Available online on 15.6.2025 at http://ajprd.com

Asian Journal of Pharmaceutical Research and Development

Open Access to Pharmaceutical and Medical Research

Open Access

Research Article

To Formulate and Evaluate the Herbal Gel Using Woodapple Pulp Extract

Vinit Isankar*[1], Kavita Pandey[2], Vanshita Bobde[3], Jagdish Baheti[4]

Department of Pharmaceutical Chemistry, Kamla Nehru College of Pharmacy, Rashtrasant Tukadoji Maharaj, Nagpur University, Nagpur 441108, Maharashtra, India.

A B S T R A C T

The creation of herbal formulations, especially in cosmetics and pharmaceuticals, has been spurred by the growing desire for natural medicinal treatments. The goal of this study is to develop a new herbal gel with pulp from wood apple (Limonia acidissima) as the main component. Well-known for its therapeutic qualities, woodapple is a good choice for skincare because it is high in antioxidants, phenolics, vitamins, and minerals. The goal of the study was to create a stable, potent gel and evaluate its phytochemical and physicochemical properties as well as its benefits for the skin.Carbopol 940 and additional ingredients were added to a gel foundation to guarantee stability and skin compatibility after the pulp from fresh wood apple fruits was extracted. The gel's pH, viscosity, homogeneity, stability, spreadability, and microbiological safety were assessed. Bioactive substances, including flavonoids, tannins, and saponins that contribute to anti-inflammatory and antioxidant properties, were validated by phytochemical analysis.During stability testing, the gel showed no phase separation or microbiological contamination, good viscosity, and appropriate pH (5.5–6.5). All formulations exhibited antibacterial action against S. aureus and E. coli, but the F1 formulation was noticeably more effective, particularly against S. aureus. The medicinal potential of woodapple in herbal skincare treatments is highlighted in this study.

KEYWORDS: Woodapple (Limonia Acidissima), Herbal Gel, Natural Therapeutic Product, Skincare, Antioxidant.

A R T I C L E I N F O: Received 05 Jan. 2025; Review Complete 13 March. 2025; Accepted 22 April 2025. ; Available online15 June. 2025

Cite this article as:

Isankar V, Pandey K, Bobde V, Baheti J, To Formulate and Evaluate the Herbal Gel Using Woodapple Pulp Extract, Asian Journal of Pharmaceutical Research and Development. 2025; 13(3):32-39, DOI: http://dx.doi.org/10.22270/ajprd.v13i3.1571

*Address for Correspondence:

Vinit Isankar, Department ofPharmaceutical Chemistry, Kamla Nehru College of Pharmacy, Rashtrasant Tukadoji Maharaj, Nagpur University, Nagpur 441108, Maharashtra, India.

INTRODUCTION

Drugs have been successfully administered to the human body by a variety of ways, including as the mouth, sublingual, rectal, intravenous, cutaneous, inward breath, and so on.

The skin, the biggest organ in the human body, is the body's first line of defense against aging and diseases brought on by bacteria, fungi, dust, UV rays, and other environmental factors. Skin can provide insight into internal health and aging, according to reports. Because flavonoids have anti-microbial, anti-inflammatory, and antioxidant properties, they are utilized in topical polyherbal formulations to treat acne, skin tans, and other skin issues. [1]

Cosmetics

The Drugs and Cosmetics Act defines cosmetics as items that are meant to be rubbed, poured, sprinkled, or sprayed on, introduced into, or applied in any other way to the human body or any portion of it in order to cleanse, beautify, promote attractiveness, or change appearance. The cosmetic is not covered by the drug license preview. Cosmeceuticals are pharmaceutical-cosmetic blends that use particular substances to alter the biological texture and function of the skin in order to enhance beauty and health. The term "cosmeceuticals" was first used in 1961 by Raymond Reed, a founding member of the US Society of Cosmetics Chemists.[2]

Herbal Cosmetics

Plant-based substances with cosmetic qualities are used to make these cosmetics. The usage of botanicals in cosmetics has increased recently due to their non-toxic nature and gentle impact. Cosmetics contain both natural and phyto-ingredients. Phyto-ingredients are pure compounds obtained through various procedures.[3]

Benefits of Herbal Cosmetics

Herbs are useful for boosting health and preventing disease because of the following advantages, which are listed below. Herbal cosmetics are natural and free of all harmful synthetic ingredients that could otherwise be lethal to the skin. All skin types and skin tones, including fair and dark complexion, can use herbal cosmetics, such as lipstick, eye shadow, and foundation. It is possible for synthetic cosmetics to cause skin irritation and breakouts. They could create dry or oily skin by clogging the pores. When using natural cosmetics, these are not issues to be worried about. Since the natural ingredients promise no adverse effects, they can be used anywhere and at any time.[3]

HERBAL GEL

A gel is a system consisting of at least two solid or semisolid components, consisting of a condensed mass encircled and penetrated by a liquid. One of the characteristics that sets gel and jelly apart is the epidermal structure that gives them their solid-like properties. Gels and jellies, which are composed of a small number of solid particles dispersed throughout a large volume of liquid, have more of a solid than a liquid quality. Gel forms can be used for the most effective cutaneous and percutaneous drug administration. They can avoid the first pass effect, which is the first time a drug passes through the human body and are not broken down by liver enzymes because the liver is circumvented. For a long, slow absorption, they are applied to the skin.

Despite having a number of vitamins, minerals, and bioactive compounds, the Feronia limonia (L.) swingle is a tropical fruit that is underestimated and has gotten far less attention. All stages of the fruit—unripe, intermediate, and ripe—can be eaten, but it is only used in a very small number of culinary preparations. [4,5]

PLANT PROFILE
WOOD APPLE PLANT

Acidissima Limonia The tropical fruit Groff, sometimes referred to as the "Wood apple," is a member of the underused Rutaceae family. It is mostly grown in Southeast Asian nations, Penang Island, Sri Lanka, and semi-arid and dry areas of India. It can be found in the Western Himalaya, West Bengal, Chhattisgarh, Maharashtra, Madhya Pradesh, and Uttar Pradesh in India. Elephant apple, curd apple, monkey fruit, kothbel, koyito, pushpahala, and kaitha are some of its common names.[6]The wood apple is a deciduous tree that grows slowly. Its spherical fruit, which ranges in diameter from 5 to 12.5 cm, has a sour pulp and a hard, woody outer shell. In India, wood apples are a seasonal fruit that ripens in October and is accessible until January. In addition to a wide range of vitamins and minerals, the wood apple fruit is high in tannins, glycosides, flavonoids, saponins, ascorbic acid, riboflavin, vitamin B, and β-carotene.Amino acids, polyphenols, saponins, coumarins (such as osthenol, psoralen, demethylsuberosin, bergapten, and isopimpinellin), tri-terpenoids, phytosterols, and tyramine derivatives are among the nutritional and phytochemical components that are frequently missing from many other fruits. Taking all of this into account, it was discovered that wood apple fruits had a strong ability to scavenge free radicals, potentially serving as an antioxidant. It is known that both ripe and unripe fruits have advantageous medicinal properties. Liver diseases have been shown to be treated by the mature fruit.[7]

Scurvy can be prevented and treated with wood-apple, which also helps with flatulence. The raw wood apple fruit's mashed pulp (seedless) can help with diarrhea, dysentery, and piles. In addition to its many biological actions, such as adaptogenic activity against blood impurities, jaundice, dyspepsia, and leucorrhea, L. acidissima is thought to have hepatoprotective properties. All of the wood apple's plant parts have historically been used as natural remedies for a variety of illnesses. In the event of a snakebite, it is commonly utilized. It is also used to treat diarrhea and dysentery and as a liver and heart tonic. Deadly bug bites and stings are treated with the fruit pulp. This fruit is thought to be a good treatment for hiccups as well as mouth and throat issues.[6]

Because of its therapeutic qualities, wood apples have been employed in traditional Indian medicine. Phytochemical substances found in wood apple seeds help cure a variety of illnesses, including persistent skin infections.[6,7]

Figure 1: Wood Apple Fruit

Table 1: Taxonomical classification of Wood apple plant[8]

FAMILY	Rutaceae
KINGDOM	Plantae
SUB-KINGDOM	Tracheobionta
SUPERDIVISION	Spermatophyta
DIVISION	Magnoliophyte
CLASS	Magnoliospida
SUBCLASS	Rosidae
ORDER	Sapindales
FAMILY	Rutaceae
GENUS	Limonia L.
SPECIES	L. acidissima

Nutritional Composition and Phytochemicals

Many active ingredients, including phenols, flavonoids, saponins, terpenoids, tannins, fat steroids, gum mucilage, fixed oils, alkaloids, and glycosides, have been identified in wood apple extracts as the cause of the fruit's numerous therapeutic properties. Since ancient times, various components of the Limonia acidissima plant, including its leaves, roots, bark, and fruits, have been used to cure a range of illnesses, including diarrhea and dysentery. Fruits are regarded as protective foods since they include proteins, carbs, vitamins, and minerals. About 70% of the total weight of ripe fruit pulp is made up of embedded seeds. Fruit pulp is a good source of calcium (0.17%) and riboflavin (77 mg/100 g). It also contains roughly 1.9% mineral matter, 70% moisture, 2.3% acidity, 7.3% protein, 0.6% fat, 0.07% iron, 7.2% carbohydrates, and 0.08% phosphorus. Saponins, polyphenols, tannins, amino acids, coumarins, phytosterols, vitamins, amino acids, terpenoids, and other phytochemicals are also present in the fruits. Fruit contains between 3 and 8% pectin.[9]

Pulp

The pulp is sticky, dark, mealy, aromatic, resinous, astringent, sour, or sweet, and contains a large number of tiny white seeds. Fixed oils, fats (4.3%), resins, carbohydrates (70.14%), proteins (13.8%), dietary fiber (1.7%), amino acids, anthocyanins, tannins, alkaloids, steroids, cyanogenetic glycoside, cardiac glycoside, citric acid, fruit acids, minerals, thymol, dodecanoic acid, α-pinene, carvacrol, camphoric acid, and caryophyllene oxide, flavonoids, gum, mucilage, carbohydrates, saponins, steroids, and glycosides.[10]

MATERIALS AND METHODS

Collection of Plant Material

The wood apples were from the Butibori local market in Nagpur, Maharashtra, India.

Sr. no.	Ingredients	Properties
1	Wood Apple Pulp Extract	Antioxidant, Anti-bacterial, Anti-inflammatory, Rich in Vitamins and Minerals.

Formulation of Herbal Gel

Collection of Plant

The wood apple fruit was gathered from Butibori, Nagpur, Maharashtra, India's local market.

Preparation of Extract [Maceration as an extraction technique]

Wood apple pulp, the sample material, was dried for five to ten days. To improve its surface area for extraction, the pulp was crushed after it had dried. The solvent chosen for the procedure was methanol. After dissolving the dried pulp in methanol, it was allowed to extract for ten to fifteen days. Following the extraction time, the wood apple extract was gathered after the solvent was filtered through Whatman filter paper.[11]

Figure2: Drying of Sample

Figure 3: Powdered Sample

Figure 4: Solvent Extraction

Figure 5: Extraction

EVALUATION OF EXTRACT

ANTIOXIDANT TEST

DPPH Assay (2,2-diphenyl-1-picrylhydrazyl)

The DPPH test was used to measure the radical scavenging activity of various substances. At 517 nm, the drop in DPPH solution absorption following the addition of an antioxidant was observed. The reference was 10 mg/ml DMSO of ascorbic acid.

Principle

When scavenged, 1,1-Diphenyl-2-picrylhydrazyl, a red free radical that is stable when in powder form, turns yellow. This characteristic is used in the DPPH experiment to demonstrate free radical scavenging activity. The following represents the scavenging reaction between DPPH and an antioxidant (H-A):

(DPPH) + (H-A) → DPPH-H + (A)

When antioxidants react with DPPH, they convert it to DPPH-H, which lowers absorbance. In terms of hydrogen-donating capacity, the degree of discolouration reveals the antioxidant compounds' or extracts' scavenging activity.

Reagent preparation

10 mg of DPPH was dissolved in 50 mL of methanol to create a 0.5 mM DPPH solution.

Working procedure

2.96 ml of DPPH (0.5 mM) solution was added to samples in varying quantities (2–20 µl) that had been prepared up to 40 µl with DMSO. For 20 minutes, the reaction mixture was allowed to sit at room temperature in the dark. The mixture's absorbance was measured at 517 nm after 20 minutes. DPPH (3 ml) was used as a control. The following formula was used to determine the plant extracts' percentage of radical scavenging activity:

% RSA = (Abs control - Abs sample) / Abs control × 100

In this case, RSA stands for Radical Scavenging Activity, Abs control for DPPH radical + ethanol, and Abs sample for DPPH radical + plant extract absorbance.

DPPH SCAVENGING ACTIVITY

Calculation of % Radical Scavenging activity		
Absorbance Measurement Data		
Concentration of test (µg/ml)	**Absorption of test**	**%RSA**
10	0.569	79.69%
20	1.886	32.69%
30	2.22	20.77%
40	2.55	8.99%
Concentration of standard (µg/ml)	**Absorption of standard**	**%RSA**
10	1.229	56.13%
Absorption control (methanol + DPPH) is 2.802 Abs		

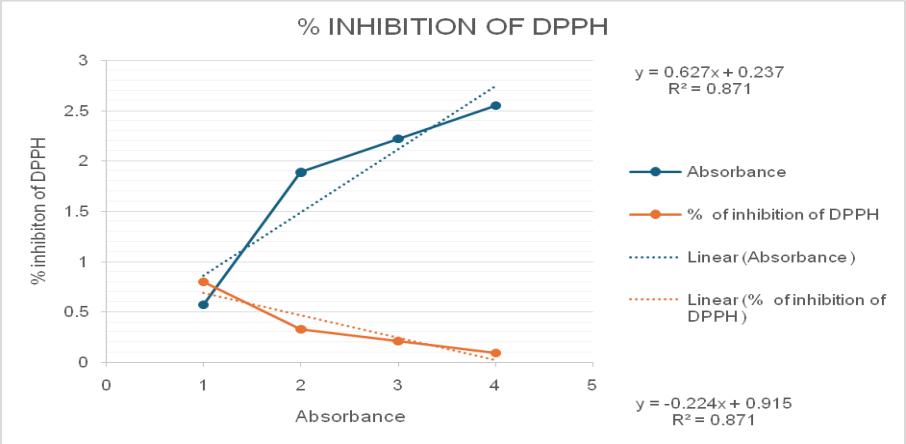

Figure 6: Dpph inhibition activity

FTIR (Fourier transform infrared analysis) of Wood apple extract.

For FTIR analysis, the Wood apple extract was used. Fourier Transform Infrared Spectroscopy (FTIR) can be used to identify these components' vibrations, which TOSHVIN-RG can verify. One method for identifying polymeric, organic, and inorganic compounds is FTIR analysis. The sample will absorb infrared light between 500 cm-1 and 4500 cm-1. The formulation's spectra were recorded at a wavelength of 517 nm.

Figure 7: FTIR

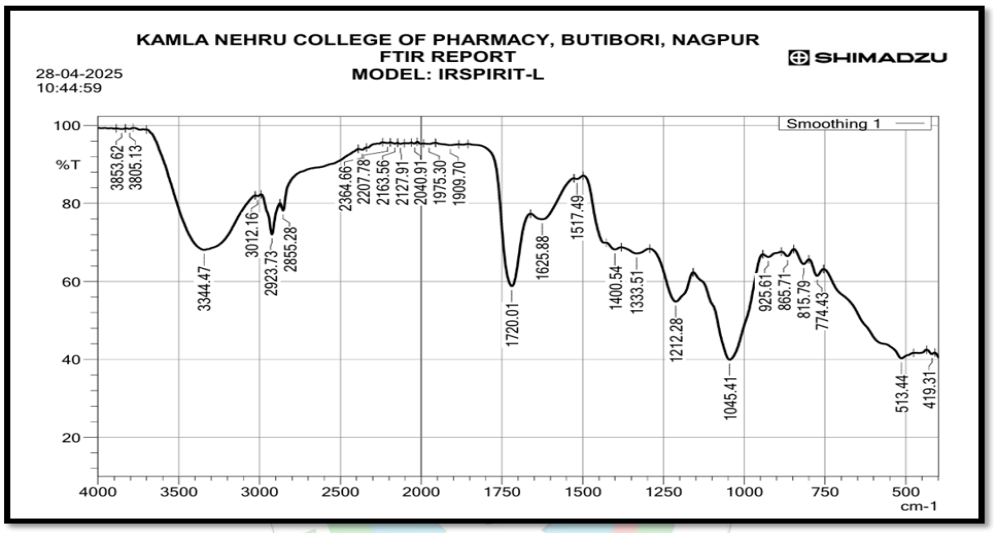

Figure 8: FTIR of Wood Apple Extract

Interpretation of FTIR analysis-

Sr. No.	Frequency (cm^{-1})	Bond and Type of Vibration*	Functional Groups
1..	513.44	C–Br (m), C–Cl stretch (m)	Alkyl halides
2.	774.43	C–H (s), C=C–H bend alkenes (s)	Aromatic, Alkenes
3.	816.706	C–H (s), C=C–H bend alkenes (s)	Aromatic, Alkenes
4.	865.882	C–H (s), C=C–H bend alkenes (s)	Aromatic, Alkenes
5.	925.61	O–H bend	Carboxylic acid
6.	1045.94	C–N stretch	Aliphatic amines
7.	1212.28	C–N stretch	Aliphatic amines
8.	1400.54	C–C stretch (in-ring)	Aromatic
9.	1517.49	N–O stretch	Nitro compounds
10.	1625.88	C=O stretch (m)	Amino acids
11.	1720.00	C=O stretch	α, β-unsaturated esters
12.	2040.91	C≡C stretch	Alkynes
13.	2923.73	C–H stretch	Amines
14..	3344.47	O–H stretch, H-bonded (s,b)	Alcohols and Phenols

* **Bond strength key:**

- **m** = medium
- **s** = strong
- **b** = broad

FORMULATION OF HERBAL GEL

The required quantity of gelling agent (Carbopol 940-1) was weighed and combined with a small amount of wood apple extract to create a homogenous dispersion. Triethanolamine and preservatives were weighed and added to the solution appropriately. Subsequently, the previous solution was continually agitated while the necessary volume of water was added.[11,12]

Table 2: Formulation of Herbal Gel

Sr.no.	Ingredients	Property	Quantity [F1]	Quantity[F2]	Quantity[F3]
1	Wood Apple Extract	Antioxidant	2 ml	4 ml	6 ml
2	Carbopol [940]	Thickening Agent	1 g	1 g	1 g
3	Methyl Paraben	Preservative	0.1g	0.1g	0.1g
4	Propyl Paraben	Preservative	0.2g	0.2g	0.2g
5	Triethanolamine	Humectant	2-3 Drops	2-3 Drops	2-3 Drops
6	Distilled Water	--	Q. S	Q. S	Q. S

Figure 9: Formulated Gel [F1, F2, F3]

EVALUTION OF HERBAL GEL

ORGANOLEPTIC EVALUATION

The gel's colour and scent were used to evaluate its organoleptic properties.[12]

pH [MFRS TOSHINIWAL INST.MFG.PVT.LTD.AJMER]

Deionized water was used to rinse the electrode tip. A click was heard after pressing the dispenser button on top of the electrode. After dipping the electrode into the gel, the readings were tracked until they stabilized. The outcomes were noted when the readings had stabilized. After use, the electrode was finally rinsed once more.[13]

Spread ability

The time in seconds it took for two slides to separate from the formulations positioned between the slides under a specific weight was used to express the spreadability. The better the spreadability, the less time it takes to separate the two slides. Two sets of standard-sized glass slides were taken. The formulation was then put onto a slide that had been appropriately sized.[12,13]

Spreadability = M x L/ T
Where,
M = standard weight, which is tied to or placed over the upper slide
L = length of a glass slide
T = time taken in seconds.

Viscosity [Brookfield Viscometer]

The pre-assembled gel's consistency was assessed using a Brookfield viscometer. Spindle number 7 was used to rotate the gel at rpm 10, and the matching dial reading was noted.[13]

Washability

A small amount of the prepared gel was applied to the hand, and it was subsequently washed with tap water to conduct a washability test.[11]

Irritancy

On the left-hand dorsal surface, the area (1 cm2) was marked. After applying the gel to that location, the time was recorded. After that, it is examined for irritability, erythema, and edema every 24 hours and reported.[11,12]

Anti-Microbial Activity

Using a sterile swab, evenly distribute the test microorganism suspension onto the agar surface after preparing the agar medium (Mueller-Hinton agar) and pouring it into sterile petri dishes to harden. Afterwards, using a sterile cork borer, make three to four wells in the agar, add predetermined amounts of antimicrobial agents to each well, and include a control well with a solvent. After the plates were incubated for 24 to 48 hours at 37°C, the diameter of the zones of inhibition surrounding the wells was measured. The antimicrobial agents were then divided into the following categories based on the size of the zones:

There are three types of zones: sensitive (big), intermediate (moderate), and resistant (no or small).[11,13]

RESULTS AND DISCUSSION

Table 3: Comparative evaluation of the formulation

Sr.no.	Evaluation	F1	F2	F3
1	**Organoleptic evaluation**	**Colour –** Transparent **Smell** – Pungent and Polarizing	**Colour** – Transparent **Smell-** Pungent and Polarizing	**Colour** – Transparent **Smell-** Pungent and Polarizing
2	**PH**	4.02	5.87	5.89
3	**Viscosity**	42800 cP	38000 cP	60400 cP
4	**Spreadability**	62.5 gcm/sec	61 gcm/sec	65.5 gcm/sec
5	**Washability**	Washable	Washable	Washable
6	**Irritancy**	No irritancy	No irritancy	No irritancy
7	**Anti-microbial**	10µl -15 mm	10µl -17 mm	10µl – 20 mm

Figure 10: -pH

Figure 11: Viscosity

Figure 12: Spread ability

Figure 13: Anti-Microbial

CONCLUSION

In terms of stability, effectiveness, and physicochemical characteristics, the creation and assessment of wood apple extract gel showed encouraging outcomes. The gel was acceptable for topical administration due to its adequate pH, consistency, and spreadability. The wood apple extract's potential as a natural medicinal agent is confirmed by the active components' antibacterial, wound healing, and antioxidant qualities. To confirm its long-term safety and efficacy for commercial and therapeutic usage, more research, including preclinical trials, is advised.

REFERENCES

1. Sharma MU, Arjariya S, Chouksey R, Sharma N. A Review: Formulation and Evaluation of Pharmaceutical Gel. Journal of Pharmaceutical Negative Results ¦. 13.
2. Kaur L, Singh AP, Singh AP, Kaur T. A review on herbal cosmetics. International Journal of Pharmaceutics and Drug Analysis. 2021 Sep 30;196–201.
3. Kumar D, Rajora G, Parkash O, Antil M, Kumar V. Herbal cosmetics: An overview. International Journal of Advanced Scientific Research International Journal of Advanced Scientific Research www.allscientificjournal.com [Internet]. 2016;1:36–41. Available from: www.allscientificjournal.com
4. Formulation and Evaluation of A Novel Herbal Gel Of Stevia Extract [Internet]. 2009. Available from: www.SID.ir

5. Selim Ali S, Samad A, Sekhar Maji H, Kumar De P. Formulation and Development of Herbal Gel Utilizing Natural Fruit Extracts [Internet]. Int. J. Sci. R. Tech. 2025. Available from: www.ijsrtjournal.com
6. Srivastava R, Mishra N, Arshi, Tripathi S, Smriti, Fatima NT, et al. Influence of fruit stages on chemical compositions, phytochemicals, and antioxidant activity of wood apple (Feronia limonia (L.) Swingle). Heliyon. 2025 Feb 15;11(3).
7. Shah MS, Kamble SM, Shinde AR, Jagtap Dr. Novel Utilization And Phytopharmacological Review Of Multipotential Traditional Plant Limonia AcidissimA *Corresponding Author. Available from: www.wjpr.net
8. Fegade VC, Narkhede SB, Kumar R. A Review on Limonia Acidissima: An Underutilized Fruit. International Journal of Renewable Energy Exchange. 2023 Apr 11;11(4):195–201.
9. Srivastava R, Mishra N, Arshi, Tripathi S, Smriti, Fatima NT, et al. Influence of fruit stages on chemical compositions, phytochemicals, and antioxidant activity of wood apple (Feronia limonia (L.) Swingle). Heliyon. 2025 Feb 15;11(3).
10. Khatun S, Sen S. A Comprehensive Review on Ethnomedicinal Aspects, Phytochemical and Pharmacological Properties of Limonia acidissima Linn. Pharmacognosy Res [Internet]. 2024 Nov 1;16(4):688–97.
11. Vispute YM, Yadav P. Formulation And Evaluation Of Anti-Oxidant Herbal Gel.
12. Pawar DP, Shamkuwar Pb. Formulation And Evaluation Of Herbal Gel Containing Lantana Camara Leaves Extract.
13. Sharma MU, Arjariya S, Chouksey R, Sharma N. A Review: Formulation and Evaluation of Pharmaceutical Gel. Journal of Pharmaceutical Negative Results ¦. 13.