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THE EFFECT OF DIFFERENT STRUCTURES ON THE PROPERTIES OF FABRICS USED IN THE TREATMENT OF DIABETIC FOOT THAT IS TREATING BY NANOTECHNOLOGY

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Abstract:

Recent researchers are interested in achieving health safety through the textile industry by developing products used in the medical field from just public uses to more precise uses. The fabrics used in diabetic foot treatment are one of the most important applications of medical fabrics. In some cases, in some cases to amputate the leg, and the nano- fiber is used in medical fields where they have the ability to resist bacteria and thus rush from the healing process. This research aims to study the production of fabrics used in the treatment of diabetes, which are deployed among different age groups through the production of fabric samples (woven - knitwear) and to determine the most suitable materials, as raw materials (100% cotton - cotton / polyester 50% - 50%) and also the most suitable structural compositions for production, as it used plain 1/1, Imitation Gauze and Jersey and Rib 1/1 The most important results that were reached through the research were as follows:

1- The Imitation Gauze cotton / polyester 50%: 50% sample recorded the lowest weight among the samples, while plain 1/1 cotton 100% recorded the highest weight among the produced samples.
2- The Traditional cheese cotton / polyester 50%: 50% sample recorded the lowest thickness among the samples, while plain 1/1 cotton 100% recorded the highest weight among the produced samples.

3- The samples produced using cotton 100% recorded the highest air permeability, as the jersey cotton 100% sample achieve the highest air permeability, while the plain sample 1/1 polyester 100% recorded the lowest air permeability among the samples produced.

4- The jersey cotton 100% sample recorded the highest percentage of water absorption among the samples, while the plain 1/1 polyester 100% sample recorded the lowest water absorption percentage among the produced samples.

5- The difference in the structural composition does not affect the resistance of bacteria and wetness, but it is affected by the use of the preparation material against bacteria.

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Statement of the Problem:

There are no consistent criteria explaining the impact of different ores and execution methods on the utilitarian properties of the fabrics used to treat the diabetic foot.

Objective:

Establish consistent criteria that illustrate the impact of the use of different ores and different execution methods on the utilitarian properties of the fabrics used to treat the diabetic foot.

Hypothesis:

The researcher assumes that there is an effect of different ores and execution methods on the utilitarian properties of the fabrics used to treat the diabetic foot.

Significance:

Improving the utilitarian properties of the fabrics used to treat the diabetes foot. and reducing the economic cost of such fabrics through the use of natural and industrial ores.

Research tools:

Production of fabric samples (woven - knitwear) and to determine the most suitable materials, as raw materials (100% cotton - cotton / polyester 50% - 50%) and also the most suitable structural compositions for production, as it used plain 1/1, Traditional cheese.

METHODOLOGY:

The research depends on the experimental analysis.

Medical textiles

Medical textiles are one of the most dynamically expanding sectors in the technical textile market. At a time when new knowledge changes people's lifestyle on a regular basis both technological push and the market pull in medical and healthcare fields have generated a strong momentum for research, manufacture, development, and sale of novel medical textile materials (1).

Medical textiles are classified as non-implantable (e.g., wound dressing, bandages, gauzes), implantable (e.g., artificial arteries, sutures, vascular grafts), extracorporeal devices (e.g., artificial organs) and healthcare and hygiene products (2). Surgical textiles for medical personnel fall within the classification of healthcare and hygiene products. Fibers used in medical textiles must be non-toxic, non-allergic, and non-carcinogenic and be able to be sterilized without imparting any change in physical or chemical characteristics. Strength, flexibility, absorbency or biodegradability could be expected for particular products.

Medical textiles are a relatively new area of research, with potential biomedical applications. Manufacturing of smart textiles requires a complex and innovative technological approach, which combines conventional textile manufacturing such as weaving, knitting, and embroidery with technologies such as coating, lithography, and ink-jet printing (3).

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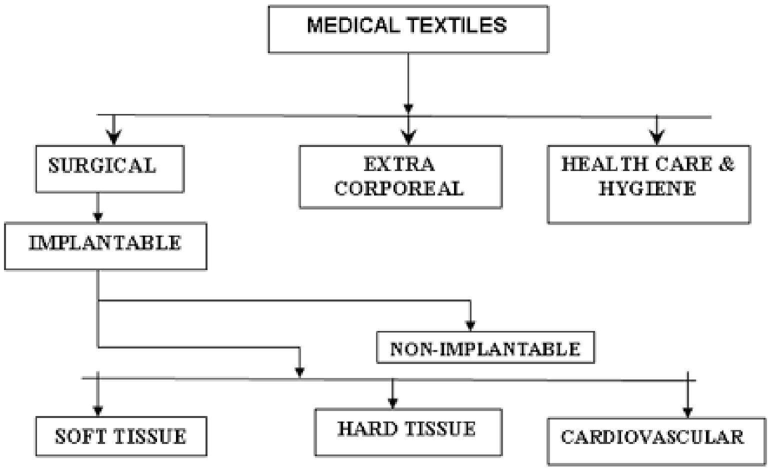

Figure 1: Medical textiles classify

Fabrics used in the treatment of diabetic foot

Infection, ulceration or destruction of deep tissues associated with neurological abnormalities and various degrees of peripheral vascular diseases in the lower limb.

Diabetes mellitus and its chronic complications are the major public health problem and grow rapidly in the world [(4)]. Foot infections are common in persons with diabetes mellitus. Most diabetic foot infections occur in a foot ulcer, which serves as a point of entry for pathogens. Unchecked, infection can spread contiguously to involve underlying tissues, including bone. A diabetic foot infection is often the pivotal event leading to lower extremity amputation, which account for about 60% of all amputations in developed countries. Given the crucial role infections play in the cascade toward amputation, all clinicians who see diabetic patients should have at least a basic understanding of how to diagnose and treat this problem[(5)].

as shown in the images below, occur as a result of various factors, such as mechanical changes in conformation of the bony architecture of the foot, peripheral neuropathy, and atherosclerotic peripheral arterial disease, all of which occur with higher frequency and intensity in the diabetic population.

Figure 2: Diabetic foot

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Patients with diabetes are at an increased risk of infection with slowed wound healing due to immune system changes that must be monitored. Wound cultures are swabs taken from the wound to determine if bacteria is growing for the correct antibiotic to be prescribed. Infected ulcers may require more aggressive treatment such as cleaning out the infection in the office.

The sooner wounds can be treated, the better chance of preventing the spread of infection. Regular wound care with a podiatrist, cleaning and bandaging of the wound are key steps in wound healing [7].

Skin changes on the feet are another finding seen with diabetes. The skin may become dry, flaky and crack which can cause a wound and possibly an infection. Moisturizing the bottoms of the feet with a diabetic foot cream each day will soften the skin and prevent the skin from drying out. Water after a shower or sweat can trap moisture between the toes also resulting in possible infections. Cleaning the feet carefully with soap and water and drying between toes will prevent this issue.

Once a wound develops on the foot or the leg, evaluation, wound care and guidance is needed from a podiatrist who specializes in the leg and foot. Diabetic foot treatment for wounds includes cleaning the wound, applying medicated ointments and creams and applying special bandages to promote wound healing.

One of the bandages used in diabetic wounds is a total contact cast that is used specifically in diabetic foot treatment for wound healing. This type of wound care bandage is safe for patients with neuropathy and is the gold standard treatment for diabetic foot wounds. The cast is padded around bony prominences to take the pressure completely off the pressure points for the ulcer to heal.

Wound dressings represent a part of the management of diabetic foot ulceration also [8]. Ideally, dressings should alleviate symptoms, provide wound protection, and encourage healing.

A wide array of dressings is now commercially available for treatment of diabetic foot ulcers. New products are frequently being released, each targeted at different aspects of healing. Without clinical trials involving infected ulcers, no evidence can be gathered to differentiate these products. An appropriate dressing will control exudate and odor, alleviate pain, and contain wound infection. Whatever dressing is chosen, there is no substitute for adequate wound debridement, appropriate systemic antibiotic therapy, and frequent (daily) dressing changes and wound inspection.

Before choosing a regime, one should consider factors such as the general health of the patient, the process of tissue repair, assessment of the wound by means of grading, description and classification of the wound, local environment of the wound, knowledge on specific properties of the dressing materials and devices as well as their availability, affordability, and accessibility [9].

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Dressing	Advantages	Disadvantages
Low-adherence	Simple Hypoallergenic Inexpensive	Minimal absorbency
Hydrocolloids	Absorbent Can be left for several days Aid autolysis	Concerns about use for infected wounds May cause maceration Unpleasant odor
Hydrogels	Absorbent Aid autolysis Donate liquid	Concerns about use for infected wounds May cause maceration
Foams	Thermal insulation Good absorbency Confirm to contours	Can adhere to wound Occasional dermatitis with adhesive
Alginates	Highly absorbent Bacteriostatic Hemostatic Useful in cavities	May need wetting before removal
Iodine preparations	Antiseptic Moderately absorbent	Iodine allergy Discolors wounds Avoid in case of thyroid disease or pregnancy
Silver-impregnated	Antiseptic Absorbent	Cost No proven advantage

Figure 3: Classes of dressings for diabetic foot infections

The ideal characteristics of a wound dressing are as follows [10]:

1- Sterile, easy to use, cost effective.

2- Maintain a moist wound healing environment.

3- Absorb excess exudate.

4-non-adherent /non-toxic, non-allergic.

5- Not contaminate the wound with foreign particles.

6- Protect the wound from microorganisms.

7- Allow gaseous exchange and control wound odor; and (8) Provide thermal insulation and mechanical protection.

The wound dressing has a good debriding action and helps in wound bed preparation. Wet-to-dry dressings are described in the literature as a means of mechanical debridement [11]. It is very absorptive as well as adherent and one of the cheapest dressings used throughout the world, but requires frequent dressing change (twice or thrice a day) based on wound severity. Dressings should be moistened before removal to minimize any chance of bleeding. A gentle cleanser (normal saline or neutral-pH cleanser) will minimize wound irritation and discomfort [12]. When treating a granulating or epithelizing wound one should soak the dressing thoroughly with normal saline for five minutes (based on our clinical experience) to prevent trauma and heavy bleeding.

Generally, the successful management of diabetic foot wounds requires the multidisciplinary teamwork of specialists. The management of diabetic foot wounds needs timely detection of

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complications and frequent assessment of the wound. No wound should be treated as simple. It is important to take into account all the related causes, identify the problem, and treat it. There are various topical regimes available, but the choice depends only on the treating physicians, podiatrist, or clinical care nurse. While selecting wound care materials one should bear in mind the properties of the ideal wound care dressing which should maintain a moist wound healing environment, absorb exudates, control infection/odor and be effective in treating diabetic foot wounds. In addition to these wound care techniques, antibiotic therapy and offloading plays a very important role.

Types of compression dressings [14]:

The first bandage pressure between 14-17 mmHg, the second bandage pressure between 18-24 mmHg, the third bandage pressure between 25-35 mmHg, high bandage pressure to 60 mmHg.

Pressure dressings can be applied in a number of techniques to cover all pressure using bandages, stockings, and intermittent pneumatic compression. The application of a compressive dressing will provide a very different pressure difference to the bandage with a four-layer system of bandages and stockings creating low to high pressure depending on the type of bandage to be used. Pressure dressings can also be applied to vein and arterial wounds, stockings can also be used to regulate venous pressure and prevent diabetic foot wounds with impaired venous blood circulation [15].

Use Nanotechnology in Textiles [16]:

Nanotechnology is a growing interdisciplinary technology often seen as a new industrial revolution. Nanotechnology (NT) deals with materials 1 to 100 nm in length. The fundamentals of nanotechnology lie in the fact that the properties of materials drastically change when their dimensions are reduced to nanometer scale. Nowadays also the textile industry has discovered the possibilities of nanotechnology. So, we can define nanotechnology in textile as the understanding, manipulation, and control of matter at the above-stated length, such that the physical, chemical, and biological properties of the materials (individual atoms, molecules, and bulk matter) can be engineered, synthesized, and altered to develop the next generation of improved materials, devices, structures, and systems. It is used to develop desired textile characteristics, such as high tensile strength, unique surface structure, soft hand, durability, water repellency, fire retardancy, antimicrobial properties, and the like.

Application of Nanotechnology:

1. Application in department wise.
2. Application in apparel industry.
3. Application in properties of textile material.

Application in properties of textile material:

The properties imparted to textiles using nanotechnology include water repellence, soil resistance, wrinkle resistance, anti-bacteria, anti-static and UV-protection, flame retardation, improvement of dye ability, Self-cleaning fabrics and so on. Among them important applications are described shortly.

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Anti-bacterial Finishes:

For imparting anti-bacterial properties, nano-sized silver, titanium dioxide and zinc oxide are used. Metallic ions and metallic compounds display a certain degree of sterilizing effect. It is considered that part of the oxygen in the air or water is turned into active oxygen by means of catalysis with the metallic ion, thereby dissolving the organic substance to create a sterilizing effect. With the use of nano-sized particles, the number of particles per unit area is increased, and thus anti-bacterial effects can be maximised.

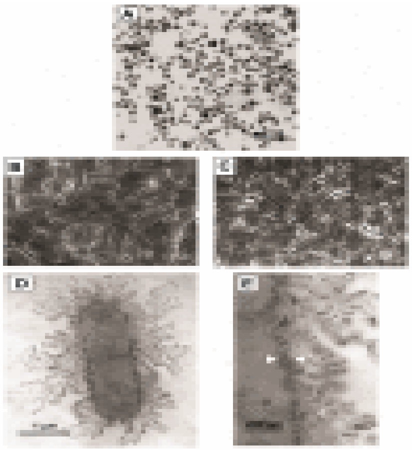

Figure 5

Transmission electron microscope images of silver nanoparticles used (A). Scanning electron microscope image of Escherichia coli control group (B) and E. coli exposed to 50 µg/mL of silver nanoparticles in lysogeny broth medium for 4 hours (C)

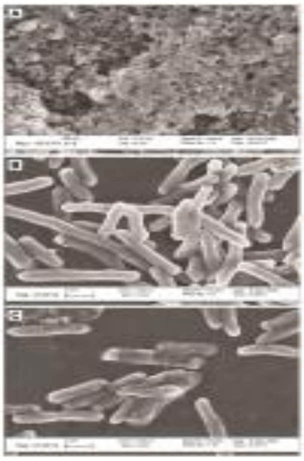

Figure 5

Zinc oxide (ZnO) nanoparticles (A), Escherichia coli bacteria prior to exposure to ZnO nanoparticles (B), and E. coli bacteria after exposure to ZnO nanoparticles (C).

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Experimental work:

To study the impact of different structures and nomination on the properties used in the treatment of diabetes.

Type of material: (100% cotton - cotton / polyester 50%: 50%).

Structure: The structures (plain 1/1-Imitation Gauze- Jersey-Rib has been used.

Samples were produced and treated with Zinc oxide at focus 75.0%.

Processing fabrics to resist bacteria using Zinc oxide:

Treatment steps:

Preparation of Zinc oxide with 0.75% concentration.

Treatment of fabric by immersion method for five Minutes to make sure that fabric impregnates the treated material for 100% then squeeze fabric to get rid of the excess solution.

Dry at 80 degrees.

Laboratory tests:

The tests were held at the National Research Institute, and these tests were conducted according to Egyptian, American and British standards.

Air permeability:

ASTM-737-175-1980 (17) American Standard.

Fabric weight: -

ASTM-D3776-79 (18) American Standard.

Water absorption:

AATCC/ASTM Test Method TS-018 (19) American Standard.

Anti-bacterial:

AATCC Test Method 90-1977 (20) American Standard.

The test was conducted on (Escherichia coli).

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Result & Discussion

Results of sampling tests produced table (1)

Anti-bacterial mm	water absorption %	Air permeability)cm².s/(cm²	Thickness mm	Fabric weight Gm/m²	structure	material
18	69.2	112.1	0.28	203.2	plain 1/1	Cotton100%
19	78.5	132.4	0.036	48.6	Imitation gauze	
18	90.2	186.7	0.053	87.4	Jersey	
14	82.3	192.5	0.12	148.5	Rib	
23	63.3	87.6	0.19	197.4	plain 1/1	cotton/ polyester 50%: 50%
28	68.4	99.5	0.031	46.4	Imitation gauze	
24	85.3	142.2	0.044	71.3	Jersey	
20	77.5	155	0.089	132.2	Rib	

RESULT &DISCUSSION

1- The effect of the different kind of materials and structures on the weight of fabrics used in diabetic foot:

The weight of fabrics is one of the most important factors that must be observed when producing fabrics used in diabetic foot to be easy to use.

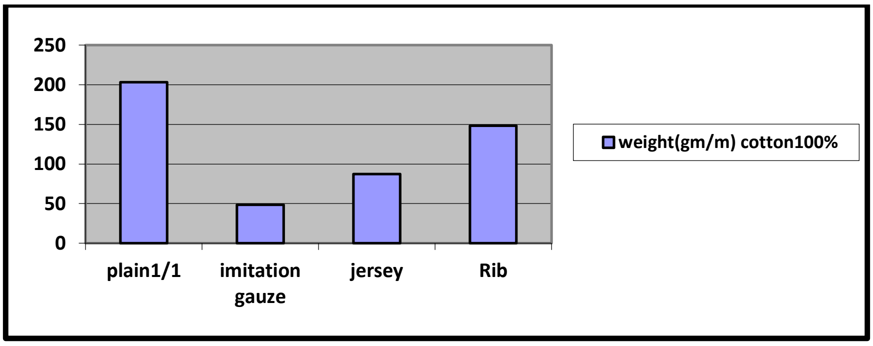

Figure 6: The effect of the structures on the weight of fabrics used in diabetic foot by using cotton 100%

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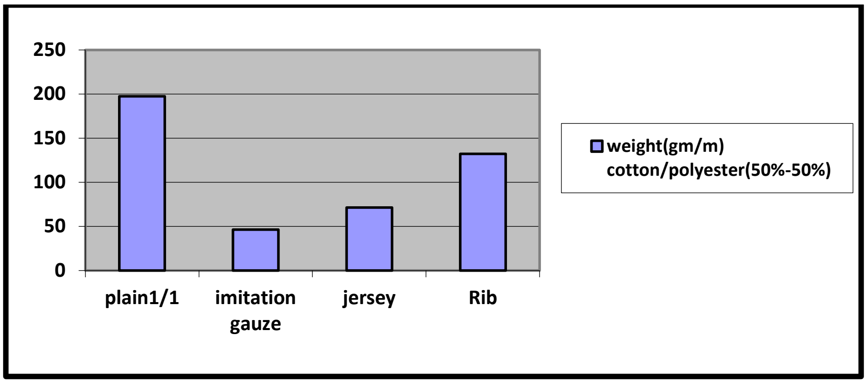

Figure 7: The effect of the structures on the weight of fabrics used in diabetic foot by using cotton /polyester (50%-50%)

Of Table (1) and forms (6-7) illustrated that:

The imitation gauze sample has recorded the lowest weight between samples. The weight of the executed samples using 100% cotton higher than the weight of the cotton / polyester (50% -50%) and 100% polyester samples due to molecular weight of the cotton is greater than molecular weight of polyester**.**

2- The effect of the different kind of materials and structures on the Thickness of fabrics used in diabetic foot:

The Thickness of fabrics is one of the most important factors that must be observed when producing fabrics used in diabetic foot to be easy to use.

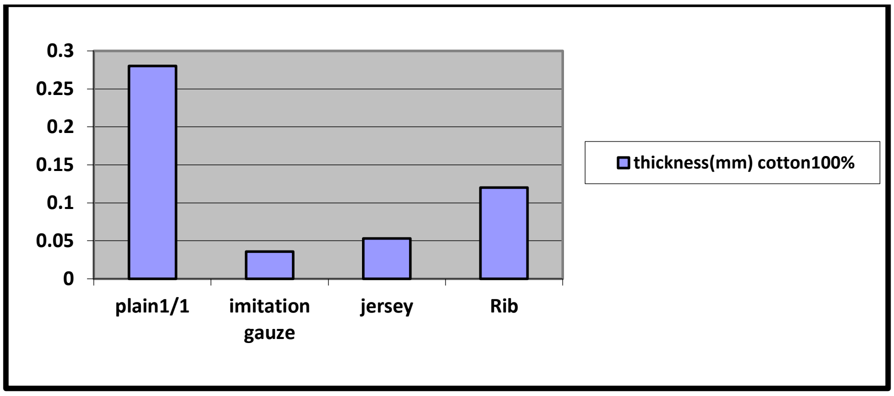

Figure 8: The effect of the structures on the Thickness of fabrics used in diabetic foot by using cotton 100%

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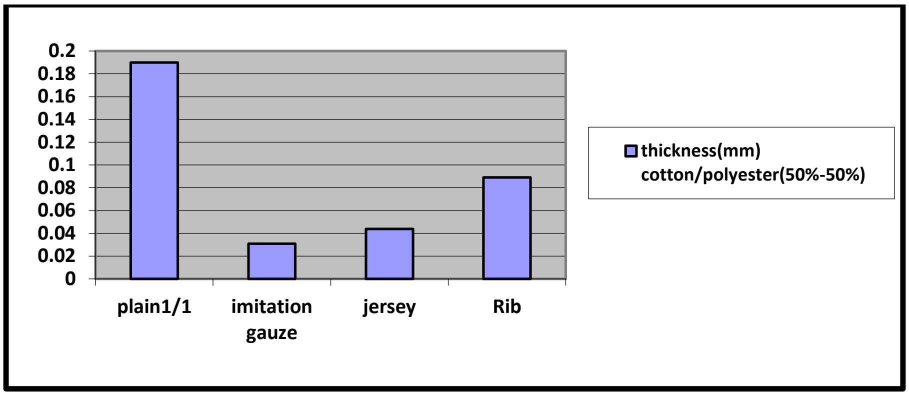

Figure 9: The effect of the structures on the thickness of fabrics used in diabetic foot by using cotton /polyester (50%-50%)

Of Table (1) and forms (8-9) illustrated that:

The imitation gauze sample has recorded the lowest thickness between samples. The thickness of the executed samples using 100% cotton higher than the weight of the cotton / polyester (50% -50%) and 100% polyester samples due to weight of the cotton is greater than weight of polyester**.**

3- The effect of the different kind of materials and structures on the Air permeability of fabrics used in diabetic foot:

The Air permeability of fabrics is one of the most important factors that must be observed when producing fabrics used in diabetic foot to prevent the occurrence of ulcers.

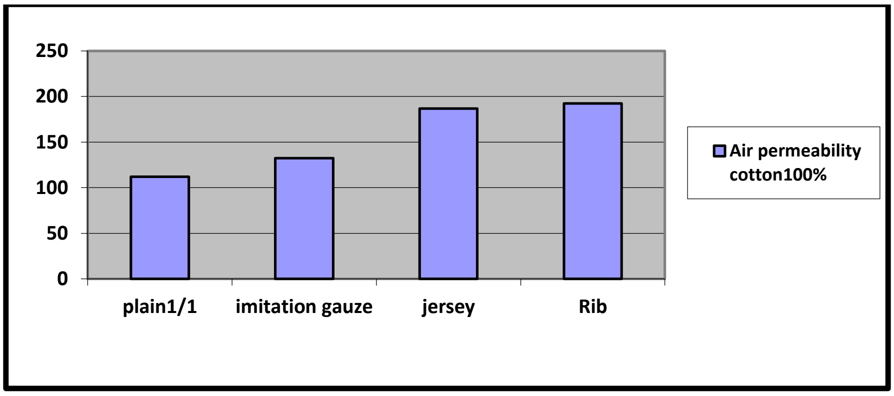

Figure 10: The effect of the structures on the Air permeability of fabrics used in diabetic foot by using cotton 100%

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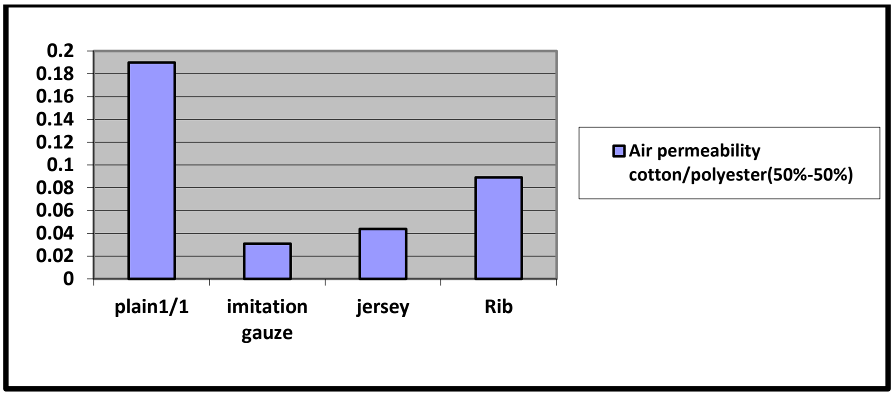

Figure 11: The effect of the structures on the Air permeability of fabrics used in diabetic foot by using cotton /polyester (50%-50%)

Of Table (1) and forms (10-11) illustrated that:

The Rib cotton 100% sample has recorded the highest Air permeability between samples due to the shape of loops.

4- The effect of the different kind of materials and structures on the water absorption of fabrics used in diabetic foot:

The water absorption of fabrics is one of the most important factors that must be observed when producing fabrics used in diabetic foot to give a comfortable feeling.

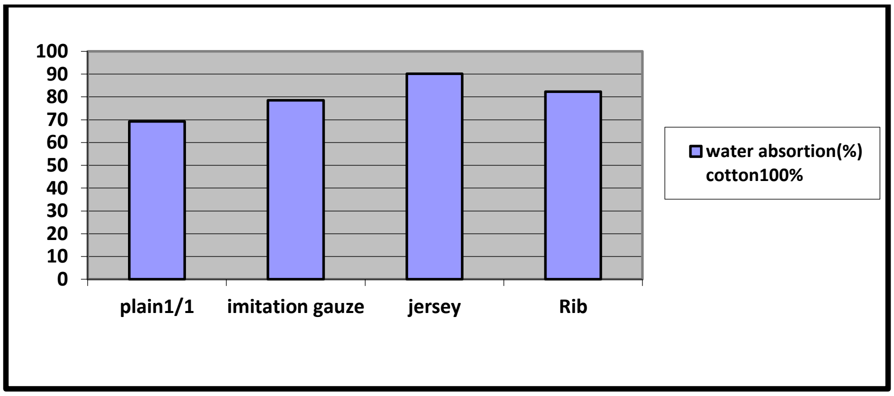

Figure 12: The effect of the structures on the water absorption of fabrics used in diabetic foot by using cotton 100%

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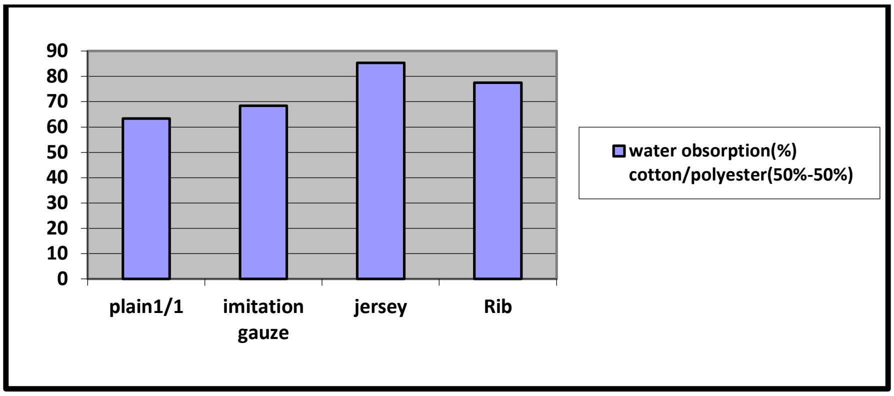

Figure 13: The effect of the structures on the water absorption of fabrics used in diabetic foot by using cotton /polyester (50%-50%)

Of Table (1) and forms (12-13) illustrated that:

The jersey cotton 100% sample recorded the highest percentage of water absorption among the samples, while the plain 1/1 polyester 100% sample recorded the lowest water absorption percentage among the produced samples.

5- The effect of the different kind of materials and structures on the Anti- bacterial of fabrics used in diabetic foot:

The Anti- bacterial of fabrics is one of the most important factors that must be observed when producing fabrics used in diabetic foot to resist bacteria and prevent ulcers.

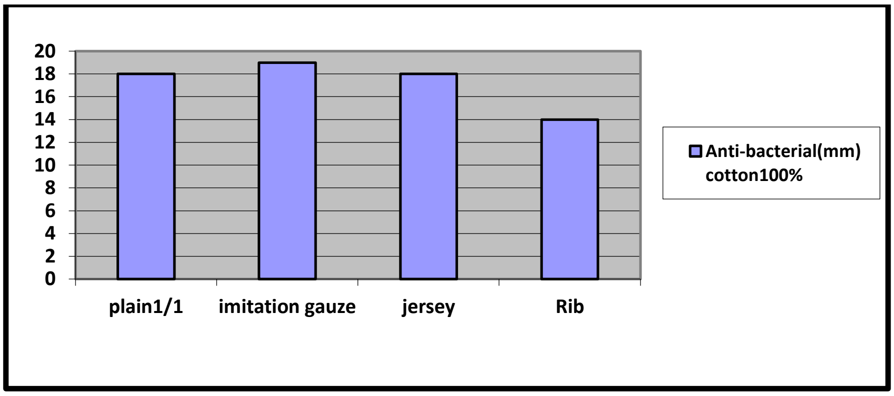

Figure 14: The effect of the structures on Anti- bacterial of fabrics used in diabetic foot by using cotton 100%

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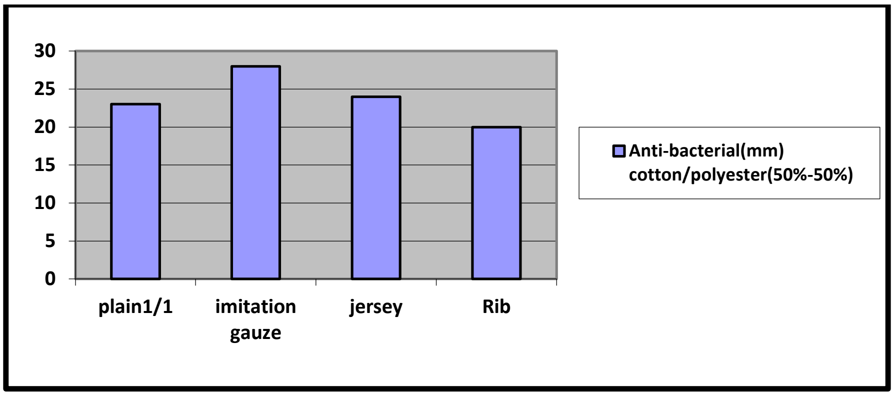

Figure 15: The effect of the structures on the Anti- bacterial of fabrics used in diabetic foot by using cotton /polyester (50%-50%)

Of Table (1) and forms (14-15) illustrated that:

The difference in the structural composition does not affect the resistance of bacteria and wetness, but it is affected by the use of the preparation material against bacteria.

Assessment of samples to determine the best sample:

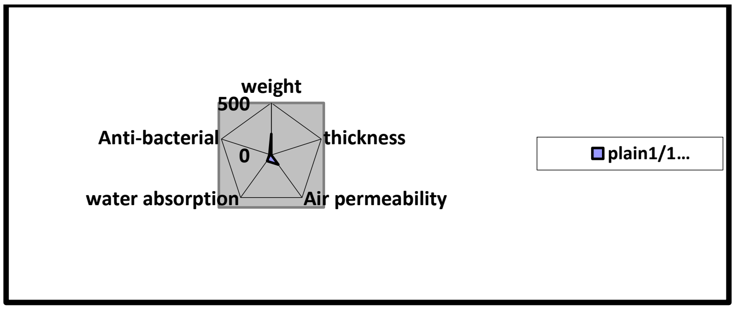

Figure 16: Assessment of plain 1/1 cotton 100% sample

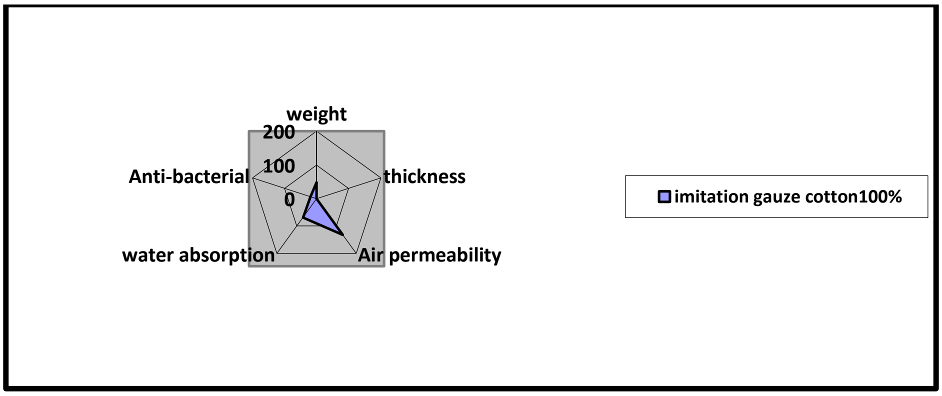

Figure 17: Assessment of imitation gauze 1/1 cotton 100% sample

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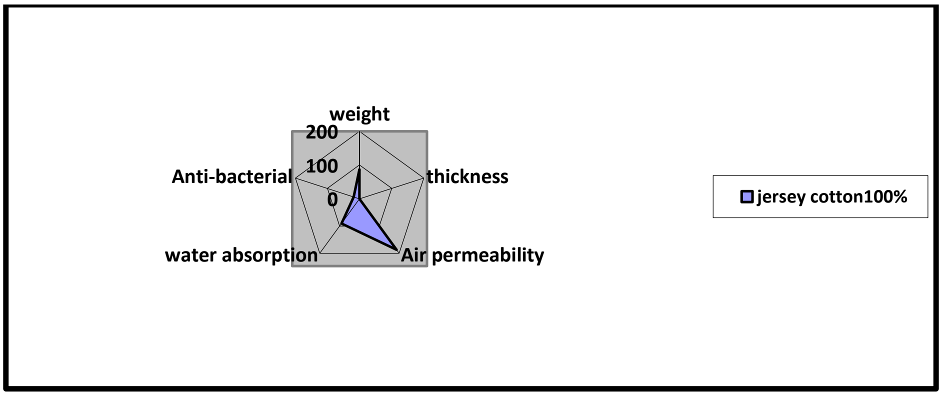

Figure 18: Assessment of jersey 1/1 cotton 100% sample

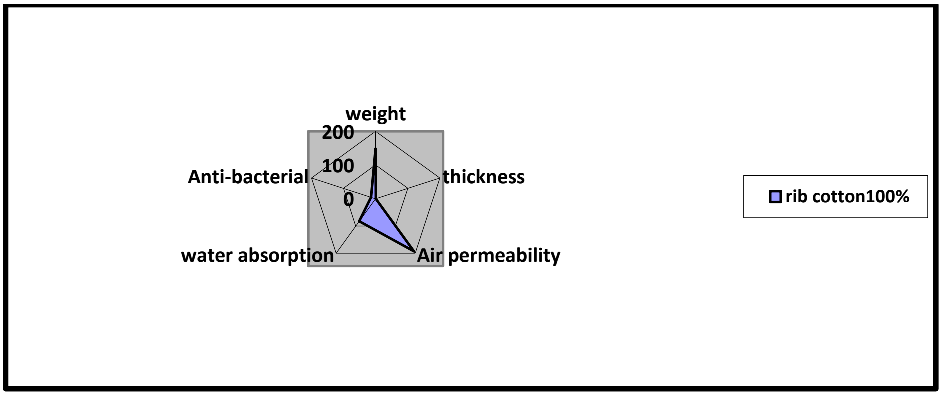

Figure 19: Assessment of Rib 1/1 cotton 100% sample

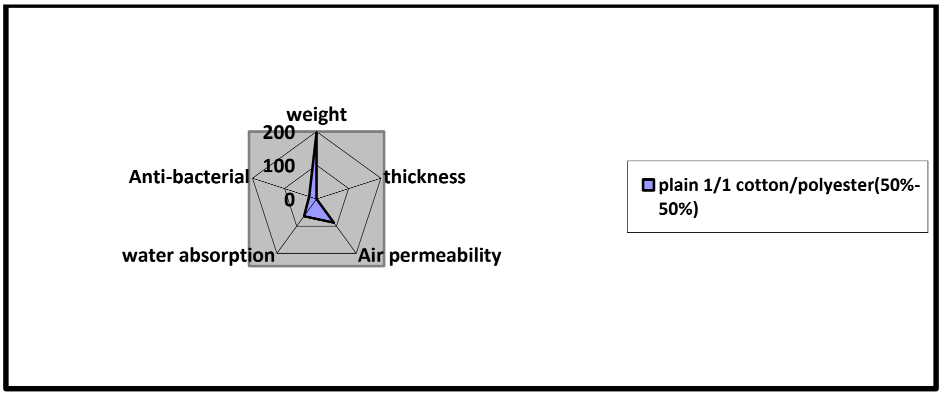

Figure 20: Assessment of plain 1/1 cotton /polyester (50%-50%) sample

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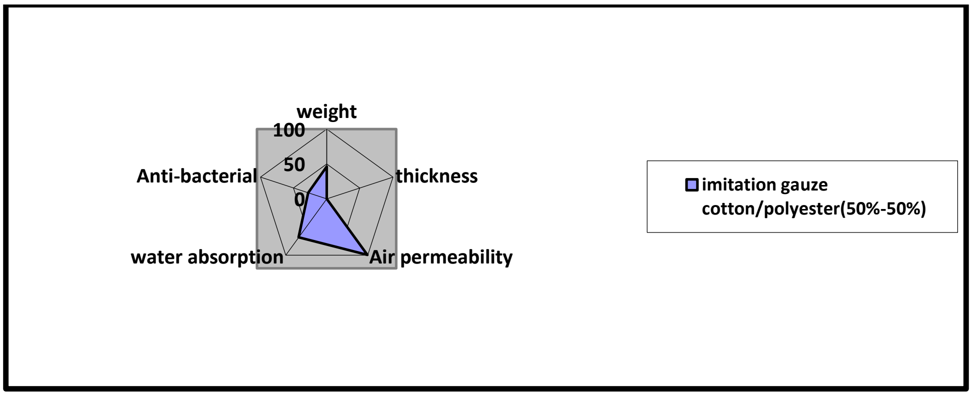

Figure 21: Assessment of imitation gauze cotton /polyester (50%-50%) sample

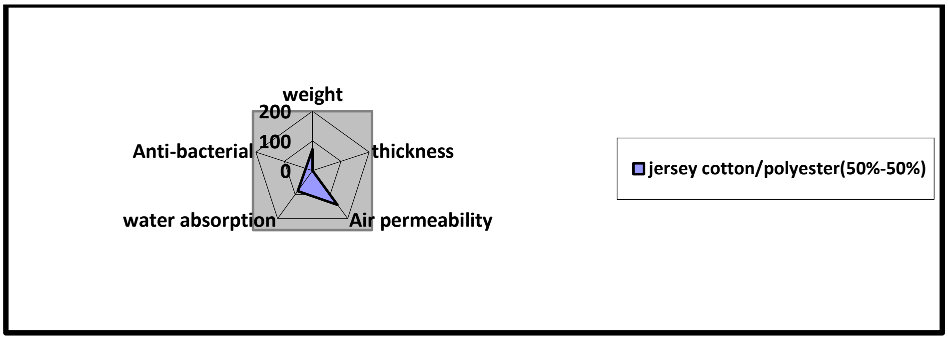

Figure 22: Assessment of jersey cotton /polyester (50%-50%) sample

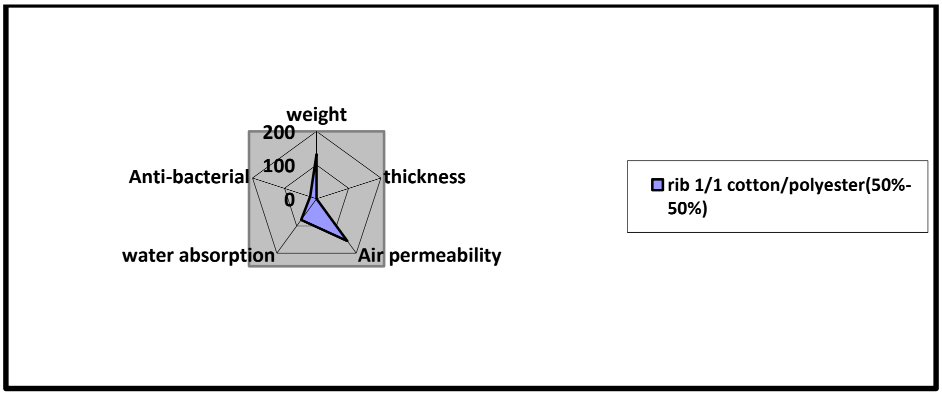

Figure 23: Assessment of Rib 1/1 cotton /polyester (50%-50%) sample

Of forms (16-17-18-19-20-21-22-23) illustrated that:

The best sample is imitation gauze cotton /polyester (50%-50%). And the worst sample is plain 1/1 cotton 100%.

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