FORMULATION, DEVELOPMENT AND EVALUATION OF NAIL PAINT REMOVER CREAM

Abstract

Nail paint remover plays a significant role in personal grooming products and it is commonly used for removal of nail paints from the surface of nails. However, these products often contain harsh chemicals that can lead to nail dryness, irritation and lingering odour. It is reported that, Dibutyl Adipate is often employed as a plasticizer, a colourless, odourless,clear liquid having good solvency, moisturizing effect and skin conditioning property. Hence, in this research study, we propose the formulation, development and evaluation of nail paint remover cream, having gentle nail paint removing ability with moisturizing effect by using Dibutyl Adipate as an active. The idea of formulation was designed to improve efficacy and reduced skin irritation as compared to traditional liquid nail paint removers. Hence nail paint remover cream with Dibutyl Adipate was formulated to offer a convenient, moisturising and mess free alternative for nail paint removers. Suitable nail paint remover cream was developed with three different concentrations of Dibutyl Adipate and final formulation with 25% of active was evaluated for parameters such as colour, odour, pH, and appearance, nail paint removing ability and accelerated stability study. Subjective evaluation was carried out to study the functional parameters of the final formulation, like time required to remove nail paint from nail surface, moisturizing effect on nails, irritancy to nails on human volunteers. The study showed that the nail paint remover cream with 25% Dibutyl Adipate gives satisfactory nail paint removing activity and moisturizing effect on nail surface with no irritation.

Keywords: Dibutyl Adipate, Efficient removal, Removal time, moisturising effect, Irritation, Nail paint.

Authors

K. S. Misar
Department of Cosmetic Technology
Kamla Nehru Mahavidyalaya
Nagpur, Maharashtra, India.
ketkimisar11@gmail.com

P. T. Khachane
Department of Cosmetic Technology
Kamla Nehru Mahavidyalaya
Nagpur, Maharashtra, India.
khachane.prerana@gmail.com

M. H. Taywade
Department of Cosmetic Technology
Kamla Nehru Mahavidyalaya
Nagpur, Maharashtra, India.
manjushataywade1988@gmail.com

M. R. Raut
Department of Cosmetic Technology
Kamla Nehru Mahavidyalaya
Nagpur, Maharashtra, India.
mahimaraut68@gmail.com

W. B. Gurnule
Department of Chemistry
Kamla Nehru Mahavidyalaya
Nagpur, Maharashtra, India
wbgurnule@yahoo.co.in

I. INTRODUCTION

Nail paint is a popular cosmetic product used by individuals of all ages to add vibrancy and style to their nails. As the demand for nail paint continues to grow, the need for efficient and safe nail paint removers has become increasingly important [1]. Nails refer to the tough, protective covering at the end of each finger and toe. It is composed of a protein called keratin and serves to protect the sensitive tips of our nails [2]. Traditional nail paint removers are effective in removing nail paint but can lead to several issues such as nail dryness, cuticle damage and skin irritation [3]. As a result, there is a growing interest in developing innovative alternatives that can effectively remove nail paint while promoting nail health and minimizing adverse effects on nails [4]. Nail paint remover is a specialized product designed to effectively remove nail paint from fingernails and toenails. It is an essential part of personal grooming and nail care for those who regularly use nail paint [5]. Nail paint is a cosmetic lacquer applied to nails to enhance their appearance, add color and express individual style. Now a days, the popularity of nail art and nail care has further increased the demand for nail paints and consequently nail paint removers. While these products play a vital role in the beauty routine of millions of individuals [6]. The idea of formulation of nail paint remover cream was conceptualized by observing that the nail paint removers available in the market are liquid based and they can spill off during usage or travelling, and may leak from container eventually, gives dryness and lingering odour[7]. Dibutyl Adipate (DBA) is a colorless and odorless chemical compound belonging to the class of adipic acid esters. It is reported that, Dibutyl Adipate is often employed as a plasticizer, a clear liquid having good solvency, emollient effect and skin conditioning property. Hence, in this research study, we propose the formulation, development and evaluation of nail paint remover cream, having gentle nail paint removing ability with moisturising effect by using Dibutyl Adipate as an active. It is commonly used in cosmetics and personal care products for its properties which helps to enhance flexibility and durability in formulations [8]. In nail paint remover creams, Dibutyl Adipate serves as the primary solvent responsible for dissolving and lifting the nail paint from the nail surface [9].

Nail paint remover cream, under this study offers several benefits as compared to traditional liquid nail paint removers i.e., gentle on nails and skin, gives moisturizing effect along with removal of nail paint, freedom from typical organic odour, no spills and leaks and travel friendly. In comparison to conventional liquid removers, this nail paint remover cream is more convenient and nail moisturizing alternative [10]. The primary function of nail paint removers is to dissolve and remove the nail paint from the nails, allowing for a clean and fresh canvas to apply new nail paints and keep nails moisturized [11].

II. MATERIAL AND METHODS

1. **Analysis of Dibutyl Adipate:** Dibutyl Adipate was procured for the present study from Subhash Chemical Industries Pvt. Ltd., Pune, India, along with Certificate of Analysis. The procured sample was validated for parameters such as colour, clarity, acid value, and relative density and saponification value (Table No. 2).

2. **Formulation and Development of Nail-Paint Remover Cream:** Three different formulations of Nail paint remover cream (i.e. Trial I, II and III) were formulated with three different concentrations of Dibutyl Adipatei.e. 15%, 20%, 25% respectively. Since,

formulation Trial III with 25% dibutyl adipate gave a satisfactory cream with good consistency and nail paint removing ability it was selected for further study (Table no.1).

Table No. 1: Formulation and Development of Nail-Paint Remover Cream

S. N.	Ingredients	Use of Ingredient	Trial I (Quantity in %)	Trial II (Quantity in %)	Trial III (Quantity in %)
		Phase A			
1.	Water	Vehicle	Upto100 % (61%)	Upto 100% (56.49%)	Upto 100% (51.49%)
		Phase B			
2.	Glycerin	Humectant	6%	6%	6%
3.	Guar gum	Emulsifier	1.5%	1%	1%
4.	Sodium Hydroxide	pH Stabilizer	0%	0.01%	0.01%
		Phase C			
5.	Glyceryl stearate and laureth-23	Thickener	5%	5%	5%
6.	Glyceryl stearate	Conditioning agent	5%	5%	5%
7.	Di-isopropyl adipate	Conditioning and moisturizing agent	6%	6%	6%
8.	Dibutyl Adipate (Active)	Solvent and plasticizer	15%	20%	25%
		Phase D			
9.	Liquid Germall plus	Preservative	0.5%	0.5%	0.5%
10.	Perfume (Lavender)	Gives Fragrance	q. s.	q. s.	q. s.

3. **Analysis of Nail Paint Remover Cream:** Nail paint remover cream formulation (Trial III with 25% Dibutyl Adipate) was subjected to study parameters like colour, odour, pH, appearance, nail paint removing ability and accelerated stability study. The results are summarized in Table no.3.

4. **Stability Study**: The objective of stability study is to ensure that product will remain stable till the consumer has used the entire product. The stability not only indicates stability of formulation but also the stability of other ingredients present in the formulation of nail paint remover cream [12]. After analyzing all the three formulations, on the basis of functional parameters, it was observed that the nail paint remover cream formulation (Trial-III with 25% Dibutyl Adipate) was giving satisfactory results. Hence the trial-III nail paint remover cream formulation was subjected to accelerated stability

studies. Changes in parameters like colour, odour, pH at three different temperatures [i.e. in oven at (45^0C), in refrigerator at (4^0C) and at room temperature] was recorded for 30 days at the interval of 5 days. The results were noted (Graph no.1) [13].

5. **Subjective Evaluation:** Since the nail paint removing ability and moisturising effect of Nail paint remover cream (Trial III with 25% Dibutyl Adipate) was satisfactory, it was selected for further study on human volunteers. It was given to 30 human volunteers of age group between 18 to 60 years to carry out subjective evaluation on the basis of their feedback. Subjects were asked to use nail paint remover cream to remove the nail paint and note the changes they observed on the surface of the nail where they applied the product. Subjective evaluation was carried out to study the functional parameters like time required to remove nail paint, moisturizing effect on nails and irritancy to nails on human volunteers.The results were noted in table no.4.

III. RESULT AND DISCUSSION

Traditional nail paint removers are effective in removing nail paint but can lead to several issues such as nail dryness, cuticle damage, skin irritation and lingering organic odour. Hence the present research study was undertaken with the aim to formulate, develop and evaluate nail paint remover cream, having gentle nail paint removing ability with emollient effect by using Dibutyl Adipate as an active.

1. **Result of Analysis of Dibutyl Adipate:** From the analysis of Dibutyl Adipate it was observed that procured sample passes the test as per certificate of analysis, and hence was used for incorporation in formulation (Table No. 2).

Table No. 2: Results for Analysis of Dibutyl Adipate

S.N.	Parameters	Requirement as per Certificate of analysis of Dibutyl Adipate	Result	Inference
1.	Colour	Colourless	Colourless	Passes the test
2.	Clarity	Clear	Clear	Passes the test
3.	Acid Value	0.98	0.98	Passes the test
4.	Relative Density	0.9610 g/cc	0.9610 g/cc	Passes the test
5.	Saponification Value	430.41	430.41	Passes the test

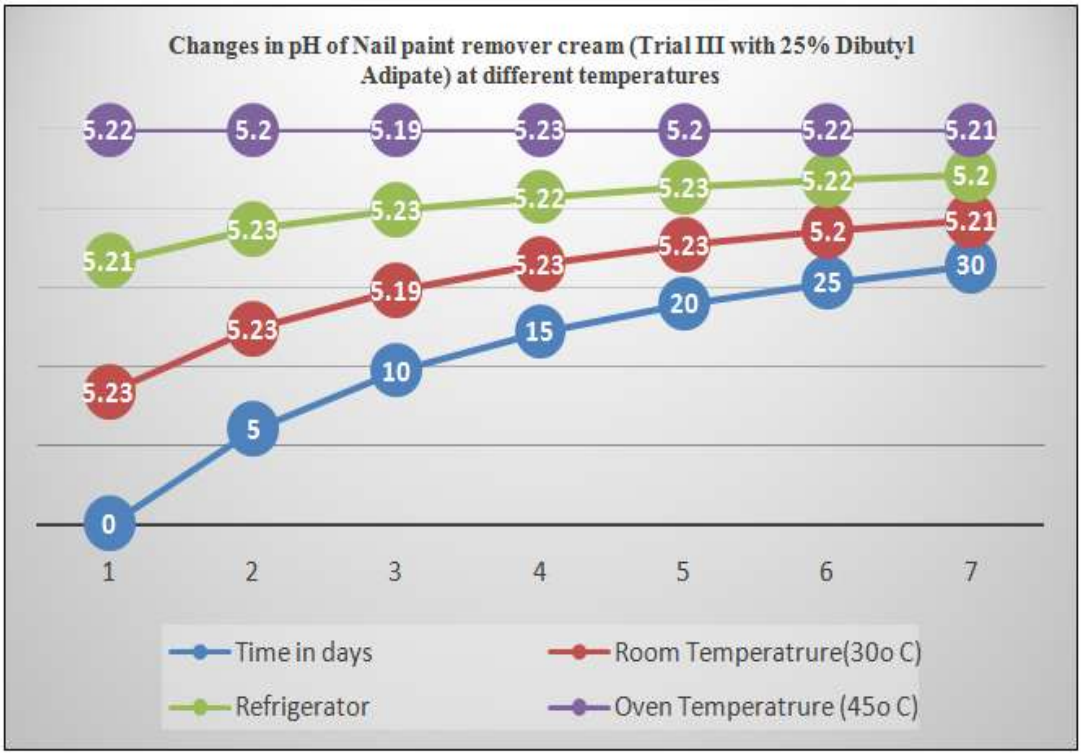
2. **Result of Formulation and Development of Nail-Paint Remover Cream:** In the present study after analyzing all the three formulations (i.e. Trial I, II, III), on the basis of functional parameters, it was observed that the formulation (Trial III) with 25% Dibutyl Adipate was giving satisfactory results. Hence nail paint remover cream (Trial III with 25% Dibutyl Adipate) was selected for further study.

3. **Result for Analysis of Nail Paint Remover Cream (Trial III with 25% Dibutyl Adipate):** From the results of analysis of nail paint remover cream (Trial III with 25% Dibutyl Adipate), it was observed that the cream was satisfactory with respect to all the parameters. (Table 3)

Table No 3: Result of analysis of Nail Paint Remover Cream (Trial III With 25% Dibutyl dipate)

S.N.	Parameters	Results for Nail paint remover cream (Trial III with 25% Dibutyl Adipate)	Inference
1.	Color	White	Passes the test
2.	Odour	Characteristic	Passes the test
3.	pH	5.23	Passes the test
4.	Appearance	Satisfactory	Passes the test
5.	Nail paint removing ability	Satisfactory	Passes the test

4. **Results of Stability Study:** From the result of stability study, it was observed that the nail paint remover cream (Trial-III with 25% Dibutyl Adipate) was stable with respect to physical parameters such as colour, odor and pH at three different temperatures i.e., at 4^0C, at room temperature and at 45^0C (Graph No. 1).



Graph No.1: Graphical Representation of Changes in Ph of Nail Paint Remover Cream (Trial III With 25% Dibutyl Adipate) at Different Temperatures

5. **Subjective Evaluation:** From the results of subjective evaluation, it was observed that nail paint remover cream (Trial III with 25% Dibutyl Adipate) was well appreciated, it showed satisfactory nail paint removing ability and moisturizing effect on nail surface without any irritancy.

Table No 4: Results of Subjective Evaluation of nail Paint Remover Cream (Trial III With 25% Dibutyl Adipate)

S.N.	Parameters	Nail paint remover cream(Trial III) with 25% Dibutyl Adipate
1.	Time required to remove nail paint from nail surface (Nail Paint removing ability)	Less than 1 minute
2.	Moisturizing effect on nail surface	Satisfactory
3.	Irritancy to nails	No Irritancy

IV. CONCLUSION

Liquid Nail paint removers available in market, often contain harsh chemicals that can lead to nail dryness, irritation and lingering odour. It is reported that, Dibutyl Adipate is often employed as a plasticizer, a colourless, odourless, clear liquid having good solvency, moisturizing effect and skin conditioning property.

Hence, the present research study was undertaken with the aim to formulate, develop and evaluate nail paint remover cream, having gentle nail paint removing ability with moisturizing effect by using Dibutyl Adipate as an active.

From the above study it can be concluded that the nail paint remover cream (Trial-III) with an active Dibutyl Adipate (25%) is a satisfactory formulation in terms of appearance, nail paint removing ability, moisturizing effect without any irritation on nail surface.

REFERENCES

[1] Chandra S. (2019) The Science of Nail Paint, Nail Paint Remover, And Nail Moisturizers: A Comprehensive Approach, Nail Disorders (Pp.497-501) DOI:10.1201/9781351139724-35
[2] Haneke E. (2015)Anatomy of The Nail Unit and The Nail BiopsySeminarsin Cutaneous Medicine and Surgery 34(2):95-100, DOI: 10.12788/J.Sder.2015.0143
[3] MadnaniN.(2012)Nail CosmeticsIndian Journal of Dermatology, Venereology and Leprology 78(3):309-17, DOI:10.4103/0378-6323.95445
[4] Yang J.(2017) Nail Art Convergence Design Apply the Principles of Formative Art -Focusing on Balance and Emphasis, DOI:10.15207/JKCS.2017.8.3.275
[5] DavisL.,Khoza L., Brooks J(2019)Nail Art, Nail Care and Self Expression: Gender Differences in African Americans' Consumption of Nail Cosmetics, Fashion Style & Popular Culture 6(2):159-174 , DOI:10.1386/Fspc.6.2.159_1
[6] Arora H.,Tosti A(2017)Safety and Efficacy of Nail Products Cosmetics 4(3)DOI:10.3390/Cosmetics4030024
[7] Chandra S., Das A. (2019) The Science of Nail Polish, Nail Polish Remover, and Nail Moisturizers: A Comprehensive Approach,Nail Disorders (Pp.497-501) DOI:10.1201/9781351139724-35

[8] Andersen A. (2006)AmendedFinal Report of The Safety Assessment of Dibutyl Adipate as Used in Cosmetics, International Journal of Toxicology;25 1:129-34. Doi: 10.1080/10915810600716679.
[9] Di isopropylAdipate, Chemical Safety Data Sheet MSDS/ SDS; Chemical Book, According To Regulation (EC) No. 1907/2006 (REACH), Https://Www.Chemos.De/Import/Data/Msds/GB_En/6938-94-9-A0219258-GB-En.Pdf
[10] Mohite M., Kharat J., Deshmukh S., Kashid G., (2022); Formulation and Evaluation of Herbal Based Nail Polish; Cross Current International Journal of Medical and Bioscience, ISSN: 2663-2446 4(2),21, DOI: 10.36344/Ccijmb. 2022.V04i02.004
[11] Barle A., Paya M., Maibach H., (2001); Handbook of Cosmetic Science and Technology, Published by Marcel Dekker; INC, 32
[12] Indian standard (2001); Skin Creams- Specifications; IS 6608:2004; Bureau of Indian standard ;3rd Revision;3
[13] Tuf H., I., Hora P., Macat Z., Machac O., (2011); Stability and toxicity of polish nail marks on Porcellio scaber, Conference: 11th Central European Workshop on Soil Zoology

