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Development of Ultraviolet Protective Fabric with Natural Herb

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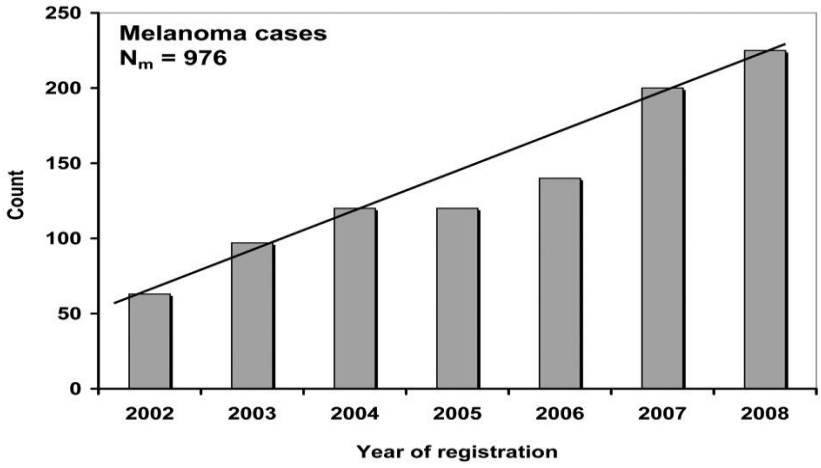
ABSTRACT

Effective textiles are a part of technical textiles that are defined as comprising all those textile-based products that are used principally for their performance or functional characteristics rather than their aesthetic or decorative characteristics. protective clothing is specially designed for sun protection and generally produced from the fabric rated for its level of ultraviolet (UV) protection. Ultraviolet rays constitute a very low fraction of the solar spectrum but influence all leaving organism. The sun is the principal source of UV exposure for most people. Exposure to the sun is known to be associated with various skin diseases, skin cancers, accelerated skin aging and other eye diseases, and probably has an adverse effect on persons ability to resist infectious diseases. The rating system of fabric specifies an ultraviolet protection factor (UPF) value, which can be thought as a time factor for the protection of Caucasian skin compared to exposure without exposure without any protection from sun's UV as a means of protecting skin from damage. The shorter the wavelength, the higher the energy of radiation.UVA rays account for 90 to 95% of UV radiation that reaches the earth. While UVB makes only 5 to 10% of solar radiation, its high-energy damages surface epidermal layers and cause sunburn.UVB is strongest particularly between 10 AM to 4 pm from April to October and UVA present equally throughout daylight hours and throughout seasons both types of UV rays can cause skin cancer because they damage skin cells and alter their DNA, and also causes premature aging of the skin. A novel weave structure and denier (related to thread count per inch) may provide the sun protective properties. nowadays textiles and fabrics used for sun protective clothing are pre-treated with chemically modified UV-inhibiting ingredients during manufacturing to enhance their effectiveness, here in this paper author tried to use some environment-friendly natural ingredients as an alternative to chemically modified UV-inhibiting ingredients. All-natural ingredients from herbs like green tea leaf, pudina, and neem leaf extracts are used and experimental findings related to UPF(Ultraviolet protection factor) are discussed.

Keywords-- Ultraviolet, Diseases, Protective Clothing, Ingredients, Herbs

I. INTRODUCTION

The problem that humans dealing with harmful UV radiation is not unknown to the world , Incidence of skin cancer increasing since last few dacades. The largest incidence is seen in the white population. Conventional wisdom has it that the incidence of all varieties of skin cancers is lower among Indians due to the protective effects of melanin.[1] Refering to the studies done in croatia (2002 to 2008) one can easily relate the seviarity of the situation (fig 1) skin cancer will soon become a major public health problem. It is therefore impotent to study various protective devices and one of which is a proper UV clothing[2].



The major cause of skin cancer is known to be a long exposure to solar ultraviolet (UV) radiation. Due to decline in the thickness of Ozone layer more UV light reaches the ground and cause series of skin diseases such as acceleration to skin ageing, photo dermatosis(acne) and even skin cancer.

There are indications that other parts of solar spectrum (e.g. blue light) might also have effects on skin

and vision[2]. In addition to its carcinogenic potential, both A and B UV radiation are also known to be immune suppressive.

The UVR (ultraviolet radiation) covers the wavelength range 100-400nm and is arbitrary divided into three bands of different bands of different wavelength. The divisions first proposed by the second international congress on Light in 1932were as fallows. UVA 400-320nm,UVB 320-290nm and UVC 290-200nm. UVC is totally absorbed by atmospheric ozone ,has minimal penetration to the surface of the Earth and thus has little effect on human health, Ninety percent of UVB is absorbed by atmosphere ozone ,while UVA passes though the atmosphere with little change [4]. Thus the solar ultraviolet radiation of importance to human health consists of UVA and UVB, there fore the main UV radiation that should be blocked by textiles are UV-A and UV-B.

Various factors affect the ability of fabrics to provide enough protection from ultraviolet radiation (UVR) such as Chemical composition, fabric construction, textile auxiliaries, colour and finishing processes etc, most of the times dyes used provide good resistance against the ultraviolet light transmittance , and the protection level generally increases with the increase in dye concentration, Light colours reflect solar radiation more effectively than the dark ones allowing incident radiation to penetrate the fabric supported by reflecting actions(scattering).[5]

Most of the studies previously done used synthetic dyes from petrochemical sources through hazardous chemical processes which not only became the main cause of threat to environment but also human body health is also affected. [6]

The reason for increase interest to use natural dyes on account of their high compatibility with the environment as well as availability of various natural coloring resources like ,plants, minerals, fugi and animals[3]. It was earlier reported that some natural dye dyed the fabric in elegant colours but impart antibacterial and ultraviolet protection.[6]

The ultraviolet protection is dealt with the rating system for fabrics specifies an Ultraviolet protection factor(UPF)value, which is nothing but a time factor for the protection of Caucasian skin compared to exposure without any protection. For example if the person would show visible erythema (sun burn),fabric with a UPF of fifty extends that time to five minute times the protection factor, i.e. 250 minutes approximates to four hours. For evaluating the UPF scientific methods have been developed and specified according to (AS/NZ) Austrelia/New Zealand standard 4399:1996[2],other nations and regions have produced their own standards based on this original work, e.g.AATCC183:2004[2] With ASTM D6544and ASTM D6603 in the United States and EN 13758-1 in Europe[7]The potential of UV radiation to cause skin damage rises exponentially with decreasing wave length . UV light at 280nm is 1000 times more damaging than light at 340 nm so a fabric ability to block UV-B is the most important factor in preventing the negative side effects of sun exposure. [7]

II. EXPERIMENTAL

Materials and Chemicals

Three different plain woven cotton fabric are sourced from the local market , the fabric sourced consist of plain woven slub cotton fabric, plain woven cotton Sheeting fabric and plain woven cotton Satin fabric, green tea dried leaf, pudina leaf brought from the local market and Neem leaf are collected from the tree available in NIFT, Bhubaneswar premises. Methanol(CH_3OH) with purity ≥ 99.0% was used from dyeing and printing lab.

Extraction of green tea leaf, pudina leaf and Neem leaf dye:

The green tea leaf, pudina leaf and Neem leaf are dried in the day light for 32 hours, the dried leaf are again dried in the hot air oven for 5 min at 50^0C. The dried leaf are grounded in the powder form. 6 gm of powder is added to 100 ml of methanol and kept for 48 Hrs in glass container . the solution is steered by spoon after every 6 Hrs interval. The solution is filtered to remove the insoluble residue and the resultant filtrate is heated continuously to get the leaf extract powder at 50 to 70^0 C which is used as the dye stuff for further dyeing.

Dyeing Procedure

The fabric smaples were padded by the extract of the different solutions by using a laboratory padding mangle by pad dry cure method then samples were dried in open air and cured using hot air oven.

III. TEST AND ANALYSIS

UV protection measurement- calculations to determine UPF as defined by AS/NZS4399:1996, AATCC 183:2004 and EN 13758 involve measurement of the percent transmission of the fabric samples across the UV spectrum weighted by internal weighing factor at different wave lengths . The AS/NZS 4399:1996 method is particularly convenient because it does not specify any preconditioning of the fabric and involves only measurements on dry fabric**.**

A spectrophotometer was used to evaluate the UV protection by measuring the Ultraviolet radiation transmittance value of each fabric across the wave length range 280-400nm, which includes UV-A and UV-B. The Ultraviolet Protection factor (UPF) was obtained using spectrophotometer Macbeth-FX600.

IV. RESULT AND DISCUSSION

Readings were taken on the all three different samples of cotton fabrics with little difference in the composition of fabric in terms of the type of yarn used and difference in their construction in view of their end

use. The spectrophotometer test results related to all three untreated samples are taken and summarized in Table 1.

Sample 1 has shown comparatively lower values for UPF,UVA% and UVB% , it might be because of the slub yarn used in the construction of fabric where the incidence of light is not able to refracted uniformly because of the uneven density the yarn have and the surface of the fabric is uneven the UV values are very contrary to the comfort values of the slub cotton fabric. Sample 2 and 3 has shown comparatively better results than the sample one it might be because of the weave construction difference, sample 3 which is cotton satin has shown the best result because of the even surface it provide to the cloth.

Table 1: Untreated samples

Sample No	Name of the Fabric	UPF	UVA Blocking %	UVB Blocking %
1	Cotton Slub	11.2	84.25	86.15
2	Cotton Sheeting	12.5	90.17	91.56
3	Cotton Satin	14.8	93.86	94.29

When all the three sample were treated with the three different extract, It was observed that the all relevant values in Table 2 has shown incremental behavior in all the categories like UPF,UVA% and UVB%, as discussed earlier the dye stuff of all the components used may have change the surface characteristics of all the three samples and subsequently the values related to UPF, UVA% and UVB% has shown incremental growth. It is observed that the satin cloth shown better result in all the categories when treated with three different extract, however in contrary to above when cotton sheeting fabric is treated with neem extract it shows better results for UPF value than other two fabrics.

For sample 1 (cotton slub) when treated with green tea leafs the values related to UPF,UVA% and UVB% has gone approximately doubled when compared to same sample is treated with other two extracts it might be because the extract of green tea leaf shown better leveling properties and typical structure of slub yarn caused to accommodate more molecules of the tea leaf extract and able to provide more even surface for incidence and later for the refraction also. It is also observed that the performance of application of green tea leaf extract on all the samples is excellent where the all values shown a significant difference.

Table 2: Treated sample with extract

Sample No	Name of the Fabric	Name of the Extract	UPF	UVA Blocking%	UVB Blocking %
1	Cotton Slub	Pudina	14.11	90.51	94.12
2	Cotton Sheeting		16.92	90.48	94.9
3	Cotton Satin		20.71	95.52	95.64
1	Cotton Slub	Neem	18.12	85.56	87.56
2	Cotton Sheeting		22.15	92.15	94.1
3	Cotton Satin		21.1	92.4	91.5
1	Cotton Slub	Green Tea leafs	32.45	95.25	96.25
2	Cotton Sheeting		28.53	94.79	95.47
3	Cotton Satin		38.25	95.18	98.25

All the relevant result related to treated and untreated samples with three different extract are summarized in table 3 to have better comparison and analysis , when the sample 1,2 and 3 are compared on the basis of three different extract treatment ,sample 1 (cotton slub) has shown incremental behavior when treated with extracts of Pudina, Neem and green tea leaf as far as the UPF value is concerned , the same trend is not continued in the values of UVA% and UVB% when sample treated with neem extract and there is no significant difference observed between treated and untreated sample. It is also observed that the behavior of neem extract is remain same with sample no 2(cotton Sheeting) and sample No.3 (cotton satin) where the difference between treated and untreated samples is not significant.

Table3: Comparative chart of treated and untreated samples

Sample no	Name of the fabric	Untreated fabric & Treated extract fabric	UPF	UVA blocking %	UVB blocking %
1	Cotton Slub	Untreated	11.2	84.25	85.00
		Pudina	14.11	90.56	94.12
		Neem	18.12	85.56	87.56
		Green tea leaves	32.25	92.25	96.25
2	Cotton sheeting	Untreated	12.50	90.17	91.56
		Pudina	16.92	94.48	94.90
		Neem	22.15	92.15	94.10
		Green tea leaves	28.53	94.79	95.47
3	Cotton Satin	Untreated	14.8	93.00	93.00
		Pudina	20.71	95.52	95.64
		Neem	21.10	92.40	91.50
		Green tea leaves	38.25	95.18	98.25

V. CONCLUSION

According to the findings of the work that the major factor that contribute to the difference in values related to UV radiation are primarily depend on the type of extract used to treat the sample and secondly depend on the composition and construction of the fabric.

It is observed that the extract of green tea leaf has brought the significant difference in the values referring to UPF, UVA% and UVB%

Considering the availability neem tree leaves and its ability to protect UV radiation may be considered as positive finding of this work even though it shows moderate results.

The another finding of this work is that how the different weave and construction of the same component fabric affecting the UV radiation value where it was observed that how cotton satin sample is more beneficial for UV protection than cotton sheeting and cotton slub.

There might be possibility that because of the difference in size of the dyestuff molecule and ability to form the bonding between dye stuff and material is weak and some extracts like Pudina have not shown the significant result related to UV radiation on all the types of samples

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