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FORMULATION AND EVALUATION OF NIOSOMAL BASED HERBAL SUNSCREEN SPRAY

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ABSTRACT

Background: In the current paradigm, herbal remedies are more appropriate than synthetic ones due to their protection and less harmful impacts. The present research work has been undertaken with the aim to formulate and evaluate niosomal based herbal sunscreen spray.

Materials and methods: Essential oils (carrot seed oil, blue berry seed oil) having good SPF. Aloe vera (Aloe barbadensis Mill. belonging to the family Asphodelaceae), Cholesterol, Tween80, Alcohol, Glycerine, Water. Niosomes were prepared by coacervation method.

Results: It has been identified that carrot seed oil, blue berry seed oil have good SPFs. The combination of both the essential oils is having SPF higher than the individual formulations. 3 formulations are made F1, F2, F3. Carrot seed oil was incorporated as a UV protecting agent in F1 and SPF was found to be 27.78; blue berry seed oil was incorporated as UV protectant in F2 and SPF was found to be 21.65 and F3 is the combination of both carrot seed oil and blue berry seed oil where the SPF was found to be 28.90.

Conclusion: Results have shown that F3 is having high SPF than F1 and F2. Thus it has high UV protection capacity.

Keywords: Niosomal, Carrot seed oil, Blue berry seed oil, Asphodelaceae, Coacervation, SPF (Sun protection factor)

INTRODUCTION

Sunscreens: Sunscreens are the substances that protect the skin from UV radiation, helps to prevent the development of wrinkles, darkspots and sagging skin. Modern sun screens provide excellent and robust protection against UVA and UVB while avoiding water and sweat wash-offs. Aerosol sprays are of great demand because they are easy to use and fairly quick to apply **[1]**.

Types of UV- Radiation [2]

UV-A Radiation: This ranges from 320 to 400 nm. UV-A radiation is primarily responsible of tanning or darkening of the skin.

UV-B radiation: Radiation ranges from 280 to 320 nm. It is known as burning rays because it causes sunburn 1000 times more than UV-A.

UV-C radiation: The radiation ranges from 200 to 280 nm. UV-C radiation is less powerful and harmful.

Protection:

Sun protection choices can be very common, but suntan screens are the most preferred and popular mode of sun protection due to numerous social factors such as ease of application and greater safety effects. Most animals (the elephant uses mud as a sun cover) use sunlight. Sun protection clothing, sun glasses, hats, umbrellas, shade and potential avoidance of sun light **[3]**.

SPF is measured as ratio of amount of UV radiation required to burn the protected skin (with sunscreen) to that required to burn the same unprotected skin (without sunscreen), all other factors being constant.

$$SPF = \frac{\text{Minimal erythema dose of protected skin}}{\text{Minimal erythema dose of unprotected skin}}$$

Mansur mathematical equation

$$SPF = CF \sum_{290}^{320} EE(\lambda) \times I(\lambda) Abs(c)$$

Where,
CF= Correction factor
EE[λ] = Erythmagenic effect of radiation with wavelength
Abs[λ] = Spirit photometric absorbance values at wavelength
EE values are constant

Herbal sunscreen agents:

These herbal sunscreen acts by either effectively scattering the incident light or they adsorb the erythemal portion of sun energy.

Aloe vera gel:

It is collected from the leaves of Aloe barbadensis belonging to the family Asphodelaceae. Aloe vera is widely used in

cosmetics for its moisturizing action. It can block both UVA and UVB rays, so that it can maintain skin natural moisture balance. Aloe contains the enzyme bradykinase which stops sunburns and stimulate immune system. Acemannan is the main ingredient in aloe vera. It is a D-isomer of mucopolysaccaride which speeds up the repair phase and increase production of collagen and fibroblasts **[4]**.

Carrot seed oil:

It is yellow to pale orange-brown in colour. It contains 3 flavones (luteolin, luteolin 3-O-beta-D-glucopyranoside, luteolin 4-O-beta-D-pyranoside). These flavones are having high anti oxidant properties which are helpful in treatment of skin related problems and also protects skin from UV radiations **[5]**.

Blue berry seed oil: It is highly moisturizing with charecteristic aroma. It contains high concentration of alpha and gamma tocopherols (vitamin E), vitamin C, poly phenols, 83% omega-3 and omega-6 fatty acids , vitamin A. It is also useful in treatment of psoriasis and other skin conditions. It is a strong anti oxidant and also used for its healing and nourishing properties. Due to high vitamin A content it is suitable for oily and acneic skin types **[6]**.

MATERIALS and METHODS

Collection of materials:

Aloe vera was collected from our college (Chalapathi Institute of Pharmaceutical Sciences) medicinal garden. Carrot seed oil and blue berry oil were procured from ALPS Goodness Pvt. Ltd. Cholesterol, Tween80, alcohol, Glycerine were procured from Thermo Electronus India Pvt. Ltd. Aloe vera used for the experimental work was authenticated in Acharya Nagarjuna University.

Method of Preperation

Coacervation Method of Preperation of Proniosomes

Taken the required quantity of cholesterol into a clean and dry beaker. Placed the beaker on magnetic stirrer with moderate rpm and 30-35˚C. To this Tween80 was added. Finally aloevera, essential oils and alcohol were incorporated. Stirred the above

contents until all the ingredients were completely miscible and formed a single phase at 60-65˚C. Slowly added the aqueous phase and stirred to form a uniform dispersion.

Table 1: List of Ingredients

S. No	NAME OF INGREDIENT	QUANTITY	PURPOSE
1.	Carrot seed oil	5ml	Essential oil with SPF of 35-40
2.	Blue berry oil	5ml	Essential oil with SPF of 20
3.	Aloe vera	10gms	Skin Moisturizer
4.	Cholesterol	5gms	Lipid phase for niosomes
5.	Tween 80	10ml	Non ionic surfactant
6.	Alcohol	10ml	Penetration enhancer
7.	Glycerine	10ml	Aqueous phase
8.	Water	qs	Aqueous phase

Table 2: Composition of Formulation

S. No	NAME OF INGREDIENT	F1	F2	F3
1.	Carrot seed oil	1ml	-	1ml
2.	Blue berry oil	-	1ml	1ml
3.	Aloe vera	10gms	10gms	10gms
4.	Cholesterol	0.25gms	0.25gms	0.25gms
5.	Tween 80	1.5ml	1.5ml	1.5ml
6.	Alcohol	10ml	10ml	10ml
7.	Glycerine	1ml	1ml	1ml
8.	Water	qs	qs	qs

Evaluation Parameters

Physical parameters:

Appearance, colour, and solubility were determined.

By using standard techniques and methods the physical parameters of herbal sunscreen formulations like colour, odour, spreadability, pH, specific gravity (25˚C) and limit test for lead were determined. The viscosity of sunscreen was measured at 10-100rpm at 25˚C with Brookfield viscometer. Stability of sunscreen was determined by centrifugation at 3500-13500 rpm for 10 min interval and observed for phase separation. A sensitivity study was done by patch test to ensure that sunscreen is free from adverse effects **[7]**.

Subjective Properties:

Consistency, feel on application and irritation parameters were determined.

Rancidity:

This test was performed by using the Phloroglucinol solution. The rancidity is due to the oxidation of the fats and oils; during oxidation free fatty acids were liberated. These free fatty acids react with the Phloroglucinol solution and gives pink colour. This indicates the rancidity of the

product. 10 ml of the preparation was taken then added 10 ml of concentrated hydrochloric acid and 10 ml of Phloroglucinol solution and shaken for one minute. The material shall be taken to have passed the test if no pink colour developed **[8-12]**.

Particle size analysis:

Particle size of niosomes formed was determined with the help of particle size analyser.

Percentage of nanoparticles formed and the range of particle size was obtained in the form of a graph.

Initially, the sample was transferred to a cuvette and placed in a particle size analyser, final results obtained in the form of graph was collected and evaluated.

Sun Protection Factor determination [8]

SPF of formulated creams, marketed sunscreen products and synthetic sunscreen agents were calculated by the application of equation:

Sample Preparation

Weighed 1.0 g of both the samples and added into 100ml volumetric flask, diluted with ethanol and ultrasonicated for 5 min. Filtered using cotton and then rejected first 10 ml. Into a 50 ml volumetric flask an aliquot of 5 ml was transferred and diluted with ethanol. To the 25ml volumetric flask an aliquot 5ml was transferred and diluted with ethanol. Measured the absorbance values of each aliquot from 290-320nm at 5nm interval taking ethanol as a blank. The absorbance values were taken thrice and at each point determinations were made followed by application of Mansur equation.

Mansur *et al* (1986) **[13-17]** developed a mathematical equation

$$\mathbf{SPF = CF\sum_{290}^{320} EE(\lambda)\times I(\lambda)Abs(c)}$$

Where,

CF= correction factor

EE[λ] = Erythmagenic effect of radiation with wavelength

Abs[λ] = spirit photometric absorbance values at wavelength

EE values are constant

The aliquot prepared were scanned between 290-320 nm and the obtained absorbance values were multiplied with the respective EE (λ) and I (λ) values. Then, their summation was taken and multiplied with the correction factor (10) **[18-22]**.

RESULTS AND DISCUSSION:

Effectiveness of a sunscreen was determined by using SPF. An effective sunscreen should have wide range of absorbance from 290-400nm to prevent sunburn and skin damage. Evaluation of sunscreen formulation for a long time was through *in- vivo* test using human volunteers but it is time consuming

and leads to grade of variability. But, during production and development the SPF test is useful for scanning. By applying mathematical equation the herbal sunscreen containing carrot seed oil and blueberry seed oil were evaluated.

During handling and storage of cosmetic formulation

- The prime parameters which effect formulations acceptability are physicochemical characters.
- Phase separation was not observed by performing stability studies using centrifugation. This proves the stability of formulation at high stress conditions.
- By using UV spectrophotometric method, the SPF values were obtained and observed high absorbance values at 290-320nm. The SPF values of carrot seed, blue berry oil and combination of both oils in sunscreen spray were 27.78, 21.65 and 28.90 respectively.

Particle size analysis:

Particle size of niosomes was analysed by particle size analyser.

It was found that almost 30% of particles in the sample were of nano size.

Average particle size of the formulation was found to be 0.5 microns.

Table 3: Physical Properties of Herbal Drugs

S. NO	parameters	observations		
		F1	F2	F3
1	Colour	Yellowish to brown	light greenish yellow	Yellowish brown
2	Odour	characteristic	characteristic	characteristic
3	Specific gravity	0.918(Kg/m3)	0.915 to 0.930(Kg/m3)	0.920(Kg/m3)
4	Solubility	Soluble in oily substances	Soluble in oily substances	Soluble in oily substances
5	pH	7.4	6.9	7.2
6	Acid value	2.5806	6.2	4.81

Table 4: Determination of SPF values

S. No	Wave length	EE value	Carrot seed oil	Blue berry seed oil	Combination of both oils
1	290	0.015	0.0848	0.0423	0.0723
2	295	0.0817	0.1837	0.1212	0.2437
3	300	0.2874	0.2992	0.2318	0.2398
4	305	0.3278	0.3755	0.3122	0.3925
5	310	0.1864	0.2412	0.2014	0.2721
6	315	0.0837	0.1359	0.0948	0.1213
7	320	0.018	0.0551	0.0315	0.0621
Sun protection factor			27.78	21.65	28.90

CONCLUSION

From the results obtained in the study it can be concluded that carrot seed oil, blue berry seed oil, aloevera sunscreen have significant UV absorbing property. It also helps in protection from Ultra Violet radiation. Considering the patients suffering from skin diseases and adverse effects associated with synthetic sunscreens it is the best option to use herbal sunscreens without fail. Herbal sunscreens are more safe and efficacious than synthetic sunscreens and also cost effective. Carrot seed oil and blue berry oils are selected because of their good SPF values. Aloe vera is having numerous advantages related to skin. Niosomal formulation is prepared to enhance the absorption ability of sunscreen.

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