RESEARCH PAPER

Formulation Of Solid Lipid Nanoparticles Containing Kalanchoe Pinnata (Lam) Pers. Extract

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ABSTRACT
Although it is found all over the world, the perennial plant Kalanchoe pinnata is mostly found in the Caribbean, Central America, North America, and some regions of Africa and Asia. It is a member of the Crassulaceae family. Kalanchoe pinnata, a native of Madagascar, grows best on sandy and granitic soil in subhumid to temperate humid climates with 1000–2000 mm of annual rainfall. This fragrant plant has huge therapeutic potential and significant medical significance because of its unique chemical components, which include essential oils that include alkaloids, lipids, triterpenes, bufadienolides, glycosides, steroids, flavonoids, and cardienolides.
The leaves of Kalanchoe pinnata include a class of chemicals called "bufadienolides" that are biologically active. Digoxin, cardiac glycoside, bryotoxin A, bryotoxin B, and bryotoxin C are some of these substances. They may be antibacterial, chemopreventive, insecticidal, and anticancer. Kalanchoe pinnata is known to have wound-healing, insecticidal, anti-inflammatory, anti-allergic, anti-microbial, anti-tumor, and CNS depressing qualities in addition to its anti-oxidant and anti-diabetic qualities.
Solid lipid nanoparticles (SLNs), which were first introduced in the early 1990s, are believed to be the most effective lipid-based colloidal carriers. This work used cow's ghee as the lipid core to produce solid lipid nanoparticles filled with Kalanchoe Pinnata extract. The current study used a high-speed homogenization approach to create solid lipid nanoparticles of Kalanchoe pinnata extract.
The particle size analysis found that the SLNs varied from 194.7 nm to 297.1 nm. In SLNs, the highest entrapment rate is 95.64%. The enhanced batch yields 98.37% release in phosphate buffer. Physical analyses of all batches also showed increased stability at room temperature..
Keywords: Cow ghee, *Kalanchoe pinnata* extract, solid lipid nanoparticles, etc
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INTRODUCTION

Although it is found all over the world, the perennial plant *Kalanchoe pinnata* is mostly found in the Caribbean, Central America, North America, and some regions of Africa and Asia. It is a member of the Crassulaceae family. *Kalanchoe pinnata*, a native of Madagascar, grows best on sandy and granitic soil in sub-humid to temperate humid regions with 1000–2000 mm of annual rainfall on average. This fragrant plant has huge therapeutic potential and significant medical significance because of its unique chemical components, which include essential oils that include alkaloids, lipids, triterpenes, bufadienolides, glycosides, steroids, flavonoids, and cardienolides. campesterol, caffeic acid, bufadienolides, bryotoxin-C, bryophynol, bryophyllol, bryophyllin-A and bryophyllin-C, bryophyllin, bryophollone, bryophollenone, β-sitosterol, β-amyrin, benzenoids, behenic acid, astragalin, arachidic acid, and numerous others.
A biologically active class of compounds known as "bufadienolides" is found in the leaves of Kalanchoe pinnata. These compounds include digoxin, cardiac glycoside, bryotoxin-A, bryotoxin-B, and bryotoxin-C. They have the potential to be insecticidal, chemopreventive, antitumor, and antibacterial. *Kalanchoe pinnata* is known to have wound-healing, insecticidal, anti-inflammatory, anti-allergic, anti-microbial, anti-tumor, and CNS depressing qualities in addition to its anti-oxidant and anti-diabetic qualities.

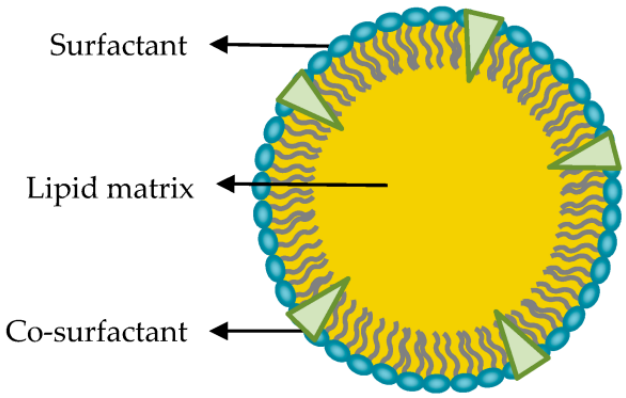

Fig.no 1: Structure of SLN

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MATERIAL AND METHODS:

Materials:

The leaves of *Kalanchoe pinnata* were purchased at Umerga's local market. The lipid core is cow's ghee. The remaining ingredients, such as tween 80, polyethylene glycol 400, and pluronic F68, were all of pharmaceutical quality.

Developing *Kalanchoe pinnata* leaf extracts using the maceration method

1.5 kg of fresh leaves were cleaned with water. The leaf material was then allowed to air dry for two days. In order to obtain extracts, a specific amount of dried material was macerated with ethanol by soaking 500 g of dried powdered plant in a bottle with two liters of ethanol for seventy-two hours. After that, the ethanol mixture was filtered and concentrated by utilizing a rotary evaporator to evaporate the alcohol under low pressure.

Solid lipid nanoparticle formulation for *Kalanchoe pinnata* extract

Solid lipid nanoparticles (SLNs) loaded with extract from Kalanchoe pinnata leaves were made using a high-speed homogenization technique. The drug was dissolved in cow ghee in a beaker that was melted for 60 to 70 degrees Celsius. The solution was then sonicated for five minutes. Next, surfactant and polymers were combined in another beaker, added to distilled water, and stirred with a magnetic stirrer for five minutes. The prepared oil phase was then progressively added to the aqueous phase, and the combination was allowed to cool at room temperature while being homogenized for ten minutes.

Evaluation of solid lipid nanoparticles

1. Drug Entrapment efficiency
2. *In-vitro* drug release study
3. Measurement of Particle size

1. Drug Entrapment Effectiveness:

The percentage of drugs that are trapped inside the core of the lipid matrix is represented by the E.E. of SLNs. High-speed cooling centrifugation was used to measure the drug's entrapment % in SLN formulations. It was centrifuged at 10,000 rpm for two hours at 4°C. The amount of unbound drug in the supernatant was measured using a double beam ultraviolet (UV) Spectrophotometer. The percentage of the drug that was successfully entrapped was determined using the following formulas:

Table no 1: Formulation Table of SLN

Sr. No	Ingredients	F1	F2	F3	F4	F5	F6	F7	F8	F9
1	*Kalanchoe Pinnata* (mg)	100	100	100	100	100	100	100	100	100
2.	Cow ghee (ml)	10	10	10	15	15	15	20	20	20
3.	PEG-400 (ml)	10	10	10	10	10	10	10	10	10
4.	Pluronic F68 (mg)	100	100	100	100	100	100	100	100	100
5.	Tween 80 (ml)	1	1	1	1	1	1	1	1	1
6.	Distilled Water (ml)	29	29	29	24	24	24	19	19	19
7.	RPM	15000	17500	20000	15000	17500	20000	15000	17500	20000

Table No. 2: % Drug Entrapment Efficiency

Batch	Absorbance	Conc (ug/ml)	Dilution	Actual Conc (ug/ml)	Final Conc (mg)	Initial Conc (mg)	% EE
F1	0.046	7.26	10	72.61	0.73	10	92.74
F2	0.028	4.51	10	45.14	0.45	10	95.49
F3	0.038	6.04	10	60.40	0.60	10	93.96
F4	0.049	7.72	10	77.19	0.77	10	92.28
F5	0.043	6.80	10	68.03	0.68	10	93.20
F6	0.052	8.18	10	81.77	0.82	10	91.82
F7	0.027	4.36	10	43.62	0.44	10	95.64
F8	0.033	5.28	10	52.77	0.53	10	94.72
F9	0.039	6.19	10	61.93	0.62	10	93.81

Table No. 3: % Drug Release of F7 Batch

F7			
Time (min)	**Absorbance**	**Dilution**	**% DR**
0	0.000	1	0.00
30	0.006	1	9.26
60	0.014	1	19.02
120	0.028	1	36.11
180	0.043	1	54.43
240	0.055	1	69.07
360	0.070	1	87.39
480	0.076	1	94.71
720	0.079	1	98.37

$$\% EE = \frac{initial\ weight\ of\ drug - free\ weight\ of\ drug}{nitial\ weight\ of\ drug} \times 100$$

2. *In-vitro* drug release:

Using dialysis bags, *in-vitro* drug release experiments were completed for SLNs that were developed. To remove excess glycerin and sulfur, the dialysis membrane was cleansed with distilled water prior to use. To confirm the sink conditions of the dissolving media, it was then submerged in the releasing medium (PBS) pH 6.8 for the whole night Five milligrams of the same amount of the developed SLNs were suspended in five milliliters of the release medium in a dialysis bag that was tightly sealed on both sides with a thermo-resistant thread to prevent leaks. The bag was then submerged in the Dissolution apparatus, which had four hundred milliliters of the release medium in each vessel (75 ±1 rpm and 37±0.5 °C). At a prearranged interval

To maintain sink conditions, 5 mL samples were taken out, filtered through a 0.220 µm syringe filter at predetermined intervals, and then continually refilled with equal amounts of new dissolving liquid. A UV-Vis spectrophotometer was used to measure the aspirated samples at the determined λ max of *Kalanchoe Pinnata* (241 nm).

3. Particle size measurement

The optimized SLN batches' particle size distribution is shown by the Horiba SZ-100 size analyzer. The SLNs ranged from 194.7 nm to 297.1 nm, according to particle size analysis. In comparison to the other batches, the SLNs made with cow ghee and the F7 Batch exhibit lower particle sizes.

The particles in batch F7 are smaller, measuring 194.7 nm.

RESULTS AND DISCUSSION:

1. Preformulation Studies
2. Drug authentication
3. *Kalanchoe pinnata* FTIR

Drug characterization

The standard calibration curve for *Kalanchoe Pinnata* Lam. The Pers calibration curve for *Kalanchoe Pinnata* Lam. Pers was determined to be linear over the concentration range of 0-25 µg/ml, with an equation of y=0.0065x-0.0015 and a correlation coefficient of 0.993 at 241 nm. The curve shows good linearity as a result.

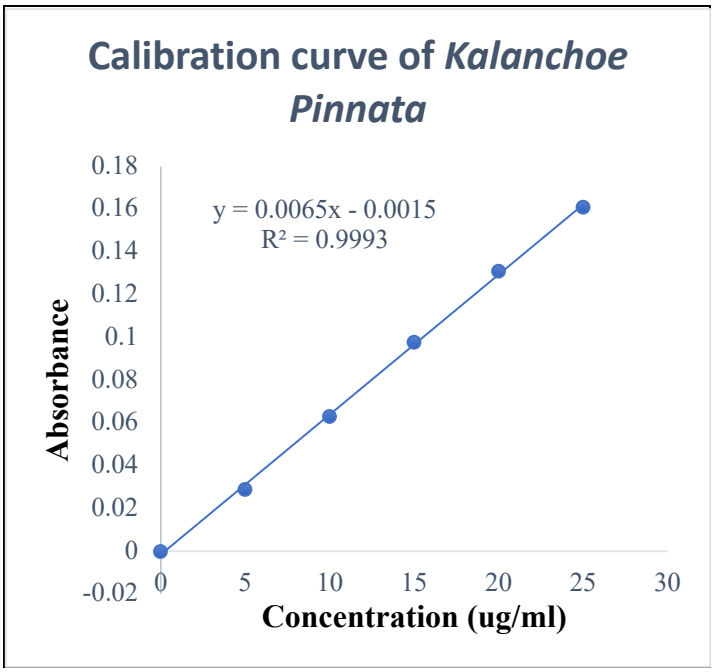

Fig.no 2: Calibration Curve of *Kalanchoe Pinnata*

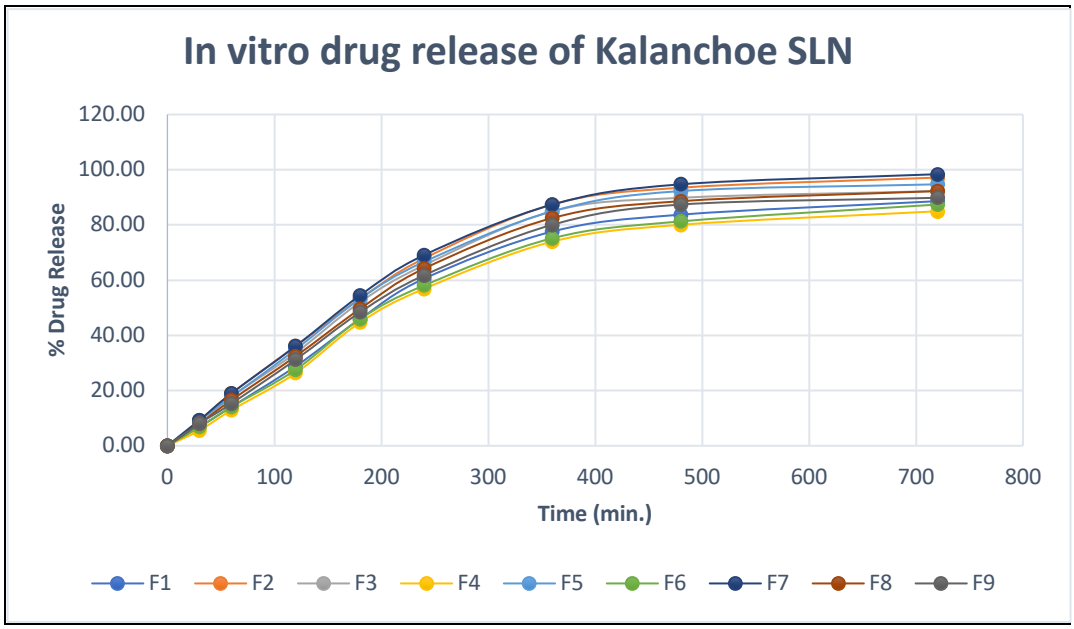

Fig.no 3: % Drug release

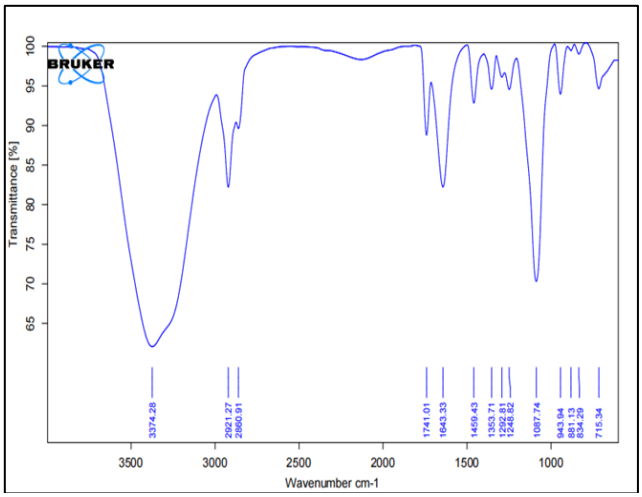

Fig.no 4: FTIR of F7 Batch SLN

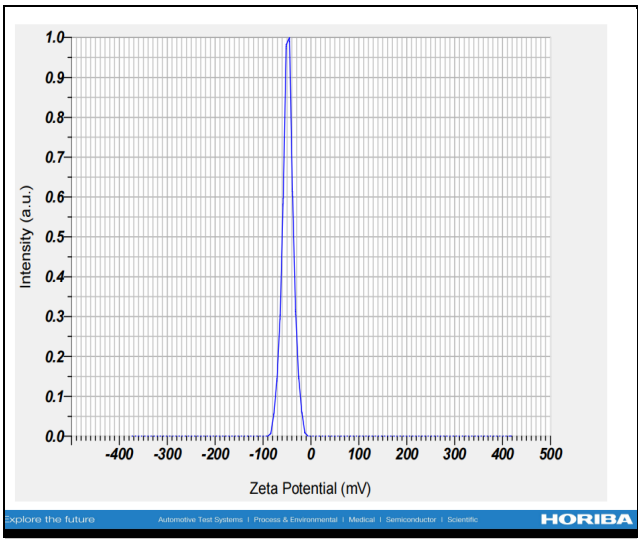

Fig.no 6: Zeta Potential of F7 Batch

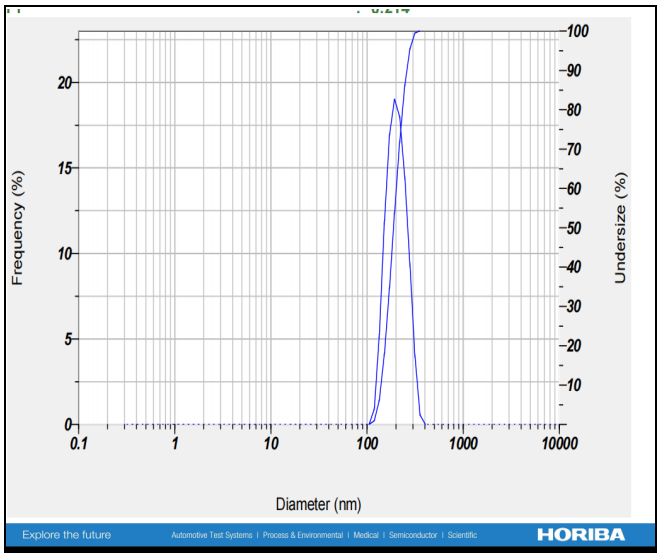

Fig.no 5: Particle size analysis F7 batch

CONCLUSION:

Finally, the study showed that cow ghee may be used as the lipid core to properly construct solid lipid nanoparticles from an extract of *Kalanchoe Pinnata Lam. Pers.* SLN yields excellent results.

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CONFLICT OF INTREST:

The authors declare there is no conflict of interest

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