UV PROTECTIVE FABRICS BY APPLICATION OF BALL MILLED NEEM TREE LEAVES

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ABSTRACT

As the UV radiation is harmful to human skin, the aim of this research was to develop UV protective fabrics. The neem tree (Azadirachta indica) has many compounds in its every part. These compounds possess UV protective properties. Neem tree (Azadirachta indica) leaves were ball milled to obtain fine powder. Particle size of powder was analyzed by Laser Scattering Particle Size Distribution Analyzer. The obtained powder was applied to 100% cotton fabric. The surface morphology of fabric was observed by scanning electron microscopy (SEM). Subsequently fabric was examined against ultraviolet radiation. Treated fabric showed excellent UV blocking. Furthermore the bending rigidity of the fabric was examined. After coating bending rigidity of fabric was increased. Lastly the effect of washing was examined on UV protection. The fabric showed moderate wash durability.

Keywords: Azadirachtaindica, Neem, Ball milling, UV protective fabrics,

1. INTRODUCTION

UV protective clothing can protect human skin from UV radiations [1]. Finishing of fabrics with plant extracts or particles to impart required properties is the safest way. Many plants found all over the world have UV protective properties. Aloe vera, tea plant leaves, neem, mint, and tulsi are some of them [2].

Neem (Azardira Indica) is a tree that is found abundantly in South Asia and considered to be important due to its beneficial properties. It is evergreen tree that has many organic compounds in its different parts, however major compound in it is Azardirachitin. Azardirachitin is an effective antimicrobial and UV blocking agent [3].

Chemicals being used to extract desired compounds from different parts of plants are toxic and not eco-friendly. Pulverization (ball milling) is a novel eco-friendly, a top down technique to obtain fine powder [4]. The aim of this research work is to prepare fine powder from neem leaves with ball milling method and its application on textile fabric for UV protection.

2. EXPERIMENTAL

Ball milling of neem leaves was done with fritsch pulverisette 7 high energy planetary ball mill for the duration of 3 hours. The particle size distribution of milled leaves was examined with laser scattering particle size distribution analyzer Horiba LA 920. Coating dispersions were made at three concentrations (1%, 3% and 5%). 1% Acramin SW multiple binder and the dispersing agent was also added under vigorous stirring. Cotton fabrics were immersed, padded, dried at 100 ºC and cured at 120 ºC. Surface morphology of coated fabrics was examined by scanning electron microscope (SEM) TS5130 Vega 3 Tescan. Ultraviolet

protection efficiency evaluated with the help of UV–vis-NIR Spectrophotometer (UV-3101PC) as per AATCC 183–2000 standard. The Instrument TH-7 was used to evaluate bending rigidity. The wash durability of coated fabrics was investigated according to ISO 105-C06 in order to evaluate their activity for UV protection against washing.

3. RESULTS AND DISCUSSION

Figure 1 describes the particle size distribution It shows that distribution is unimodal with mean particle size 1.59 micrometer, median 0.93 micrometer and mode 0.82 micrometer.

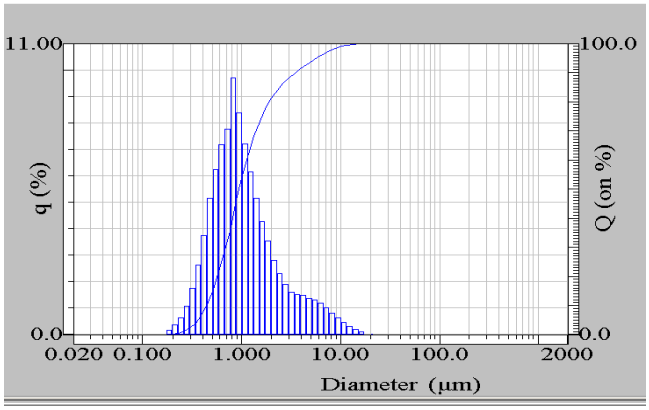

Figure 1 Particle size distribution

Surface morphology analyzed by SEM is shown in figure 2. It reflects that as the concentrations of leaves particles were increased the particles were distributed more evenly covering more area of fabric.

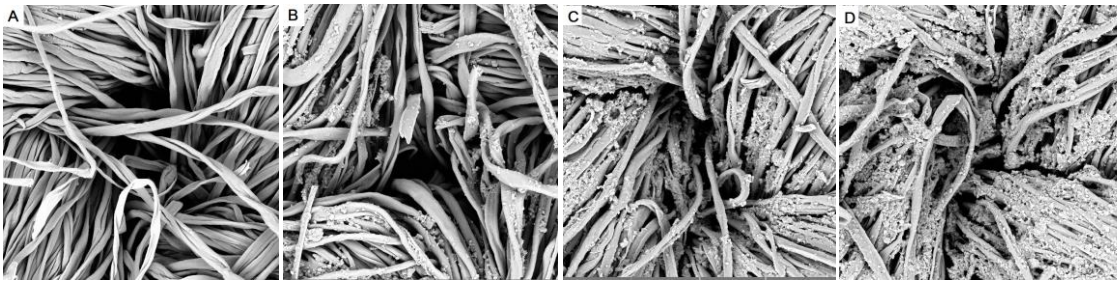

Figure 2 SEM images (A uncoated B 1% coating, , C 3% coating, D 5% coating)

Table 1 shows that with increasing the concentration of neem leaves particles UVR blocking was also increased. Excellent UV blocking behavior was observed at 5% neem leaves particles coated fabric. It is clear from the table 1 that uncoated fabric has UPF only 4.59, however with increasing the coating percentage the UPF was also increased and maximum UPF value 59.23 was observed at 5% neem leaves particles coating. Table 2 shows that there was a decrease in UV blocking and UPF value after each wash cycle. However, 5% coating showed excellent UPF value for 5 wash cycles and very good UPF value for 10 wash cycles.

Table 1 UV protection behavior of coated and uncoated fabrics

Sample	UVA Blocking (%)	UVB Blocking (%)	UPF
Untreated	72.74	78.71	4.59
1% neem particles	94.06	95.68	23.02
3% neem particles	97.64	97.79	48.12
5% neem particles	98.12	98.83	59.23

Table 2 UV protection behavior of coated and uncoated fabrics after washing

Sample	UVA Blocking (%)	UVB Blocking (%)	UPF
After 5 washes			
Untreated	72.57	78.64	4.52
1% neem particles	92.01	94.52	17.70
3% neem particles	95.89	96.85	30.74
5% neem particles	97.47	98.20	46.79
After 10 washes			
Untreated	72.23	78.44	4.47
1% neem particles	87.35	91.15	10.83
3% neem particles	93.72	95.43	21.71
5% neem particles	94.52	96.24	26.12

Samples coated with neem particles significantly indicated an increase in the bending force (Fm) as well as bending rigidity (B) in warp and weft of the fabric as disclosed in Table 3.

Table 3 Bending force and bending rigidity of coated and uncoated fabrics

Sample	Bending Force (Fm) mN		Bending Rigidity (B)x10-4Nm2/m	
	Warp Wise	Weft Wise	Warp Wise	Weft Wise
Untreated	8.23	5.91	0.057	0.041
1% neem particles	13.23	8.79	0.093	0.061
3% neem particles	19.94	13.08	0.14	0.092
5% neem particles	22.57	15.32	0.15	0.11

4. CONCLUSIONS

In this research work, it was shown that the ball milling technique is very useful to convert neem leaves into fine powder. UPF and UV blocking values of coated fabrics with neem fine powder presented the excellent results up to 5 washing with increased bending rigidity.

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