

Formulation and *in-vitro* determination of Sun Protection Factor of *Nigella sativa* Linn. Seed Oil Sunscreen Cream

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Abstract : In the present study, we isolated the fixed oil from the dried seeds of *Nigella sativa* Linn. (Kalongi) by petroleum ether (40–60°C) using a Soxhlet apparatus, as described by AOAC (1990). Efforts were made to formulate sunscreen cream using extracted *Nigella sativa* L. seed fixed oil. Evaluation of same was done for sunscreen activity by using *in vitro* SPF method using optometrics LLC, SPF-290S instrument. The protection factor is calculated over the wavelength range from 290 - 400nm as per US-FDA standards. SPF of formulation was found 1.05 with ultra boot star rating 2 which approaches toward sunscreen activity.

Keywords: *Nigella sativa* (Ranunculaceae), Kalongi, SPF, Sunscreen activity.

INTRODUCTION

Sun protection products including sunscreen creams, lotions are designed to absorb or reflect the sun's UV radiation to protect the skin from damage. Ultraviolet light which is responsible for sunburn, suntan and increases the risk of basal cell carcinoma and malignant melanoma. The UV spectrum lies between 200 nm to 400 nm and is commonly divided into three regions: UV-A: 320-400 nm, UV-B: 280-320 nm, UV-C: 200-280 nm. Exposure to solar radiation is recognized to have negative effects on the human skin. UVA rays can be divided into two key wavelengths: short-wave UVA (320-340 nm) and long-wave UVA (340-400 nm). Ultraviolet radiation A and B (UVA, UVB) are especially harmful by different mechanisms that result in suppression of skin's immune system. This immunosuppressive effect generates photodermatoses, skin premature aging and skin cancers. The Sun Protection Factor (SPF) measures the length of time a product protects against skin reddening (sunburn) from UVB (Ultra Violet) radiation, compared to how long it takes to redden without protection. To maintain the SPF, reapply sunscreen every two or four hours and right after swimming or sweating.^{1,2}

An individual's response to UV radiation and melanin production is dependent on skin color and other genetic factors. Even if an individual has dark skin or whose skin readily produces melanin when exposes to UV radiation, may still experience sunburn as a result of high intensity of UV radiation and an extended length of exposure. Sunscreens are cosmetic formulations that block UV rays. Sunscreens are assigned sun protection factors or SPF, ratings that are supposed to indicate the level of protection from UV radiation³. This is important for human well-being because exposure to ultraviolet radiation (principally UV-B radiation) has a number of effects on health including sunburn, skin cancer, immune suppression and damage to the eyes⁴.

The seeds of *Nigella sativa* Linn. is also known as black cumin or kalongi in Hindi. They have been used for medicinal purposes as a natural remedy for a number of illness and conditions that includes bronchial asthma, cough, rheumatism, hypertension, diabetes, inflammation, eczema, fever, tumor, and influenza.⁵⁻⁸ Carminative, diuretic, lactogouge, and vermifuge properties have been attributed to a variety of active phytoconstituents in seeds and its oil.⁹⁻¹² Various bioactive compounds have been isolated such

as alkaloids, steroids, cycloartenol, fatty acids, sugars, flavonoids of trigillin quercetin-3-glucoside, and an isobenzofuranone derivative.¹³⁻¹⁶ A bioactive principle α -hederin was isolated from the seeds, and reported to have *in vivo* anti-tumor activity.

Fatty oil obtained from the seed of *Nigella sativa* L. is reddish brown, with a faint odour of bitter almonds. The % composition of mixed fatty acids in seed oil as Linoleic (49-67.5%), oleic acid (15.12-38.19%) & Palmitic (9.9-23.5%), *N. sativa* fixed oil also contains the unusual C20:2 eicosadienoic acid (1.7-3.1%). In addition, the content of linoleic acid (C18:2) was much higher than that of oleic acid (C18:1).^{17, 20}

The study was designed with an objective to determine the *In vitro* Sun Protection Factor (SPF). In present study, we have made an attempt to formulate the topical cream from seed oil of *Nigella sativa* L. and evaluation of the same.

MATERIAL AND METHODS

Plant material

The seeds of *Nigella sativa* L. were collected from local market of Malegaon and Nashik Dist. Nashik, India. The plant material was identified, authenticated taxonomically and herbarium sheet deposited to Botanical Survey of India, Pune. The seed were cleaned, dried under direct sunlight and powdered by a mechanical grinder.

Seed oil extraction

Dried powdered material of seed of *Nigella sativa* L. (50 g) was extracted with 50 volumes of petroleum ether (40-60°C) using a Soxhlet apparatus as described in AOAC (1990).²¹ This process of extraction was repeated for 6hrs. The petroleum ether distilled out by distillation assembly, then concentrated by hot plate drying and air-drying at temperature of 40 \pm 2°C (yield 24.86% w/w).

Sunscreen cream formulation

Step I: Water phase was prepared by collecting deionised water (72 %) and then 5 % water was removed aside from this for final volume makeup. Water soluble components Disodium EDTA (0.02%), Sodium Methyl Paraben (0.3%) and Triethanolamine (0.5%) were dissolved in deionised water, meanwhile, carbopol (0.5%) was allowed to swell using an homogenizer and heated up to 80 °C.

Step II: Oil phase was prepared by heating Sodium Propyl Paraben (0.06%), Stearic acid (2%), Cetyl alcohol (1%), Cetomacrogol-1000 (2%), Cetostearyl alcohol (5%) and *Nigella sativa* L. seed oil (5%) at 80 °C.

Step III: Oil phase was added in water phase at 80 °C with continuous stirring for 20-25 min and then it was homogenized till uniform emulsion is formed. To improve the aesthetic value of the product, perfume was added in quantity sufficient. The finished product has white color and gel-like consistency. It was then poured into the wide mouth container and stored at temperature not exceeding 37°C.

Table 1 Composition of *Nigella Sativa* Linn. seed oil sunscreen cream.

Sr. No.	Ingredients	Use	Components (% w/w)
1	Cetosteryl alcohol	Emulsifier	5
2	Stearic acid	Emollient, Coemulsifier	2
3	Cetomacrogol-1000	Emulsifier	2
4	Cetyl alcohol	Emollient, Coemulsifier	1
5	Carbopol 940	Gelling agent	0.5
6	Disodium EDTA	Chelating Agents	0.02
7	Na Methyl Paraben	Preservative	0.3
8	Na Propyl Paraben	Preservative	0.06
9	Triethanolamine	Surface active agent	0.5
10	Purified Water	Vehicle	62
11	<i>N. Sativa</i> seed oil	Active ingredients	5
12	Perfume	-	q.s.

Determination of *In-Vitro* SPF of Sunscreen Cream Method

Approximately 100 mg of the investigational sample was applied and spread on 50 sq.cm area to obtain a sample film thickness of 2 µl /cm² on Transpore surgical tape to get an even film as suggested in the operation manual of Optometrics LLC SPF-290S for the sample preparation and application technique. The samples thus prepared were exposed to Xenon arc lamp with UV range 290nm to 400nm for determining the SPF.

$$SPF_{SCAN} = \frac{\sum_{290}^{400} E\lambda B\lambda}{\sum_{290}^{400} \frac{E\lambda B\lambda}{MPF\lambda}}$$

Where,

MPFλ = scan MPF value

Eλ = Spectral Irradiance of terrestrial sunlight under controlled conditions

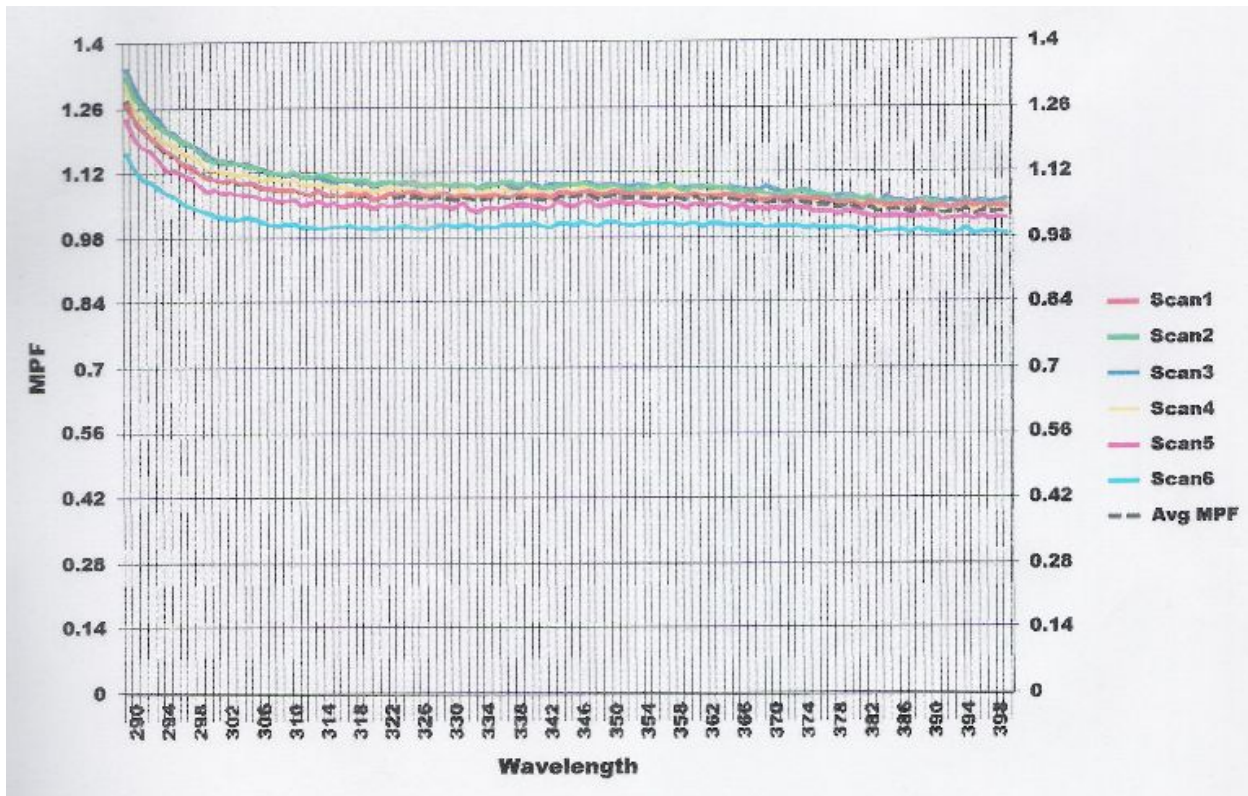
Bλ = Erythral Effectiveness.

The SPF-290 software used Trapezoidal Approx. calculating technique to approximate the integral for SPF and Erythral UVA protection factor. These include UVA/UVB ratio, critical wavelength, cumulative absorbance, etc. The Average Absorbance method is used for calculating average protection factor. For calculation of standard deviation, Diffey’s method is used.

Table 2: Results of SPF and other parameters of *Nigella sativa* L. sunscreen cream

Sr. no.	Parameter	Scan I	Scan II	Scan III	Average value
1	SPF	1.09	0.99	1.07	1.05
2	Standard deviation	0.04	0.02	0.02	0.03
3	UVA/UVB ratio	0.459	0.025	0.660	0.380
4	Critical wavelength	374.4	109.8	377.0	287.0
5	Boot star rating	02	0	03	02

Fig.1 SPF-290 Graph Report of *N.Sativa* L. oil sunscreen cream



RESULT

Seed oil of *Nigella sativa* L. was extracted and Sunscreen cream was formulated using this oil. Formulated cream was evaluated for sunscreen activity using *in vitro* SPF method. SPF value of sunscreen cream was found to be 1.05 with ultra boot star rating 2.

DISCUSSION

SPF value for sunscreen above 2 is considered as having good sunscreen activity. In present study formulated sunscreen cream was found near the range of good sunscreen activity and hence *Nigella sativa* L. seed oil may be considered as good candidate for sunscreen or cosmoceutical purposes. Further this cream can be evaluated for spreadability, viscosity, microbial testing, water content etc.

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