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Analysis of Chemical Components and Antimicrobial Activity on Vetiver Extract for Home Textile Applications

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Abstract

Home Textiles is one of the most rapidly expanding sectors in the technical textile market. The scope of hometech envelops all textile materials used in home and hygiene applications should be sustainable and also free from hazards. The consumers are now increasingly aware of the hygienic life style and there is a necessity and expectation for a wide range of textile products finished with antimicrobial properties. From the plant kingdom, one of the abundant sources of strong natural fiber is *Vetiveria zizanioides* and it has numerous properties such as antimicrobial property and inherently filled with good aroma. The extract was prepared with *Vetiveria zizanioides* powder using the solvent. The chemical components and phytochemicals were identified and screened from the extract and then antimicrobial activity was analyzed on the extract against standard microorganisms. The quantitative and qualitative tests of antifungal activity were tested on the fabrics against *Aspergillus niger* and *Candida albicans* fungi and antibacterial activity against *Staphylococcus aureus* ATCC 25923 and Escherichia coli ATCC 25922 of both positive and negative bacteria. The test results depict the clear picture and benefits for medical and home textile applications.

Keywords: *Vetiveria zizanioides*; Antimicrobial; Box and behnken; Microorganisms; Home textiles

Introduction

Vetiver (*Chrysopogon zizanioides*, previously *Vetiveria zizanioides*) is a perennial grass and native to India. Vetiver can grow up to 1.5 meters high and form clumps as wide. The stems are tall and the leaves are long, thin, and rather rigid. Vetiver's roots grow downward, 2-4 meters in depth [1]. *Vetiveria zizanioides* is profoundly used in Ayurvedic medicine. The chemical constituents present in the plant are Vetiverol, Vetivone, Khusimone, Khusimol, Vetivene, Khositone, Terpenes, Benzoic acid,Tripene-4-ol, ß-Humulene, Epizizianal, vetivenyl vetivenate, iso khusimol, ß-vetivone, vetivazulene. Ayurvedic literature mentioned that plant is used as digestive, carminative stomachic, constipating, haematinic, expectorant, antispasmodic, antiasthmatic, antigout, anthelmentic, antimicrobical and diuretic [1-3].

Vetiver fibre was one of natural fibres from leaves. They are lignocellulosic biocomposites comprising α-cellulose-type-I, hemicellulose, lignin and low molecular weight compounds. Their main component is α-cellulose in nature [4-6]. Vetiver has many end uses such as are aromatic, antifungal, cooling, antiemetic, diaphoretic, haemostatic, expectorant, diuretic, stimulant, hysteria, insomnia, skin diseases, asthma, amentia, amenorrhoea, antispasmodic, kidney problems, gall stones, mosquito repellent, tonic and antioxidant [6-9]. Vetiver has been found to have better antimicrobial properties under laboratory conditions. It has been found that this vetiver gives bacterio-static and fungi-static properties against pathogens namely *Staphylococcus aureus* and Escherichia coli and also it has the good inhibition against bacteria and will prevent the growth of bacteria [9]. This vetiver also gives pleasant odor because of its inherent aroma characteristics nature [10]. Hence the present investigation aims at analyzing the chemical components and antimicrobial activity on vetiver extract for home textile applications.

Materials and Methods

Selection of plant

Vetiveria zizanioides the roots are stout, dense and aromatic; leaves are narrow, erect, keeled with scabrid margins. Vetiver grows wild in almost all plain states in India up to an elevation of 1200 meters. The vetiver roots were purchased from Agriculture University, Coimbatore.

Preparation of vetiver extract

The vetiver roots were shadow dried, choked and converted into powder form by using automatic machines. This vetiver powder was converted into solution form using solvents by soxhlet apparatus (Figure 1).

Identification of chemical components in vetiver root

The different chemical components and physical parameters were analyzed and identified. These chemical compositions will distribute the quality of the particular purpose. The identified chemical components from the vetiver plant comprised such as α-cellulose-type-I, hemicellulose, lignin and low molecular weight compounds. The main component α-cellulose was present in the vetiver in the nature itself.

Screening of phytochemical components in vetiver root

The Phytochemical examination of the extract was performed by the standard test methods and shown the presence of various phytochemical constituents in the plant. The phytochemical screening tests reveals the components in the root extract such as saponins, flavanoids, phenols and steroids were present where as tannins were absent in the extract.

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Assessment of Antimicrobial activity in Vetiver Root Extract

Antibacterial activity by agar diffusion test: 25 ml of nutrient agar was prepared and sterilized at 121°C for 15 minutes. Petri plates were autoclaved in hot air oven at 121°C for 30 minutes. 20 ml of Nutrient agar was poured into each of these plates and were allowed to solidify. 100 micro liters of 10 (-8) diluted culture was taken aseptically and poured onto the petri plates. This was spreaded by using L rod. The plates were incubated at 37°C for 24-48 hours then the microbial zone of inhibition were identified.

Antifungal activity by agar diffusion method: The antifungal activity of vetiver extracts were determined by agar diffusion method. 25 ml of potato dextrose was prepared and sterilized at 121°C for 15 minutes. Petri plates were autoclaved in hot air oven at 121°C for 30 minutes. 20 ml of potato dextrose was poured into each of these plates and were allowed to solidify. 100 micro liters of 10 (-8) diluted culture was taken aseptically and poured onto the petri plates. This was spreaded by using L rod. The plates were incubated at 37°C for 48-72 hours then the microbial zone of inhibition were identified.

Results and Discussion

Identification of chemical components in vetiver root

The chemical composition of vetiver root was identified and presented in the Table 1. The identified main chemical composition of lignocellulosic materials such as vetiver includes cellulose, hemicellulose, and lignin (Table 1).

Since the lignin content was below 20%, the vetiver extract can be more suitable for home textile applications.

Screening of phytochemical components in vetiver root

Phytochemical screening tests were performed and the test results were presented in the (Table 2).

From the Table 2, it has been revealed that *Vetiveria zizanioides* root extract has the phytochemicals such as Saponins, Flavanoids and Phenols present in it. The compound such as flavanoid and phenol represents the antimicrobial property. Hence it can be suitable for home and hygienic applications.

Assessment of antibacterial activity in vetiver root extract

The antibacterial activity of vetiver has been performed against gram positive and gram negative bacteria. The test results have been displayed in the (Table 3).

From the Table 3, it has been found that *Vetiveria zizanioides* extract of 50% concentration coated fabric shows highest antibacterial activity against positive pathogenic micro-organism namely *Staphylococcus aureus* than the negative pathogenic microorganism *Escherichia coli.*

Antifungal activity of vetiver root extract

The antifungal activity of vetiver has been performed against the micro organisms namely *Aspergillus niger* and *Candida albicans*. The test result has been shown in the Table 4.

From the Table 4, it has been found that *Vetiveria zizanioides* root

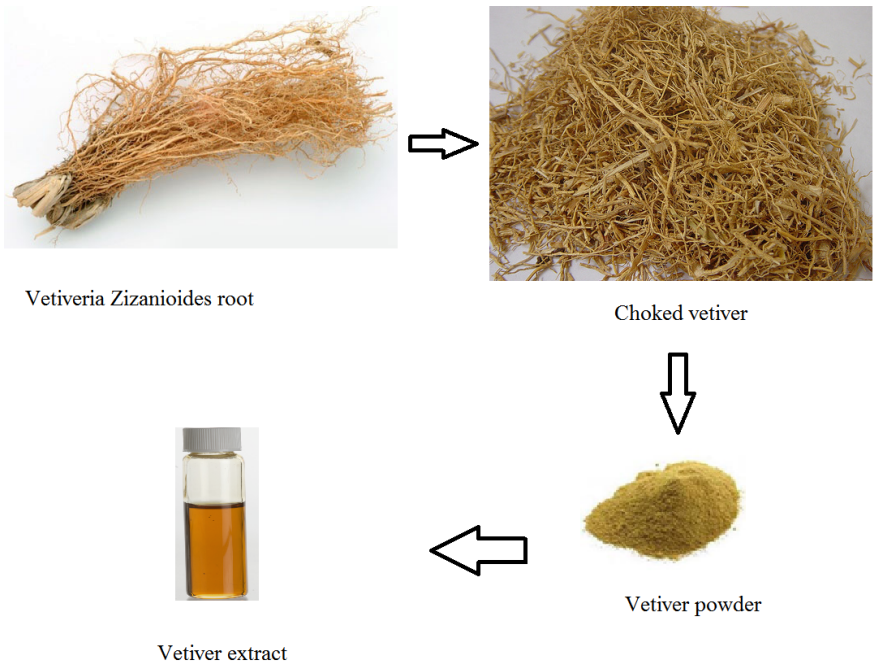

Figure 1: Preparation of Vetiver extract.

Portion	Hollo-cellulose%	Lignin%	Pentosan%	Solubility in			
				Hot water%	Cold water%	1% NaOH%	Alcohol Benzene%
Vetiver	71.63	17.22	28.26	10.56	7.39	39.57	9.47

Table 1: Chemical analysis of vetiver.

S. No	Phytochemicals	Root extract
1	Saponins	+
2	Tannins	-
3	Triterpenes	+
4	Steroids	+
5	Flavanoids	+

Table 2: Phytochemical screening of vetiver root extract.

S.No	Samples	Antibacterial activity against *Staphylococcus aureus* (Zone of inhibition in mm)	Antibacterial activity against *Escherichia coli* (Zone of inhibition in mm)
1	10% conc vetiver extract sample	19	11
2	30% conc vetiver extract sample	24	15
3	50% conc vetiver extract sample	29	21

Table 3: Antibacterial activity of vetiver root extract.

S.No	Samples	Antifungal activity against *Aspergillus niger* (Zone of inhibition in mm)	Antifungal activity against *Candida albicans* (Zone of inhibition in mm)
1	10% conc vetiver extract sample	24	12
2	30% conc vetiver extract sample	27	15
3	50% conc vetiver extract sample	31	20

Table 4: Antifungal activity of vetiver root extract.

extract of 50% concentration of coated fabric shows highest antifungal activity when compared to 10% and 30% concentration against *Aspergillus niger* than *Candida albicans.*

Conclusion

From the results, it can be concluded that the Vetiver root has the minimum level of lignin content and the extract showed good results in antimicrobial property against pathogenic bacteria and fungi. It has been found that the highest percentage concentration of *Vetiveria zizanioides* extracts showed good antibacterial and antifungal activity when compared to untreated or lowest concentration of vetiver. It shows good antibacterial activity against the gram positive bacteria than gram negative bacteria and good antifungal activity against *Aspergillus niger* than *Candida albicans*. The presence of flavanoids phytochemical compounds exhibit antimicrobial effect. So this new idea of analyzing the *Vetiveria zizanioides* extract will perform better in preventing microbes from penetrating it into the textile materials and also can be used for developing various home applications and healthcare products.

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