

# Development of UV Protection Finish on Cotton Fabric using Lemon Plant Extracts

S. Karthik<sup>1</sup>, P. Periyasamy<sup>2</sup>

<sup>1</sup>M.Tech. Scholar, Department of Textile Chemistry, SSM College of Engineering, Komarapalayam, India

<sup>2</sup>Assistant Professor, Department of Textile Chemistry, SSM College of Engineering, Komarapalayam, India

**Abstract:** Light is one of the essential sources on earth in order to run human life style. Natural light source on earth is “Sun” and it gave some benefits and adverse effects to the environment and which falls on the earth and absorption by human skin. These protection offered by textile is often inadequate to prevent the melanomas formation. We all must go with the nature, results earth as green and safe than chemical treatments to any process. Thus our textile wet processing needs eco friendly technique and process sequences. Based on this concept in this present study it was observed that Lemon leaves, Lemon peels and lemon juice (All have natural “Anti oxidant” in its structure) may able to give UV protection on the Cotton by treating them to its extracts by micro encapsulation method and also give anti- microbial finish to this fabric and some basic test to be conducted. Therefore, this study end product increases its sale value and more economical

**Keywords:** Ultraviolet rays, skin-cancer, Natural UV-absorbers, Lemon leaves, Juice, Peels, Antioxidant, Antimicrobial, UV-Protective Textiles and Micro encapsulation.

## 1. Introduction

Exposure to minimal doses of sunlight is beneficial for organisms, since it contributes to the development of the bones and the assimilation of vitamins. However, over exposure to the sun increases the risk of permanent damage to the skin.

UV radiation can lead to acute and chronic reactions resulting in damage to skin such as sunburn, acceleration of ageing including roughening, blotches, sagging, wrinkles, Cancer and DNA damage.

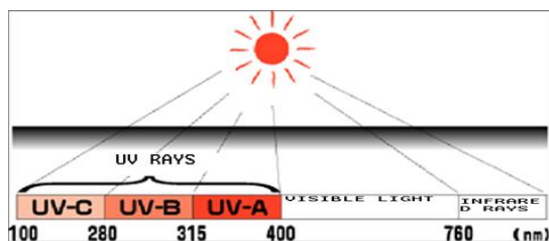


Fig. 1. The electromagnetic spectrum and wavelength band

The risks posed by ultraviolet radiation have become more dangerous in recent years. Ozone depletion in earth’s atmosphere occurs due to the release of man-made fluorocarbons, in particular chlorofluorocarbons (CFCs), has minimized the protection against the incoming solar Ultraviolet

Radiation (UVR). A decrease of one percent in the thickness of the ozone layer would lead to 2-3 % increase in skin cancer. Among other protection measures recommended by dermatologists such as avoiding prolonged exposure on skin, wearing sunglasses, using cosmetics equipped with sunscreen formulations, the use of textile garments is one of the most important. Clothing has the ability to protect the skin from incident solar radiations because the fabric from which it is made can reflect, absorb and scatter solar wavelengths. Protection properties of such textiles can be successfully improved by the use of special auxiliaries which absorb light in the UV-B and UV-A regions (290–400 nm). The UV-blocking property of a fabric is enhanced when a dye, pigment, delustrants, or ultraviolet absorber finish is present that absorbs ultraviolet radiation and blocks its transmission through a fabric to the skin. The sun emits a range of energy known as the electromagnetic spectrum. The various forms of energy, or radiation, are classified according to wavelength. These emissions are characterized by their wavelength, expressed in nanometers (1 nm = 10<sup>-9</sup> m). The radiations with shorter wavelength are more energetic. Sunlight that reaches the earth is composed of 66% of infrared light, 32% visible light and 2% ultraviolet light. Ultraviolet light is defined as electromagnetic radiation in the spectral region between 180 and 400 nm. The three categories of UV radiations are UV-A, UV-B and UV-C. UV-A rays (320-400 nm) are the least powerful of the UV rays, but they are present all year and can penetrate windows and clouds. They penetrate more deeply into the skin and contribute to premature aging of the skin and skin cancers. UV-B rays (280-320 nm) are the most powerful and potentially harmful form of radiation. It is the most common cause of sunburn, aging, wrinkling and skin cancer. UVB is particularly strong at the equator, at high elevations or during the summer. UV-C rays (200-280 nm) are the shortest and the most powerful of the UV rays. UV-C is the most likely to cause cancer if it reaches skin. Most of the UV-C radiation is absorbed by the ozone layer in our atmosphere. The order of potency is UVC > UVB > UVA.

### A. Lemon plant

Citrus is an ancient crop and the lemon is a small evergreen tree native to Asia, and the tree's oval yellow fruit. With records

of human cultivation extending back to 2100 BC. It has more powerful Vitamin E, limonene, citral, citric acid alpha pinine, myrcene, 1,8 cinol for neutralizing free radicals. The lemons interact with protein, astringent and also have antioxidant activity. Citrus essential oils showed a broad spectrum of biological activities mainly antimicrobial, antioxidant and cytotoxic activities. The fruit juice is about 5% to 6% citric acid, which gives lemons a sour taste, and a pH of 2 to 3. It contains caffeine as well as triterpene saponins, carotenoids and non-protein amino acids (theanine, 2-amino-6-ethylamidoadipic acid). Lemon is also rich in vitamin C and contains smaller amounts of the B vitamins, particularly B1, B2, and niacin. Early studies of Citrus have a great mission, as they often revealed a rich harvest of biologically active principles including essential oil, flavonoids, coumarins and limonoids.

## 2. Materials and methodology

### A. Material

#### 1) Cotton Fabric - Fabric parameters are listed below

Table 1  
Fabric parameters

S. No.	Specification	Values
1	Warp count	2/30 <sup>s</sup> Ne
2	weft count	80 <sup>s</sup> Ne
3	EPI	74
4	PPI	50
5	GSM	97.12 gms
6	Weave	Plain

Scoured and bleached plain weave cotton fabric was purchased from the ALC (P) Ltd salem. Distilled water is used throughout the study.

#### 2) Herbs

1. Botanical name : Citrus limon Osbeck
2. Family : Rutaceae
3. Parts used : Fruit juice, Peels and Leaves
4. Chemical composition: Vitamin C, Ascorbic acid, Citric acid and Quercetin etc.

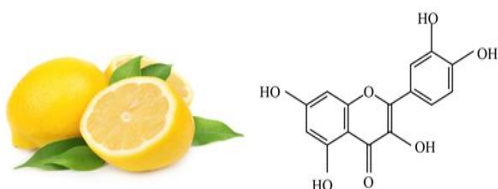


Fig. 2. Lemon and their anti oxidant (Quercetin)

#### 3) Chemicals

1. Sodium alginate (Tween 20 as Cross linking agent)
2. Calcium chloride (polymerizing agent)
3. Citric acid (Binder)

### B. Methodology

#### 1) Extraction principles of herbs

Lemon peel, Juice and Leaf were shadow dried and grounded in the form of a powder. Then about 20 grams of the powder

were taken and mixed with 250 ml of 80 % of ethanol. Extraction was done using aqueous extraction method using ethanol as an organic solvent. The dried ground samples were mixed together with the solvent in the ratio 1:1. The mixture was kept at room temperature under shaker for 24 hours. After 24 hours the ethanol was evaporated. The residue is filtered using filter paper no 2 and the extraction is collected.

#### 2) Encapsulation by ionic gelation process

Microcapsules containing extract were prepared by employing the sodium alginate. 3 % of sodium alginate was prepared separately. 30 ml of that extraction and 10 ml of Tween 20 were added to the polymer solution and mixed thoroughly to form smooth viscous dispersion solution. This was sprayed into Calcium chloride solution by means of a sprayer as droplet for 15 minutes. The microcapsules were obtained by decantation and repeated washing with iso propyl alcohol followed by dried at 45 °C for 12 hours. Then those microcapsules were used to finish the selected fabric.

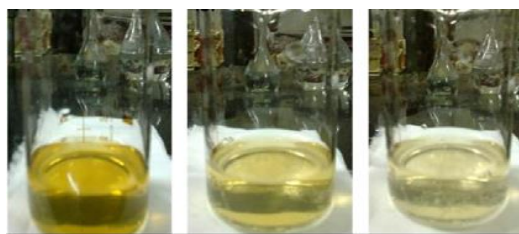


Fig. 3. Lemon Leaf, Peel, Juice extract

#### 3) Exhaust method

The fabric sample was finished with the above prepared 3 different microencapsulate according with the following recipe:

1. M: L Ratio - 1:20
2. Capsules - 70 gms
3. Citric acid (Binder) - 8%
4. Time -30 mins
5. Temperature - 50°C
6. pH - 7.2 to 7.5

Then the finished fabric subjected to the hot and cold wash several times and dried using hot oven.

## 3. Results and discussion

### A. Result for UV report

Table 2  
Ultra Violet Protection Factor of the samples

S. No.	Sample	Ultra Violet Protection Factor # (AS/NZS 4399: 1966)	
		Mean UPF	UPF Rating
1	Juice treated	28.2	25
2	Peels treated	25.3	22
3	Leaves treated	27.27	24

The above result shows that UV protection is very good for Lemon juice and Leaves followed by peels treated cotton fabric. But the true SPF of cotton is just 4 to5 only so this is not

sufficient to sun light exposure therefore this allows the UVB and UVA rays to its structure thus results damage to the wearer. Now it has been enriched by the lemon plant extract (because of the natural anti oxidant activity by the presents of Vitamin C, Ascorbic acid, polyphenols, Quercetin and etc.)

*B. Result for antimicrobial activity*

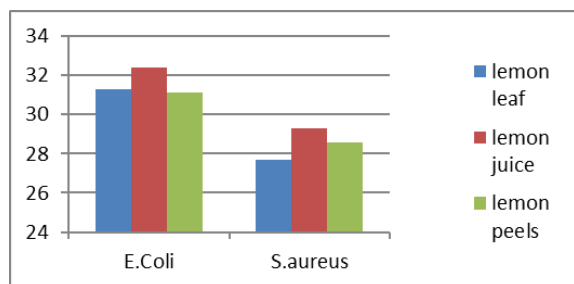


Fig. 4. Antibacterial assessment by ENISO 20645 Standard

The antibacterial activity of the finished fabric was tested based on the ENISO 20645 against Staphylococcus aureus and Escherichia coli. Nutrient agar plates were prepared by pouring 15 ml of media into sterile Petri dishes. The plates were allowed to solidify for 5mins and 0.1% of inoculums was swabbed uniformly and dried for 5 minutes. The finished fabric with the diameter of  $2.0 \pm 0.1$ cm was placed in the surface of medium and plates were kept about 37°C for 24 hours. At the end of incubation, the zone of incubation formed around the fabric was measured and recorded. Very good results to the lemon plant extract treated cotton fabric as shown above. In reality the cotton shown very low its nature itself allows the bacterial growths, now it is been enriched by the lemon plant extract.

**4. Conclusion**

To conclude, after analyzing various methodologies of existing methods, a new method is proposed. The necessity of protecting humans from harmful UV radiation is obvious when faced with a thinning down of the ozone layer and the growth of skin cancer. Various factors affecting the sun protection and the effective measure to improve the protection clearly indicate that UPF of a fabric is dependent on many factors. An efficient result of bacterial free with UV protection finish on cotton fabric from the development of lemon plant extracts like Juice, Peel, Leaf are analyzed using appropriate testing methods is given.

The present work shows that, Juice, leaves oils of all cultivars under investigation exhibited more potent antioxidant and antimicrobial activities than the lemon peels extraction finished fabric because in which limonene only available. On comparison of UPF values of different lemon plant extract with cotton finishing by microencapsulation exhibits the effectiveness of UV protection is in the order Lemon peels < Lemon Leaves < Lemon Juice.

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