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Antimicrobial Finishing for Cotton Fabrics and its Blend Using Melia Azedarach Ethanol/ Water Extract Containing Printing Paste Formulation

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THE purpose of the present study is to biosynthesis of ethanol extracts from The Ripe fruits of Melia azedarach plant to investigate the eco-friendly and economic efficient and apply this extract on cotton fabrics and its blend to impart antimicrobial efficacy by printing style under different concentration . Where the fabric samples were pre-treated with tannic acid which used as a mordant . The Results of GC-MS analysis showed that the ethanol extract of M. azedarach contains 27 compounds and it is rich in many substances such as tannins, flavonoids and other phenolics compound , also results showed that the crude extract of Melia azedarach possess antimicrobial activity against Gram negative and Gram positive bacteria . The results of scanning electron microscope (SEM) indicated that there is a difference in the surface shape of the treated and untreated fabrics. As well the treated fabrics showed good inhibitory activity against Gram positive bacteria with inhibition zones range from 7 to 12 mm and Gram negative one with inhibition zones range from 7 to 15 mm.

Keywords: Melia azedarach,Tannin, Gas chromatography–mass spectrometry, Antimicrobial, Flavon.

Introduction

Nature and its plants and herbs are a source of medicinal materials since ancient times [1]. Majority of the inhabitance in developing countries and approximately 25% people in developed regions use herbal medicine for treatment and prevention of diseases [2].

The properties of antibacterial fabrics can be improved and achieved using Nano-materials and natural materials [(1,4)].

Currently in mainstream medicine there is a growing demand for antimicrobial products, especially those extracted from plants Because it contains substances such as: *alkaloids*, which is the oldest biological compounds and have an impact on many viruses and Gram negative bacteria, due to the presences *flavones, flavonoids, flavonols, phenols, phenolic acids, quinones, tannins and coumarins which have antimicrobial activity* [5].

Many plants continue to contribute significantly to the medical field at present as they have been used in folk medicine, especially in developing countries, for their preventive and therapeutic properties [6]. in addition, these plants are safe and effective mostly without any side effects compared to industrial medicines [7].

Melia azedarach is a plant belonging to a family Meliaceae which contain 45 genus and 750 species [8] (local name in Egypt: zanzalacht). Tropical Asia is the original home of the Melia azedarach, and it is also widespread in tropical and subtropical countries as well as in America, Argentina and some African and Arab countries

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including Egypt, It was brought from Sudan to Egypt in 1963 [9].

Melia azedarach plant has many therapeutic properties such as anti-fungal [10], anti-malarial activity, anti-bacterial, antioxidant, anti-helminthic and anti-infertility activities [11]. Also, Dry powder fruit of Melia azedarach was used for the treatment of stomach, diabetes and fever [12].

It is one of the most useful plants in traditional medicine as well as modern medicine where leaves are used in treatment anthelmintic, leprosy and scrofula [13] .

The present work deals a new application of *Melia azedarach* extract (as antimicrobial agent) in textile printing. According to the author's background, no work has been published in this field especially in Egypt. On the other hand, and in general, most of the researches were working on the anti-bacterial activity testing for extract only without using it in the textile finishing. Also Tannic acid was used as a natural mordant before printing process and the printing paste made from natural thickener and water and *Melia azedarach* extract only without using any chemicals. We using printing style to treatment the fabrics because it more beneficial than padding and other methods in environmental and economic aspect, saving water and energy. The curd extract of *Melia azedarach* extract evaluate though GC / MS / MS analysis , antibacterial activity and MIC testing .The produced prints evaluate though antimicrobial activity testing .

Material and Methods

Fabrics

100% bleaching cotton fabric(Giza 86, Plain weave1/1,144gm/m^2 Number of threads in the warp 84, Number of threads in the weft 66, count number yarn of warp 24/1, count number yarn of weft 24/1) supplied by Misr Company for Spinning and Weaving, Mehalla El-Kubra, Egypt.

100% bleaching blending cotton fabric(45% poly ester – 55% cotton, Plain weave1/1, 116 gm/m^2 Number of threads in the warp 111, Number of threads in the weft 68, count number yarn of warp 36/1, count number yarn of weft 36/1) supplied by Misr company for spinning and weaving, Mehalla El-Kubra, Egypt .

Mordant

Tannic acid ($C_{76}H_{52}O_{46}$) [Loba Chemie pvt. ltd , India].

Plant material

Ripe fruits of the plant were collected from Al Qanater Alkhairia Nurseries, Egypt, in April 2018. The ripe fruits of M. azedarach were washed well many times with tap water to get rid of impurities and dust and then dried in shade at temperature between 21-38°C for 20 days, These fruits were then grinded to obtain finely grounded dried powder, using a special laboratory mill (ARC - Department of Fiber Chemistry) because the fruits are very solid .

Extraction procedure

The dried powdered plant materials(50 gm) were extracted via maceration in 1000 ml ethanol (50%) and left for 72 at room temperature With shaking In dark around bottom flask to avoid oxidative factors After this period it is left for three hours at 70 ° C using the water bath then the mother solution is filtered using filter paper and vacuum pump then the residual plant material refluxed again with ethanol (50%) , these process repeated four times until reaching 0 in mass loss . finally In the end, extract was evaporated under reducing pressure using water bath to obtain a dry weight . the curd extract preserved at 4 ° C Until it is used .

Printing technique

All the pastes were applied to the fabrics through flat screen by traditional technique .

Thickening agent

High viscosity Carboxyl Methyl Tamarind 8 (CMT), which is Anionic thickening agent and it has Viscosity of 8% paste from 33000 — 37000 cps at 25 °C 6/20 Brookfield viscometer RVT model 9 -Il in 8% solution .

Dye Materials

Melia azedarach ethanol extract and used as a pigment colour.

Preparation of printing paste

The printing paste was prepared using a concentration of 8% Carboxy methyl Tamarind (CMT), where the degree of printing past viscosity was 34000 cps at 25 °C.

The pastes used for application of dye extract (Melia azedarach as a pigment color in printing were prepared using the following recipe :-

Dye extract----------	400g
Thickener----------	80 g
Water ----------	520 g
Total	1000g

Mordanting of fabrics

Mordanting of the fabrics (cotton and cotton/ polyester) were conducted utilizing pre-mordant technique using a concentration of 1% tannic acid at 80 ° C for 30 min .

Fixation

After printing, the printed samples were dried at room temperature, which was approximately 30 ° C for 18 hours. Then the samples were subjected to fixation by steaming at 102 ^{O}C for 30 min **.**

Washing

After the fixation process, the printed samples were washed to remove the excess material from the surface of the fabric and to ensure the stability of the printed materials . The washing process was done in four steps :

1. Rinse the samples gently using cold water
2. Rinse samples using hot water
3. Rinse the samples using non-ionic soap 2 g / L at 45 ° C for 20 minutes.
4. Finally, the samples are rinsed with cold water.

The washed samples are left to dry at room temperature.

Testing and analysis

GC / MS / MS analysis

The analysis was carried out using a GC (Agilent Technologies 7890A) interfaced with a mass-selective detector (MSD, Agilent 7000) equipped with a polar Agilent DB-5ms (5%-phenyl methyl poly siloxane) capillary column (30 m × 0.25 mm i. d. and 0.25 µm film thickness). The carrier gas was helium with the linear velocity of 1ml/min. The injector and detector temperatures were 200 ºC and 250 ºC, respectively. Volume injected 1µl of the sample. The MS operating parameters were as follows: ionization potential 70 eV, interface temperature 250 ºC, and acquisition mass range 50–800.

SEM Analysis for printed samples

The surface morphology of Treated fabrics were Scanning by Electron Microscope(SEM). Using SEM Model Quanta 250 FEG (Field Emission Gun) attached with EDX Unit (Energy Dispersive X-ray Analyses), with accelerating voltage 30 K.V., magnification14x up to 1000000 and resolution for Gun.1n).

In-vitro antimicrobial assay for aqueous extract .

Antimicrobial activity of the ethanol extract of the Ripe fruits of melia azedarach was screened in-vitro by the agar diffusion technique according to [14]. the plant extract were prepared and tested against Gram negative bacteria (*Escherichiacoli* ATCC 35218 , *Pseudomonas aeruginosa* ATCC 9027), Gram positive bacteria (*Staphylococcus aureus* ATCC 25923, *Bacillussubtilis* ATCC 33018). The medium of Bacteria strains are Mueller-Hinton Agar , incubation conditions used for (*Escherichiacoli*, *Staphylococcus aureus and Bacillussubtilis*) are 37 ^{O}C24-48/ h. and While incubation conditions used for(*Pseudomonas aeruginosa*) is 30 ^{O}C24-48/ h .

The method used to test the antimicrobial effect of the samples is the well diffusion assay .The well, which is used in the experiment was 9mm and saturated with 100µl.the experiment was conducted in triplicate .

Minimal inhibitory concentration (MIC) measurement

The ethanol extract of the Ripe fruits of melia azedarach showed antimicrobial activity against Gram negative and positive bacteria was later tested . In this test will be determined the Minimal Inhibitory Concentration (MIC) for each bacterial sample . The method used to test the antimicrobial effect of the samples is the well diffusion assay

Antimicrobial activity of printing samples

Antibacterial test of printing samples was quantitatively evaluated against Cultures of the following microorganism were used in the test: Gram- positive bacteria: *Staphylococcus aureus* (ATCC25923) and *Bacillus subtilis* (ATCC 6635), Gram – negative bacteria: *Escherichia coli* (ATCC 25922) and *Salmonella typhimurium* (ATCC 14028), Yeast: *Candida albicans* (ATCC 10231) and Fungus: *Aspergillus fumigatus*. The antibacterial activity of the treated fabrics is performed as follow: Immediately after the completion of the various printing processes, the printed fabrics are placed in nylon bags and isolated from the surrounding environment in order to avoid contamination with microorganisms that would affect this test. three tablets of each sample were placed on each type of microorganism used in the test (bacteria, fungi) in a petri dish which has been prepared according to (Bauer – Kirby 1966 & CLSI 2006)[15&16] .

Testing for anti-fungal activity:

Active inoculum for experiments were prepared by transferring many loopfuls of spores from the stock cultures to test tubes of sterile

distilled water (SDW) that were agitated and diluted with sterile distilled water to achieve optical density corresponding to 2.0 x105 spore/ ml. inoculum of 0.1 % suspension was swabbed uniformly and the inoculum was allowed to dry for 5 minutes then the same procedure was followed as described above.

Standard references

The antibiotic, chloramphencol was used as standard reference in the case of Gram – negative bacteria, Cephalothin was used as standard reference in the case of Gram – positive bacteria and cycloheximide was used as standard reference in the case of yeasts and fungi.

Result and Discussion

After performing the extraction process and obtaining the extract, tests were performed on the extract to ensure its effectiveness in treatment the fabrics against bacteria , such as a) GC-MS analysis , b) Measurement of antimicrobial activity for M.azedarach extraction and c) Determination of MIC.

After termination of the printing process and treating cotton and cotton blended fabrics, two tests were performed to ensure the effectiveness of the treatment, namely: a) Scanning by Electron Microscope(SEM) and b) Antimicrobial Activity assay . The results of all tests were as follows :

GC-MS analysis of the ethanolic extract of Melia azedarach fruit .

Gas chromatography and mass spectroscopy (GC-MS) analysis of compounds was carried out in ethanolic extract of *M. azedarach* Ripe fruit Where it was used to detect the substances contained in the extract . The results analysis are given in Table 1.

TABLE 1. Results of Qualitative Phytochemical Screening of aqueous and ethanolic extracts of the fruits of Melia azedarach by GC-MS.

No	RT (min)	Name of compound	Formula Structure	Area Sum%
1	3.69	Methylmalonic acid	$C_4H_6O_4$	3.24
2	4.49	Ethanol, 2,2'-oxybis-	$C_4H_{10}O_3$	1
3	4.637	Methylmalonic acid	$C_4H_6O_4$	0.84
4	4.879	(R)-3-Hydroxybutyric acid	$C_4H_8O_3$	0.69
5	5.117	Pyruvaidehyde	$C_3H_4O_2$-	2.77
6	5.884	Araguspongin B	$C_{28}H_{50}N_2O_2$	1.75
7	6.638	d-Mannose	$C_6H_{12}O_6$	12.14
8	8.504	Stevioside	$C_{38}H_{60}O_{18}$	16.77
9	10.173	2-Hexadecanol	$C_{16}H_{34}O$	13.22
10	11.346	Desulphosinigrin	$C_{10}H_{17}NO_6S$	10.35
11	12.691	Tacrine	$C_{13}H_{14}N_2$	1.98
12	13.396	Quinine	$C_{20}H_{24}N_2O_2$	2.12
13	13.904	9-Octadecenoic acid (Z)-tetradecylester	$C_{32}H_{62}O_2$	7.07
14	14.479	Gardenin	$C_{21}H_{22}O_9$	0.4
15	14.917	Ethyl iso allocholate	$C_{26}H_{44}O_5$	5.34
16	15.885	Vincristine	$C_{46}H_{56}N_4O_{10}$	1.33
17	16.176	Gardenin	$C_{21}H_{22}O_9$	0.37
18	16.689	Canrenone	$C_{22}H_{28}O_3$	2.14
19	17.103	Isovitexin	$\mathbf{C_{21}H_{20}O_{10}}$	0.62
20	17.546	4',7-Dimethoxy-8-methylisoflavone	$C_{18}H_{16}O_4$	0.28
21	17.907	4-Hydroxy-2',4',6'-trimethoxychalcone	$C_{18}H_{18}O_5$	3.01
22	18.949	Urobilin	$C_{33}H_{42}N_4O_6$	0.51
23	19.605	6,7,3',4r-Tetramethoxyflavone	$C_{19}H_{18}O_6$	3.78
24	20.605	3,4-Dihydrocoumarin	$C_9H_8O_2$	4.2
25	21.803	4-Hydroxy-2',4',6'-trimethoxychalcone	$C_{18}H_{18}O_5$	1.68
26	22.484	Quercetin3,5,7,3',4'-pentamethyl ether	$C_{20}H_{20}O_7$	1.99
27	23.148	Glafenin	$C_{19}H_{17}ClN_2O_4$	0.42

The results indicate a large number of phytochemicals components in ethanol extract. It showed the presence of 25 major compounds, that could contribute to the medicinal properties of the plant. The identification of the active principles present in the fruit extract was confirmed based on the peak area, retention time, molecular formula, and Area Submission in percentage Table 1 and Figure 1 shown that The first compound identified with the lowest time (3.69 min) was Methylmalonic acid , whereas Glafenin was the last compound with the longest retention time (23.148min) to identify. the major peak areas were 16.77% for Stevioside ($C_{38}H_{60}O_{18}$), 13.22% for 2-Hexadecanol ($C_{16}H_{34}O$), 12.14 % for d-Mannose ($C_6H_{12}O_6$) and 10.35 % for Desulphosinigrin ($C_{10}H_{17}NO_6S$) .

Measurement of antimicrobial activity for M.azedarach extraction using Agar well diffusion Method

The antibacterial activity of M.azedarach extract was evaluated according to their inhibition zone . The antimicrobial potential of M.azedarach extract was presented in Tables 2 and Fig 2 .The tested showed that the maximum antibacterial activity in inhibition zone diameter was obtained in *Bacillus cereus* ATCC 6635 with diameter 20 mm , *Staphylococcus aureus* ATCC 25923 with diameter 12mm and *Escherichia coli* ATCC 25922 with diameter 9mm . The degree of susceptibility of the tested Gram positive bacteria to the extract can be arranged as the following order *Bacillus cereus* ATCC 6635> *Staphylococcus aureus* ATCC 25923 . Results also indicated that, there wasn't inhibition zone in *Pseudomonas aeruginosa* ATCC 9027.

These results can be interpreted likely due to the presence of substances possessing antimicrobial activity such as alkaloids, tannins and flavonoids. This is confirmed by those substances and compounds contained in the extract which have been detected using spectroscopy by GC/MS , for example Stevioside which manifests antimicrobial activity against a broad spectrum of pathogens [17], 2-Hexadecanol which has Antimicrobial and Anti-inflammatory activity[18] , D-Manus also has antibacterial activity, especially for *Escherichia coli* bacteria, and it is used with urinary tract patients[19], Desulphosinigrin which has anti-oxidant activity[20], also there is a wide range of flavonoids, which have a high antimicrobial activity such as (Isovitexin, Quercetin3,5,7,3', 4'pentamethylether, Gardenin, 4Hydroxy2',4' ,6'trimethoxychalcone, 6,7,3',4rTetramethoxy flavone and 4',7Dimethoxy-8-methyliso flavone) tannin compound such as Pyruvaidehyde and another antimicrobial compound such as Ethyl iso allocholate which is Steroids derivative [21].

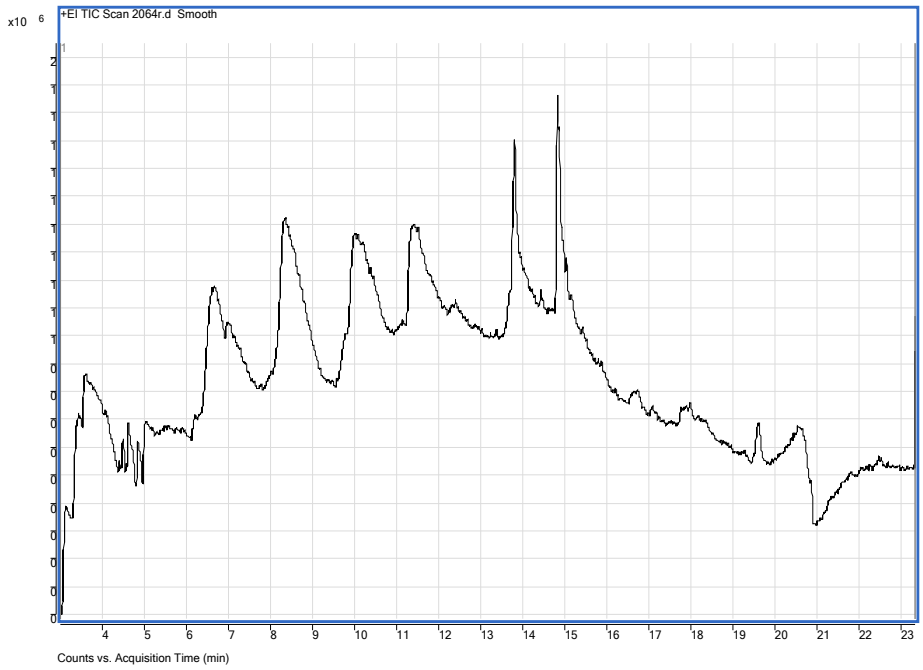
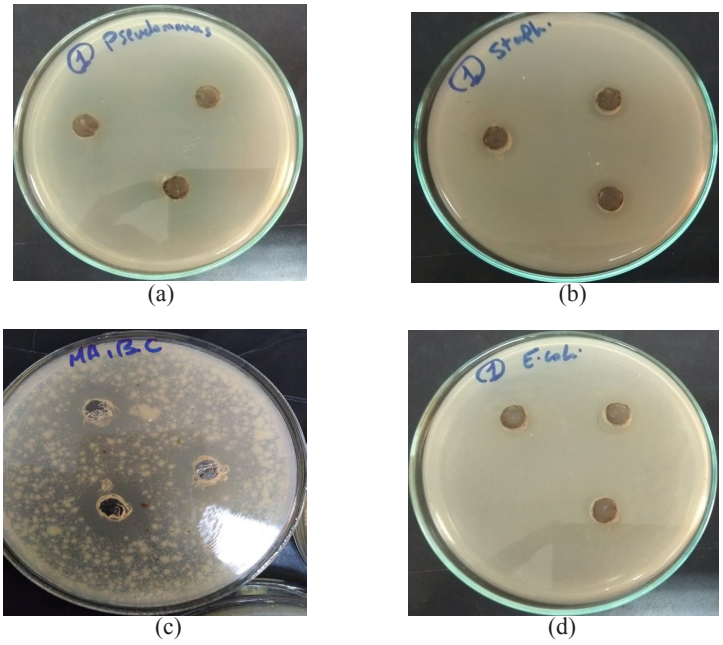


Fig. 1. GC-MAS chart of the Melia azedarach fruit extract.

TABLE 2. Antimicrobial activity of M. azedarach extract through well diffusion assay .

	concentration	Gram positive bacteria		Gram negative bacteria	
		***B. cereus* ATCC 6635**	***S. aureus* ATCC 25923**	***E. coli* ATCC 25922**	***P.aeruginosa* ATCC 9027**
M. azedarach extraction	**ml/100ml**	15 mm	11 mm	9 mm	No inhibition
		15 mm	12 mm	9 mm	No inhibition
		15 mm	12 mm	9 mm	No inhibition
Control disc#		35	35	38	37

Control disc: where Chloramphencol in the case of Gram-positive bacteria, Cephalothin in the case of Gram-negative bacteria



(a) (b) (c) (d)

Fig. 2. Antimicrobial activity of M. *azedarach* extract against pathogenic bacteria. (a) Pseudomonas aeruginosa (b) *Staphylocous aureus* (c) *Bacillus cereus*,(d) *Escherichia* coli.

The previous results showed that the crude extract of Melia azedarach which wasn't active against of Gram-negativ, This high resistance can be explained as a result of thick murein layer in outer membrane of gram negative bacteria, which prevents the entry of inhibitor substances into the cell and The Gram-positive bacteria were more sensitive than Gram negative because of hydrophobic lipopolysaccharide in the outer membrane which provides protection against different agents [22] .This may also be due to the type of solvent used, Because the effectiveness of the extracts depends largely on the type of solvent [23].

Determination of MIC

Minimum Inhibitory Concentration (MIC) is defined as the least concentration of the extracts that inhibit microorganisms growth . The results in table 3 showed that the least MIC value was

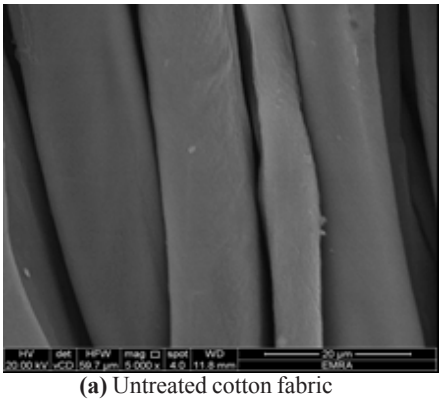
.015 ml/ml against *Bacillus cereus* ATCC 6635 while MIC value against *Escherichia coli* ATCC 25922 was .125 ml/ml and 1.00 ml/ml against *Staphylococcus aureus* ATCC 25923 . These results indicate that the lowest concentration of Melia azedarach extract possesses bacterial inhibiting activity and this is due to its contain of many active substances mentioned in Table1.

SEM Analysis for printed sample

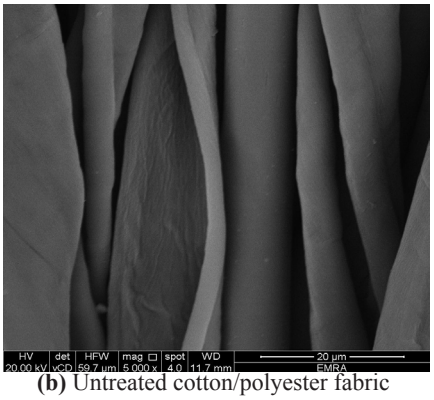
The SEM images of the untreated and treated fabrics (cotton 100% and cotton/polyester) with extract of M. azedarach, are presented in Fig. 3. The surface morphology of the untreated cotton sample shows a clean surface (Fig. 3 a), while the surface of the cotton-treated fabric sample (Fig. 3 c), shows the distribution of a thin film along the fiber surface which covering the fiber, This also indicates that the active substances of Melia azedarach extract were well correlated with tannic acid on the surface of the fabrics , although microscopic scans were performed on the sample after several times of repeated washing. On the other hand, SEM images of the untreated and treated fabrics (cotton/polyester 50/50) samples are shown in Fig 3.b&d

TABLE 3. Minimum inhibition concentration (MIC) of M. azedarach extract against bacteria.

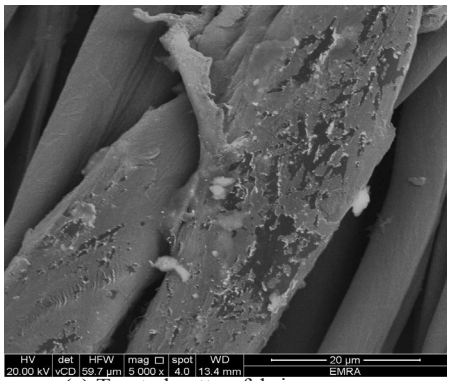
Entry	MIC (µl/ml)		
	Gram positive bacteria		Gram negative bacteria
	B. cereus ATCC 6635	***S. aureus* ATCC 25923**	***E. coli* ATCC 25922**
M. azedarach extraction	0.015	1.00	0.125
	0.015	1.00	0.125
	0.015	1.00	0.125



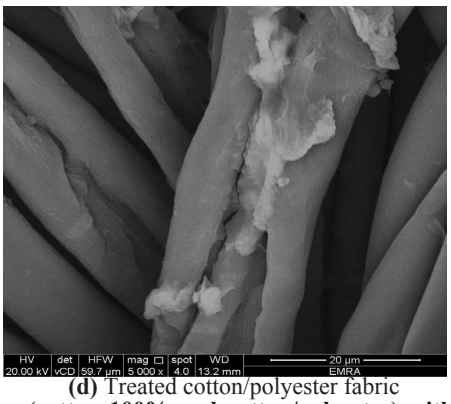
(a) Untreated cotton fabric



(b) Untreated cotton/polyester fabric



(c) Treated cotton fabric



(d) Treated cotton/polyester fabric

Fig. 3. SEM images of untreated and treated fabrics (cotton 100% and cotton/polyester) with extract of M. azedarach.

.Antibacterial Activity assay of Printed Fabrics

The antimicrobial activity of the treated fabrics was investigated against 4 bacteria ,1 Yeasts and 1 Fungi , using disc diffusion method. two fabrics control samples were tested along with the Melia azedarach treated samples. The results of antimicrobial activity of the printed fabrics which treatment with tannic acid as a mordant and melia azedarach ethanolic extract against different microorganisms are summarized in Table 4.the results clearly show that all treated fabrics are having very good antibacterial properties to both Gram positive and Gram negative micro-organisms. the treated fabrics samples did not allow microbes to grow under the test sample .all the treated fabrics show a zone of inhibition ranging from 7 mm to 13 mm for Gram positive and inhibition zone ranging from 7 mm to 15 mm for negative . For treated cotton samples the maximum inhibition zone of antibacterial activity were 15,14 and 11 mm against Escherichia coli, at concentration 100 % , 75% and 50% respectively, Similarly the maximum inhibition zone against Salmonella typhimurium were 13, 12 and 12 mm at concentration 100 % , 75% and 50% respectively . As for the gram-positive bacteria, the inhibition zone against Bacillus cereus were 13, 12 and 12 at concentration 100 % , 75% and 50% respectively, as well the inhibition zone against Staphylocous aureus were 12, 10, 8 mm at concentration 100 % , 75% and 50% respectively, This are the lowest inhibition zones obtained through treated cotton fabrics. As for the inhibition zone against yeasts of Candida species, the results were as follows : 13, 12 and 11 mm at concentration 100 % , 75% and 50% respectively . Concerning blended cotton samples the results were as follows: it demonstrated significant activity against Escherichia coli where the inhibition zones were 14mm,10mm and 7 mm, at concentration 100 %, 75% and 50% respectively . Similarly the maximum inhibition zone against Salmonella typhimurium were 12, 11 and 10 mm at concentration 100 % , 75% and 50%respectively.

TABLE 4. Antimicrobial activity of fabrics treated with different concentrations of M. azedarach extract through disc diffusion assay.

No	Sample	Conc. (%)	Gram - positive bacteria		Gram – negative bacteria		Yeasts and Fungi*	
			S. Aureus ATCC 25923	***B. cereus* ATCC 6635**	***Salmonella typhimurium ATCC 14028***	***E. coli ATCC 25922***	***Candida albicans ATCC 10231***	***Aspergillus fumigatus***
1	Cotton 100%	50%	8	12	12	11	11	-
2	Blending		7	11	10	7	8	-
3	Cotton 100%	75%	10	12	12	14	12	-
4	Blending		9	12	11	10	9	-
5	Cotton 100%	100%	12	13	13	15	13	-
6	Blending		11	12	12	14	10	-
7	Cotton 100%	control	-	-	-	-	-	-
8	Blending	control	-	-	-	-	-	-
	Control disc#		35	35	36	38	35	37

* = identified on the basis of routine cultural, morphological and microscopical characteristics.
# **Control disc:** where Chloramphencol in the case of Gram-positive bacteria, Cephalothin in the case of Gram-negative bacteria and cycloheximide in the case of fungi .
– = No effect.

As for the gram-positive bacteria The antimicrobial activity of treatment blended fabric were 12,12 and 11 mm against *Bacillus cereus* at 100%,75% and 50% respectively. While antimicrobial activity of against *Staphylocous aureus* were 11, 9 and 7 at 100 % , 75% and 50% respectively. Also the treatment blended fabric showed that they had a yeast-resistant activity of Candida type and the results were as follows 10, 9 and 8 mm at 100 % , 75% and 50% respectively.

From the previous results, it is clear that the increased concentration increases the antimicrobial activity of treated samples, as well the treated cotton samples have higher activity than the blended cotton samples . Unfortunately, the treated samples, either cotton or cotton blended, did not have any antimicrobial activity against the fungus of the type *Aspergillus fumigatus* at different concentrations.

Generally, antimicrobial action can be explained by six possible mechanisms which include: The first mechanisms is disintegration of cytoplasmic membrane, then interaction with membrane proteins (ATP ases and others), thereafter disturbance of the outer membrane of gram negative bacteria with the release of lipopolysaccharides, then destabilization of the proton motive force with leakage of ions, then coagulation of the cell content, and finally inhibition of enzyme synthesis [24].

Conclusion

In conclusion, plants are still a source of biochemical substances which used in many medical fields.

One of these plants is Melia azedarach plant, which the current study proved to it contain many active substances and compounds such as *flavonoids, phenols, , tannins and coumarins which have antimicrobial activity* . This was confirmed by GC-MS analysis of ethanolic extract which showed the presence of 25 components.

This study also confirmed that the treatment of cotton and cotton fabrics mixed with the use of M.azedarach extract in the print paste made the fabrics possess a high resistance to some types of Gram positive and Gram negative bacteria and to some types of yeast .

Through this study also it was found that the treated cotton fabrics had a higher resistance than treated cotton blended fabrics, as it was also shown that with an increase in the concentration of the M.azedarach extract, the resistance increased.

The high antibacterial activity of *Melia extract* and treatment fabrics may be due to hydroxyl groups existing in the flavonoids and phenolic compounds. It is reported that phenols are responsible for the variation in the antioxidant and antimicrobial activity of the plant [25].

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تجهيز الاقمشة القطنية وخلطاتها ضد الميكروبات باستخدام مستخلص الايثانول المائي للزنزلخت كأحد محتويات عجينة الطباعة .

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يهدف هذا البحث الى عمل مستخلص ايثانول مائي من ثمار نبات الزنزلخت الناضجة كمادة اقتصادية وصديقة للبيئة واستخدامها في معالجة الاقمشة القطنية والقطنية المخلوطة لتصبح ذات فاعلية في مقاومة البكتريا باستخدام طريقة الطباعة عند تركيزات مختلفة منها .كما تم استخدام حمض التانيك كمثبت طبيعي .اظهرت نتائج تحليل اجهزة التحليل الطيفي أن مستخلص الإيثانول المائي من الزنزلخت يحتوي على ٢٧ مركبًا وأنه غني بالعديد من المواد مثل الفلافونويد ومركبات الفينول الأخرى ومشتقات حمض التانيك. كما أظهرت النتائج أن مستخلص الزنزلخت له نشاط مضاد للميكروبات مثل البكتيريا موجبة الجرام والبكتريا سالبة الجرام . أشارت نتائج المسح بالميكروسكوب الإلكتروني إلى وجود اختلاف في شكل سطح الأقمشة المعالجة وغير المعالجة. كذلك أظهرت النتائج ان الأقمشة المعالجة تمتلك نشاطًا مثبطًا جيدًا ضد البكتيريا موجبة الجرام حيث كانت مناطق التثبيط تتراوح ما بين ٧ إلى ١٢ مم ، ونشاطا مثبطا ضد البكتريا سالبة الجرام حيث كانت مناطق تثبيط تتراوح بين ٧ إلى ١٥ ملم .