

Formulation and Evaluation of Beetroot Based Nail Polish

Vaibhavi M. Mali¹, Sarika J. Alhat²

1 Final Year B.Pharm Student, Dr. D. Y .Patil College of Pharmacy, Akurdi, Pune, Maharashtra, India.

2 Assistant Professor, Department of Pharmaceutical Chemistry, Dr .D. Y .Patil College of Pharmacy, Akurdi, Pune, Maharashtra, India.

ABSTRACT: Cosmetics are products that are used to enhance or alter the appearance of the face, body, or nails. They can include a wide range of products such as makeup, skincare products, hair care products, nail care products, fragrances, and more. Cosmetics are commonly used for personal grooming, self-expression, and to enhance one's physical appearance. Nail paints, also known as nail polish or nail lacquer, are a cosmetic product that is applied to the nails to enhance their appearance. Nail paints come in a wide variety of colors, finishes, and formulations, and are typically used to add color, shine, and style to the nails. The study aimed to develop an herbal nail paint formulation that could potentially reduce the damage to the nails caused by chemicals commonly found in synthetic nail paints. The formulation was prepared using natural color pigments, and various parameters, including drying time, appearance, smoothness, hardness, color, stability, and spreadability, were analyzed to assess the performance of the herbal nail paint. The formulation process involved simple mixing of natural color pigments with other herbal ingredients to create a nail paint that is free from synthetic chemicals. The natural color pigments were carefully selected to provide vibrant and long-lasting colors, while the herbal ingredients were chosen for their potential benefits in promoting nail health and reducing the risk of side effects. According to I.P., evaluation tests were found to be within normal limits. This was anticipated to enhance user compliance, increase safety when applying, and enhance attractiveness. We may draw the conclusion that the beetroot nail paint and other herbal nail paints might be one of the most revolutionary products that might fully transfigure the cosmeceutical and healthcare world.

KEY WORDS: Betalins, Beta vulgaris, Natural colour pigment, Nail polish, Nitrocellulose

INTRODUCTION

For multitudinous, well- fixed, glossy nails are a symbol of health and youth and are greatly asked ¹. The significance of nail beautification is deep- seated, constantly made up subconsciously at a youthful age, and while nail cosmetics have been traditionally reserved for women, the request for manly mani- cures is

hastily expanding². The human nails are not only defensive and ornamental part, but also considered as indispensable pathway for the medicinal delivery, especially in nail conditions like psoriasis or Onychomycosis³. Onychomycosis is likewise known as tinea unguium which is a chronic fungal infection affecting nail plate and nail bed^{4,5}. Different types of fungus like dermatophytes and Fusarium can produce onychomycosis. It's seen largely in Males than ladies and aged people are more affected^{6,7}. The challenges of the medicine delivery to the nail, with the lack of the accord of both the barrier parcels of the nail and formulations to achieve the enhanced ungula delivery confining the effectiveness of topical treatments for nail diseases. And also suffer from low patient compliance due to the lengthy treatment ages up to 4 - 8 months which are needed. still, being oral formulations generally not only contain large dosages of active constituents but also bear long treatment and creating the eventuality for systemic toxicity especially in the liver. therefore, developing further effective styles for nail medicine delivery is an important goal for the pharmaceutical industry⁸.

Nail unit anatomy

The nail unit is composed of the nail matrix, proximal and lateral nail folds, the hyponychium, and the nail bed:

- **Nail matrix** :The nail unit is composed of the nail matrix, proximal and side nail crowds, the hyponychium, and the nail bed Nail matrix The nail matrix is comprised of germinative epithelium from which the nail plate is derived. The maturity of the matrix underlies the proximal nail fold. The distal portion of the nail matrix is the white lunula visible through the proximal nail plate on some integers. It's presupposed that the white color of the lunula can be attributed to both deficient nail plate keratinization and loose connective towel in the bolstering dermis. The proximal nail matrix generates the rearward(superficial) nail plate, while the distal nail matrix generates the frontal(inferior) nail plate⁹.
- **Nail Plate**: The nail plate is the hard, visible part of the nail that extends from the nail root to the free edge. It is made up of layers of flattened, keratinized cells and appears pink due to the underlying blood vessels.
- **Nail Bed**: The nail bed is the soft tissue underneath the nail plate. It contains blood vessels and nerves that supply the nail plate with nutrients and sensation.

- Lunula: The lunula is the crescent-shaped area at the base of the nail plate. It appears white because the underlying matrix cells are not visible through the thickened nail plate.
- Eponychium: The eponychium is the narrow band of skin that covers the base of the nail plate. It acts as a protective barrier against infection and damage.
- Hyponychium: The hyponychium is the thickened skin under the free edge of the nail plate. It provides a seal to prevent dirt and bacteria from entering the nail bed^{10,11}.

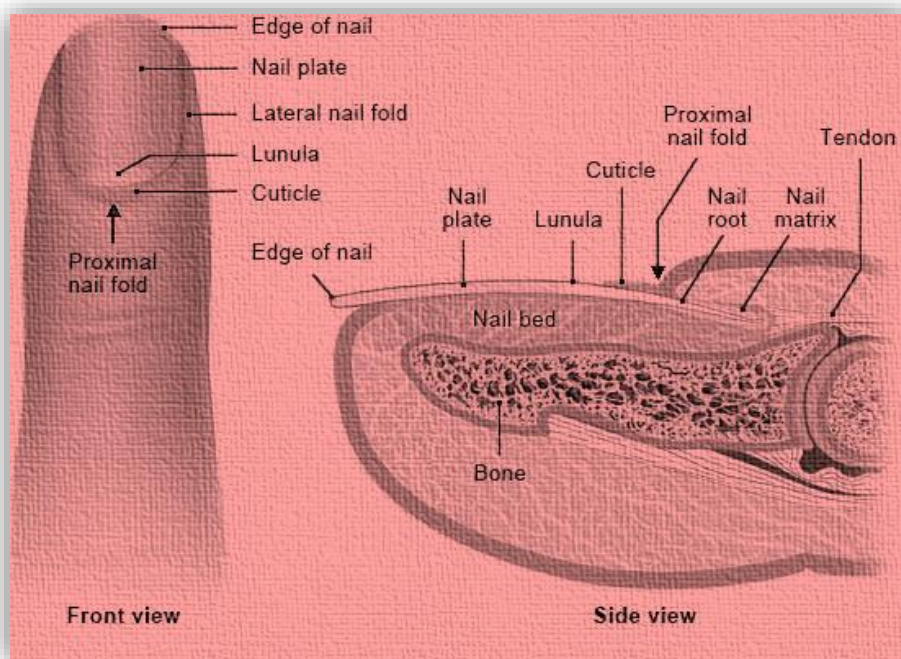


Figure 1. Schematic Representation of Anatomy of human nail

Herbal Nailpolish:

Herbal nail polish, also known as natural nail polish or organic nail polish, is a type of nail polish that is formulated with ingredients derived from natural sources, typically plant-based or botanical ingredients. These nail polishes are marketed as a safer and more environmentally friendly alternative to conventional nail polishes that may contain harsh chemicals and toxins.

Herbal nail polishes are typically free from harmful chemicals such as toluene, dibutyl phthalate (DBP), and camphor, which are commonly found in conventional nail polishes and can potentially cause health concerns. Instead, herbal nail polishes often contain plant-based ingredients such as fruits, vegetables, and herbs that are believed to be gentler on the nails and cuticles.

In addition to being free from harmful chemicals, herbal nail polishes may also offer other benefits such as being cruelty-free, vegan, and eco-friendly. Some herbal nail polishes may also contain nourishing ingredients like vitamins, minerals, and oils that are believed to promote healthier nails.

Beetroot Nailpolish

Beetroot nail polish is a type of nail polish that is made from beetroot extract or beetroot juice. It is a natural, vegan, and eco-friendly alternative to traditional nail polishes that are often made with synthetic chemicals and harmful ingredients. Beetroot nail polish is known for its vibrant and rich color, which can vary from deep red to pinkish-purple, depending on the concentration of beetroot used. Beetroot nail polish is generally considered safe and non-toxic, as it does not contain harmful chemicals such as toluene, dibutyl phthalate (DBP), and camphor, which are commonly found in conventional nail polishes. However, like any cosmetic product, some individuals may have sensitivities or allergies to beetroot or other ingredients used in the nail polish formula^{12,13,14}.

Plant Profile

Table 1. Beta vulgaris

Species	<i>Beta vulgaris</i>
Subspecies	<i>Beta vulgaris</i> subsp. <i>vulgaris</i>
Cultivar group	Conditiva Group
Origin	Sea beet (<i>Beta vulgaris</i> subsp. <i>maritima</i>)

Cultivar group members	Many ¹² .
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Table 2. Scientific classification

Scientific Classification		
Kingdom:		Plantae
Clade:		Tracheophytes
Clade:		Angiosperms
Clade:		Eudicots
Order:		Caryophyllales
Family:		Amaranthaceae
Genus:		<i>Beta</i>
Species:		<i>B. vulgaris</i>
Binomial name		
<i>Beta vulgaris</i> L. ¹⁵ .		

Synonyms

Bitā gacha :Bengali

Bit :Malayalam

Bitā:Marathi

Beet:Punjabi

Carkkarai vali kilanku ceti :Tamil

Dumpamokka :Telegu

Salada :Gujarati

Gajarugadde :Kannada^{13,15}.

Figure 2. Beetroot and beetroot powder



Benefits of beetroot traditionally

Various phytochemicals like flavonoids, phenolics, betacyanin, betanin, and betanidine in beetroot shows multitudinous health benefits.

The implicit benefits of beetroot are given below

- Beetroot may show antioxidant properties
- It may show anti-inflammatory properties
- It may show blood glucose- lowering activity
- It may show blood pressure- lowering activity
- It may show anticancer activity
- It may help avoid the development of cancer
- It may help with weight control
- It may show lipid- lowering activity¹⁶.

Extraction of Freeze-Dried Beetroot Powder

A. **Beet Root Collection** Beta vulgaris was used as a source of the natural colors viz. betalains in the present study. 600 g of beetroot was washed and skinned. It was also grated using a grater and kept in the microwave at 100 °C for 30- 40 min. The sample was also pulverized using a blender and stored in an tight vessel under chilled conditions(4 °C) for additional analysis. 250 g of dehydrated beetroot powder was mixed with 550 ml of water. It was mixed dynamically to get a homogenized solution. This was subjected to vacuum evaporation at Eighty degree celcius for three hours. The residue was collected and Freeze-dried.

B. Extraction

Water solvable betalain, and therefore it was extracted using water. 200 g of dehydrated beetroot powder was blended with 500 ml of water. It was stirred vigorously to get a homogenized solution. Vacuum evaporation at 80 degree celcius for three hours. The extract collected and freezed¹⁷.

Table 3. Formulation Table

Sr.n o.	Ingredient	Quant ity F1	Quant ity F2	Quant ity F3	Quant ity F4	Quant ity F5	Quant ity F6	Quant ity F7	Quant ity F8	Quant ity F9	Uses
1	Nitrocellulose	8.5gm	8gm	8.5gm	8gm	8.5gm	8gm	8.5gm	8gm	8.5gm	Film Former
2	Formaldehyde	2.5ml	2ml	2.5ml	2ml	2.5ml	2ml	2.5ml	2ml	2.5ml	Resin
3	Ethyl acetate	1.5ml	1ml	1.5ml	1ml	1.5ml	1ml	1.5ml	1ml	1.5ml	Solvent
4	Castor oil/Sweet Almond oil	1ml	1ml	1ml	1ml	1ml	1ml	1ml	1ml	1ml	Plastici zer
5	Beetroot extract powder	2gm	2gm	2gm	2gm	2gm	2gm	2gm	2gm	2gm	Colorin g agent

Formulation Procedure

1. Triturate the film former (nitro cellulose) to make powder of it.
2. Dissolved nitrocellulose (filmformer) and Formaldehyde (resin) in the ethyl acetate (solvent) mixture.
3. Disperse the colour of the castor oil with freeze dried beetroot extract.
4. Mix the above dispersion in the nitrocellulose solution with uniform stirring.
5. Transfer all content in to suitable container, label it and submit.

Filling the formulation

1. Glass bottles with a brush applicator are the most conventional container which is used for the packaging of nail lacquers.
2. The capacity varies from 8ml to 18ml.
3. The applicator consists of an air-tight aluminium canister with an acrylic fiber tip or Nib which applies polish directly to nail



Figure 3. Formulation of Beetroot Nailpolish By Vigorous Stirring



Figure 4. Prepared Optimal Beetroot Based Nailpolish Batches F1,F2 &F3

EVALUATION OF BEETROOT NAILPOLISH:

Visual Aspects: The samples were analyzed by visual inspection to observe changes in color, visual precipitate formation and nail-lacquer unevenness.

Nonvolatile content: 10 ml of sample was taken in a petri dish and initial weights were recorded. The dish was placed in the oven at 105°C for 1 hr, the petri dish was removed, cooled and weighed. The difference in weights was recorded. Average of triplicate readings was noted¹⁸.

The non-volatile content of all formulations has been reported in the Table No.6, given below

Table 4. Non-volatile content

Formulation code	Non-volatile content
F1	33±0.38
F2	33±0.38
F3	41±0.81
F4	39±0.40
F5	37±0.81
F6	35±0.71
F7	37±0.81
F8	31±0.40
F9	31±0.41

Determination of Drying Time: Apply material on the nail of the thumb with the help of a nail polish brush in a usual manner. Start stopwatch. Touch the film with the finger at a frequent time interval. When the film becomes dry on touch stop the watch and note the time. The time recorded is taken as drying time. The test shall be conducted away from direct air¹⁹.

Table 5. Drying time of nail lacquers

Formulation code	Drying time (sec)
F1	56
F2	50
F2	52
F4	127
F5	59
F6	58
F7	58
F8	56
F9	52

Viscosity : Viscosity was determined using Brookfield Viscometer, model LVF at room temperature using spindle no. 3 at 20 rpm.

- Viscosity

Table 6. Viscosity of nail lacquers

Formulation code	Non-volatile content (centipoise)
F1	142
F2	146
F3	152
F4	100
F5	122
F6	133
F7	184
F8	198
F9	111

The viscosity of the sample ranged from 100 to 220 centipoise and it was observed that between 140 to 160 centipoise the product was clear and glossy. More over this viscosity range provided good adherence and flow property. Viscosity outside this range produces clouding and decreases gloss which will not be cosmetically acceptable.

Smoothness to flow and Gloss: The nail lacquer poured onto the glass plate was found to spread and result in a uniform smooth film . The gloss of the applied lacquer was comparable with marketed cosmetic sample proving the cosmetic acceptance.

Test For Smoothness Of The Film: The smoothness is the most important characteristic of the film. The surface property can be studied by the microscopic analysis. The film should not contain any foreign matter or particles of the coating material. It should also be free from the orange peel effect when seen under microscope.

Blush Test: Pour the nail polish on the slide and allow it to spread into a uniform film. Drain the excess and dry plate over 24 hrs. at ambient conditions. Fill a beaker to half a fixed level with ordinary tap water. Dip the plate in water in the beaker such that half the coating is in water and the remaining portion is above the water. Let it stand for 4 hrs. Remove the plate and dry it with tissue paper. Allow it to further dry in ambient condition for 4 hrs. Check for blush. If the film tends to absorb water it will show a tendency to swell and come out easily. The material can be taken to have passed if it has no or slight whitishness. The film should not show any blistering or peeling off.

3. **Smoothness:** This is the character of film. The film is applied to a surface of the nail paint then after the drying rub the nail surface and check the smoothness of nail paint

Both these parameters was found to be satisfactory as can be observed from Fig. The nail lacquer poured onto the glass plate was found to spread and result in a uniform smooth film . The gloss of the applied lacquer was comparable with marketed cosmetic sample proving the cosmetic acceptance²⁰.



Figure 5. Smoothness to flow and gloss



Figure 6. Sample beetroot nailpolish and Marketed nailpolish

The smoothness is the most important characteristic of the film. The surface property as studied by the simple microscopic analysis. The film should does not contain any foreign matter or particles of the coating material. It is also free from the orange peel effect when all samples were seen under simple microscope.

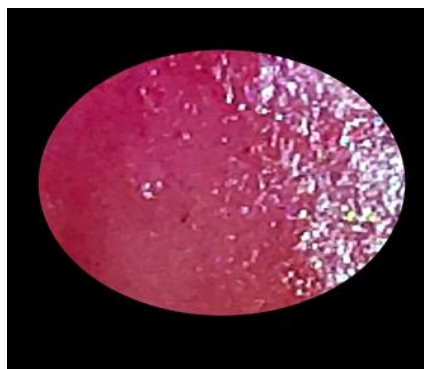


Figure 7. Smoothness of Film under simple microscope

4. **Hardness:** This is the measure of the hardness of the film. Nail paint apply on surface then check the hardness of the nail paint by applying the pressure by hand and determine the hardness of nail paint.

5. **Color:** Color comparing with master colour standards by applying on thumbnails, holding them side by side, moving the thumb with the standard first on the right and then on left.

Color of beetroot nailpolish was compared with master colour standards by applying on thumbnails, holding them side by side, moving the thumb with the standard first on the right and then on left.



Figure 8. Color comparison of nailpolish with standard

RESULTS AND DISCUSSION

Table 7. Physicochemical parameter of Beetroot nailpolish

Parameter s	F1	F2	F3	F4	F5	F6	F7	F8	F9
Colour	Orange red	Maroon red	Maroon red	Maroon red	Maroon red	Maroon red	Maroon red	Maroon red	Maroon red
Consisten cy	Good	Good	Good	Good	Average	Average	Average	Average	Average
Drying time (sec)	56	50	52	127	59	58	58	56	52
Smoothne ss to flow and Glosiness	Smooth ly flowabl e and glossy	Smooth ly flowabl e and glossy	Smooth ly flowabl e and glossy	Smooth ly flowabl e and glossy	Smoothl y flowable and glossy	Average ly flowable and glossy	Average ly flowable and glossy	Average ly flowable and glossy	Average ly flowable and glossy
Appearan	Maroon	Maroon	Maroon	Maroon	Maroon	Maroon	Maroon	Maroon	Maroon

ce	shiny liquid	shiny liquid	shiny liquid	shiny liquid	shiny liquid	shiny liquid	shiny liquid	shiny liquid	shiny liquid
Smoothness of film	Smooth film	Smooth film	Smooth film	Smooth film	Consists of some particulate matter but average smooth film	Consists of some particulate matter but average smooth film	Consists of some particulate matter but average smooth film	Consists of some particulate matter but average smooth film	Consists of some particulate matter but average smooth film

From the following evaluation parameters we can conclude the result that

- From the F1,F2 ,F3,F4,F5,F6,F7,F8,F9 batches of nailpolishes formulated F1,F2 & F3 has smooth consistency ,drying time is less than (F4-F9 batches).
- All the batches are consistently having glossy finish with maroon beetroot color appearance and Particulate matter in some batches due to less solubility of beetroot powder with other contents and smooth films in F1 ,f2 & F3 shows greater solubility of pigment than other batches.
- The viscosity of the sample ranged from 100 to 220 centipoise and it was observed that between 140 to 160 centipoise the product was clear and glossy. More over this viscosity range provided good adherence and flow property. Viscosity outside this range produces clouding and decreases gloss which will not be cosmetically acceptable.As viscosity of F1,F2 & F3 range are 142,146,152 centipose respectively hence the product was clear and glossy.

Hence,

“The formulation F1,F2 and F3 was selected as the optimized beetroot based nail lacquer formulation based on drying time,viscosity and non-volatile contents.”

Stability studies

Stability studies were used to determine the shelf life and storage condition of a product. In this investigation F1,F2 and F3 were subjected to accelerated stability studies for a period of 1 month. Accelerated stability studies were performed in accordance with ICH guidelines with necessary modifications.

The studies were carried out to verify the changes in physical characteristics such as Non -volatile content, Drying time at two different conditions of higher temperature ($40\pm 20^{\circ}\text{C}$) for 1 month. The results are reported in Table No.28,29,30.

Table 8. Stability studies data of F1

Parameter	Initial	After
Non-volatile content	33 ± 0.38	32 ± 0.35
Drying time	56	58

Table 9. Stability studies data of F2

Parameter	Initial	After
Non-volatile content	33 ± 0.38	32 ± 0.35
Drying time	50	48

Table 10. Stability studies data of F3

Parameter	Initial	After
Non-volatile content	41 ± 0.81	32 ± 0.35
Drying time	52	50

The evaluation of formulations after stability charging showed there was no significant change with respect Non -volatile content, Drying time with respect to results obtained before stability charging. Thus it was concluded that the formulations were found to possess stability compliance requirements as per ICH guidelines

However, beetroot-based nail polishes are known for their natural and non-toxic formulation, making them a safer alternative to traditional nail polishes that contain harmful chemicals. Beetroot-derived pigments provide a natural and vibrant color, and the use of natural ingredients like castor oil, almond oil make them more nourishing for the nails and cuticles. Overall, beetroot-based nail polishes have gained popularity in recent years due to their safer and more eco-friendly formulation.

SUMMARY

The objective of the present work was to formulate a natural beetroot based nail lacquer it can also help Conventional treatments for diseases topically can clinically not efficient, as formulations must permeate the nail barrier in order to deliver therapeutic levels of active agents to the target site. In the present study, nail lacquer containing a herbal agent containing freeze dried extract and nitrocellulose as film former ,Formaldehyde as resin ,Ethyl Acetate as solvent castor oil and almond oil Castor oil and almond oil are both commonly used as natural ingredients in various cosmetic and personal care products, including nail polish. All nailpolish batches F1 ,F2 & F3 in different batches concentration and were evaluated and comparison has been done among the same. The formulation F1,F2 and F3 was selected as the optimized beetroot based nail lacquer formulation based on drying time,viscosity and non-volatile contents.

Initially, research work started with a wide and through literature survey followed by

Study of natural dyes with its resources like

- Henna Leaf
- Beetroot
- Turmeric

- Saffron
- Pomegranate
- Indigo
- Red onion peel
- Marigold flower
- Eucalyptus tree

Finally Beetroot was taken as natural pigment among all because its stability study was better than other dyes studied & experimented.

Various studies on physicochemical parameters like film formation, optimization of salicylic acid concentration, non-volatile content, drying rate, gloss, viscosity, smoothness of flow, anti-microbial studies and stability studies were evaluated. All the above parameters were checked to find the compliance.

CONCLUSION

The nail polish can cause negative health effects. The several ingredients use in nail polish has been connected to cancer, heart problems, reproductive abnormalities, thyroid disorders and allergies. Visualize 768 million bottles of nail polish that are sell in a year. They can cause an even higher chance to connect to cancer in many other disease..Nail polish consists of a film-forming polymer dissolved in a volatile organic solventNail polish has a vast environment result on our environment. The U.S EPA considers nail polish to be house held dangers waste because of the toxic chemicals flock within that bottle of glint and shine. Take old nail polish bottles to your nearest facility and these able will put them to rest safely. It should be illegal to put in the refuse. Human costs on nail polish can be joining or connect to cancer and many other disease. They can also damage the environment if you cannot recycle it correctly. The people should recycle nail polish correctly; we can take our old bottle of nail polish to the nearest space and put them to rest protected. To make my plan successful the companies that make nail polish have to make it more safe for our environment to use nail polish, without fret the affects that can happen from using nail polish. The possessors of these companies that make nail polish are the only ones with control over their companies. This should take place in homes and companies since it's not safe for our bodies. The chemicals inside nail

polish are connected to cancer and can cause many other diseases. Many ingredients in nail polish is not good for your body or your environment. It need to be safer for your health and environment, completing this successful this action can better to situation since we will no longer have to worry about the toxics were allowing in our body which effects our health and environment.

From the following research evaluation parameters we can conclude the result that

From the F1,F2 & F3 nailpolishes formulated F1 has orange red color with average consistency ,drying time is more than F2 & F3 batches its spreadability is 1.5 cm so it has poor spradability because a shorter interval indicates better spreadability. Hence F2 and F3 show better spreadability due to its shorter interval.All the batches are consistently having glossy finish with maroon beetroot color appearance and Particulate matter in F1 and smooth films in F2 & F3 shows greater solubility of pigment than F1 batch.

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