GSC Biological and Pharmaceutical Sciences
eISSN: 2581-3250 CODEN (USA): GBPSC2
Cross Ref DOI: 10.30574/gscbps
Journal homepage: https://gsconlinepress.com/journals/gscbps/

(RESEARCH ARTICLE)

Check for updates

Development and evaluation of tablet formulation from *Calotropis gigantea* Linn (leaf extract)

Gauri V. Raut [1,*], Tejaswi S. Kohale [1], Prashant J. Burange [2], Pankaj H. Chaudhary [3] and Dipti B. Ruikar [4]

[1] *Department of Pharmaceutics, P.R.Pote Patil College Of Pharmacy, Amravati, Maharashtra, India*
[2] *Department of Pharmaceutical Chemistry, P.R.Pote Patil College Of Pharmacy, Amravati, Maharashtra, India.*
[3] *Department of Pharmacognosy, P.R.Pote Patil College Of Pharmacy, Amravati, Maharashtra, India.*
[4] *Department of Quality Assurance, P.R.Pote Patil College Of Pharmacy, Amravati, Maharashtra, India.*

GSC Biological and Pharmaceutical Sciences, 2024, 28(02), 026–035

Publication history: Received on 02 June 2024; revised on 22 July 2024; accepted on 25 July 2024

Article DOI: https://doi.org/10.30574/gscbps.2024.28.2.0262

Abstract

The term "Medicinal Plants" is typically used to describe plants that have curative benefits or have beneficial pharmacological effects on animal bodies. Herbal tablets, derived from medicinal plants, have been used for centuries in traditional medicine to treat various ailments. With increasing interest in natural and alternative therapies, there is a need to scientifically evaluate their efficacy and safety. They contain active compounds extracted from various parts of plants, such as leaves, roots, flowers, and seeds, which have been traditionally used in medicine across different cultures. *Calotropis gigantea* Linn (Apocynaceae) is a well known plant for its antioxidant, anti-malarial, antimicrobial, anti-inflammatory, analgesic activity. Herbal tablets represent a promising avenue in the realm of natural health products, balancing traditional wisdom with modern scientific approaches. This study aims to formulate and evaluate the herbal tablets made from *Calotropis gigantea* Linn leaf extract.

Keywords: *Calotropis gigantea*; Milk weed; Leaf extract; Traditional medicine; Formulation

1. Introduction

The giant Calotropis Linn, Often called milk weed or a popular restorative plant, has been used in Indian medicine for many years. It has a smooth stem and round , light green leaves. The plant may grow naturally in a variety of solis and environments and doesn't require any special gardening techniques. Numerous pharmacological effects have been reported, including antioxidant, anti-malarial, antimicrobial, cytotoxic, antipyretic, anti-asthmatic, anti-inflammatory, analgesic, insecticidal, wound healing, and anti-diarrheal effects.(1,2) The plants *Calotropis gigantea* and *Calotropis procera* are referred to as "Sweta Arka" and "Raktha Arka," respectively, in archaic ayurveda medicine(3). *Calotropis gigantea* Linn is flowering plants belong to apocynaceae family. It is also known as Akada, Aak, Mandar, Aakh etc.(4)

1.1. Plant profile

Table 1 Taxonomical classification of *Calotropis gigantea* Linn. (5)

Kingdom	**Plantae**
Order	Gentianales
Family	Apocynaceae
Subfamily	Asclepiadaceae

* Corresponding author: Gauri V. Raut

Genus	*Calotropis*
Species	*C.gigantea*

1.2. Phytochemical aspects

Table 2 Various chemical constituents isolated from Calotropis gigantea Linn (6)

Class of Chemical Constituent	Name of Chemical Constituent	Plant Part Used	Extract Taken
Triterpenoids	Di-(2-ethylhexyl) Phthalate	Flowers	Ethyl acetate extract
	Anhydrosophoradiol-3-acetate		
	Lupeol	Aerial parts	Latex
	α –Taraxerol	Root bark	Ethyl acetate extract
Triterpene esters	γ-Taraxasterol	Aerial parts	Hexane and methanol soluble extract
	Lupenyl-1-acetate	Root bark	Petroleum ether extract
Flavonol	Isorhamnetin	Aerial parts	Methanol extract
Cardiac glycosides	Calotropone	Roots	Ethanol extract
	Gofruside		
Steroids	Stigmasterol	Root bark	Methanol extract
	β-Sitosterol		
	β–Sitosterolacetate		Ethyl acetate extract
Resin	β-Amyrin	Root bark	95 % Alcohol extract
	β-Amyrin acetate		
Fatty acids	Isovaleric acid	Root bark	95 % Alcohol extract
Miscellaneous	Asclepin	Roots	Latex

1.3. Pharmacological aspects

1.3.1. Antimicrobial Activity

Madhu Prakash Srivastav et al.(2020) was studied that the antimicrobial activity of aqueous, methanolic and ethanolic extract of leaves and flower of *Calotropis gigantea* Linn shows potent antimicrobial activity against Staphylococcus aureus.(7)

1.3.2. Cytotoxic Activity

S. Rajashekara et al. (2020) was studied that synthesized Zinc oxide nanoparticles from aerial (leaf) parts of *Calotropis gigantea* Linn showed a cytotoxic effect against MDAMB-231 cell lines. So, plant extract also shows cytotoxic effect. (8)

1.3.3. Antiasthmatic Activity

S. Sarkar et al. (2018) was studied anti asthmatic activity of *Calotropis gigantea* in ova albumin (OVA) induced asthma. The impact of *Calotropis gigantea* at 100, 200, 400 mg/kg, on various body cells, catalysts and histopathological changes were noticed. Along these lines, plant concentrate might help for treating asthma. (9)

1.3.4. Anti-Malarial Activity

Shripad M. Bairagi et al.(2018) was studied the mosquito repellent activity of *Calotropis gigantea* flower extract was studied. The distinctive extract of the plant was utilized for the investigation against the multi day blood starved female Culex quinquefasciatus mosquito. The alcoholic extract showed high mosquito repellent action against the female Culex quinquefasciatus mosquito as compared to the petroleum ether and chloroform extract. The dose dependent mosquito repellent activity of the extract was found.(10)

1.3.5. Antioxidant Activity

Mushir Ansari et al.(2016) was studied the *in vitro* antioxidant activity of *Calotropis gigantea* root extract by 2, 2-diphenyl- 1-picrylhydrazyl and fluorescence recovery after photobleaching assay. In both the method, extract possesses high antioxidant activity when compared with standard ascorbic acid due to presence of high content of various phytochemicals. (11)

1.3.6. Antipyretic Activity

Namrata Singh et al. (2014) was studied that root extract of *Calotropis gigantea* has expected antipyretic action against both yeast-induced and TAB vaccine-induced fever, showing the chance of creating *Calotropis gigantea* as a less expensive and intense antipyretic agent. (12)

1.3.7. Anti-Inflammatory Activity

V. A. Jagtap et al. (2010) was examined that ethanolic extract of leaves of *Calotropis gigantea* linn. On in-vitro models shows significant anti-inflammatory activity.(13)

1.3.8. Wound Healing Activity

Narendra Nalwaya et al. (2009) examined wound healing activity of latex of *Calotropis gigantea* Linn. in albino rats by using extraction and entry point wound model and the latex showed the significant wound healing activity. (14)

1.3.9. Insecticidal Activity

M. Rezaul Karim et al.(2009) was read for methanolic extract of root bark of *Calotropis gigantea* Linn. furthermore, its chloroform and petroleum ether soluble portions against several instar of larvae and adult of Tribolium castaneum. The methanol extracts and furthermore, its chloroform and petroleum ether soluble portions were repellent to Tribolium castaneum in mild to moderate range. (15)

1.3.10. Analgesic Activity

A.K. Pathak et al.(2007) was studied the analgesic activity of alcoholic extract of *Calotropis gigantea* Linn. in acetic acid induced writhing test & hot plate technique in mice. In both the technique, extract has high analgesic activity.(16)

1.4. Solid Dosage form (17)

The majority of solid dosage forms are offered as unit dosage forms, or dose forms that are taken in numerical order, such tablets and capsules. The most practical dosage form for medications to be administered orally in a dry condition is a tablet or capsule. Patients find them easy to handle, identify, and administer, and they are effective.

1.4.1. Tablet (17)

A tablet is a pharmaceutical solid dosage form.. It consists of a combination of excipients and active ingredients, often in powder form, that has been compressed or pressed into a solid dosage. Excipients can contain lubricants, diluents, binders or granulating agents, glidants (flow aids), and disintegrants to facilitate tablet break-up in the gastrointestinal system, sweeteners or flavors to improve taste, and colors to give the tablets a visually appealing appearance. A polymer coating is frequently used to improve the tablet's appearance, manage the pace at which the active component releases, smooth out the tablet's texture and make it easier to swallow, or make the tablet more environmentally resistant

1.4.2. Advantages and Disadvantages

Advantages

- Tablets are unit dosage form and offer the greatest capabilities of all oral dosage form for the greatest dose precision and the least content variability.

- They are easiest and cheapest to package and strip.
- Low in cost.
- Lighter and compact.
- Having greatest chemical and microbial stability over all oral dosage forms.
- Suitable for large scale production.
- Easy to swallow with least tendency for hang-up.
- Objectionable odour and bitter taste can be masked by coating technique.
- Sustained release product is possible by enteric coating.
- Easy to handling.

Disadvantages

- Difficult to swallow in case of children and unconscious patients.
- Some drugs resist compression into dense compacts, owing to amorphous nature, low density character.
- Drugs with poor wetting, slow dissolution properties, optimum absorption high in GIT may be difficult to formulate or manufacture as a tablet that will still provide adequate or full drug bioavailability.
- Bitter testing drugs, drugs with an objectionable odor or drugs that are sensitive to oxygen may require encapsulation or coating. In such cases, capsule may offer the best and lowest cost.
- Irritant effects on the GI mucosa by some solids (e.g., aspirin).
- Possibility of bioavailability problems resulting from slow disintegration and dissolution.

1.5. Manufacturing: (16,17)

1.5.1. Manufacture of the tableting blend

Making ensuring each tablet contains the right amount of active substance is the first rule when it comes to tablet pressing. Therefore, be sure to thoroughly combine all of the components. To ensure a uniform distribution of the active chemical in the finished tablet, the ingredients must be granulated before compression if a sufficiently homogeneous mix of the components cannot be generated with straightforward blending techniques. Wet granulation and dry granulation are the two fundamental methods used to granulate powders for compression into a tablet. Granulation is not necessary for well-mixed powders because they may be directly crushed into tablets.

1.5.2. Wet granulation

Using a liquid binder to gently agglomerate the powder combination is known as wet granulation. It's important to carefully regulate the amount of liquid used since too much will make the granules too hard, and too little would make them too soft and friable. Although aqueous solutions are safer to work with than solvent-based systems, they might not be appropriate for medications that are hydrolyzed.

1.5.3. Procedure

- Step 1: The active ingredient and excipients are weighed and mixed.
- Step 2: The wet granulate is prepared by adding the liquid binder– adhesive to the powder blend and mixing thoroughly. Examples of binders/adhesives include aqueous preparations of cornstarch, natural gums such as acacia and cellulose derivatives such as methyl cellulose, gelatin, and povidone.
- Step 3: Screening the damp mass through a mesh to form pellets or granules.
- Step 4: Drying the granulation. A conventional tray-dryer or fluid-bed dryer are most commonly used.
- Step 5: After the granules are dried, they are passed through a screen of smaller size than the one used for the wet mass to create granules of uniform size.

Low shear wet granulation methods might take a long time to reach an evenly mixed condition and require very basic mixing equipment. The production process is accelerated by the employment of equipment in high shear wet granulation operations, which rapidly combines the liquid and powder. Preheating, granulating, and drying the powders are all done in one vessel using the fluid bed granulation method, which involves many steps of wet granulation. Because it gives precise control over the granulation process, it is in use.

1.6. Tablet Presses (15,17)

Tablet presses, also known as tableting machines, come in a variety of sizes and prices. Single-station presses, which are small, low-cost benchtop models that produce one tablet at a time with approximately half a ton of pressure, and

multi-station rotary presses, which are large, computerized, industrial models that produce hundreds of thousands to millions of tablets per hour with much higher pressure. A vital piece of equipment for manufacturers of pharmaceuticals and nutraceuticals is the tablet press.

Tablet presses need to give the user precise control over the lower and higher punch positions in order to regulate tablet weight, thickness, and density. A number of cams, rollers, and/or tracks that operate on the tablet tooling (punches) are used to do this. Additionally, mechanical mechanisms are included for die filling as well as for ejecting and taking the tablets out of the press once they have been compressed. Because pharmaceutical tablet presses are typically used to make a wide variety of pharmaceuticals, they must be simple to clean and quick to reconfigure with alternative equipment.

2. Materials and methods

2.1. Collection and authentication of plants

Leaves of *Calotropis gigantea* were collected from devi residency municipal park, Amravati(Maharashtra).The plant was identified and authenticated by Dr. Parul Nandgaonkar of department of Dravyaguna ,P. R. Pote Patil College Of Medical Sciences Ayurved,Amravati, and a voucher sample (code:DGH/24021 dated 16/05/2024) was deposited at the Herbarium of this department.

The leaves was dried in the sun exposure. Dried leaves were powdered in grinder and powder was kept in an airtight container for further study. According to the literarure survey the ethanolic extract of leaves of *Calotropis gigantea* Linn. shows significant anti-inflammatory activity.

Various excipients are required for the herbal tablet formulation including binders, fillers, dinintegrants, lubricants etc.

2.2. Extraction of Plant Material (18,19)

The dried leaves of plant *Calotropis gigantea* linn were allowed to air dry in a shade under normal environmental conditions for about one week, after that broken in to small pieces with the help of cutter and grinded in a grinder to coarse powder. Coarsely grinded plant parts were extracted in soxhlet apparatus successively with solvents ethanol. Table shows percentage yield of successive extraction.

Figure 1 Extraction Process

2.3. Preformulation Study (20)

2.3.1. Organoleptic characters

Organoleptic characteristics refer to the aspects of food, pharmaceuticals, and other substances as experienced by the senses, including taste, sight, smell, and touch. For herbal products, these characteristics play a crucial role in assessing quality, acceptance, and therapeutic efficacy..The organoleptic characteristics are important not only for ensuring the quality and efficacy of herbal products but also for consumer acceptance and safety.

2.3.2. Bulk density and tap density

Bulk and tapped density are critical parameters in the formulation and quality control of herbal tablets. Bulk density is the mass of a powder divided by its volume when loosely packed, reflecting the initial state of the powder before any compression or compaction. Tapped density, on the other hand, is the mass of the powder divided by its volume after being subjected to standardized tapping or vibration, which compacts the powder and reduces the volume it occupies. These measurements are essential for understanding the powder's flow properties and its ability to be compressed into a tablet. High bulk and tapped densities typically indicate good flowability and uniform packing, which are crucial for consistent tablet weight and active ingredient distribution. The difference between these densities, quantified as Carr's Index or compressibility index, provides insight into the powder's compressibility and flow characteristics, aiding in the optimization of the tablet manufacturing process.

2.3.3. Compressibility

Compressibility of herbal products, particularly in the context of tablets or powders, is an important parameter in the formulation and quality control of these products. It refers to the ability of a powder to decrease in volume under pressure and is a critical factor in tablet formation.

2.4. Development Of Formulation (21-19)

All ready standardized ethanolic leaf extract from *Calotropis gigantea* Linn were used to prepared granules by wet granulation technique as follows: -

- Following the addition of lactose to absorb moisture, the precisely weighed extract amounts were put through sieve number 60.
- Add enough isopropyl alcohol to the mixture together with weighed amounts of the excipients (Starch, PVPK-30, Sodium methyl paraben, and Sodium propyl paraben) to create dough mass.
- The wet mass was passed through sieve no.12.
- Granules were dried for 30 minutes at 50–55 °C in an oven.
- Dried granules were passed from sieve no. 20.
- Then granules were mixed with Lubricants (Talc, Magnesium stearate & Sodium starch glyconate).

Table 3 Formula for Tablet

Granulation				
S.No.	**Contents**	**Quantity per tablet**		
		Formula 1	**Formula 2**	**Formula 3**
1	Extract of *Calotropis gigantea*	71.4 mg	71.4 mg	71.4 mg
2	Lactose	30.61 mg	28.42 mg	35.71 mg
3	Starch	15.7 mg	16.8 mg	17.8 mg
4	Poly Vinyl Pyrrolidone K-30	23 mg	24 mg	25 mg
5	Sodium methyl paraben	1.75 mg	1.90 mg	2.85 mg
6	Sodium propyl paraben	0.81 mg	0.91 mg	0.71 mg
7	Isopropyl alcohol	Quantity sufficient	Quantity sufficient	Quantity sufficient
Compression				
1	Granules	250 mg	250 mg	250 mg

2	Magnesium stearate	7.5 mg	6.4 mg	7.1 mg
3	Talk	9.5 mg	10.15 mg	g

- The granules developed in this study were evaluated to ensure that they meet the specified formulation criteria. (e.g.,practicle size,dissolution rate,stability,etc,).
- Based on the results obtained from the tests,it is confirmed that the granules prepared according to the formula 3 (table no.2) comply with the formulation.
- 40 tablets for 250mg were prepared.

2.4.1. Compression Process:

The formulation consisted of ethanolic extract of leaves of *Calotropis gigantea* Linn in defined proportions.Wet granulation was performed Magnesium stearate was used as a lubricant. Tablets were compressed with a target weight of 250mg each.

2.5. Evaluation of Tablet Formulation

Tablets prepared by compression method were evaluated for General Appearance, Weight Variation, Thickness of Tablet, Hardness of Tablet, Friability, Disintegration time, dissolution test as per IP.

2.5.1. General Appearance

Consumer acceptability, lot-to-lot uniformity control, and tablet-to-tablet uniformity are all dependent on a tablet's overall look, identity, and general elegance. Measurements of size, form, color, taste, odor, and other elements are all part of controlling overall appearance.

2.5.2. Size & Shape

It is controllable and dimensionally characterized. A tablet's thickness is only one of several factors. A micrometer or another equipment can be used to measure the thickness of a tablet. Tablet thickness needs to be managed within a standard value fluctuation of ± 5%.

2.5.3. Organoleptic properties

Color distribution must be uniform with no mottling. For visual color comparison compare the color of sample against standard color.

2.5.4. Hardness

A tablet needs to be strong enough to endure mechanical shaking during manufacturing, packing, and delivery, as well as resistant to friability. In general, hardness indicates how strong a tablet can be crushed.

2.5.5. Friability

A Roche friabilator can be used in a lab to test a tablet's friability. This is made out of a plastic chamber that spins at 25 rpm and drops the tablets into the friabilator six inches away. The friabilator then runs for 100 revolutions. We weigh the pills once again. Tablets that compress to less than 0.1 to 0.5% of their original weight are deemed acceptable.

2.5.6. Weight Variation test (U.S.P.)

20 tablets should be taken and weighed separately. Compute the mean weight and contrast each tablet's weight with the mean. If no more than two tablets deviate from the % restriction and if no tablet varies by more than twice the percentage limit, the tablet passes the U.S.P. test.

2.5.7. Disintegration Test (U.S.P.)

A 1-liter beaker of water, simulated gastric fluid, or simulated intestinal fluid at 37 ± 20 ℃ is used to hold the basket rack while one tablet is placed inside each of the six 3-inch glass tubes with 10 mesh screens at the bottom end and an open top. This is the U.S.P. device for testing disintegration time. The tablet should remain 2.5 cm below the liquid's surface during its upward movement and should not come any closer to the beaker's bottom during its downward movement. Move the tablet-containing basket up and down at a rate of 28 to 32 cycles per minute across a distance of 5 to 6 cm. Placing perforated plastic disks on each tablet can stop it from floating. The tablet needs to break down and

all of the particles need to get through the 10 mesh screen within the allotted time, according to the test. If any residue is left, it ought to be soft in texture.Breakdown duration: Tablets without coating: 5–30 minutes; tablets with coating: 1–2 hours.

2.5.8. Dissolution Test

The dissolution appratus, as specified by the United States Pharmacopiea (USP), is crucial for ensuring the quality,efficay, and safety of oral dosage forms. It stimulates gastrointestinal conditions to predict the release and bioavailability of active pharmaceutical ingredients, ensuring consistency between batches and supporting formulation development.

Compliance with USP standards sor dissolution testing is mandatory for regulatory approval, ensuring tha tproducts meet stringent quality control criteria. Additionally, dissolution testing aids in stability studies and comparative analyses between brand-name and generic products, thereby maintaing therapeutic reliabilty and patient safety.

3. Result and discussion

Table 4 Organoleptic features of *Calotropis gigantea* leaves

Sr. No.	Features	Observations
1	Shape	elliptic-oblong
2	Width	8-12 cm
3	Length	10-15cm
4	Color	Green
5	Odor	Toxic
6	Taste	bitter

3.1. Precompression parameters

Table 5 Precompression parameters

Bulk density	Tapped density	Compressiblity
0.61 ± 0.006	0.72 ± 0.016	17.289 ± 1.321

3.2. Evaluation of Formulation:

Around 40 tables were prepared and pharmaceutically evaluated.

The results observed are as follows:

Table 6 Evaluation of Developed Tablet

Sr.No.	Test	Result	Compliance
1	Avg. Weight (mg)	245	Complies as per IP
2	Thickness (mm)	3.2	Complies as per IP
3	Hardness (kg/mm)	4.2	Complies as per IP
4	Friability (%)	0.86	Complies as per IP
5	Disintegration time (min)	20-22	Complies as per IP

3.3. *In vitro* dissoultion study

The *in vitro* dissolution study was conducted using USP apparatus II (paddle method) in 900 mL of distilled water maintained at 37°C ± 0.5°C. Sampling was performed at predetermined time intervals over a 120-minute period. The *in vitro* dissolution study was conducted using USP apparatus II Drug release was quantified by measuring the concentration of the API in the dissolution medium using UV-Vis spectroscopy.

Table 7 *In vitro* dissoultion study

Time Interval	Absorbance
30 min	0.004
60 min	0.035
90 min	0.046

4. Conclusion

The literature survey reveals that the ethanolic extract of leaves of *Calotropis gigantea* Linn shows anti-inflamatory activity. There is enough scope for the development of an effective formulation from the leaf extract of *Calotropis gigantea* Linn for the anti-inflamatory activity.

Moreover this study aslo focused on the development and evaluation of formulation of herbal tablet. The major finding includes that the formulation of tablet met the desired specifications.

Despite the promising outcomes this study has several limitations that the study was conducted in controlled laboratory conditions,which may not fully replicate real-world scenarios also variations in the active ingredients of herbal components due to environmental factors.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflict of interest regarding the publication of this paper on herbal medicine. No financial support or benefits from any commercial sources have been received, and there are no personal or professional relationships that could have influenced the research outcomes.

References

[1] Kumar PS, Suresh E, Kalavathy S. Review on a potential herb *Calotropis gigantea* (L.) R. Br. Scholars Academic Journal of Pharmacy. 2013 Oct 2;2(2):135-43.

[2] Negi D, Bisht AS. A review on brief study of *Calotropis gigantea* Linn. Journal of Drug Delivery and Therapeutics. 2021 Sep 20;11(5):224-8.

[3] Athijayamani A, Sekar S, Sidhardhan S, Ramanathan K. Mechanical properties of randomly oriented *Calotropis gigantea* fiber-reinforced phenol formaldehyde biocomposites. Journal of Advances in Chemistry. 2017;13(11):6043-50.

[4] Kori P, Alawa P. Antimicrobial activity and phytochemical analysis of *Calotropis gigantea* root, latex extracts. IOSR J. Pharm. 2014;4(6):7-11.

[5] Amutha A, Jeyalalitha T, Kohila M. *Calotropis gigantea* a review paper. Int J Recent Sci Res. 2018;9(10):29386-90.

[6] Kumar D, Kumar S. *Calotropis gigantea* (L.) Dryand-A review update. Indian Journal of Research in Pharmacy and Biotechnology. 2015, 2320 – 3471.

[7] Srivastava MP, Awasthi K, Kumari P. Antimicrobial Activity of *Calotropis gigantea* against Staphylococcus aureus: Eco-Friendly Management. INTERNATIONAL JOURNAL OF PLANT AND ENVIRONMENT. 2020 ,94-8.

[8] Rajashekara S, Shrivastava A, Sumhitha S, Kumari S. Biomedical Applications of Biogenic Zinc Oxide Nanoparticles Manufactured from Leaf Extracts of *Calotropis gigantea* (L.) Dryand. BioNanoScience. 2020 ,654-71

[9] Deshpande S, Deshpande K, Tomar E. *Calotropis gigantea*: a phytochemical potential.(2018),402-409.

[10] Bairagi SM, Ghule P, Gilhotra R. Pharmacology of Natural Products: An recent approach on *Calotropis gigantea* and Calotropis procera. 2018 ,37-44.

[11] Mushir A, Jahan N, Ahmed A. A review on phytochemical and biological properties of *Calotropis gigantea* (Linn.) R. Br. Discovery Phytomedicine. 2016,15.

[12] Singh N, Gupta P, Patel AV, Pathak AK. *Calotropis gigantea*: A Review on its phytochemical & pharmacological profile. Int. J. of Pharmacognosy. 2014,1-8.

[13] VA J, Usman MR, Salunkhe PS, Gagrani MB. Anti-inflammatory Activity of *Calotropis gigantea* Linn. Leaves Extract on In-vitro Models. IJCP Review and Research. 2010; 1-5

[14] Nalwaya N, Pokharna G, Deb L, Jain NK. Wound healing activity of latex of *Calotropis gigantea*. International journal of pharmacy and pharmaceutical sciences. 2009 ,176-81.

[15] Alam MA, Habib MR, Farjana N, Khalequzzaman M, Karim MR. Insecticidal activity of root bark of *Calotropis gigantea* L. against Tribolium castaneum (Herbst). World Journal of Zoology. 2009,90-5.

[16] Pathak AK, Argal A. Analgesic activity of *Calotropis gigantea* flower. Fitoterapia. 2007 40-2.

[17] Mullika T. Chomnawang, Puvapan Paojinda1, Noparatana Narknopmanee, Lek Rungreang yingyod. Evaluation of microbiological quality of herbal products in Thailand, Thai Journal of Phytopharmacy Dec. 2003,10(2), 37-48.

[18] Xue J, Liu D, Chen S, Liao Y, Zou Z. Overview on external contamination sources in traditional Chinese medicines. World Science and Technology. 2008 Feb 1;10(1):91-6.

[19] Chaudhary PH, Khadabadi SS. Bombax ceiba Linn.: Pharmacognosy, Ethnobotany and Phyto-pharmacology. Pharmacognosy Communications 2012; 2 (3): 2-9.

[20] Chitme HR, Chandra R, Kaushik S. Studies on anti-diarrhoeal activity of *Calotropis gigantea* R. Br. in experimental animals. J Pharm Pharm Sci. 2004 Feb 25;7(1):70-5.

[21] Usman MRM, Usman MAM and Patil Sa. "Isolation of priliminary phytoconstituents and anti-inflammatory and anti-pyretic activity of *Calotropis gigantea* Linn. Leaves extract." Int pharm sci Res 4 (2012):1208-1214

[22] Indian Drug Manufacturers' Association. Indian herbal pharmacopoeia. Revised New Edition, Indian Drug Manufacturers Association, Mumbai. 2002:376-83.

[23] Chaudhary and Tawar. Pharmacognostic and Phytopharmacological Overview on Bombax ceiba. Systematic Reviews in Pharmacy 2019; 10 (1): 20-25.

[24] Chaudhary PH. et al. Pharmacognostical and phytochemical studies on roots of Bombax ceiba Linn. Journal of Pharmacy & Pharmacognosy Research 2014; 2 (6): 172-182.

[25] Lachman L, Lieberman HA, Kanig JL. The theory and practice of industrial pharmacy. Philadelphia: Lea & Febiger; 1976.

[26] Loyd V, Allen Jr, Nicholas G. Popovich, Howard C. Ansel. Pharmaceutical Doasge Forms and Drug Delivery System, 8th edition. Lipincott, Williams and Wilkin Publication 1997.

[27] Michael E. Aulton, Diana M. Collet. Pharmaceutical Practice. Churchill Livingston 2000

[28] James Swarbick, James C. Boylan. Encyclopedia of Pharmaceutical Technology VOl.14. Spinger-Link 1998.

[29] Koch WF, Ma B. The US Pharmacopeia: interfacing chemical metrology with pharmaceutical and compendial science. Accreditation and quality assurance. 2011 Jan;16:43-51.