



**EMERGING WAY TO INCREASE SPF FACTOR OF SYNTHESIZED
SUNSCREEN LOTION FROM SOLANUM LYCOPERSCIUM AND
CAMELLIA SINENSIS**

TIRTH THAKER*, KRUPA PADARIYA AND SHREYA PATEL

Department of Chemistry, Parul Institute of Applied Sciences, Parul University, Waghodia,
Vadodara-391760, Gujarat, India

*Corresponding Author: Dr. Tirth Thaker: E Mail: tirth6582@gmail.com

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ABSTRACT

An antioxidant found in *Solanum lycopersicum* and *Camellia sinensis* can protect from ultraviolet (UV) exposure in sunlight and shield skin from UVB-induced photodamage. This research carried out to create a *Solanum lycopersicum* extract and *Camellia sinensis* extract-based sunscreen cream subjected to phytochemical screening and measurements of sun protection factor (SPF) values. Centrifugation was used as a qualitative test for the cream preparation in comparison to the extract, and observations of antibacterial activity, physical properties, pH, saponification value, acid value, SPF value and stability of the cream formulation were evaluated. Sunscreen creams having different compositions with *Solanum Lycopersicon*, *Camellia sinensis* and *Cucumis sativus* extract contain SPF values in promising range of 20 - 25. The cream has antibacterial properties due to the addition of steric acid, which acts as a preservative.

Keywords: *Solanum lycopersicum*; *Camellia sinensis*; *Curcuma longa*, Sun Protection Factor (SPF)

INTRODUCTION:

The best defence against sunlight is human skin, which can stop sunlight from penetrating the body's organs, veins and bones. Erythema and hyperpigmentation are typical skin responses to the presence of too much

sunshine. UV rays from the sun can burn, accelerate the ageing process or cause a variety of skin conditions including cancer [1]. Chronic sun exposure damages the skin by causing the development of squamous cells

and basal carcinomas. Acute sun exposure causes pigmentation and redness, which can thereafter deteriorate into redness and sunburn [2-6].

The ability of sun cream to protect the skin from UV radiation is significantly influenced by the sun protection factor [SPF]. Some bioactive elements in the environment absorb UV radiation, shielding our bodies from its damaging effects. In recent time, the use of biologically active chemicals in cosmetic formulations has increased due to their security, lack of troublesome side effects, lack of hazardous chemical ingredients, and preservation of the environment [7]. The organic anti-cancerous, anti-mutagenic and harmless qualities of plant nutrients are finding favour as important cosmetic elements because they are less harmful and carcinogenic than manufactured photo-protective compounds. Genuine herbal ingredients in sunscreen are the least abrasive on human skin, particularly for those with delicate skin [8], and involve organic components that can renew the skin, and provide sufficient defence against air pollution and climatic fluctuations. Looking towards skin protection & welfare of human beings, authors formulated sunscreen cream using different composition taking extracts of *Aloe barbadensis*, *Curcuma longa*, *Azadirachta indica*, *Solanum lycopersium*,

Cucumis sativus, *Camellia sinensis*, *Ocimum tenuiflorum*, *Carica papaya* and *Santalum album*.

MATERIAL AND METHOD:

Aloe barbadensis (aloevera), *Curcuma longa* (turmeric), *Azadirachta indica* (neem), *Solanum lycopersium* (tomato), *Cucumis sativus* (cucumber), *Camellia sinensis* (green tea), *Ocimum tenuiflorum* (tulsi), *Carica papaya* (ripe papaya), *Santalum album* (sandal wood), Beeswax, Borax, Stearic acid, Liquid paraffin, Distilled water, Rose oil, Vitamin C have been taken for the formulation of sunscreen cream.

Formulation of Cream: Beeswax and liquid paraffin were heated in an oil phase in a borosilicate glass breaker to a constant temperature of 75 °C. In another beaker, borax and stearic acid dissolved in distilled water at 75°C & agitated to get a homogeneous aqueous mixture. Above both oily & aqueous phase mixed slowly in 10-15 mins. Immediately after mixing the two phases all other ingredients should be added respectively to their formula as given in Table 1. The mixture should be stirred continuously until it forms a smooth cream. As soon as the cream has formed, rose oil has to be added as a scent. If necessary, combine the cream in a geometric design while adding a few drops of distilled water and vitamin C.

Table 1: Formulations of Sunscreen creams-F1, F2, F3 & F4 having different composition

S. No.	Substance	F1	F2	F3	F4
1.	<i>Aloe barbadensis extract</i>	5.6ml	5.6ml	5.6ml	5.6ml
2.	<i>Curcuma longa extract</i>	5.4ml	5.4ml	5.4ml	5.4ml
3.	<i>Azadirachta indica extract</i>	1.8ml	-	-	-
4.	<i>Solanum lycopersium extract</i>	-	5.4ml	5.4ml	5.4ml
5.	<i>Cucumis sativus extract</i>	-	-	4.5ml	4.5ml
6.	<i>Camellia sinensis extract</i>	-	5.4ml	-	5.4ml
7.	<i>Ocimum tenuiflorum extract</i>	3.4ml	-	-	-
8.	<i>Carica papaya extract</i>	5.4ml	-	-	-
9.	<i>Santalum album extract</i>	-	-	5.4ml	5.4ml
10.	Beeswax	10.90gm	10.90gm	10.90gm	10.90gm
11.	Borax	0.54gm	0.54gm	0.54gm	0.54gm
12.	Stearic acid	0.06gm	0.06gm	0.06gm	0.06gm
13.	Liquid paraffin	36.2ml	36.2ml	36.2ml	36.2ml
14.	Distilled water	0.5 ml	0.5 ml	0.5 ml	0.5 ml
15.	Rose oil	0.5 ml	0.5 ml	0.5 ml	0.5 ml
16.	Vitamin C	0.5 ml	0.5 ml	0.5 ml	0.5 ml

Antibacterial activity of sunscreen cream:

The antibacterial activity of the organism was assessed using cultures that had been cultivated for the organism for 24 hours. The nutrient agar medium plates were created with 15 to 20 ml of nutrient agar media and 90 cm of sterile Petri dishes. The dishes were allowed to solidify for 5 to 10 minutes before being injected with 0.1 per cent inoculum. Agar discs with a 5 mm diameter were made using the agar disc diffusion method and they were autoclaved with No. 1 Whatman filter paper or newspaper to sterilise them. The discs were then treated with

formulated sunscreen cream dissolved in DMSO in the following phase. The plates were then incubated for 24 hours at 37 °C. The plates were left to stand for 30 minutes before being incubated for 24 hours at 37 °C. Antibacterial activity was assessed by calculating the width of the inhibitory zone in millimetres. A positive study result was given to them. Examining the antibacterial investigation was done using the disc-plate method [9].

Pseudomonas aeruginosa and *E. coli* are gram-negative, while *Staphylococcus aureus* and *Bacillus subtilis* are gram-positive.

Table 2: Antibacterial Activity of Sunscreen Cream

Name of sample	Conc. (µg/ml)	Antibacterial activity			
		Microorganisms and zone of inhibition			
		Gram-positive bacteria		Gram-negative bacteria	
		<i>S. aureus</i>	<i>B. subtilis</i>	<i>E. coli</i>	<i>P. arginase</i>
F1	10	22mm	28mm	18mm	17mm
F2	10	13mm	24mm	19mm	16mm
F3	10	22mm	22mm	18mm	20mm
F4	10	18mm	22mm	19mm	14mm
Control penicillin G	10	15mm	16mm	13mm	14mm

Study of different parameters of cream:

Physical parameters: To identify the colour of the sunscreen cream formulation, a visual examination was conducted. The determination of the mixture's aroma was sniffed. It was computed automatically to find the sample state. Take a cream and dissolve it in water. The cream is not soluble in water but soluble in n-hexane. After the formation of the cream, we find the weight of the cream.

Melting point: The capillary method is the most widely used and fundamental technique for testing. Using this technique, a capillary tube is used to contain the material to be studied, which is then heated in an investigation before it melts. After that, the melting point may be noted.

Measurement of pH value: A pH meter was used to ascertain the pH of the formulation's 1% water solution.

Measurement of Saponification Value:

Take 1 g of fat and dissolve in 3 ml of ethanol. Filter it and wash it with 7 ml of ethanol. Take an RBF and reflux the residue with 25 ml of alcoholic KOH for 30 min, add 1 ml of phenolphthalein and titrate to 0.5N HCl. Take the blank reading in the same way as before.

Formula: Saponification value = $(b-a) \times 56.1056$

Where,

a = Volume in ml of titrant in RBF1

b = volume in ml of titrant in RBF2

56.1056 = Equivalent of KOH

Measurement of Acid value: Take 1 g of fat in a 250 ml conical flask add 25 ml of ethanol and then place in a heating metal for methanol to dissolve the fat. Cool the solution, add 2-3 drops of phenolphthalein indicator and titrate against 0.1 N methanolic KOH. Not below the endpoint.

Formula: Acid value = $n \times N \times 56.1$

Where,

n = The number of ml of KOH required

N = Normality of KOH

56.1 = Equivalent of KOH

Irritation test: A one-square centimetre area of a particular sunscreen weighing 1.0 g was applied to the upper part of the hand.

Determination of the SPF value: Both with and without exposing the cream to UV light, the SPF value was determined in vitro. The product was dissolved in n-hexane to get it to a concentration of 200 g/mL. The solution's absorbance was measured in the 290–320 nm region at 5 nm intervals in comparison to n-hexane, which served as a control. The data was processed using the Mansur equation, which is described in more detail below [10, 11].

320

$$SPF = CE \frac{\sum EE(\lambda) \times I(\lambda) \times A(\lambda)}{290}$$

290

Where,

EE = erythema effect spectrum

I = Intensity of spectrum

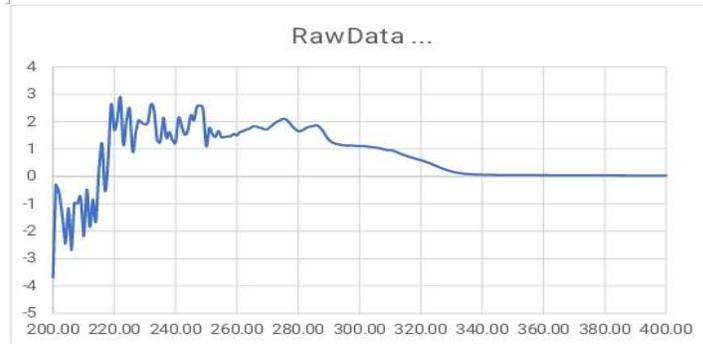
Abs = Absorbance of sunscreen product

CF = correction factor

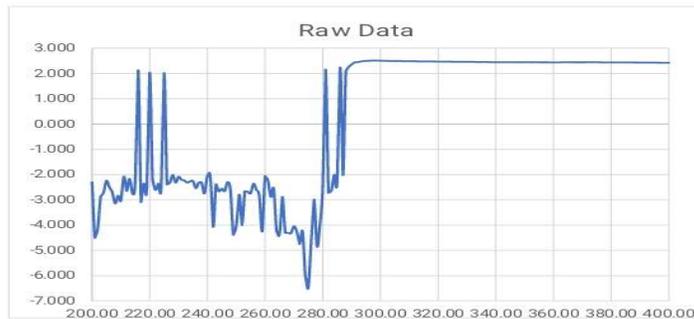
The values of EE x I are constant

According to the findings of our research, 71% of the identified natural sun protection is constant in the ultraviolet (UVA) and

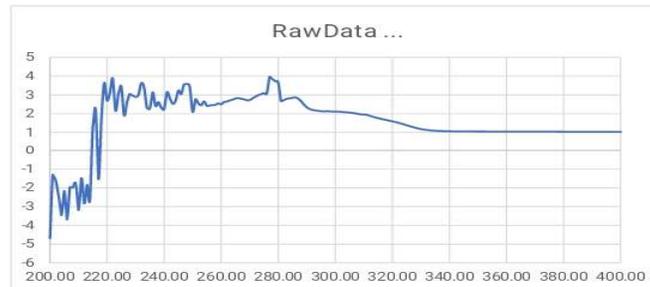
ultraviolet (UVB) ranges, and 100% of them are photostable in the UVB range.



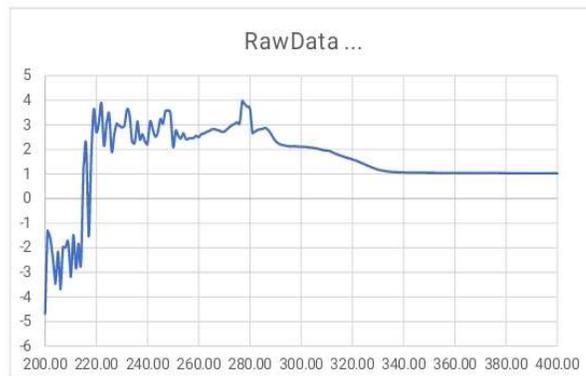
UV spectrograph for formula-1



UV spectrograph for formula-2



UV spectrograph for formula-3



UV spectrograph for formula-4

Table 3: With the help of the UV spectrophotometer graph Calculation of SPF

Wavelength nm	E × I (Normalised)	Absorbance (A)				E × I × A			
		F1	F2	F3	F4	F1	F2	F3	F4
290	0.0150	1.341	2.351	2.341	2.512	0.201	0.0352	0.035	0.0376
295	0.0817	1.132	2.495	2.132	2.520	0.092	0.2038	0.1748	0.2057
300	0.2874	1.902	2.503	2.908	2.528	0.3184	0.7193	0.605	0.7265
305	0.3278	1.056	2.489	2.050	2.513	0.3469	0.8158	0.6719	0.8237
310	0.1864	0.955	2.483	1.955	2.511	0.1780	0.4628	0.3644	0.4680
315	0.0839	0.762	2.477	1.762	2.504	0.0639	0.2078	0.1469	0.2083
320	0.0180	0.593	2.470	1.593	2.496	0.0106	0.044	0.0280	0.0049
Total	1					=1.2108 =1.2108×10 =12.108	=2.4887 =2.4887×10 =24.887	=2.026 =2.026×10 =20.26	=2.5147 =2.5147×10 =25.147

RESULT & DISCUSSION:

Table 4 findings demonstrate that creams' pH values vary, and the four formulas are suitable for application as sun protection compositions since their pH ranges from 4.0 to 8.0. Both acid value and saponification value are different for all four methods. There was no irritation in the cream because it was made

from natural ingredients. According to the outcomes of antibacterial testing, there are no microbes in any of the treatments (including the control). It was caused by the usage of stearic acid. stearic acid is a preservative that is used as an addition. This substance has the power to shield the cream against the development of germs and fungus.

Table 4: Evaluation of different formulations of Sunscreen cream F1, F2, F3 & F4

Sr no	Evolution parameter	Observation F1	Observation F2	Observation F3	Observation F4
1	Odour	Organic smell	Organic smell	Organic smell	Organic smell
2	Colour	Light green	Skinny	Orange	Orange
3	State	Solid-state	Solid-state	Solid-state	Solid-state
4	Solubility	n-Hexane	n-Hexane	n-Hexane	n-Hexane
5	Melting point	90°C	87°C	85°C	84°C
6	Yield	89 gm	94 gm	90 gm	85 gm
7	Saponification value	84.1584	95.37952	106.60064	112.2112
8	pH	7	7.1	7.3	7.4
9	Acid Value	8.415	7.854	6.171	7.293
10	Irritation	No Irritation	No Irritation	No Irritation	No Irritation
11	SPF	12.108	24.887	20.26	25.147

Costing of the natural sunscreen cream:

Raw material	₹ for 50gm	F1	₹	F2	₹	F3	₹	F4	₹
<i>Solanum lycopersicum</i>	20₹	-	-	5gm	2₹	5gm	2₹	5gm	2₹
<i>Cucumis sativus</i>	20₹	-	-	-	-	5gm	2₹	5gm	2₹
<i>Camellia sinensis</i>	50₹	-	-	5gm	5₹	-	-	5gm	5₹
vitamin-c	99₹	1gm	1.98₹	1gm	1.98₹	1gm	1.98₹	1gm	1.98₹
Beeswax	199₹	10.90 gm	43.38 ₹						
Stearic acid	80₹	0.06 gm	0.10₹						
<i>Carica papaya</i>	15₹	5gm	1.5₹	5gm	1.5₹	5gm	1.5₹	5gm	1.5₹
<i>Aloe barbadensis</i>	60₹	5gm	6₹	5gm	6₹	5gm	6₹	5gm	6₹
<i>Rosa damascene</i>	15₹	5gm	1.5₹	5gm	1.5₹	5gm	1.5₹	5gm	1.5₹
<i>Azadirachta indica</i>	108₹	5gm	10.5₹	5gm	10.5₹	5gm	10.5₹	5gm	10.5₹
<i>Ocimum tenuiflorum</i>	123₹	5gm	12.3₹	5gm	12.3₹	5gm	12.3₹	5gm	12.3₹

Sandalwood	180₹	1gm	-	1gm	3.6₹	1gm	3.6₹	1gm	3.6₹
Curcuma Longa	12₹	1gm	0.24₹	1gm	0.24₹	1gm	0.24₹	1gm	0.24₹
Borax	78₹	0.57 gm	0.88₹						
Liquid paraffin	30₹	36gm	21.6₹		21.6₹		21.6₹		21.6₹
Total:			99.98 ₹		86.28 ₹		83.28 ₹		88.28 ₹

The obtained cream cost around:

Formula	Gram	Rupees
SP-01	89	99.98
SP-02	94	86.28
SP-03	90	83.28
SP-04	85	88.28

The production price of the obtained different creams is less than the market price.

CONCUSSION:

According to research findings, *Camellia sinensis* & *Solanum lycoperscium* extract combined formulation (SP-02), *Camellia sinensis*, *Solanum lycoperscium*, *Cucumis sativus* extract combined formulation (SP-04) have greater SPF values than other types of extract. It indicates that *Camellia sinensis* enhances the SPF value. With lotion sunscreen formulations incorporating emulsifying the representative paraffin liquid, borax, distilled water, as well as stearic acid preservatives, extracts can be created using either formula-1,2,3 and 4. Sunscreen lotion with a *Camellia sinensis* extract contain high SPF values of 24.887 (F2) and 25.147 (F4), respectively. *Camellia sinensis* is a key factor to increase the SPF value. Formulated sunscreen creams have comparatively low price than market sunscreen products hence, have a great commercial scope.

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