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Phytotherapeutic textile innovations: A non-pharmaceutical approach to sleep disorder

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Traditional medicinal herbs are increasingly used for practical finishes on textile materials for a healthier lifestyle. Medicinal herbs can be used for managing lifestyle diseases as they are safer to use and they do not cause any allergic reactions. One of the most common health problems in the modern society is sleep disorder. Conventional treatment causes dependency on the medicines which can lead to severe health care consequences in future. An alternative to this is the usage of herbal remedies which can positively influence the sleep pattern and improve the sleep quality. Herbal medicines when infused into eco-friendly textile materials can offer a promising natural alternative to conventional medical treatments. The research paper aims to study and optimize herbal ratios and their application to ecofriendly textile materials for developing herbal healthcare products and evaluate the performance of the developed products for alleviating the symptoms of sleep disorder.

Keywords: Herbal textiles, Medicinal herbs, Sleep disorder

1 Introduction

Sleep is an essential component in our daily routine which regulates and promotes the physical, mental, social, and emotional well-being of a person[1]. It is a physiological condition of the nervous system which controls many of the life function.[2]Adequate sleep restores the body and makes it fit for the normal functioning of the body[3]. One of the most common disease conditions seen in the modern society with lifestyle changes is the sleep disorder. Conditions which affect the normal sleep patterns in a human body is called as sleep disorder. When there is a difficulty in the initiation, maintenance, duration in the quality of sleep it is called as insomnia[4]. Insomnia is a threatening condition for an individual's personal and occupational life as sleep restores health and provides relaxation to the brain. It can also cause poor concentration in the work, poor work quality, and low productivity, if not treated well. If sleeplessness is prolonged without proper treatment, it can result in total collapse of an individual. Plants have been used in traditional, modern, folk medicines, and as food supplements. In the recent years, there has been an increasing awareness in the use of herbal drugs. International organizations, such as the World Health Organization (WHO), are placing great importance on the growth and promotion of natural products, while concurrently advocating that non-pharmaceutical therapies, particularly for mild to moderate conditions such as non-severe insomnia, as the first-line interventions prior to the use of chemical medications. There are many medicinal herbs in Ayurveda which are utilized for its sedative and relaxant properties. The extracts of these medicinal plants can be used to treat insomnia, brain fatigue, and loss of memory[5]. Medicinal herbs can be used as oil for massaging head, whereas perfumes of some flowers and pleasant music will also help one to sleep[6]. Dyeing of textile materials with medicinal herbs devoid the use of any chemicals and do not pollute the environment. It helps to restore the body's balance which will strengthen the immune system[7].Use of herbal coated textile materials provide protection against biological toxins and pathogens[8]. Fibres which are eco-friendly in nature are resistant to mould and mildew and they do not need any chemicals or pesticides to grow. While synthetic fibres become a waste and pollute the environment, eco-friendly fibres are naturally biodegradable. Many of the eco - fibresare hypoallergenic and they have natural antibacterial properties. There are innumerable number of important medicinal herbs with therapeutic value and many ecofriendly potential sustainable fibres with

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advantageous properties that can be infused with medicinal herbs to produce herbal treated eco-textile materials. The research aims to develop an eco-friendly herbal healthcare textile product which will alleviate the symptoms of insomnia and thereby induce good sleep for patients suffering with this sleep disorder.

2Materials and Methods

2.1 Selection of Ecofriendly Yarns and Fabric Construction

100% ecofriendly yarns of Wool, Soy and Milk yarn were selected and blended with cotton in the ratio of 50:50. The selected 100% yarns and 50:50 cotton blend yarns were converted into fabric by handloom weaving and knitting methods (Table 1). Thus, 12 ecofriendly fabrics were developed for the study. The yarn strength and elongation of the developed yarns were studied and recorded (Table 2).

2.2 Selection Medicinal Herbs

Three medicinal herbs namely Santalum Album (Sandalwood) Vetiveria Zizanioides (Vetiver) Phyllanthus Emblica (Amla Powder) were selected for the study. The herbs collected were washed, cleaned, dried, and powdered and ethanolic extraction was done. The extracted medicinal herbs underwent phytochemical screening test for identification of secondary metabolites and the results are record in Table 3.

2.3 Optimization of Herbal Ratios for Antibacterial Activity

Based on the phytochemical Screening test, the three selected herbs were optimised by antibacterial activity. From the results of a preliminary test conducted using 10 herbal ratio proportions, the final qualitative analysis was carried for 6 handloom test samples by selected best proportions of 1:1:1, 1:2:3, 3:2:1 and 2:3:2 for optimizing the herbal combination by ENISO 20645 method (Table 3). The results of antibacterial activity for the selected medicinal herbal combination consisting of Santalum Album (SA) Vetiveria Zizanioides (VZ) Phyllanthus Emblica(PE) to optimize the herbal ratios 1:1:1, 1:2:3, 3:2:1 and 2:3:2 was recorded. (Table 4, Fig. 1, Fig. 2). The functional groups present in the medicinal herbal combination of the selected optimized ratio was studied and recorded through FTIR spectroscopy (Table 5).

2.4 Application of the Optimized Medicinal Herbal Extracts to the Developed Fabrics

The selected optimized herbal extracts were applied to the developed hundred per cent and blended handloom and knit fabrics by dip pad dry method(D) and micro encapsulation (M) methods. The original and dyed fabrics were subjected to visual inspection to evaluate the colour, texture, lustre, odour and general appearance and the results were

Table 1 — Selection of yarns and fabric construction

Yarns	100% Handloom fabrics	100% Knitted fabrics
100% Wool yarns (100% W)	100% Handloom wool fabric (100% HW)	100% Knit wool fabric (100% KW)
100%Soy yarns (100% S)	100% Handloom soy fabric (100% HS)	100% Knit soy fabric (100% KS)
100% Milk yarns (100% M)	100% Handloom milk fabric (100% H M)	100%Knit milk fabric (100% KM)
50:50 Wool cotton blend (50:50 WC)	50:50 Handloom wool cotton fabric (50:50 HWC)	50:50 Knit wool cotton fabric (50:50 KWC)
50:50 Soy cotton blend (50:50 SC)	50:50 Handloom soy cotton fabric (50:50 HSC)	50:50 Knit soy cotton fabric (50:50 KSC)
50:50 Milk cotton blend (50:50 MC)	50:50Handloom milk cotton fabric (50:50 HMC)	50:50Knit milk cotton fabric (50:50 KMC)

Table 2 — Yarn strength and yarn elongation of selected yarns

Selected spun yarns	Single yarn strength		Single yarn elongation	
	Avg. Strength, g/tex	CV % of Strength	Avg. Elongation, g/tex	CV % of Elongation
100% W	954.7	13.42	13.58	15.52
100% S	280.9	10.92	14.95	7.20
100% M	214.1	12.62	16.23	20.18
50:50 WC	50:50 WC	765.8	12.14	9.56
100% SC	50:50 SC	351.8	14.76	15.43
50:50 MC	50:50 MC	287.6	14.89	16.3

recorded (Table 6).The results of the SEM analysis carried out in the micro encapsulated handloom fabrics to study the fixation of the dye is recorded in Fig. 4, 5.

2.5 Developing Herbal Healthcare Product for Sleep Disorder

The hundred per cent and 50:50 blend handloom and knit herbal finished dip pad dry and micro encapsulated wool, soy and milk fabrics were used for develop sleep cushions for sleeplessness or insomnia. Sample of the sleep cushion shown in Fig. 6. The developed herbal finished products were evaluated for its aesthetic appearance and curative performance among the selected patients and the results are recorded in Table 7 and 8.

3 Results and Discussion

3.1 Analysis of Yarn Strength and Elongation

From the results given in Table 2, it was observed that all the developed spun yarns had good strength and elongation which makes it suitable for weaving and knitting methods.

3.2 Results of Phytochemical Screening of Selected Medicinal Herbs

The results of the phytochemical screening tests from Table 3 indicates that all the medicinal herbs selected are good in advantageous phyto-constituents. Presence of alkaloids indicated that the herb can be used as an analgesic, local anaesthetic, muscle relaxant and for hypotensive conditions. They also have anti- bacterial and anti-microbial properties. Flavonoids exhibit anti-viral, anti- inflammatory, cardio-protective, anti-ageing, anti-cancer, and anti-diabetic activities. Tannins, phenols and saponins are known to be anti-microbial, anti-fungal anti-inflammatory, neuro protective and destressing agents. Phyllathus Emblica can be used as natural mordant besides its medicinal properties.

3.3 Analysis of Antibacterial Activity of the Selected Medicinal Herbs

The results of the antibacterial activity from Table 4 reveals that among the four ratios 1:1:1, 1:2:3, 3:2:1 and 2:3:2 of herbal combination, comprising of Santalum Album (SA) Vetiveria Zizanioides (VZ)

Table 3 — Phytochemical screening of selected medicinal herbs

Selected Medicinal Herbs	Phytochemical screening tests								
	Alkaloids			Flavonoids	Glycosides	Saponins	Tannins and phenols		Sterols and terpenoids
	Mayer's test	Wagner's test	Dragondroff's test	Shinoda test	Salkowski's test	Froth test	Lead acetate test	Ferric chloride test	Libermann Burchard test
Santalum Album	+	-	-	+	+	+	-	-	+
Vetriveria Zizanoides	-	+	-	-	+	+	-	+	+
Phyllathus Emblica	+	-	-	+	+	-	+	+	+

Note: *+ present - Absent*

Table 4 — Analysis of herbal extracts for antibacterial activity

Herbal Combination	Analysis of herbal extracts for antibacterial activity Zone of Inhibition											
Selected Ratios of Medicinal Herbs	Treated Samples											
	Gram Negative Organism (Escherichia Coli)						Gram Positive Organism (Bacillus Subtilis)					
	100% HW	100% HS	100% HM	50:50 HWC	50:50 HSC	50:50 HMC	100% HW	100% HS	100% HM	50:50 HWC	50:50 HSC	50:50 HMC
1:1:1	27	33	28	31	27	29	30	33	24	30	27	26
1:2:3	32	30	22	31	31	28	30	30	24	31	28	27
3:2:1	30	30	30	32	30	27	32	30	26	33	25	25
*2:3:2	33	34	31	33	32	30	33	35	28	34	30	29

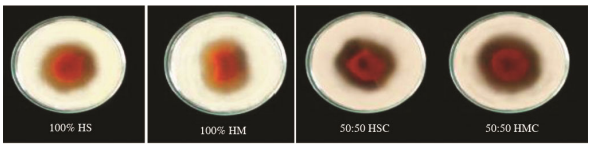

Fig. 1 — Antibacterial activity of gram-positive bacteria in the ratio 2:3:2

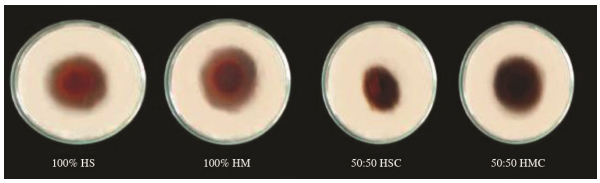

Fig. 2 — Antibacterial activity of gram-negative bacteria in the ratio 2:3:2

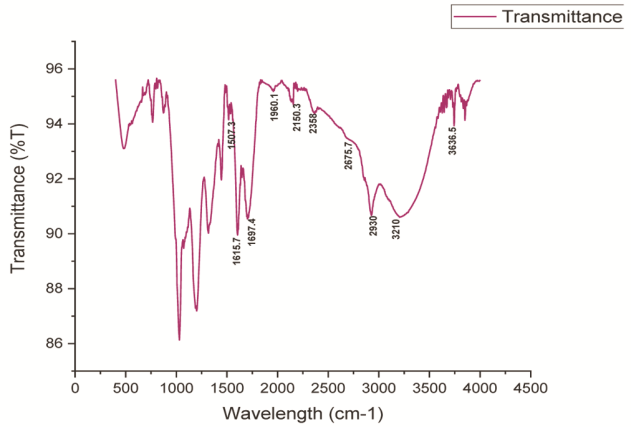

Fig. 3 — FTIR spectroscopy of optimized ratio 2:3:2

Phyllanthus Emblica (PE) , the highest zone of inhibition was displayed in the ratio 2:3:2 for all the treated 100% HW 100% HS, 100% HM and50:50 HWC, 50:50 HCS, 50:50 HCM and blend handloom fabrics for Escherichia Coli (gram negative) and for Bacillus Subtilis (gram positive) respectively (Fig. 1, Fig. 2). Hence for dyeing the developed fabrics, the optimized ratio 2:3:2 was selected.

3.4 Results of FTIR Spectroscopy of Selected Medicinal Herbs

From the results of Fig 3 and Table 5 it was observed that herbal combination comprising of Santalum Album, Vetiveria Zizanioides and Phyllathus Emblica in the optimized ration 2:3:2 shows the presence of alchohol, carbon dioxide, azide, aldehyde and carboxyl groups with characteristic bands of 3636.5cm^{-1}, 3210cm^{-1}, 2358.8cm^{-1},2150cm^{-1}, 2676.7cm^{-1} and 2930cm^{-1}.The spectrum also shows peak values of 1615 cm^{-1}, 1697.4cm^{-1}, 1507.3cm^{-1} and 1950.1cm^{-1} which indicates the presence of α, β-unsaturated ketone, conjugated aldehyde, nitro compound and allene groups.

Table 5 — FTIR spectral peak values and functional groups

Herbal Combination (SA, VZ, PE) in the ratio 2:3:2

Peak values	groups	Compound class
3636.5	O-H stretching	alcohol
3210.3	O-H stretching	alcohol
2358.8	O=C=O stretching	carbon dioxide
2150.3	N=N=N stretching	azide
2675.7	C-H stretching	aldehyde
2930	O-H stretching	carboxylic acid
1615.7	C=C stretching	α,β-unsaturated ketone
1697.4	C=O stretching	conjugated aldehyde
1507.3	N-O stretching	nitro compound
1960.1	C=C=C stretching	allene

3.5 Analysis of Visual Evaluation of Original and Treated Handloom and Knit Fabrics

The results of visual evaluation of handloom and knit dip- pad dry (D) and micro encapsulated (M) fabrics from Table 6 reveals that, the handloom and knit dip pad dry and micro encapsulated fabrics were good in color, medium in texture, lusture and had a pleasant odour. The general look of the dip pad dry and micro encapsulated treated fabric sal together had an even appearance.

3.6 SEM Analysis of Micro Encapsulated Fabrics

Handloom (H) and knit (K) materials consisted of the same type of yarn in both warp and weft, wales and course directions. Hence to understand the binding of herbal micro capsules to the fabric surfaces, handloom fabrics in the optimized ratio 2:3:2 were subjected to SEM analysis to confirm the binding of micro capsules. The findings showed that the handloom fabrics 100% HW, 100% HS and 100% HM displayed a uniform deposition of the herbal capsules with a reduced pore size on the surface of the fabrics(Fig. 4), while the 50:50 HWC, 50:50 HSC, and 50:50 HMC images revealed the herbal deposition on the surface of the fabrics with some protruding fibres and gap in the capsules (Fig. 5).

3.7 Aesthetic and Performance Analysis of Developed Herbal Dyed Health Care Products

The developed health care products aesthetic properties like design, comfort of wearing the product, texture and suitability to the ailments were evaluated by the selected patients. From Table 7, the results obtained showed that, the design and suitability of the handloom and knit health care products were ranked as excellent whereas the texture and comfort of using the health care products were rated as very good by all the subjects for all the treated products.

Table 6 — Visual inspection of treated handloom and knit dip-pad dry and micro encapsulated fabrics

H,KDIP-PAD DRYFABRICS	Visualevaluation of handloom,H,Knit (K) dippaddryfabrics															H,K MICRO-ENCAPSULATEDFABRICS	Visualevaluation of handloom, H,Knit, K MicroencapsulatedFabrics														
	COLOUR			TEXTURE			LUSTURE		ODOUR			GENERALAPPEARANCE					COLOUR			TEXTURE			LUSTURE		ODOUR			GENERALAPPEARANCE			
	Good	Fair	Poor	Soft	Medium	Rough	High	Medium	Dull	NoOdour	Pleasant	Unpleasant	Even	Partially even	Uneven		Good	Fair	Poor	Soft	Medium	Rough	High	Medium	Dull	NoOdour	Pleasant	Unpleasant	Even	Partiallyeven	Uneven
100%HS^{D}	100	-	-	100	-	-	100	-	-	-	100	-	100	-	-	100%HS^{M}	100		-	100	-	-	-	100	-	-	100	-	100	-	-
100%HM^{D}	100	-	-	100	-	-	100	-	-	-	100	-	100	-	-	100% HM^{M}	100		-	100	-	-	-	100	-	-	100	-	100	-	-
50:50HSC^{D}	100	-	-	100	-	-	100	-	-	-	100	-	100	-	-	50:50HSC^{M}	100		-	100	-	-	-	100	-	-	100	-	100	-	-
50:50HMC^{D}	100	-	-	100	-	-	100	-	-	-	100	-	100	-	-	50:50HMC^{M}	100		-	100	-	-	-	100	-	-	100	-	100	-	-
100%PS^{D}	100	-	-	100	-	-	100	-	-	-	100	-	100	-	-	100%PS^{M}	100	-	-	100	-	-	-	100	-	-	100	-	100	-	-
100%PM^{D}	100	-	-	100	-	-	100	-	-	-	100	-	100	-	-	100%PM^{M}	100	-	-	100	-	-	-	100	-	-	100	-	100	-	-
50:50PSC^{D}	100	-	-	100	-	-	100	-	-	-	100	-	100	-	-	50:50PSC^{M}	100	-	-	100	-	-	-	100	-	-	100	-	100	-	-
50:50PMC^{D}	100	-	-	100	-	-	100	-	-	-	100	-	100	-	-	50:50PMC^{M}	100	-	-	100	-	-	-	100	-	-	100	-	100	-	-
100%KS^{D}	100		-	100	-	-	100	-	-	-	100	-	100	-	-	100%KS^{M}	100	-	-	100	-	-	-	100	-	-	100	-	100	-	-
100%KM^{D}	100		-	100	-	-	100	-	-	-	100	-	100	-	-	100% KM^{M}	100	-	-	100	-	-	-	100	-	-	100	-	100	-	-
50:50KSC^{D}	100	-	-	100	-	-	100	-	-	-	100	-	100	-	-	50:50KSC^{M}	100	-	-	100	-	-	-	100	-	-	100	-	100	-	-
50:50KMC^{D}	100	-	-	100	-	-	100	-	-	-	100	-	100	-	-	50:50KMC^{M}	100	-	-	100	-	-	-	100	-	-	100	-	100	-	-

Table 7 — Aesthetic Evaluation of Developed Dip pad dry and Microencapsulated Handloom and Knit sleep Cushions

H, K Dip Pad Dry and Microencapsulated Sleep cushions	COLOUR			TEXTURE			LUSTURE			ODOUR			GENERAL APPEARANCE		
	Good	Fair	Poor	Soft	Medium	Rough	High	Medium	Dull	No Odour	Pleasant	Unpleasant	Even	Partially even	Uneven
100%HW^{D}	2	98	nil		98	2	nil	91	9	nil	100	nil	97	3	nil
100% HS^{D}	100	nil	nil	nil	100	nil	nil	100	nil	nil	100	nil	100	nil	nil
100% HM^{D}	100	nil	nil	nil	100	nil	nil	100	nil	nil	100	nil	100	nil	nil
50:50 HWC^{D}	97	3	nil	nil	97	3	nil	94	6	nil	100	nil	96	4	nil
50:50 HSC^{D}	100	nil	nil	nil	100	nil	nil	100	nil	nil	100	nil	100	nil	nil
50:50 HMC^{D}	100	nil	nil	nil	100	nil	nil	100	nil	nil	100	nil	100	nil	nil
100% KW^{D}	97	3	nil	nil	96	4	nil	93	7	nil	100	nil	92	8	nil
100% KS^{D}	100	nil	nil	nil	100	nil	nil	100	nil	nil	100	nil	100	nil	nil
100% KM^{D}	100	nil	nil	nil	100	nil	nil	100	nil	nil	100	nil	100	nil	nil
50:50 KWC^{D}	94	6	nil	nil	96	4	nil	95	5	nil	100	nil	94	6	nil
50:50 KSC^{D}	100	nil	nil	nil	100	nil	nil	100	nil	nil	100	nil	100	nil	nil
50:50 KMC^{D}	100	nil	nil	nil	100	nil	nil	100	nil	nil	100	nil	100	nil	nil

The developed herbal dyed handloom (H), and knit (K) healthcare products were given to ten patients with the corresponding conditions. They were instructed to use the sleep cushions for a certain period, and the outcomes were noted. From Table 8, the results of using the sleep cushions made for sleeplessness or insomnia, from herbal finished handloom and knit dip pad dry and micro encapsulated fabrics displayed that quality

Table 8 — Performance Evaluation of Sleep Cushion for Sleeplessness

HEALTHCARE PRODUCT	Fabrication	Performance Evaluation of Sleep Cushion for Sleeplessness IN %									
		HANDLOOM, H					KNIT, K				
		Quality of sleep			Continue to use		Quality of sleep			Quality of sleep	
		I	AI	NI	Y	N	I	AI	NI	Y	N
SLEEP CUSHION	100%W^D	100	nil	nil	97	3	100	nil	nil	100	nil
	100%S^D	100	nil	nil	100	nil	100	nil	nil	100	nil
	100% M^D	100	nil	nil	100	nil	100	nil	nil	100	nil
	50:50 WC^D	100	nil	nil	97	3	100	nil	nil	100	nil
	50:50 SC^D	100	nil	nil	100	nil	100	nil	nil	100	nil
	50:50 MC^D	100	nil	nil	100	nil	100	nil	nil	100	nil
	100%W^M	100	nil	nil	97	3	100	nil	nil	100	nil
	100%S^M	100	nil	nil	100	nil	100	nil	nil	100	nil
	100%M^M	100	nil	nil	100	nil	100	nil	nil	100	nil
	50:50 WC^M	100	nil	nil	97	3	100	nil	nil	100	nil
	50:50 SC^M	100	nil	nil	100	nil	100	nil	nil	100	nil
	50:50 MC^M	100	nil	nil	100	nil	100	nil	nil	100	nil

Key: I-Improved, AI-Average Improvement , NI–Noimprovement , Y-Yes, N-No

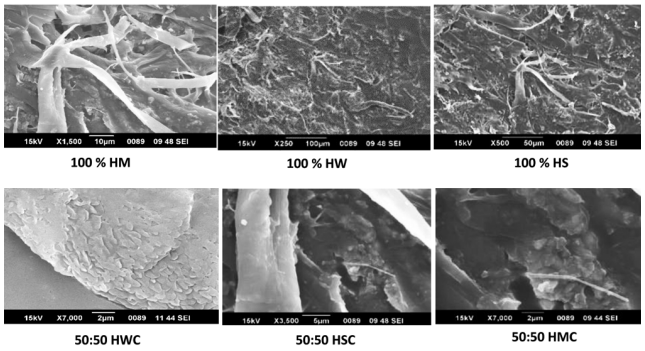

Fig. 4 — SEM analysis of 100% pure fabrics

Fig. 5 — Use of sleep cushions

of the sleep was improved very much after using the product for a period of one month while sleeping. All the subjects preferred to use the sleep cushion after the study period while 100% HW^D, 100%HW^M, 50:50 HWC^D, 50:50 HWC^M were liked by 97% for further use.

4 Conclusion

Textiles and clothing infused with medicinal herbs can protect the human body from various infections and pathogenic organisms. Today, as many of the pharmaceutical companies and research development team is involved in the isolation and extraction of medicinal plants to produce numerous medicinal drugs, the various parts of a medicinal plant like bark, leaves, root, fruits can be used for the extraction of potential medicinal compounds which can provide relief and cure to many of the human ailments. With this context in mind, an attempt was made to develop health care product for sleep disorder using ecofriendly fabrics like wool, soy, milk; to dye the same with selected herbal optimized extracts and to find out the efficacy of the developed product. From the results, it was seen that the developed fabrics were safer to use and reduced the symptoms of sleeplessness.

References

1 Liu C, He Z, Wu Y, Liu Y, Li Z, Jia Y & Xiang H, *Med Comm*, 6(3) (2025).
2 Holka-Pokorska J, Wichniak A & Lew-Starowicz M, *Psychiatry and Sexual Medicine*, (2020) 291.
3 Karna B, Sankari A & Tatikonda G, *StatPearls*, *(StatPearls Publishing, Treasure Island, FL*, (2025).
4 Shah N, Bang A & Bhagat A, *Indian J Psychiatry*, 52 (1) (2010) 255.
5 Sharma M, Sahu S, Khemani N & Kau R, *Int J Appl Biol Pharm Technol*, 4 (2) (2013) 214.
6 Rajendra N, Sandeep B & Gajanan P, *Int J Herbal Med*, 1(3) (2013) 68.
7 Mishra A & Gautam S, *Chemistry and Technology of Natural and Synthetic Dyes and Pigments*, (2020).
8 El-Shafei A, Shaarawy S, Motawe F H & Refaei R, *Egypt J Chem*, (2018).