

## Formulation and Evaluation of Herbal Based Nail Polish

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**Abstract:** Cosmetics have been in utilization for more than thousands years. Cosmetics are applied mostly to the skin, hair and nails. Nail polish is a lacquer that can be applied to the human fingernail to decorate and protect the nail plates. The formulation has been revised repeatedly to increase its decorative effects. Adverse events may occur with various nail cosmetics specifically prepared with synthetic colours. Synthetic cosmetic being harsh and prone to more side-effects, herbal cosmetic is quickly replacing it and gaining a lot of popularity. The objective of the study was to deliver an herbal nail paint to reduce the damage to the nails due to chemicals. The nail paint formulation is prepared by simple mixing by using natural colour pigments and analysed for drying time, appearance, smoothness, hardness, colour, stability, Spreadability. Formulations, prepared with 8% cellulose 2.5% formaldehyde, 1.5% castor oil, 1.5% colour. Evaluation tests were found to be in normal range according to I.P. This was expected to improve appearance, safety while applying and improve the user compliance. We can conclude that the herbal nail paint may be one of the novel products that can revolutionize the cosmeceutical and health care sector. Article contains anatomical structure of nail.

**Keywords:** Nail polish, Natural colour pigment, Bixa orientalis, curcuma longa.

### INTRODUCTION

Nails are the protective structures used for centuries as survival tools, have over the years become an accessory for beautification. The human nails not only have a protective and decorative role, but are also considered as an alternative pathway for drug delivery, especially in nail diseases like psoriasis or Onychomycosis [1]. These nail diseases are widely spread in the all over the population. Although the architecture and composition of the nail plate severely limits penetration of drugs and in addition to that only a fraction of topical drug penetrates across the nail, oral therapies are accompanied by the systemic side effects and the drug interactions. For the perfect treatment of the nail disease the applied active drug must permeate through the dense keratinized nail plate and reach in the deeper layers, the nail bed and the nail matrix [2]. The inadequate research and knowledge regarding the properties of keratinized nail plate, the nail bed and the nail matrix caused a less focus on the ungula system.

The Horny structure of the nail plate is responsible for the penetration of the drug across it. It is hard enough the penetration becomes difficult, only a fraction of topical drug penetrates across it. Hence the effective therapeutic concentration is not achieved. The

nail plate may appear abnormal as a result of decreased glow. It is due to the involvement of nail bed, reduction of blood supply, physical or chemical features of nail bed. As a result a variety of diseases occurs. These diseases can be cured by the achieving desired therapeutic concentration of the drug by nail drug delivery system [3].

The challenges of the drug delivery to the nail, with the lack of the understanding of both the barrier properties of the nail and formulations to achieve the enhanced ungula delivery restricting the efficiency of topical treatments for nail disorders. And also suffer from low patient compliance due to the long treatment periods up to 4-8 months which are required. However, existing oral formulations typically not only contain large doses of active ingredients but also require long treatment and creating the potential for systemic toxicity especially in the liver. Thus, developing more effective methods for nail drug delivery is an important objective for the pharmaceutical industry [4].

### Structure of the human nail-

The human nail consists of the following parts-

- 1) Nail matrix or the root of the nail
- 2) Nail plate

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- 3) Nail bed
- 4) Hyponychium
- 5) Eponychium or cuticle
- 6) Paronychium
- 7) Lunula

1. **Nail matrix or the root of the nail** -The nail matrix is the area where your finger nails and toenails start to grow. The matrix creates new skin cells, which pushes out the old, dead skin cells to make your nails, as the result, injuries to the nail bed or disorders that affect the matrix can affect your nail growth. The root of the fingernail is also known as germinal matrix. The edge of germinal matrix is seen as the white, crescent shaped (a thin, curved shape like half-moon) structure called the LUNULA. This portion of the nail is behind the fingernail and extends several millimetres into the finger. The root of fingernail produces the most of the volume of the nail and nail bed. This portion of the nail does not have any melanocytes, or melanin producing cells.
2. **Nail plate**-The part that we call the nail is technically known as the "nail plate". The nail plate is mostly made of a hard substance called as the keratin. It is about half millimetre thick and slightly curved. The nail is attached to the nail bed. The nail bed is skin with a layer of the epidermis and a layer of the dermis. The epidermis of the nail bed is attached to the nail plate via grooves called as matrix crests.
3. **Nail bed**-The nail bed is part of the nail matrix called as the sterile matrix. It is the pinkish - colored soft tissue underneath nail plate. It extends from the edge of the germinal matrix (lunula) to the hyponychium. It is a thin, soft, non-cornfield epithelium, connected with the ventral layer of the nail plate and underlying papillary dermis and contains the blood vessels, nerves, and melanocytes, or melanin-producing cells. As the nail is produced by the root, it streams down along with the nail bed, which adds material to the under surface of the nail making it thicker.
4. **Hyponychium**- the hyponychium is the skin just under the free edges of your nail. It is located just beyond the distal end of nail bed and near the fingertips, but sometimes the hyponychium can over grow and become thicker. As the barrier from germs and debris, the hyponychium stops external substances from getting under nail.
5. **Eponychium or cuticle**-The eponychium is the thickened layer of the skin at the base of the fingernails and toenails. It can also be called as the medial or proximal nail fold. The eponychium differs from the cuticle, the eponychium comprises live skin cells whereas the cuticle is dead skin cells.
6. **Paronychium**-The paronychium is the skin that overlies the nail plate on its sides. It is also called as the paronychial edge. The paronychium is the

site of hangnails, ingrown nails, and an infection of the skin called paronychia. Paronychia is an infection of the tissue adjacent to a nail, most often a fingernail.

7. **Lunula** -The lunula is the visible portion of the distal nail matrix that extends beyond the proximal nailfold. It is white, half-moon shaped (curve like structure), appears by week 14 of gestation, has unique histological features. The lunula has a primary structural role in defining the free edges of the distal nail plate [5, 6].

#### **Role of nail –**

1. A major role of healthy nail (nail plate) is giving protection from the injury to the nail part like distal phalanx, the finger tip, and the surrounding tissues of the nail.
2. The nail helps to increase delicate movements of the distal digits from the counter pressure which is exerted on the pulp of the finger or on the mass of the finger.
3. Without nails on the fingertips, it is impossible to clutch and hold the things accurately or correctly.
4. The nail acts as a counterforce when the end of the finger is come into contact with object and then it enhancing the sensitivity of the fingertip, even though there is no nerve endings in the nail itself.
5. Fingernails are used for scratching and grooming and are an efficient natural weapon.
6. The nails also increase to the aesthetic appearance of the hand and foot.

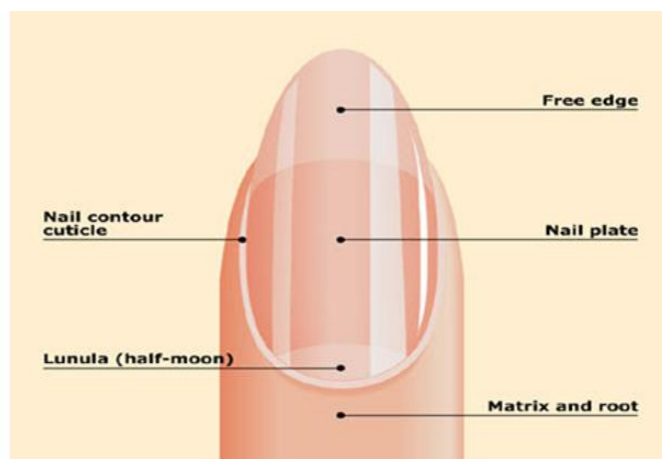
#### **Anatomy of the human nail-**

The chemical composition of human nail severely differs from other body membranes. The plate, composed of keratin molecules with many disulphide linkages and low lipid levels, it tends more like a hydrogel than lipophilic membrane.

Human finger nail macroscopic anatomy consists of three structures.

Initial from the outer structure, they are the:

1. **Nail plate**-The nail plate is a thin (0.25 - 0.6 mm for finger nails and up to 1.3mm for toe nails), hard, slightly elastic, semi-transparent, convex structure, and is made up of about 25 layers of dead keratinized, flattened cells. They are strongly bound to one another with many intercellular links. The nail plate has a rectangular shape and has a smooth shiny surface. It became pink when attached to the nail bed, as it allows visualization of nail bed blood vessels. The free edge is whitish in colour. The shape of the lunula regulates the shape of the distal margin of the nail plate. The nail plate physical properties are unique and crucial for its uses: it is hard and also difficult to break, but it is flexible, it opposes to the chemicals, and it is strictly adherent to the underlying tissues.



**Fig 1.1: Schematic representation anatomy of nail**

2. The nail bed-The nail bed dermis lies upon the distal phalangeal bone and separated from the periosteum by connective tissue with the subcutaneous generally fat will be absent. The nail bed dermis has a unique structure. It does not form papillae, but has dermal crests that run longitudinally, with the blood capillaries running parallel within. The nail bed is part of the nail matrix called as the sterile matrix. It is the pinkish - colored soft tissue underneath your nail plate (the hard part of nail).It extends from the edge of the germinal matrix (lunula) to the hyponychium. It is a thin, soft, non cornified epithelium, connected with the ventral layer of the nail plate and underlying papillary dermis and contains the blood vessels, nerves, and melanocytes, or melanin-producing cells.
3. The nail matrix- It help in production of nail plate. The nail matrix is the area where your finger nails and toenails start to grow. The matrix creates new skin cells, which pushes out the old, dead skin cells to make your nails,as the result, injuries to the nail bed or disorders that affect the matrix can affect your nail growth.The root of the fingernail is also known as germinal matrix. The edge of germinal matrix is seen as the white, crescent shaped (a thin, curved shape like half-moon) structure called the LUNULA. The matrix produces the nail plate continuously throughout life. It is well protected below the proximal nail fold and just above the bone of the distal phalanx, to which is connected by a tendon that reaches the distal interphalangeal joint. In frontal view the matrix shows a horseshoe shape, with a distal convexity and two lateral horns. In transverse view, the matrix has a v-shaped structure.

The finger nail has a three-layer structure (outer to inner) –

1. Dorsal layer(superficial) - is derived from the matrix.
2. Intermediate layer (middle) - it also derived from the matrix.

3. Ventral layer (deep)-is derived from the nail bed. With a thickness ratio of approximately 3:5:2, respectively.

The intermediate layer having the three - region of the whole nail thickness & consists of the soft keratin. The upper layer (dorsal) is only a few cell layer thick but consists of hard keratin, with the comparatively high sulphur content, mainly in form of the amino acids cysteine, which constitutes 94% by weight of nail. The dorsal layer of the nail mainly diffuses into and through the nail plate. The deepest (ventral) layer consists of soft hyponychial in which many pathological changes occur. Thus, in the treatment of these nail diseases, an effective drug concentration in the ventral nail plate would be of great significance.

Nail fold- The proximal nail fold is formed by a dorsal and a ventral part: the dorsal portion continues distally with the skin of the dorsal digit, which it vary from the absence of hair and sebaceous glands. The proximal third of the distal phalanx, the skin of the proximal nail fold consider as downward and proximally and forms the ventral part of the proximal nail fold, which is not visible from the outside and continuous with the nail matrix. The limit between both dorsal and ventral fold is marked by the cuticle, a thin band of horny layer that seals the skin of dorsal digit to the nail plate, avoiding penetration of both water and environmental particles under the nail fold and give the protection to the nail matrix. The lateral nail folds surround the nail plate and which is more or less below them.

Nail blood vessels-The blood capillaries of nail unit are oriented according to their location. The capillaries of the proximal nail fold run parallel to the skin surface, in longitudinal lines with longitudinal distal loops. In normal conditions, their number is around 30 / 5 mm. They can easily be seen with a dermatoscope at 20–40× magnifications. modification of number and shape of the proximal nail fold capillaries are typical of the connective diseases, where

they can be studied for diagnostic. The capillaries of the both nail matrix and the hyponychium having similar with skin capillaries. The capillaries of the nail bed present unique anatomy. When a capillary is damaged, the haemorrhage appears as a small black longitudinal line called as the splinter haemorrhage.

Cuticle and eponychium-Eponychium or cuticle is the Living skin covers approximately 20 percent of the nail plate. The eponychium is the thickened layer of the skin at the base of the fingernails and toenails. It can also be called as the medial or proximal nail fold. The eponychium differs from the cuticle; the eponychium comprises live skin cells whereas the cuticle is dead skin cells.

Hyponychium-Hyponychium is the most distal edge of the nail unit. It is in corresponding to the point where the nail plate is separated from the underlying tissues. Its structure is similar to the skin of the pulp, with a granular layer and a thick horny layer.

Lunula- The lunula is non-transparent, bluish white half-moon at the base of the nail plate. The lunula is the visible portion of the distal nail matrix that extends beyond the proximal nail fold.

Nail growth- The nail plate production and the growth is start in embryonic life around the 15th week up to death. The Mean growth rate of the fingernails is 3 mm/month and that of toenails is the 1 mm/month. The Complete overgrowth of a fingernail after fibular may it require 4–6 months and then up to 1 year for a toenail. Nail growth rate is maximum in beginning of adulthood and reduces with ageing [6, 9].

**The ideal nail polish application technique includes the following steps-**

1. Base coat-This is the first layer, meant to build up the nail plate. It is clear (transparent) solution with high resin content and major to stronger attachment of nail polish to the nail. It also help to restores moisture to the nail and helps in the fill up the ridges and can create a smooth surface.
2. Nail polish: Colouring nail polish applied as 2–3 coats.
3. Top coat-Again applied a transparent, clear coat that contains additional nitrocellulose than the 4 resin. This prevents the nail polish from chipping and fail. It added to get shine to the polish. This type of nail polish is a clear coloured polish formula that is used specifically after applying nail polish to the nail. Top coat help the underlying colored polish dry quickly as well.
4. Nail polish drier: Liquid that increase drying of the nail polish by the evaporation of the solvent. Generally it include the vegetable oils, alcohols, and the silicone derivatives [10, 11].

**Constituent of nail polish-**

- 1) Film forming agent-Nail polish is applied the solvent evaporates, leaving the polymer to form a film on the nail. Example- Nitrocellulose, dissolved in a solvent, usually ethyl acetate or butyl acetate.
- 2) Plasticizers- Nail polish stays flexible, it will be dries, making the nail polish last longer. Example- Dibutyl phthalate and camphor, trimethyl pentanyl di isobutyrate, triphenyl phosphate, ethyl tosylamide, glyceryl tribenzoate.
- 3) Adhesive polymer resins- To make sure that the nitrocellulose stick to the nail plate's surface. Example- 1. Tosylamide -formaldehyde resin.  
2. A polyester resin or cellulose acetate butyrate in hypoallergenic nail polishes.
- 4) Dyes and pigments -The dyes and pigment are imparted in colour. Example- Chromium oxide greens, chromium hydroxide, ferric ferrocyanide, stannic oxide, titanium dioxide, iron oxide, carmine, ultramarine and manganese violet.
- 5) Opalescent pigments-Opalescent pigment add glittery or shimmer look. Example – Mica bismuth ox chloride, natural pearls, and aluminium powder.
- 6) Thickening agents-The thickening agent used to maintain the sparkling particles in suspension while in the bottle. Example- Stearalkonium hectorite.
- 7) Ultraviolet stabilizers-Ultraviolet stabilizer is used to resist colour changes when the dry film is exposed to sunlight. Example- Benzophenone-1 [12, 13].

**Ideal characteristics of a nail polish:**

- 1) Nail polish have proper viscosity, flow and wetting properties.
- 2) It must have uniform colour.
- 3) It must have good adhesive and gloss properties [10].
- 4) Nail polish have sufficient flexibility.
- 5) Nail polish have sufficient hard surface which is resistant to impact and scratch.
- 6) Nail polish have reasonable drying time.
- 7) It should be convenient and easy to apply.
- 8) It should be stable on storage [15].
- 9) It should form a satisfactory film on nails.

**Advantage of nail polish-**

1. Prevent the nail from scratches.
2. Improve strength of nails.
3. It used to prevent growth of fungus and bacteria.
4. It used to beautify hands.
5. It is long lasting.
6. It is not damage to the nail.
7. It is easy to remove.
8. It is time saving.
9. It is no smudge.
10. Nail polish looks natural on your nails.

**Disadvantage of nail polish-**

1. Superficial nail discoloration,

2. pseudo- Leukonychia,
3. Allergic contact dermatitis (local and distal)
4. Microbial colonization,
5. Distorted pulse oximetry readings
6. Methacrylate sensitization and cross-reactivity,
7. Rhinitis/wheezing,
8. Nail brittleness
9. Thinning
10. Flammability
11. Mask nail bed

#### Disorders of nail-

1. Leukonychia
2. Koilonychias
3. Disorders due to systemic disease
4. Brittleness
5. Disorders due to fungal and bacterial origin-  
paronychia nail ring worm lesions due to syphilis
6. Disorders due to nutrient deficiency
7. Stippled nails [16].
8. Onychomycosis-

#### CLASSIFICATION OF ONYCHOMYCOSIS

- a) Distal Subungual Onychomycosis
- b) White Superficial Onychomycosis
- c) Proximal Subungual Onychomycosis
- d) Candidal Onychomycosis
- e) Total Dystrophic Onychomycosis

9. Green-nail syndrome
10. Paronychia-a) acuteparonychi
- b) Chronic paronychia
11. Parakeratosispustulosa
12. Nail Psoriasis.
13. Yellow nail syndrome1.

**Tips to keep the nail Healthy-**Cut your fingernails and toe nails accurately. It keeps your toe nails strong.

1. Clean and dry the nails correctly to avoid the bacteria and the dust particle residing under the nail.
2. Sometimes toe nails are thick and hard to cut, the toe nails are deep feet in warm salt water for 5 to 10 minutes, then apply urea or lactic acid cream on the toe nails, It softens the nail and make them easier to cut.
3. Tight shoes may cause ingrown of toe nails, so wear proper fitting shoes for avoiding the ingrown of toe nails. The medical term for ingrown toe nails is onychocryptosis or unguis incarnates [8].

#### PLANTS PROFILE:

##### 1) BIXA ORIENTA:

- Scientific name- Bixa orientia
- Synonym-Bixa purpurea Sweet
- The biological source-The drug consist of a dry powder of *Bixa orientia*
- Species-Bixa orientia
- Family-Bixaceae



**Fig 1.2: Bixa orientia seeds**

Scientific classification of Bixa orientia:

Kingdom : Plantae  
 Clade : Angiosperms  
 Clade : Eudicots  
 Clade : Rosids  
 Order : Malvales  
 Family : Bixaceae  
 Genus : Bixa  
 Species : B.orientia  
 Common name: Sendur  
 Synonym: Bixa tinctoria Salisb  
 Bixa orellana (L) kuntze  
 Bixa Americana poir

#### PLANT PROFILE:

##### 2) CURCUMA LONGA:

Scientific name –Curcuma longa  
 Synonym-Turmeric, Haldi  
 The biological source-The drug consist of a dry powder of *Curcuma longa*.  
 Family- Zingiberaceae



**Fig 1.3: Curcuma longa**

Scientific classification of curcuma longa:

Kingdom : Plantae  
 Subkingdom : Tracheobionta  
 Division : Magnoliophyta  
 Superdivision : Spermatophyta  
 Class : Liliopsida  
 Order : Zingiberales  
 Family : Zingiberaceae  
 Genus : Curcuma  
 Species : Longa

Common name-Haldi, Halad

**Synonyms**

- Bengali-Halud
- Guajarati- Halada
- Hindi-Haldi
- Kannada-Arishina
- Marathi-Halad
- Sanskrit-Haldi, Haridra
- Tamil-Manjal
- Telugu –Pasu

**Traditional use**

- 1) Anti-inflammatory.
- 2) To treat abdominal pain.
- 3) Cancer, Alzheimer’s disease and depression [17].

**The extraction process of Bixa orientata:**

- Step 1: Boil whole seed of Bixa orientata with ethyl acetate.
- Step 2: Decant the extract and concentrate it to less than half its volume.
- Step3: Collect the pure crystalline bixin which separate out on cooling the concentrated extract on a Buchner funnel [16, 17].

**The extraction process of Curcumin:**

- Step 1:
- 1) 5gm of powder +50ml petroleum ether in a beaker.
  - 2) The solution stirred for 5minutes.
  - 3) Magnetic stirred for 15 minutes
  - 4) Filtered and discard the filtrate and the obtained residue was allowed to dry.

Step 2

- 1) Dry residue +50ml chloroform
- 2) Stirred for 5min and keep on magnetic stirred for an about 15min
- 3) Filter and discard the filtrate and the residue was allowed to dry.

Step 3

Stirred for 5min and allowed to keep on magnetic stirred for an about 15 min extraction of Curcumin from curcuma longa. The solution was filtered. Concentrate the filtrate and residue dissolution methanol. [16]

**Formulation table:**

**Table-1: Formulation**

Sr. No	Ingredient	Quantity F1	Quantity F2	Uses
1	Ethyl cellulose	8.5 gm	8.5 gm	Film forming
2	Formaldehyde	2.5 ml	2.5 gm	Resin
3	Castor oil	1.5 ml	1.5 ml	Plasticizer
4	Bixa orientata	1.5 gm	-	Colouring agent
5	Curcumin	-	2 gm	Colouring agent

**Stepwise procedure for formulation:**

1. Triturate the film former to make powder of it.
2. Dissolved ethyl cellulose and resin in the solvent mixture.
3. Disperse the colour of the castor oil.
4. Mix the above dispersion in the ethyl cellulose solution with uniform stirring.
5. Transfer all content in to suitable container, label it and submit.

6. Spreadibility: Spreadibility of nail paint checked by applying of nail paint on nail by the nail paint brush.
7. Stability: The stability study of nail lacquers is very important and essential. This can be done by accelerated stability test.

**Evaluation of nail polish (F1):**

1. Appearance: Orange colored viscous liquid.
2. Drying time: Apply the nail paint on nail. Explore to the nail pain to air and determine the drying time of the nail paint. Optimum drying time obtained.
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 [18].
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 [18].

**Evaluation of nail polish (F2):**

1. Appearance: Yellow colored viscous liquid.
2. Drying time: Apply the nail paint on nail. Explore to the nail pain to air and determine the drying time of the nail paint. Optimum drying time obtained.
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
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 [17, 18].
6. Spreadibility: Spreadibility of nail paint checked by applying of nail paint on nail by the nail paint brush.

7. **Stability:** The stability study of nail lacquers is very important and essential. This can be done by accelerated stability test.

**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 nails.



**Fig 1.4: Prepared herbal nail paint**

**Brand names of nail paint-**

1. Elle 18
2. Lotus herbals
3. Lakme
4. Revlon
5. Faces Canada
6. Inglot
7. Maybelline
8. Loreal
9. Colorbar
10. Chambor
11. Nykaa
12. Kay beauty

**RESULT AND DISCUSSION**

Herbal Based Nail Polish was prepared and result obtained was following table.

**Table-2: Observations**

Test	Observation	
	(Bixa orientia) Nail paint	Turmeric Nail paint
Appearance	Orange colored liquid	Yellow colored liquid
Drying Time	Optimum	Optimum
Smoothness	Smooth	Smooth
Hardness	Less hard	Sufficient hard
Color	Orange	Yellow
Consistency	Good	Good

**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. Nitrocellulose is a film-forming polymer that is the main ingredient in most nail polish. Nail polish consists of a film-forming polymer dissolved in a volatile organic solvent Nail 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.

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