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The Effect of Finishing Treatment by Aqueus Ginger Solution on Electrostatic and Thermal Insulation Properties of Medical Bandages

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THIS research aims to study the effect of ginger solution in reducing the electrostatic property and increasing the thermal insulation of the bandage while maintaining the functional properties of the bandage fabric.To achieve this goal, bandage fabrics consisting of 70% cotton and 30% polyamide were treated with ginger in different concentrations, (25 - 50 - 100%), There are some variables such as ginger solution concentration and number of bandage layers (1, 2 and 3) whose effect on the performance properties of bandage has been studied. Several tests were performed for these samples before and after treatment such as electrostatic charge value, thermal insulation value, air permeability, water permeability and square meter weight. The results showed that with an increase in the concentration of the treatment material and the number of layers, the value of thermal insulation increased and the value of the electrostatic charge decreased, with an unnoticeable effect on the other properties of the bandage. Thus the ginger-treated bandage can be used to treat patients with arthritis.

Keywords: Medical bandages, Ginger, Electrostatic charge, Thermal insulation, Cellulose.

Introduction

In the recent period of the twenty-first century, scientists interested in the production of so-called smart textiles by introducing chemical (1-4) and natural (5,6) substances in the textile industry in order to give the fabrics special properties such as the anti-microbial property (7-10), protection from UV rays (11-14), anti-soil release (15), water permeability (16) and anti-inflammatory (17,18), electrostatic charge resistance (19) thermal insulation (20). But the greatest concentration was the use of natural materials extracted from natural plants such as the Conocarpus erectus plant extract where its extract was used in making printed anti-microbial fabrics (21), saffron plant extract where wool fabrics and blended cotton fabrics were dyed with it (22, 23) and also the extract of the lemon fruit, which was treated and dyed cotton fabrics, as it became dyed and resistant to the growth of microbes (24).

There are other plants that can be used to make these smart fabrics to give them properties they did not exist in. Among these plants is the ginger plant, as this plant is distinguished as being included in the list of medicinal herbs, and among the plants in hot regions, which are tubers (rizomes) containing volatile oil with a ratio of between 2.5-3% and also contains another group known in the name of Aryl alkanes, it is an important active ingredient in ginger. Ginger helps to prevent and treat many health problems, and it has been used as a traditional treatment for thousands of years and is well known in Chinese and Indian medicine for treating many health problems. It is abundant in East India, Philippines, China, Srilanka, Mexico, Pakistan and Jamaica, and the best ginger is Jamaican. It was found that the antioxidants and the active substance in the ginger, known Gingenol, which is attributed to him the hot taste of ginger, it is one of the oily

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resins and is considered an anti-clot as well as an anti-inflammatory of all kinds and all combats different microbes and infections in the body. Ginger contains enzymes that analyze proteins that may contribute to infections such as arthritis.

There is a lot of scientific research in the last ten years concerned with reducing the amount of electrostatic charges and increasing the thermal insulation of the fabrics that are used as medical bandages in order to reduce or prevent infections resulting from contact with these fabrics in the human body, especially if these fabrics contain artificial fibers. As the important source of electrostatic charges in the textile field is the contact between asymmetric surfaces, which leads to the transfer of charges between the surfaces. The transfer of charges does not occur when two surfaces of the same chemical composition and of the same type are in contact. However, some studies have emerged that confirm that this type of transfer can occur if there is a difference in some factors such as the coefficient of friction and temperature (25).

There are many problems that result from the formation of static electricity on fibers or fabrics: (a) The dirt of the fibers where the dust relates to it, which leads to a change in the color of the fabrics and gives the clothes an undesirable color, as it attracts the dirt and dirt during storage, as these fabrics are considered uncomfortable to use and their adhesion to the body and give a feeling of uncomfortable. (25),(b) The formation of static electricity with fabric materials leads to repulsion of capillaries to match the charge formed on them, which leads to difficulty in their operation, and static electricity causes the adhesion of fibers during drawing operations to surfaces that pass through them, whether metallic or otherwise. This is in addition to the possibility of fires due to the discharge of the static charge in the form of electric sparks and the ease of igniting the fibers because they are present in disassembled form, and (c) Static electricity causes many problems in the manufacture of ready-made clothes during the manufacturing stages. In the individual and cutting stage, static electric charges are generated between the layers of fabric, especially fabrics made from synthetic fibers, which causes an increase in the slip strength of the fabric layers, resulting in inaccuracy during shearing. It is also considered the generation of static electricity during knitting as a result of friction of the needle and thread of the fabric, which leads to a high temperature of the needle and the large number of cuts during sewing, which affects the quality of the product and the economy of the knitting process.

There are several ways to get rid of static electricity or prevent it from forming during operation, and these methods are:1- Increasing the raw material's electricity connection,2- Using antistatic materials, and 3- Use static electricity prevention devices. The materials that are used to prevent or reduce the electrostatic charge on the fabric surface are chemical compounds that have the ability to change the nature of the raw surface from non-hydrophobic surfaces. Hydrophilic surfaces like hydrophilic absorption, and thus static electricity is transferred through the surface of the material to Earth or some materials covering the surface of the material can be used and static electricity is drained through the formed layer, which is usually a single-layer layer.These materials are divided into three groups according to the chemical nature as follows, cationic inhibitors, non-anionic inhibitors and anionic inhibitors (26).

Thermal insulation properties are probably dominantly based on structure. Any material that has high porosity and, ideally, a physical structure with minimal connectivity in the direction of heat transfer should be a good insulator. These structural properties will also minimize electrical conductivity, although in addition the material should have low electrical conductivity when it has no porosity. Thermal insulation is the reduction of heat transfer (the transfer of thermal energy between objects of differing temperature) between objects in thermal contact. Insulation commonly through a combination of two characteristics: a) The insulation material's natural capacity to inhibit the transmission of heat and b) The use of pockets of trapped gases which are natural insulants. In foam materials small gas cells or bubbles occur within the structure; in fabric insulation, such as wool, small variable pockets of air occur naturally to form gas cells.

This research introduces a new trend in the processing of medical bandages fabrics made of polyamide cotton blended cotton to reduce static electricity and increase the thermal insulation of the bandages by using a natural material which is ginger solution and the possibility of its application in the medical field, which increases the added value of the garment and textile industry. The effect of some factors such as the concentration of the ginger solution (25, 50, and 100%) and the number of bandage layers (1, 2 and 3) on the properties of the bandage. Several tests were performed for these samples before and after treatment such as the value of the electrostatic charge, the value of thermal insulation, air permeability, water permeability and square meter weight.

Experimental

Materials and Methods

Materials:

Ginger powder was obtained from commercial shops in Egypt, bandage (70% cotton, 30% polyamide) were bought from pharmacy. Other chemicals were laboratory grade.

Methods:

Preparation of ginger extract

Put10 g of ginger powder in 80 ml of water and boil for 30 min under stirring until formation suspension solution is formed.

Treatment of bandages with ginger solution

The bandages samples were immersed in different concentrations of aqueous ginger solution (25, 50, and 100%) for 45 min at 90°C in presence of 2 g/l of alum [K Al2(SO4)3]. Samples have been dried at 80-85oC.

Testing and Analysis:

1- Electrostatic charge value:

It was measured according to ASTM - D-4238.

2- Thermal Insulation Charge Value:

According to the American Standard ASTMD 1518.

3- Air permeability:

It was detected according to the American standard ASTM - D737-96.

4- Water Vapor permeability:

It was measured according to the American standard AATCC Test Method 79-2000.

5- Weight of square meter:

It was detected according to the American standard ASTM-D3776-85-1990.

Results and Discussion

1-There is a statistically significant difference at the level of (0.05) between the number of layers (1, 2, 3) on the measured properties: Water Vapor permeability ($kg.sec^{-1}.m^{-2}.pa^{-1}$), Air permeability ($cm^3/cm^2.sec$), Weight of Meter Square (gm/m^2), Electrostatic Charge (KV), Thermal Insulation (Tog).

TABLE 1. The results of the average readings for the fabric tests under investigation

Number of Layers	Ginger Concentration (%)	Water Vapor permeability ($kg.sec^{-1}.m^{-2}.pa^{-1}$) (kg.sec1.m-2. (Sec.)	Air permeability ($cm^3/cm^2.sec$)	Weight of Meter Square (gm/m^2)	Electrostatic Charge (KV)	Thermal Insulation (Tog)
1	0	207	226	110	1.2	11.5
	25	204	216	117	0.47	20.2
	50	201	209	129	0.35	24.1
	100	198	205	134	0.23	29.7
2	0	200	190	221	1.3	20.2
	25	198	186	225	0.50	23.8
	50	195	180	240	0.38	28.1
	100	192	174	258	0.26	35.3
3	0	189	140	332	1.32	27.7
	25	186	131	342	0.52	34.8
	50	183	129	360	0.39	40.0
	100	181	122	375	0.29	46.1

1-The effect of the study factors on Water Vapor permeability ($kg.sec^{-1}.m^{-2}.pa^{-1}$)

TABLE 2. Tests of Between-Subjects Effects for Water Vapor permeability

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Number of Layers	648.500	2	324.250	2334.600	.000
Ginger Concentration	117.667	3	39.222	282.400	.000
Error	.833	6	.139		
Total	454730.000	12			
Corrected Total	767.000	11			

a. R Squared = .999 (Adjusted R Squared = .998)

2-There is a statistically significant difference at the level of (0.05) between the Ginger Concentration (0%, 25%, 50%, 100%)on the measured properties: Water Vapor permeability (kg.sec^{-1}.m^{-2}.pa^{-1}), Air permeability (cm^3/cm^2.sec), Weight of Meter Square (gm/m^2), Electrostatic Charge (KV), Thermal Insulation (Tog).

The results of Table (2) indicate that:

1. There is a statistically significant difference at the level (0.01) between the number of layers on the Water Vapor permeability test

2. There is a statistically significant difference at the level (0.01) between the Ginger Concentration on the Water Vapor permeability test

The equation for multiple linear regression came as follows:

From Tables1,5 and figure 1 : by increasing number of layers and ginger solution concentration water vapor permeability decreases as a result of increasing ginger quantity on surface of bandage. Where ginger absorbs many water molecules because of the presence of hydroxyl groups in its chemical composition, which reduces the amount of water in permeation through the bandage. This is illustrated by the value of the quality factor.

2-The effect of the study factors on Air permeability

The results of Tables 1,9 and figure 2 indicate that:

1-There is a statistically significant difference at the level (0.01) between the number of layers on the Air permeabilitytest

2-There is a statistically significant difference at the level (0.01) between the Genjar Concentration on the Air permeabilitytest

3-Air vapor permeability decreases by increasing number of layers and ginger solution concentration due to increase ginger quantity on surface of bandage. Where treatment material minimises the porous between fibres of textile sample, so the amount of air in permeation through the bandage decrease. This is explained by quality factor value.

The equation for multiple linear regression came as follows:

The effect of the study factors on Weight of Meter Square

The results of Table (10) indicate that:

1-There is a statistically significant difference at the level (0.01) between the number of layers on the Weight of Meter Square test

2-There is a statistically significant difference at the level (0.01) between the Genjar Concentration on the Weight of Meter Square test

The equation for multiple linear regression came as follows:

From the results of table1, 13 and figure 3: (value of quantity factor) ginger solution concentration increasing and number of layers weight of meter square increases, this arises from increasing of deposited ginger quantity on surface of bandage. Where hydroxyl groups in ginger chemical composition absorbs many water molecules, which reduces the amount of water in permeation through the bandage.

The effect of the study factors on Electrostatic Charge (KV)

The results of Table (14) indicate that:

1. There is a statistically significant difference at the level (0.01) between the number of layers on the Electrostatic Charge (KV)test

2. There is a statistically significant

TABLE 3. Coefficients a for Water Vapor permeability

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	215.883	1.358		158.932	.000
Number of Layers	-8.875-	.574	-.906-	-15.462-	.000
Ginger Concentration	-.083-	.013	-.384-	-6.552-	.000

TABLE 4. Descriptive Statistics for Water Vapor permeability

Number of Layers	Ginger Concentration	Mean	Quality factor	Arrangement
1	0%	207.0	100.00	1
	25%	204.0	98.55	2
	50%	201.0	97.10	3
	100%	198.0	95.65	4
	Total	202.5	97.83	first
2	0%	200.0	96.62	1
	25%	198.0	95.65	2
	50%	195.0	94.20	3
	100%	192.0	92.75	4
	Total	196.3	94.83	Second
3	0%	189.0	91.30	1
	25%	186.0	89.86	2
	50%	183.0	88.41	3
	100%	181.0	87.44	4
	Total	184.8	89.28	Third
Total	0%	198.7	95.99	1
	25%	196.0	94.69	2
	50%	193.0	93.24	3
	100%	190.3	91.93	4
	Total	194.5	93.96	

TABLE 5. Multiple Comparisons for Water Vapor permeability

Number of Layers		Mean Difference	Ginger Concentration		Mean Difference
N (1)	N (2)	6.2500*	0%	25%	2.6667*
	N (3)	17.7500*		50%	5.6667*
N (2)	N (1)	6.2500*		100%	8.3333*
	N (3)	11.5000*	25%	0%	2.6667*
N (3)	N (1)	17.7500*		50%	3.0000*
	N (2)	11.5000*		100%	5.6667*
			50%	0%	5.6667*
				25%	3.0000*
				100%	2.6667*
			100%	0%	8.3333*
				25%	5.6667*
				50%	2.6667*

TABLE 6.Tests of Between-Subjects Effects for Air permeability

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Number of Layers	14224.667	2	7112.333	2000.344	.000
Ginger Concentration	544.667	3	181.556	51.062	.000
Error	21.333	6	3.556		
Total	385096.000	12			
Corrected Total	14790.667	11			

a. R Squared = .999 (Adjusted R Squared = .997)

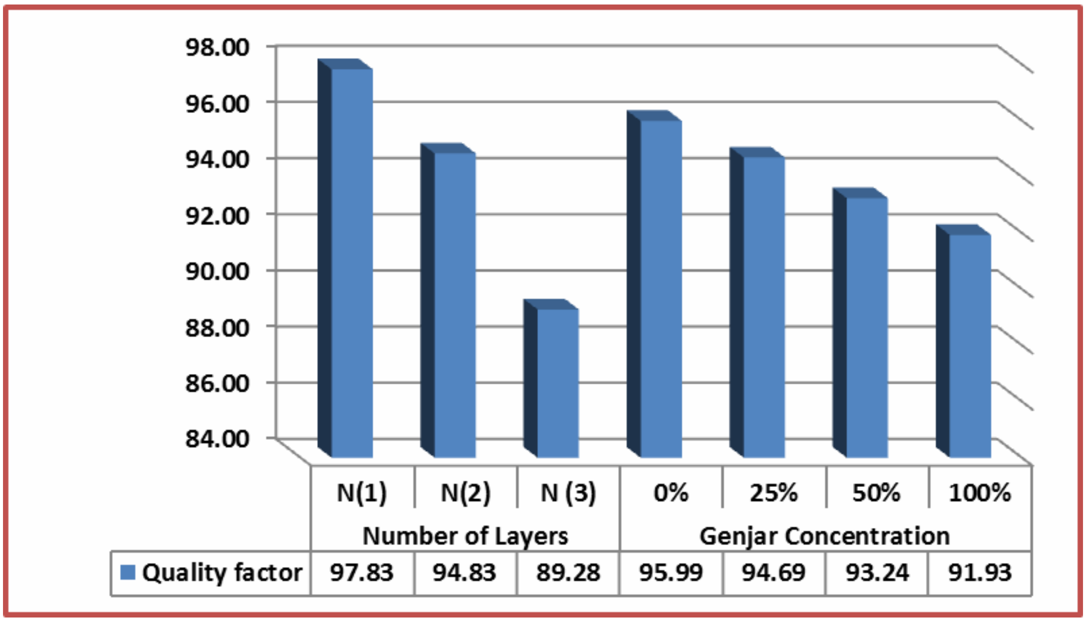

Fig. 1.quality factor for Water Vapor permeability

TABLE 7. Coefficients a for Air permeability

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	266.900	5.093		52.401	.000
Number of Layers	-41.750-	2.152	-.971-	-19.397-	.000
Ginger Concentration	-.177-	.048	-.186-	-3.719-	.005

TABLE 8. Descriptive Statistics for Air permeability

Number of Layers	Ginger Concentration	Mean	Quality factor	Arrangement
1	0%	226.0	100.00	1
	25%	216.0	95.58	2
	50%	209.0	92.48	3
	100%	205.0	90.71	4
	Total	214.0	94.69	first
2	0%	190.0	84.07	1
	25%	186.0	82.30	2
	50%	180.0	79.65	3
	100%	174.0	76.99	4
	Total	182.5	80.75	Second
3	0%	140.0	61.95	1
	25%	131.0	57.96	2
	50%	129.0	57.08	3
	100%	122.0	53.98	4
	Total	130.5	57.74	Third
Total	0%	185.3	81.99	1
	25%	177.7	78.63	2
	50%	172.7	76.42	3
	100%	167.0	73.89	4
	Total	175.7	77.74	

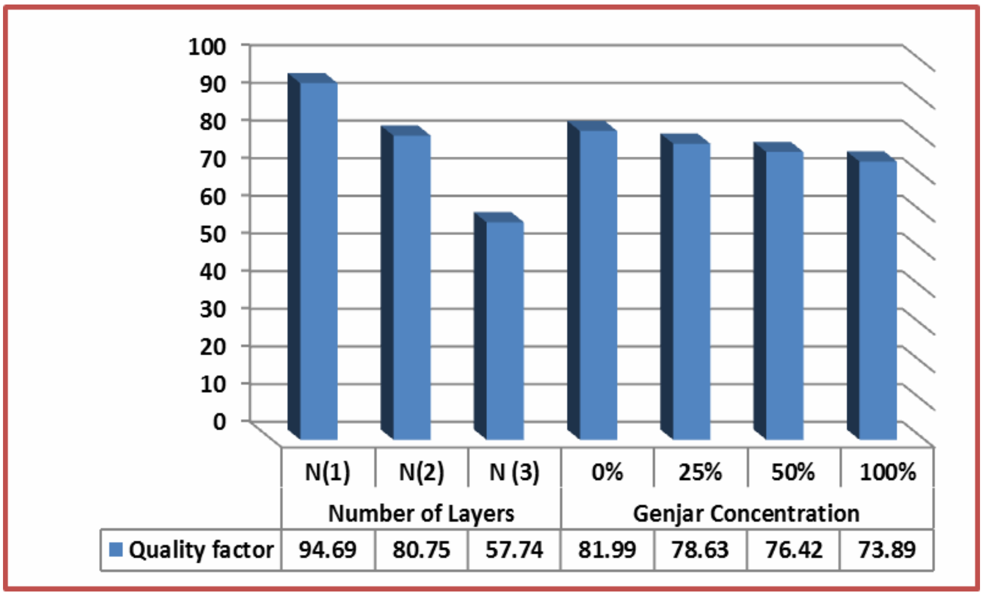

Fig. 2. quality factor for Air permeability

TABLE 9. Multiple Comparisons for Air permeability

Number of Layers		Mean Difference	Ginger Concentration		Mean Difference
N (1)	N (2)	31.5000*	0%	25%	7.6667*
	N (3)	83.5000*		50%	12.6667*
N (2)	N (1)	31.5000*		100%	18.3333*
	N (3)	52.0000*	25%	0%	7.6667*
N (3)	N (1)	83.5000*		50%	5.0000*
	N (2)	52.0000*		100%	10.6667*
			50%	0%	12.6667*
				25%	5.0000*
				100%	5.6667*
			100%	0%	18.3333*
				25%	10.6667*
				50%	5.6667*

TABLE 10. Tests of Between-Subjects Effects for Weight of Meter Square

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Number of Layers	105575.167	2	52787.583	2337.458	.000
Ginger Concentration	2164.250	3	721.417	31.945	.000
Error	135.500	6	22.583		
Total	781429.000	12			
Corrected Total	107874.917	11			

a. R Squared = .999 (Adjusted R Squared = .998)

TABLE 11. Coefficients a for Weight of Meter Square

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-8.483-	3.997		-2.122-	.063
Number of Layers	114.875	1.689	.989	68.004	.000
Genjar Concentration	.358	.037	.140	9.590	.000

TABLE 12. Descriptive Statistics for Weight of Meter Square

Number of Layers	Ginger Concentration	Mean	Quality factor	Arrangement
1	0%	110	29.33	4
	25%	117	31.20	3
	50%	129	34.40	2
	100%	134	35.73	1
	Total	122.5	32.67	Third
2	0%	221	58.93	4
	25%	225	60.00	3
	50%	240	64.00	2
	100%	258	68.80	1
	Total	236	62.93	Second
3	0%	332	88.53	4
	25%	342	91.20	3
	50%	360	96.00	2
	100%	375	100.00	1
	Total	352.3	93.95	first
Total	0%	221	58.93	4
	25%	228	60.80	3
	50%	243	64.80	2
	100%	255.7	68.19	1
	Total	236.9	63.17	

TABLE 13. Multiple Comparisons for Weight of Meter Square

Number of Layers		Mean Difference	Ginger Concentration		Mean Difference
N (1)	N (2)	113.5000*	0%	25%	7.0000
	N (3)	229.7500*		50%	22.0000*
N (2)	N (1)	113.5000*		100%	34.6667*
	N (3)	116.2500*	25%	0%	7.0000
N (3)	N (1)	229.7500*		50%	15.0000*
	N (2)	116.2500*		100%	27.6667*
			50%	0%	22.0000*
				25%	15.0000*
				100%	12.6667*
			100%	0%	34.6667*
				25%	27.6667*
				50%	12.6667*

TABLE 14. Tests of Between Subjects Effects for Electrostatic Charge

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Number of Layers	.010	2	.005	11.168	.009
Ginger Concentration	1.893	3	.631	1465.619	.000
Error	.003	6	.000		
Total	6.237	12			
Corrected Total	1.905	11			

a. R Squared = .999 (Adjusted R Squared = .998) difference at the level (0.01) between the Genjar Concentration on the Electrostatic Charge (KV) test.

From Tables 1, 17 and Figure 3 results clarify that:

a- Electrostatic charge value significant decreases by increasing ginger solution concentration, This behavior may be is due to the fact that the treatment material has the ability to change the nature of the sample surface from hydrophobic surface to hydrophilic surface, and thus static electricity is transferred from the surface of the material to the ground by the human body . Therefore, inflammation of the part adjacent to the ligament in the human body decreases.

b- The increase in the number of layers led to insignificant increase in the value of the electrostatic charge, and this may be due to the lack of accumulation and transfer of charges from one layer to another.

The results of Table (18) indicate that:

1. There is a statistically significant difference at the level (0.01) between the number of layers on the Thermal Insulation (Tog) test.
2. There is a statistically significant difference at the level (0.01) between the Genjar Concentration on the Thermal Insulation (Tog) test.

The results of Table 1, 21 and Figure 4: revealed that the value of thermal insulation increased

TABLE 15. Coefficients for Electrostatic Charge (KV)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.918	.221		4.150	.002
Number of Layers	.034	.093	.069	.361	.726
Genjar Concentration	-.009-	.002	-.816-	-4.258-	.002

TABLE16. Descriptive Statistics for Electrostatic Charge (KV)

Number of Layers	Genjar Concentration	Mean	Quality factor	Arrangement
1	0%	1.2	19.17	4
	25%	0.47	48.94	3
	50%	0.35	65.71	2
	100%	0.23	100.00	1
	Total	0.56	41.07	Third
2	0%	1.3	17.69	4
	25%	0.5	46.00	3
	50%	0.38	60.53	2
	100%	0.26	88.46	1
	Total	0.61	37.70	Second
3	0%	1.32	17.42	4
	25%	0.52	44.23	3
	50%	0.39	58.97	2
	100%	0.29	79.31	1
	Total	0.63	36.51	first
Total	0%	1.27	18.11	4
	25%	0.5	46.00	3
	50%	0.37	62.16	2
	100%	0.26	88.46	1
	Total	0.6	38.33	

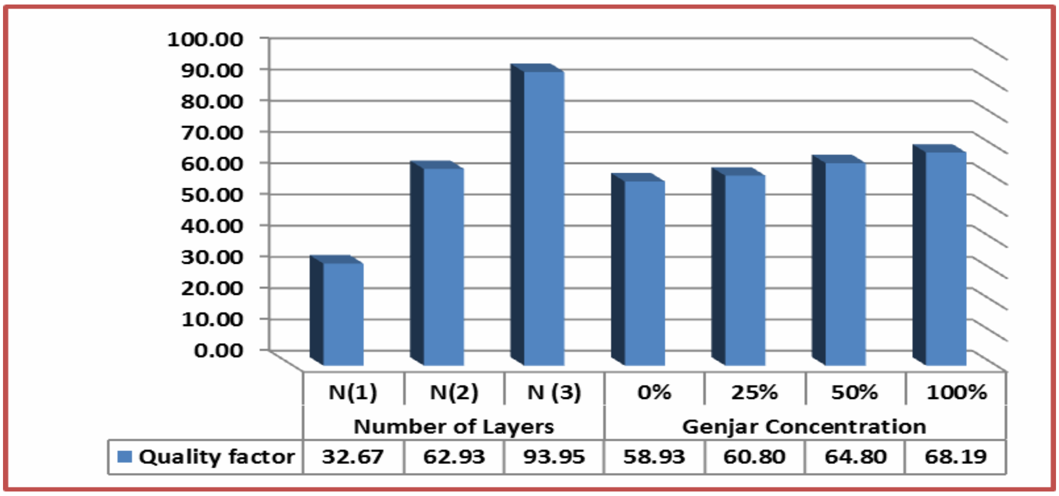

Fig. 3. quality factor for Electrostatic Charge (KV)

The equation for multiple linear regression came as follows:

TABLE 17. Multiple Comparisons for Electrostatic Charge (KV)

Number of Layers		Mean Difference	Ginger Concentration		Mean Difference
N (1)	N (2)	.0475*	0%	25%	.7767*
	N (3)	.0675*		50%	.9000*
N (2)	N (1)	.0475*		100%	1.0133*
	N (3)	.0200	25%	0%	.7767*
N (3)	N (1)	.0675*		50%	.1233*
	N (2)	.0200		100%	.2367*
			50%	0%	.9000*
				25%	.1233*
				100%	.1133*
			100%	0%	1.0133*
				25%	.2367*
				50%	.1133*

The effect of the study factors on Thermal Insulation (Tog)

TABLE 18. Tests of Between-Subjects Effects for Thermal Insulation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Number of Layers	513.222	2	256.611	158.104	.000
Ginger Concentration	475.429	3	158.476	97.641	.000
Error	9.738	6	1.623		
Total	10716.910	12			
Corrected Total	998.389	11			

a. R Squared = .990 (Adjusted R Squared = .982)

TABLE 19. Coefficients a for Thermal Insulation (Tog)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	5.352	1.763		3.036	.014
Number of Layers	7.888	.745	.706	10.589	.000
Genjar Concentration	.168	.016	.679	10.189	.000

TABLE 20. Descriptive Statistics for Thermal Insulation (Tog)

Number of Layers	Ginger Concentration	Mean	Quality factor	Arrangement
1	0%	11.5	24.95	4
	25%	20.2	43.82	3
	50%	24.1	52.28	2
	100%	29.7	64.43	1
	Total	21.38	46.38	Second
2	0%	20.2	43.82	4
	25%	23.8	51.63	3
	50%	28.1	60.95	2
	100%	35.3	76.57	1
	Total	26.85	58.24	Third
3	0%	27.7	60.09	4
	25%	34.8	75.49	3
	50%	40	86.77	2
	100%	46.1	100.00	1
	Total	37.15	80.59	first
Total	0%	19.8	42.95	4
	25%	26.27	56.98	3
	50%	30.73	66.66	2
	100%	37.03	80.33	1
	Total	28.46	61.74	

markedly by increasing the concentration of the treatment material and number of layers. This can be explained by the fact that the interfaces and porouses between the fibers of the textile material decreased. Thus, the heat generated by wrapping the bandage on the affected part of the human body does not release.

Evaluating the total quality of the fabrics produced under research:

An evaluation was made of the quality of the fabrics produced under research to suit them for the functional purpose, to choose the most appropriate study factors (Number of Layers, Genger Concentration) using the multi-axis

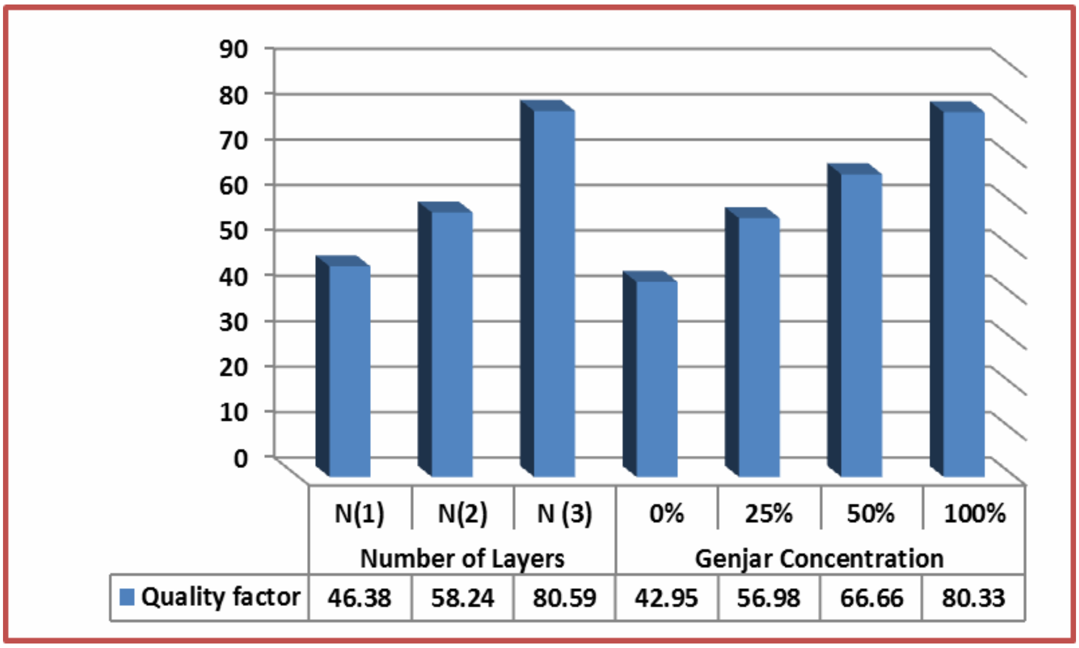

Fig.4. quality factor for Thermal Insulation (Tog)

TABLE 21. Multiple Comparisons for Thermal Insulation (Tog)

Number of Layers		Mean Difference	Genjar Concentration		Mean Difference
N (1)	N (2)	5.4750*	0%	25%	6.4667*
	N (3)	15.7750*		50%	10.9333*
N (2)	N (1)	5.4750*		100%	17.2333*
	N (3)	10.3000*	25%	0%	6.4667*
N (3)	N (1)	15.7750*		50%	4.4667*
	N (2)	10.3000*		100%	10.7667*
			50%	0%	10.9333*
				25%	4.4667*
				100%	6.3000*
			100%	0%	17.2333*
				25%	10.7667*
				50%	6.3000*

RadarChart radar forms to express an evaluation of the total quality of the fabrics produced under research through the use of the following characteristics: Water Vapor permeability ($kg.sec^{-1}.m^{-2}.pa^{-1}$), Air permeability ($cm^3/cm^2.sec$), Weight of Meter Square (g/m^2), Electrostatic Charge (KV), Thermal Insulation (Tog).

Conclusion

The study carried out in this research proved that the introduction of a natural substance such as ginger in the treatment of bandage fabrics led to achieving the goal of this study. After studying factors such as the concentration of the treatment material and the number of layers that affect the

TABLE 22. Evaluating the total quality of the fabrics produced under research

Number of Layers	Genjar Concentration (%)	Water Vapor permeability	Air permeability	Weight of Meter Square	Electrostatic Charge	Thermal Insulation	The perfect space	Quality factor	Arrangement
1	25	100.00	100.00	31.20	48.94	43.82	323.95	64.79	9
	50	98.53	96.76	34.40	65.71	52.28	347.68	69.54	7
	100	97.06	94.91	35.73	100.00	64.43	392.12	78.42	3
2	25	97.06	86.11	60.00	46.00	51.63	340.80	68.16	8
	50	95.59	83.33	64.00	60.53	60.95	364.40	72.88	5
	100	94.12	80.56	68.80	88.46	76.57	408.51	81.70	2
3	25	91.18	60.65	91.20	44.23	75.49	362.74	72.55	6
	50	89.71	59.72	96.00	58.97	86.77	391.17	78.23	4
	100	88.73	56.48	100.00	79.31	100.00	424.52	84.90	1

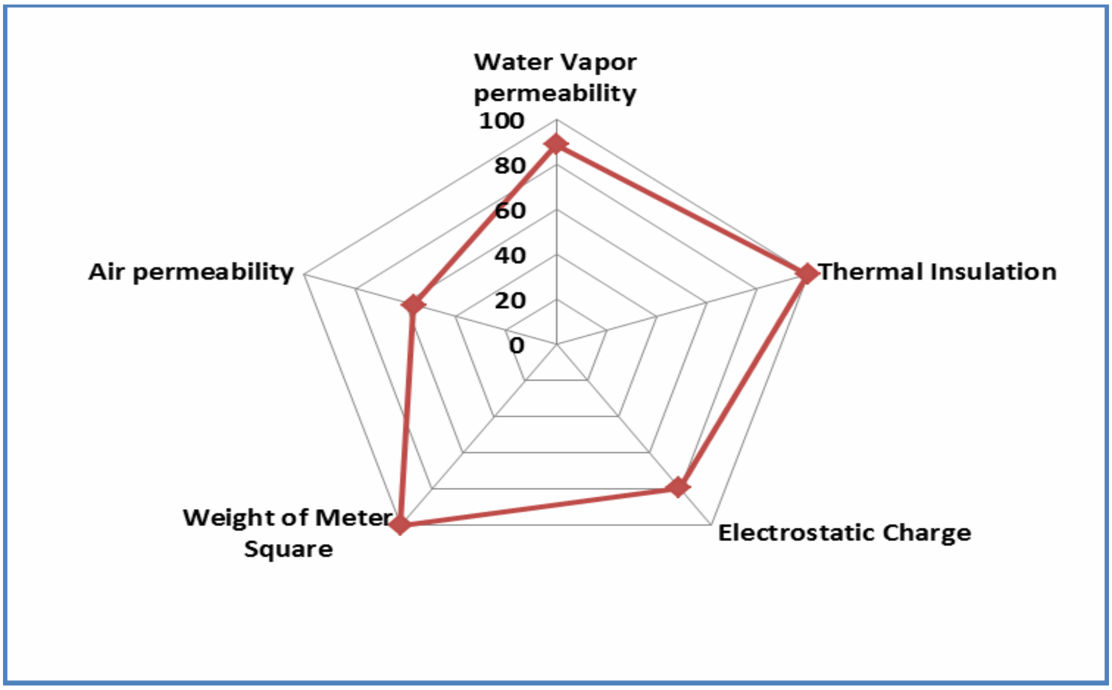

Fig. 5. The total quality factor for the best samples No. 9 with an perfect area (424.52) and the quality factor (84.90) with Genjar Concentration (100 %) and number of layers (3)

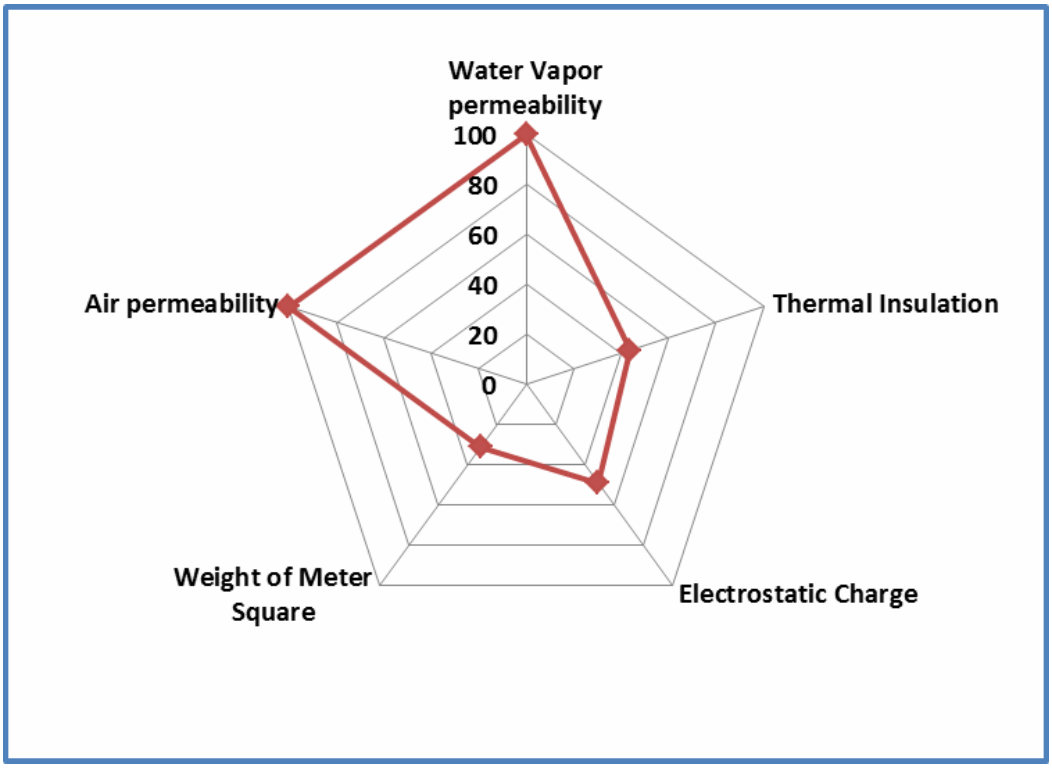

Fig. 6. the total quality factor for the less samples No. 1 with an perfect area (323.95) and the quality factor (64.79 (with Genjar Concentration (25 %) and number of layers (1)

functional properties of the medical bandage fabrics, the results showed an improvement in the properties of the treated bandage, such as increasing the thermal insulation value and reducing the electrostatic charge on its surface. Therefore it can be said that the ginger solution can be used as anti-static finish.

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