable the wide applications of SLNs in oral, parenteral, transdermal, intranasal, ocular, and pulmonary drug delivery.

Structure of solid lipid Nanoparticles

As mentioned above, SLNs are composed of a lipid substrate surrounded by stabilizers and one or more active molecules incorporated into these particles. Thus, the structure of a particle consists of an outer layer that determines its surface properties and an inner layer or core material that determines factors such as the size, shape, and location of the active ingredient **(Bunjes 2011).** Therefore, how the lipid substrates stabilizers and active components that make up the colloidal lipid system are organized and interconnected determines their behavior as drug transporters and is strongly influenced, among other factors, and the crystalline behavior of lipids used.

It has been reported that under heat treatment or during storage, polymorphic transformations can occur, and the particles can change from spherical shapes to platelets. Platelet forms are associated with the stable polymorphic state β for the solid lipid of the matrix, and spheroidal or disc-shaped records are associated with the polymorphic state α **(Schoenitz et al., 2014).**

In general, two structure models have been proposed for SLN, in which it is assumed that the particles are surrounded by the surfactant that forms the outer layer. The first is that the molten lipid droplets solidify during cooling, maintaining their spherical shape. On the other hand, the second model proposes that the cooling of molten lipids produces a flat laminar structure with surfaces structured by folds, edges, and steps that occur during the recrystallization process and where the lipid structure from polymorph α to polymorph β comes from stable **(Gordillo- Galeano & Mora-Huertas 2018).**

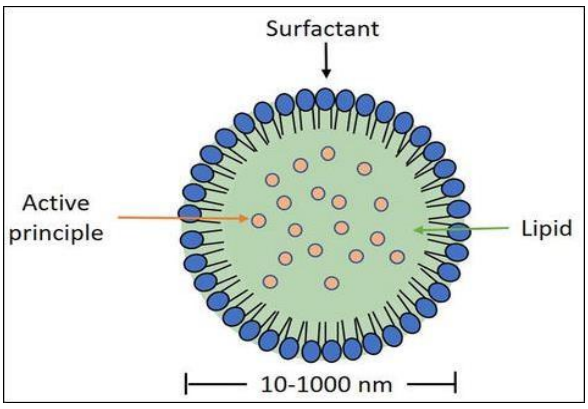

Figure 1: Structure of NPs.

The main advantages and disadvantages of Solid Lipid Nanoparticles

SLN's Advantages It reduces the risk of chronic and acute poisonousness and prevention of organic solvents in creation method through Biodegradable physiological lipids usage.

i. It improves poor water soluble molecules bioavailability.
ii. It enhances medication entrance into the skin through applying dermal by what called Site specific distribution of medications
iii. It controls drug release Possibility and also drug targeting.
iv. It protects chemically labile reducing agents in the intestine and also it safeguards delicate molecules from external world.

v. SLNs are more stable compared to liposomes.
vi. It fosters the trapped bioactive bioavailability and integrated labile chemical production compound. Highly focuses on functional compound accomplished.
vii. Lyophilization is possible **(Geszke-Moritz & Moritz 2016).**

Limitation of SLN's

i. Low medicine packing capacity.
ii. Medication exclusion following polymeric change during storing.
iii. Comparatively high dispersed water volume (70-99.9%).
iv. The bounded capacity of loading of water-soluble drugs during the manufacturing cycle due to partitioning effects **(Jaiswal & Gupta 2013).**
v. Gelation tendency.
vi. Incredible motion of polymeric transition. **(Hashem *et al.*, 2014).**

Applications

Solid lipid Nanoparticles possesses a better stability and ease of upgradability to production scale as compared to liposomes. This property may be very important for many modes of targeting. SLNs form the basis of colloidal drug delivery systems, which are biodegradable and capable of being stored for at least one year. They can deliver drugs to the liver in vivo and in vitro to cells which are actively phagocytic. There are several potential applications of SLNs some of which are given below:

1. SLNs as gene vector carrier:
2. SLNs for topical use:
3. SLNs as cosmeceuticals:
4. SLNs for potential agriculture application:
5. SLNs as a targeted carrier for anticancer drug to solid tumors:
6. SLNs in breast cancer and lymph node metastases:
7. Oral SLNs in antitubercular chemotherapy:

The current study focuses on important bioactive compounds in plants that make them pharmacologically valuable. Therefore, this study aim to develop *CouroupitaGuianensis* leaves extract loaded solid lipid Nanoparticles and explore its antimicrobial activity. *Couroupita Guianensis* belongs to the family *Lecythidaceae* and gained attention because of its number of pharmacological activity such as antifungal, anti-viral, antimicrobial, antioxidant, anti- inflammation etc. Solid lipid Nanoparticles emerged as one of the most promising nanocarriers which can help to improve bioavailability of the both lipophilic and hydrophilic active constituents. As we know that plant part extract consisting of more than two or three chemical constituents so for that this formulation will be suitable for that because the nature of each chemical constituents is varied. Later in the study characterization and *in vitro* antimicrobial activity will be performed for formulation containing leaves extract of *Couroupita Guianensis* which proof the efficacy of the extract against microbial infection. Moreover this SLN will be easily converted in the topical dosage such as cream, gel etc. against skin infection.

Plant profile

Figure 2: *Couroupita guianensis* (Cannon ball tree).

- Kingdom - Plantae-Plants
- Subkingdom - Tracheobionta
- Superdivision - Spermatophyta
- plants Division -Magnoliophyta
- Class- Magnoliopsida
- Subclass- Dilleniidae
- Order -Lecythidales
- Family- Lecythidaceae
- Genus -Couroupita Aubl
- Species- *Couroupita guianensi*

a. Botany of *couroupita guianensis*

Cannonball Tree is a deciduous tree. Native to tropical South America (particularly Guyana and Surinam) it has large, apricot-pink and gold 147-159 flowers with an unusual, lopsided arrangement of central stamens and a penetrating fragrance. It is a really wonderful tree doesn't grow branches that reach out from the straight trunk; it bears vast, showy flowers, with 3" to 5" waxy aromatic smelling growing directly on the bark of the trunk (cauliflower). In Buddhist culture in country these flowers had a special significance. The tree additionally produces orbicular brown woody, indehiscent; double

fleshy fruits of associate degree astonishing size, adequate to the scale of an individual's head. The fruit includes of little seeds in an exceedingly white, unpleasant smelling edible jelly. Size of a mature fruit is 24 cm in diameter, weight of a mature fruit-1450 gms, and weight of the shell (fruit rind) from a fruit-545 gms. It's wide planted in tropical and sub-tropical biology gardens as a decorative throughout the tropics and sub tropics, it will well below cultivations. This plant is listed as a rare tree and flower in Republic of India, by a preferred decorative in Caribbean and SE Asian biology gardens **(Satyavati *et al.*, 1987).**

b. Traditional Uses

Fruits of *Couroupita guianensis* unit edible and sometimes eaten, however attributable to dangerous smell of white flesh, it discourages the general public. The fruit pulp, bark and flowers area unit used for varied medicative applications. The pulp of the fruit of the cannon ball tree is rubbed on the infected skin of animal disease dog**.**

Phytoconstituents

Few chemical studies discovered to this species had proved the presence of α-amirin, β-amirin, β-sitosterol, tannins**,** ketosteroids and terpenoids, alkaloids, carbohydrates, proteins **(Ramalakshmi *et al.*, 2013).** Among the flowers, it completely was getable to recognize eugenol, volatile oil and (E, E)-farnesol whereas triterpenoid esters of fatty acids as β-amirin palmitate were categorized among the leaves of *Couroupita guianensis* and dyes like indigo and indirubin **(Tayade, 2013**). Associate in nursing compound stigmasterol and campesterol were isolated from fruit of *Couroupita guianensis***.**Synthesized and characterized silver nano particles from leaves of *Couroupita guianesis*. Isolated linoleic acid, nerol, tryptanthrin etc, from flowers, seeds, fruits, and leaves of *Couroupita guianensis* **(Devaraj *et al.*, 2013)**.

Pharmacological Activities

1. Antibacterial Activity of *Couroupita guianensis*
2. Antiarthritic Activity of *Couroupita guianensis*
3. Antistress Activity of *Couroupita guianensis*
4. Antipyretic Activity of *Couroupita guianensis*
5. Antidiarrheal Action of *Couroupita guianesis*

MATERIAL AND METHODS

Plant collection

The medicinal plant *Couroupita guianensis* (300 gm) was collected. After cleaning, plant part were dried under shade at room temperature for 3 days and then in oven dried at 45°C till complete dryness. Dried plant part was stored in air tight glass containers in dry and cool place to avoid contamination and deterioration.

Authentication of selected traditional plant - Medicinal plant *Couroupita guianensis* was authenticated by a plant taxonomist (Dr. Jagrati Tripati. Govt. Botnist) (Plant authentication no. AC/048/24) in order to confirm its identity and purity.

Extraction

In present study, plant material was extracted by continuous hot percolation method using Soxhlet apparatus. Powdered material of *Couroupita guianensis* was placed in thimble of soxhlet apparatus. Soxhlation was performing at 60°C using petroleum ether as non-polar solvent. Exhausted plant material (marc) was dried and afterward re-extracted with methanol solvent. For each solvent, soxhlation was continued till no visual colour change will observed in siphon tube and completion of extraction were confirmed by absence of any residual solvent, when evaporated. Obtained extracts was evaporate using rotary vacuum evaporator (Buchitype) at 40°C. Dried extract was weighed and percentage yield for each extract was determined using formula

$$\%\,\text{Yield} = \frac{\text{Weight of extract}}{\text{Weight of Plant Material used}} \times 100$$

Prepared extracts was observed for organoleptic characters (percentage yield, colour and odour) and was packed in air tight container and labelled till further use **(Baidya *et al*., 2002**).

Figure 3: Continuous hot extraction.

Phytochemical investigation

Experiment was performed to identify presence or absence of different phytoconstituents by detailed qualitative phytochemical analysis. The colour intensity or the precipitate formation was used as medical responses to tests. Following standard procedures were used **(Kokate *et al.*, 2000).**

Formulation of solid lipid Nanoparticles

Solid lipid Nanoparticles were prepared by solvent evaporation method. Briefly, required amount of extract and compritol were dissolved in 20 ml of chloroform. It was added into 200 ml of sodium lauryl sulphate aqueous solution while homogenizing at 6000 rpm by probe type homogenizer for 10 min and at the same time, stirred by mechanical mixer at 300 rpm to prevent any dead zone of unhomogenized area in the mixing beaker. After that, it was stirred mechanically at for 2 h during that period all the solvent will evaporate leaving solid residue of Nanoparticles. The Nanoparticles was retrieved by centrifugation for 1 h and washed twice with deionized water to remove surfactant. Before centrifugation, 1 ml sample was withdrawn for size distribution measurements. The obtained freeze-dried products were kept in refrigerator until further analysis **(Rahman *et al*., 2010)**.

Table 1: Ingredients used in Solid lipid Nanoparticles formulation.

Ingredients	F1	F2	F3	F4	F5
Extract (mg)	200	200	200	200	200
Compritol (Lipid) (mg)	50	100	150	200	250
Sodium lauryl sulphate (Surfactant) (%)	0.1	0.2	0.3	0.4	0.5
Stirring time (Min.)	10	15	20	25	30
Chloroform (ml)(Solvent)	20	20	20	20	20
Water	q.s	q.s	q.s	q.s	q.s

Evaluation parameter of Solid lipid Nanoparticles formulation

Particle size

The particle size is one of the most important parameter for the characterization of Nanoparticles. The size of Nanoparticles was measured using Malvern Zeta sizer (Malvern Instruments).

Zeta potential

The zeta potential was measured for the determination of the movement velocity of the particles in an electric field and the particle charge. In the present work, the Nanoparticles was diluted 10 times with distilled water and analyzed by Zeta sizer Malvern instruments.

Scanning Electron Microscopic (SEM)

The electron beam from a scanning electron microscope was used to attain the morphological features of the optimized extract loaded solid lipid Nanoparticles were coated with a thin layer (2–20 nm) of metal (s) such as gold, palladium, or platinum using a sputter coater under vacuum. The pre-treated specimen was then bombarded with an electron beam and the interaction resulted in the formation of secondary electrons called auger electrons. From this interaction between the electron beam and the specimen's atoms, only the electrons scattered at 90° were selected and further processed based on Rutherford and Kramer's Law for acquiring the images of surface topography.

Antibacterial activity of solid lipid nanoparticles by well diffusion assay

Preparation of nutrient agar media

28 g of Nutrient Media was dissolved in 1 litre of distilled water. pH of media was checked before sterilization. Media was sterilized in autoclave at 121^{o}C at 15 lbs pressure for 15 minutes. Nutrient media was poured into plates and placed in the laminar air flow until the agar was get solidified.

Well diffusion assay

The bacterial suspension of *E. coli* was standardized to 10^8 CFU/ml of bacteria and kept into the shaker. Then, 100µl of the inoculums from the broth (containing 10^8 CFU/ml) was taken with a micropipette and then transferred to fresh and sterile solidified Agar Media Plate **(Mohammadi- Sichani *et al.*, 2012).** The agar plate was inoculated by spreading the inoculums with a sterile spreader, over the entire sterile agar surface. Three wells of 6 mm were bored in the inoculated media with the help of sterile cork-borer. The wells were then formed for the inoculation of the, extract, and Nanoparticles formulation (0.5, 1 and 2mg/ml) solution. 100 µl of the sample was loaded. It was allowed to diffuse for about 30 minutes at room temperature and incubated for 18- 24 hours at 37^{o} C. After incubation, plates were observed for the formation of a clear zone around the well which corresponds to the antimicrobial activity of tested compounds. The zone of inhibition (ZOI) was observed and measured in mm. Zones were measured to a nearest millimeter using a ruler, which was held on the back of the inverted Petri plate. The Petri plate was held a few inches above a black, non-reflecting background. The diameters of the zone of complete inhibition (as judge by unaided eye) were measured, including the diameter of the well **(Manandhar *et al.*, 2019).**

RESULT AND DISCUSSIONS

Percentage Yield

In phytochemical extraction the percentage yield is very crucial in order to determine the standard efficiency of extraction for a specific plant, various sections of the same plant or different solvents used. The yield of

extracts received from the *Couroupita guianensis* is shown in Table:

Table 2: Percentage Yield of crude extracts of *Couroupita guianensis* extract.

S. No	Plant name	Solvent	Theoretical weight (gm)	Yield(gm)	% yield (gm)
1	Couroupita guianensis	Pet ether	293	1.35	0.46%
2		Methanol	290	5.88	2.02%

Preliminary Phytochemical study Table 6:

Table 3: Phytochemical testing of extract.

S. No.	Experiment	Presence or absence of phytochemical test	
		Pet. Ether extract	Methanolic extract
1.	**Alkaloids**		
1.1	Dragendroff's test	Present	**Present**
1.2	Mayer's reagent test	Present	**Present**
1.3	Wagner's reagent test	Present	**Present**
1.3	Hager's reagent test	Present	**Present**
2.	**Glycoside**		
2.1	Borntrager test	Absent	**Present**
2.2	Legal's test	Absent	**Present**
2.3	Killer-Killiani test	Absent	**Present**
3.	**Carbohydrates**		
3.1	Molish's test	Present	**Absent**
3.2	Fehling's test	Present	**Absent**
3.3	Benedict's test	Present	**Absent**
3.4	Barfoed's test	Present	**Absent**
4.	**Proteins and Amino Acids**		
4.1	Biuret test	Present	**Absent**
5.	**Flavonoids**		
5.1	Alkaline reagent test	Present	**Present**
5.2	Lead Acetate test	Present	**Present**
6.	**Tannin and Phenolic Compounds**		
6.1	Ferric Chloride test	Absent	**Present**
7.	**Saponin**		
7.1	Foam test	Present	**Present**
8.	**Test for Triterpenoids and Steroids**		
8.1	Salkowski's test	Absent	**Present**
8.2	**Libbermann-Burchard's test**	**Absent**	**Present**

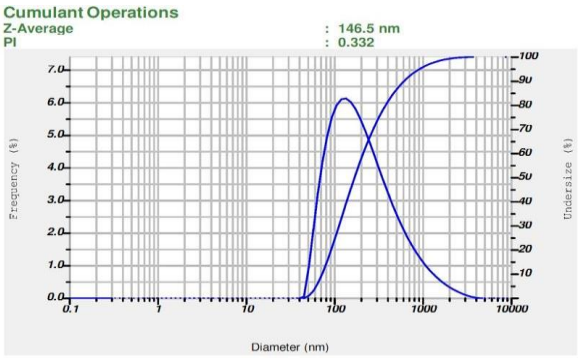

Figure 4: Particle size (F2).

Table 4: Result of particle size of all formulations.

S. No	Formulations	Particle size (nm)	PDI Value
1.	Solid Lipid Nanoparticles (F1)	663.7 nm	0.412
2.	Solid Lipid Nanoparticles (F2)	146.5 nm	0.332
3.	Solid Lipid Nanoparticles (F3)	175.3 nm	3.248

4.	Solid Lipid Nanoparticles (F4)	156.6 nm	0.291
5.	Solid Lipid Nanoparticles (F5)	808.8 nm	1.860

The particle size is one of the most important parameter for the characterization of solid lipid Nanoparticles. The average particle sizes of the prepared extract loaded Nanoparticles formulation were measured using Malvern zeta sizer. Particle size analysis showed that the average particle size of Nanoparticles was found to be range between 146.5 to 808.8 nm.

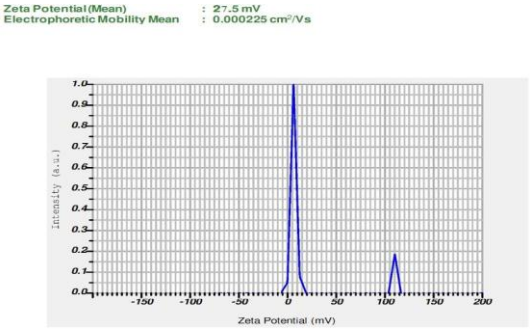

Figure 5: Zeta potential (F2).

Result of Zeta potential of all formulations

S. No	Formulation	Zeta potential
1	Solid Lipid Nanoparticles (F1)	-0.3 mV
2	Solid Lipid Nanoparticles (F2)	27.5 mV
3	Solid Lipid Nanoparticles (F3)	5.3 mV
4	Solid Lipid Nanoparticles (F4)	13.2 mV
5	Solid Lipid Nanoparticles (F5)	26.5 mV

Zeta potential analysis is carried out to find the surface charge of the particles. The magnitude of zeta potential is predictive of the colloidal stability. Zeta potential was found to be all formulation range -0.3 to 27.5 mV with peak area of 100% intensity. These values indicate that the all formulated solid lipid Nanoparticles is stable. Results show in above table.

Scanning electron microscope analysis

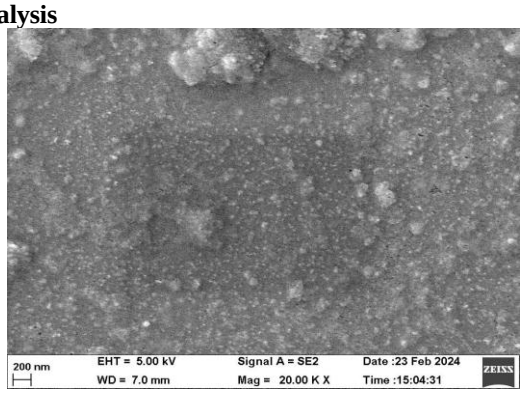

Figure 6*:* Scanning electron microscope (SEM) analysis.

SEM analysis was performed to determine their microscopic characters (shape & morphology) of prepared Solid lipid Nanoparticles. Solid lipid Nanoparticles were prepared and dried well to remove the moisture content and images were taken using scanning electron microscopy. Scanning electron micrograph of the prepared Solid lipid Nanoparticles at 20.00 KX magnification showed that the solid lipid nanoparticles were porous with a smooth surface morphology and spherical shape. The nature of solid lipid Solid lipid Nanoparticles was clearly observed in the SEM images.

Antimicrobial activity of solid lipid Nanoparticles *E.coli*

Table 5: Antimicrobial activity of solid lipid Nanoparticles (F2) against *E.coli.*

S. No	Sample name	Zone of Inhibition (mm)
1	Extract	9mm

2	SLNs (0.5mg/ml)	11mm
3	SLNs (1mg/ml)	13mm
4	SLNs (2mg/ml)	15mm

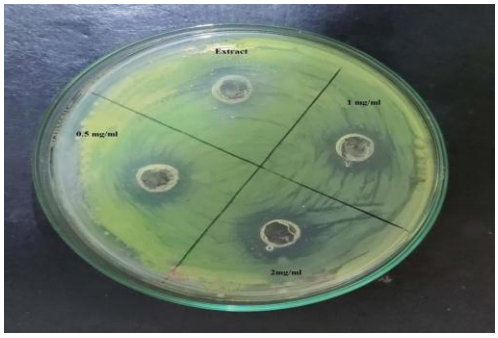

Figure 7: Antimicrobial activity against *E. coli.*

SUMMARY AND CONCLUSION

Formulation was carried out by Solvent evaporation method. Trial batches indicated that polymers are suitable for the Nanoparticles formulation polymer produced good formulations. Compritol and Sodium lauryl sulphate were selected for further studies. Scanning electron micrograph of the prepared solid lipid nanoparticles at 20.00 KX magnification showed that the Nanoparticles were smooth surface morphology and spherical shape. The porous nature of Nanoparticles was clearly observed in the SEM images. Particle size and zeta potential was determined by Malvern Zeta sizer. The particle size analysis confirmed that the prepared sample were in the nanometer range. Average particle size obtained for the all formulations were 146.5 nm to 808.8 nm. Zeta potential values of Solid lipid Nanoparticles indicated that the formulated Solid lipid Nanoparticles is stable (-03. mV to 27.5mV). This is because the newly developed Solid lipid Nanoparticles is believed to exhibit a core shell structure with a core formed. The formulations were optimized on the bases of results of all formulations. Effect of polymer type and extract: polymer ratio on the evaluation parameter of formulated extract loaded solid lipid Nanoparticles on evaluation parameter was studied. Even though the particle size of Solid lipid Nanoparticles F2 formulation is selected as the optimum formulation due to its comparatively better result of all parameter including particle size, zeta potential, antimicrobial and SEM etc.

The extract loaded solid lipid Nanoparticles can be formulated by cost effective and easy solvent evaporation method using polymer (Compritol) and surfactant agent (Sodium lauryl sulphate). The formulated extract loaded solid lipid Nanoparticles can be used in the treatment of various diseases. This can be targeted to the cells and produce sustained drug delivery which in turn reduces the dose, frequency of administration and the side effects.

Solid lipid Nanoparticles is tiny mesh-like structures with a size less than 1µm (1000 nm). Due to their porous structure and small size; they can easily bind to drugs which are poorly-soluble leading to better bioavailability and solubility of such drugs. Therefore, in this study Zextract loaded in Solid lipid Nanoparticles to improve bioavailability. So this can be overcome by developing nanotechnology based formulation like Solid lipid Nanoparticles which may increase the bioavailability. Through the different evaluation parameters the formation of Solid lipid Solid lipid Nanoparticles confirmed. The discovery of Solid lipid Nanoparticles has become a significant step in overcoming certain problems such as drug toxicity, poor bioavailability and release of drug in a predictable fashion as they can accommodate both hydrophilic and hydrophobic substance.

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