International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2019): 7.583

Study of Temperature Effect on α-Tocopherol Acetate in Commercial Synthetic and Herbal Fairness Skin Creams by UV-VIS Spectroscopy

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Abstract: ***India is a huge market for fairness creams. Herbal and synthetic fairness creams prefer α-tocopherol acetate in their formulation as it retards oxidation and rancidity of fat and oil-based formulations. It is also well known for its antioxidant activity against free radicals. During summers, when temperatures rise in most regions of India, the efficiency of α-tocopherol acetate as an antioxidant preservative is questionable in herbal as well as synthetic fairness cream formulations. It is very difficult to extract and quantify α-tocopherol acetate present in cosmetic creams by UV-VIS spectroscopy as large number of ingredients present in the cosmetic matrix which may interfere; therefore, UV-VIS Spectroscopy requires a method with special techniques of extraction. In this paper, two fairness creams (1-Herbal and 1-Synthetic) containing α-tocopherol acetate were investigated by this method at two different temperatures (37^0 C and 47^0 C) for six days and results were quite promising.***

Keywords: Antioxidant, Cosmetic creams, α-Tocopherol Acetate, UV-VIS Spectroscopy

1. Introduction

The Indian cosmetic market has historically always been dominated by fairness creams. It occupies 61% of the dermatological market of India (Anitha et al., 2018).Since long fair skin has been associated with beauty. Large number of women in India consider skin lightning as a prominent way to beautify themselves. Earlier people used to prepare face masks by mixing natural ingredient at home(Kunda, 2008), now with the adaptation of modern practices and changing lifestyles most Indian women are switching towards synthetic fairness skin creams. Indian women prefer to buyand use one cream which can be used throughout the day, giving benefits of oil-control, blemish reduction and sun protection all in one. Fairness creams fulfill these requirements at an affordable price range along with easy availability in urban and rural parts of India (Saumendra, 2013).

In the past synthetic fairness creams have always been popular and have had a strong hold on the Indian cosmetic market. Nowadays demand for herbal products are increasing all over the world. Herbal cosmetics, referred as Products, are formulated, using various permissible cosmetic ingredients to form the base in which one or more herbal ingredients are used to provide the defined cosmetic benefits only. Herbal cosmetics are considered safe for use, free from side effects of synthetic chemicals as they are made up of natural ingredients. (Laxmi et al., 2015, Shweta et al., 2011) Like synthetic fairness creams herbal fairness creams are also available to choose from a large variety; but the ingredient which is common in both herbal and synthetic fairness cream is antioxidant α-tocopherol acetate. It is among the most important ingredient of skin creams which retards the oxidation and rancidity of oil and fat and is more stable than tocopherol. In cosmetics theyact as a reducing agent and scavenges free radicals (Anca et al., 2011, Anca et al., 2012). Even synthetic fairness creams prefer α-tocopherol acetate over synthetic antioxidants likeBHA (butylated hydroxyanisole) and BHT (butylated hydroxytoluene). According to The International Agency for Research on Cancer, BHA might be carcinogenic to humans and BHA and BHT may induce allergic reaction in skin (Laxmi et al., 2015, Anca, 2011).

Extraction of α-tocopherol acetate is very difficult task as the matrix of cosmetic creams contains large number of ingredients.(Anca et al., 2011)Their separation requires special techniques like reflux condensation. UV-VIS spectrophotometer is a simple, cost effective and accurate method of analysis. The concentration of α-tocopherol acetate can be calculated through Fe (III) reduction. In presence of α-tocopherol acetate Fe(III)–bipyridyl gets reduced to intense pink colored Fe(II)-bipyridyl chelate (Khalid et al., 2020).

2. Materials and Method

All reagents used were of analytical grade without further purification. α-Tocopherol Acetate (Sigma Aldrich), Potassium Hydroxide (Molychem), Glycerol (S.D. Finechem), Methanol HPLC Grade (Ranchem), Ether (Chemix Finechem), Anhydrous Sodium Sulphate (Molychem), 2,2-Bipyridyl (Loba Chemie), Ferric Chloride (S.D. Finechem)

Commercial Cosmetic Products:
Two commercial herbal and synthetic fairness creams namely SB (synthetic fairness cream) and HB (herbal fairness cream) were purchased from a retail pharmacy in India; containing α-tocopherol acetate without specifying its quantity. Analysis study was performed before reaching the date of expiry. Each cream stored at 37^0 C and 47^0 C for six days. To evaluate chemical stability samples were taken out at zero-time, 3rd day and 6th day. Samples were kept in

individual amber-light vial and same vial sample is used throughout the study.

UV- VIS Spectrophotometer Instrumentation:
Spectroscopic study performed on Agilent Carry 100, 4.20 UV-VIS spectrophotometer in a dark room at ambient temperature. Analysis performed with 1 cm path length a pair of matched quartz cuvettes.

Extraction Method:
Reflux the 1000 mg of sample along with2 ml potassium hydroxide solution,10 ml glycerol and25 ml methanol. Cool and extract it with 50 ml ether and collect ether layer filter through anhydrous sodium sulphate. Evaporate ether layer to dryness. Reconstitute the residue into 100 ml standard volumetric flask and dilute it with methanol.

Calibration Standard Preparation: 25 mg of α-tocopherol acetate dissolved in 100ml methanol. A set of working solution prepared to give concentration ranging from 10 mg/L to 50 mg/L.

Procedure:
5 ml sample and blank solution were taken in 25 ml standard volumetric flask containing 2ml 2,2 bipyridyl, and 1 ml 0.1 % ferric chloride solution and diluted up to the mark with methanol. Absorbance recorded at 525nm against blank.

3. Result & Discussion

Fig.1. (a) & Fig.1. (b) show calibration graph of standard and its values on day 0 Fig. 2 shows effect of temperature on α-tocopherol acetate present in fairness creams.

Table 1 showing concentration of α-tocopherol acetate in herbal and synthetic fairness creams on day 0, day 3 and day 6 at various temperature (37^0 C and 47^0 C).

Table 1: Percentage concentration of α-tocopherol acetate in cosmetic creams

Sample	0^{th}Day	3^{rd} Day		6^{th} Day	
		37^0C	47^0C	37^0C	47^0C
SB	0.22	0.204	0.182	0.172	0.154
HB	0.12	0.111	0.101	0.097	0.088

Formula
In order to calculate concentration of α-tocopherol acetate following formula can be used –

$$\text{Concentration in \%} = \frac{\text{Sample Observance in ppm x Sample Dilution x Purity}}{\text{10000 x Sample Weight}}$$

4. Conclusion

Fairness creams are extremely popular in India. α-Tocopherol acetate is the common ingredient for both synthetic and herbal fairness creams. In the present study both fairness creams were kept at different temperatures (37^0C and 47^0C) for six days. Extraction and analysis were performed at 0^{th}, 3^{rd} and 6^{th} day. α-Tocopherol acetate shows loss in activity at higher temperature especially at 47^0C. In many regions of India temperatures reach 50^oC in summer days; that time of the year α-tocopherol acetate may degrade and their antioxidant, preservative property may be lost. Therefore, temperature care should be taken during storage or should be specified by manufacturer.

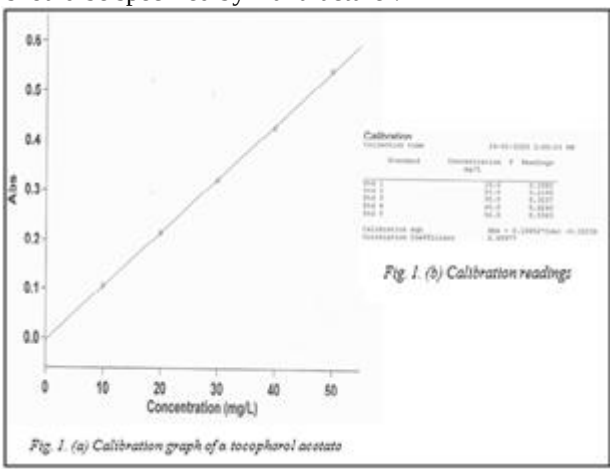

Fig. 1. (b) Calibration readings

Fig. 1. (a) Calibration graph of α tocopherol acetate

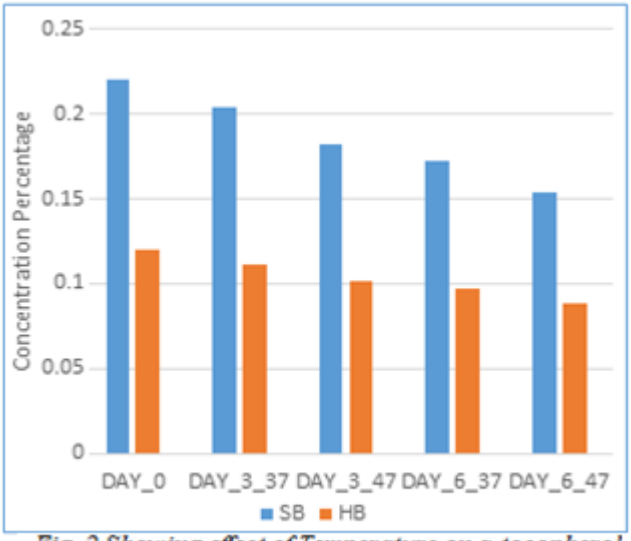

Fig. 2 Showing effect of Temperature on α-tocopherol acetate in fairness creams.

Thought initially SB showed a higher value for α-tocopherol acetate than HB but its degradation within specified time is more than HB. There is a need to optimize such a formulation which can slow down rate of degradation of α-tocopherol acetate.

The above method of extraction, separation and quantification is easy to apply, cost effective and accurate.

5. Acknowledgement

We would like to express our gratitude toMs. Archana Mahadik of Bombay Test House Laboratories for providing technical facilities and assistance.

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