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# Using Some of Ordinary Fibers and Micro Fibers to Produce Knee Support for Women to Improve Function Performance

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THE AIM of this research is for achieving best fiber material (microfibers) for the production of knee support for women by improving their function of Performance and fabric properties (absorption-compression-resistant fabric for explosion-pilling-air permeability and static electricity). Six knee support samples were produced with a manual crochet structure with 100% microfiber acrylic- 50%-50% microfiber acrylic-viscose-92%-8%micro fibers acrylic-elastic)- 100%cotton - 100% acrylic-55%-45% acrylic-cotton. Samples were applied on women at the ages between 40-60 years old they suffer from roughness of knee joint, the experimental method was done according to standard test methods. Which relies on analytical test samples produced under the research &then analyze the data and expressed .According to the quality assessment by radar chart for all measuring, it was found that sample cotton100% & the sample microfibers acrylic-viscose 50%:50 % scored the high quality factor.

**Keywords:** Microfibers , Knee support, High performance, Medical fabric, Crochet.

## Introduction

Medical fabric also known as Healthcare Textiles. It is one of the most rapidly expanding sectors in the technical textile market. It is one of the major growth areas within technical textiles and the use of textile materials for medical and healthcare products ranges from simple gauze or bandage materials to scaffolds for tissue culturing and a large variety of prostheses for permanent body implants. Textile products are omnipresent in the field of human hygiene and medical practice. Their use is based on a number of typical basic textile properties like softness and lightness, flexibility, absorption, filtering etc. [1] Advanced medical Fabric are significantly developing area because of their major expansion in such fields like wound healing and controlled release, bandaging and pressure garments, implantable devices as well as medical devices, and development of new intelligent textile products. Present day society is undergoing changes like large population size, need of increasing his life span of every individual, various situations and hazards of human activity and civilization including transport accidents, chemical materials, fire, cold, diseases, and sports. Such factors increase the demand of medical Fabric. So there are several researching works are going on all over the world in medical textile materials and polymers. [2, 3]

*Such innovative products*

Provide new treatment options (textile based implants instead of scarce donor organs; artificial tissues, joints and ligaments), Speed up recovery after medical treatment (innovative wound dressings; light, Breathable). Enhance quality of life of chronically ill people (functional clothing) Surgeons wear, wound dressings, bandages, artificial ligaments, sutures, artificial liver/kidney/lungs, nappies, sanitary towels, vascular grafts/heart valves, artificial joints/bones, eye contact lenses and artificial cornea and the like are some of the examples of medical textiles. Medical textiles are textile products and constructions for medical

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applications. They are used for first aid, clinical or hygienic purposes and rehabilitation [4].

*Examples of its application*

- Protective and healthcare textiles
- Dressings, bandages, pressure garments and prosthetics
- Hygiene products
- Antiseptic wound dressings.
- Knee Support provides basic support for weak or injured knee/ knees. The breathable materials can be worn comfortably all day. Providing moderate compression and warmath.Warmath can reduce discomfort for swelling that may be present in and around the knee joint and tendons [4].
- The development of society & progress is linked with the development of spinning, weaving and knitting industry, where the textile industry has in the areas of agriculture, industry, medicine & other field. The medical knee support is one of the most important medical fabrics. Most of women at the age of 40-60 years old they have roughness in the knee joint, & they cannot doing the daily activities. The medical knee support is discomfort while doing house work or move while you work, where causes heat .swilling, pain & redness of the skin. Making it necessary to produce knee support of the fiber is characterized by the comfort characteristics such as microfibers and by new structure (crochet) to improve the functionality of its. Micro fibers are those fibers with denier per filament that is less than 1.0 Denier Or less than 1.0 Dtex - Denier: - is the weight in grams of 9000 - Meters of a fiber, filament or yarn. - Dtex:- is the weight in grams of 10000 - Meters of a fibers , filament or yarn. - Tex:- is the weight in grams of 1000 - Meters of a fiber, filament or yarn (Fig. 1-3) [5-7].

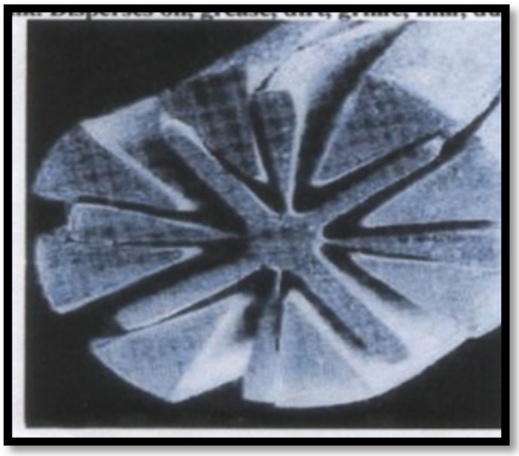


**Fig.1. the microfibers cross section.**

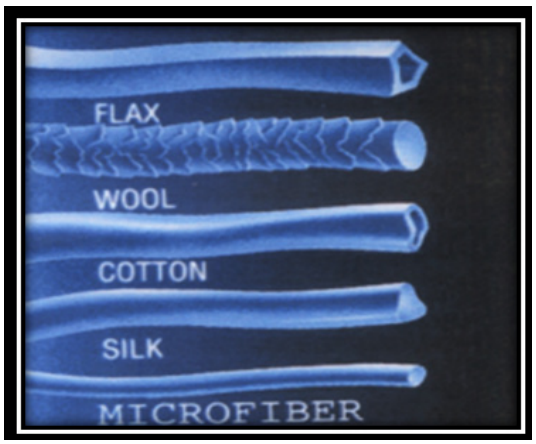
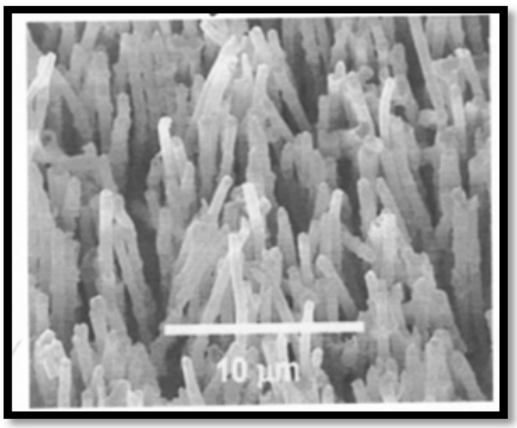



**Fig.2. Comparison the fine of the natural fibers & Microfiber) [5]**



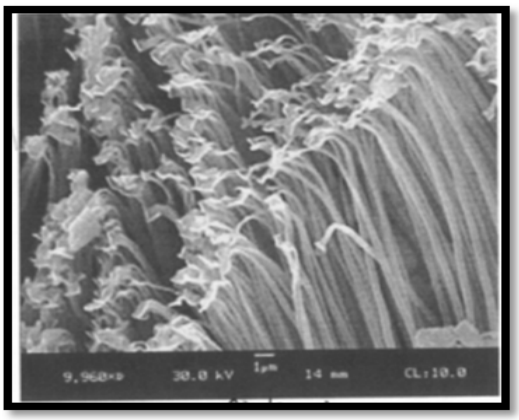



**Fig. 3. a Pair of scanning electron micrograph) [5]**

*Properties of microfiber*

Light weight - high covering – finesse - drape ability - dimensional stability – Comfort - good breathability - High appearance - Good wear resistance - Suitable for special finishing treatments - Air permeability - Moisture – absorption (Fig. 4 &5) [8].

Crochet is a process of creating fabric by interlocking loops of yarn, thread, or stands of other materials using crochet hook. The name is derived from the French term crochet, meaning (small hook).These are made of materials such as metal, wood, or plastic .The salient difference between crochet and knitting, beyond implements used for their production, is that each stitch in crochet is completed before proceeding with the next one, while knitting keeps a large number of stitches open at a time. (Variant forms such as Tunisian crochet and broomstick lace keep multiple crochet stitches open at time).

There are five main types of basic stitches (the following description uses US crochet terminology which differs from the terminology used in the UK and Europe).

1. Chain Stitch- the most basic of all stitches and used to begin most projects.
2. Slip Stitch-used to join chain stitch to form a ring.
3. Single Crochet Stitch (Called Double crochet stitch. [3].

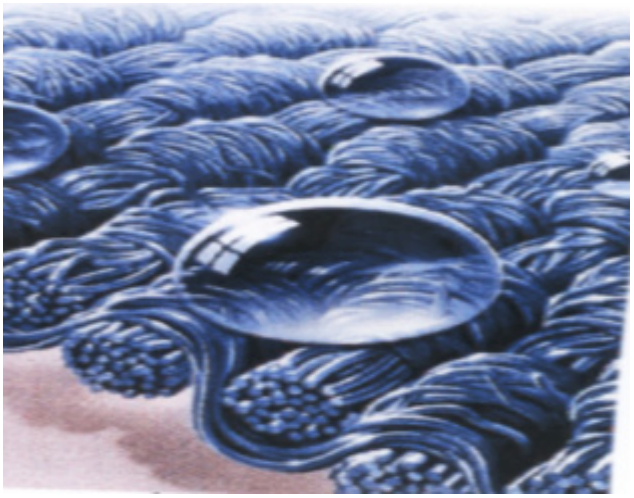


**Fig. 4. the water proof property) [8].**

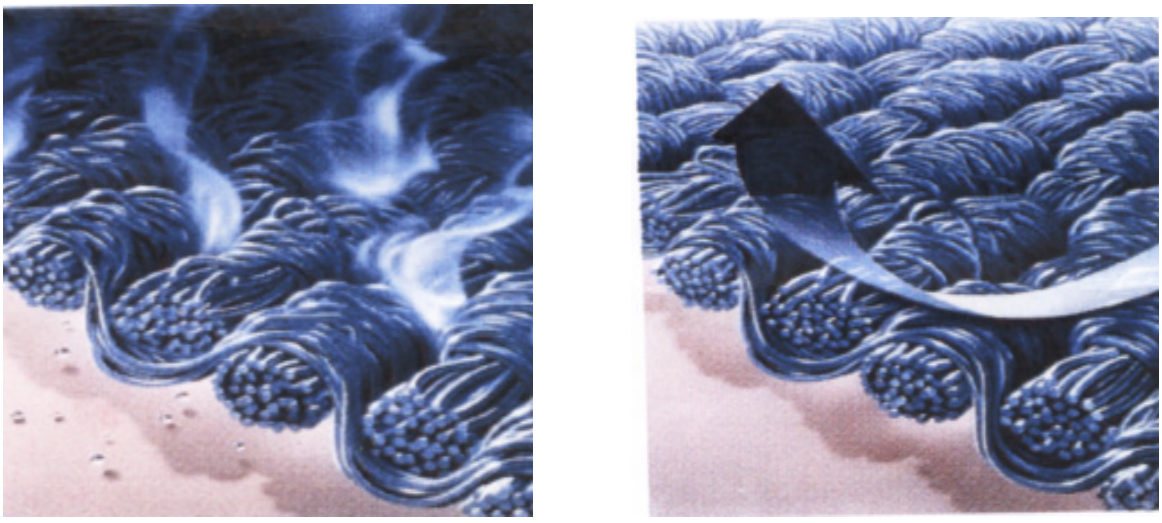


**Fig. 5. The Air Permeability Property (breathability) [8]**

## Material and Methods

A new structure (crochet) was used for producing (6) knee support samples with different materials and blending ratio (microfiber acrylic 100%)-(microfiberacrylic-viscose50%-50%)-(micro fibers acrylic-lycra92%-8%)-(cotton100%) - by using double crochet (single crochet stitch –slip stitch).

Acrylic100 % - ccotton55%-45%) using yarn counts 3.52 denier (Fig. 6)

The experimental method was done according to the standard test methods as following:-

1-the thickness measurement. ASTM D-1777.

2-Fabric weight per/m2 ASTM D-3776.

3- Water Repellency test BS3702-1982.

4- Compression test ASTM D 5199.

5- Bursting test (Steel ball Mechanical Bursting test) ASTM D3786.

6- Air Permeability test ASTM D 737.

7- Pilling test BS 5811.

8- Static Electricity test ASTM D 4328.

9- Determination of fabric Shrinkage ASTM D 437.(9),(10)

## Result and Discussion

We evaluate the mean value of their properties in its samples and Statistical data were analyzed by using one-way ANOVA Analysis test.

We evaluate the quality Assessment of the Samples by using the Radar chart .

**Fig. 6. Samples of knee support.**

*Samples specification*

| N | materials | Blending% | structure | Count denier | Thickness mm | Number of Stitch horizontal | Number of Stitch vertical |
|---|---|---|---|---|---|---|---|
| 1 | Microfiber acrylic | 100% | crochet | 3.52 | 2.70 | 115 | 113 |
| 2 | Micro fiber acrylic\ viscose | 50:50% | crochet | 3.52 | 2.87 | 115 | 113 |
| 3 | Microfiber acrylic\ lycra | 8:92% | crochet | 3.52 | 2.43 | 115 | 113 |
| 4 | Cotton | 100% | crochet | 3.52 | 3.14 | 115 | 113 |
| 5 | Acrylic | 100% | crochet | 3.52 | 2.89 | 115 | 113 |

The analysis of variance (ANOVVA-one way) had been performed to justify the goodness fit form F-test result as shown in Table (2) .It was also seen that form the P values of parameter, far less than 0.05 were significant for effect of materials on fabric absorption (absorption time) as the mainstay of producing (micro fiber acrylic / Viscose 50:50 %) absorbs water in less time either stent produced (100% acrylic fibers) absorb water in times higher.

The analysis of variance (ANOVVA-one way) had been performed to justify the goodness fit form F-test result as shown in Table (3) .It was also seen that form the P values of parameter, far less than 0.05 were significant for effect of type of fibers on fabric compression% (acrylic fiber 100%) sample recorded the highest compression ratio, producing either the mainstay of (micro fiber Acrylic / 92:8 Elastic % ) recorded the lowest compression ratio.

**TABLE 1. Result of experimental.**

| Experiment | | Microfiber acrylic100% | Micro fiber acrylic\ viscose 50:50% | Microfiber acrylic\ lycra 8:92% | Cotton 100% | Acrylic 100% | Acrylic\ cotton 55:45% |
|---|---|---|---|---|---|---|---|
| Thickness(mm) | | 2.70 | 2.87 | 2.43 | 3.14 | 2.89 | 2.99 |
| Weight gm./m2 | | 1062.48 | 997.25 | 846.71 | 1100.0 | 802.39 | 743.93 |
| Absorption time(s) | | 44.73 | 10.54 | 44.60 | 19.47 | 45.60 | 28.63 |
| Compression% | | 5.73 | 6.50 | 5.69 | 6.63 | 11.17 | 7.09 |
| Bursting Resistance | | 33.35 | 22.99 | 24.73 | 21.25 | 34.45 | 23.82 |
| Air permeability (cm3/cm2/s) | | 16.11 | 22.26 | 24.42 | 32.42 | 24.53 | 28.49 |
| Shrinkage% | Vertical | 0 | 2.08 | 0 | 2.98 | 0 | 0.39 |
| | Horizontal | 1.86 | 4.57 | 0.00 | 4.83 | 2.08 | 1.24 |
| Pilling(number | of core) | 2 | 1 | 1.50 | 1 | 4.50 | 3.5 |
| Electro static (kilo volt) | | 14 | 0.50 | 16 | 0 | 14.5 | 0.50 |

**TABLE 2. One-way ANOVA Analysis test of absorption experiment.**

| Source of Variation | SS | Df | MS | F | P-value | F crit |
|---|---|---|---|---|---|---|
| Between Groups | 11113.67 | 5 | 2222.733 | 137.3603 | 1.52E-59 | 2.38607 |
| Within Groups | 0.870154 | 54 | 0.016114 | | | |
| Total | 11114.54 | 59 | | | | |

**TABLE 3.One-way ANOVA Analysis test of compression experiment.**

| Source of Variation | SS | Df | MS | F | P-value | F crit |
|---|---|---|---|---|---|---|
| Between Groups | 209.6457 | 5 | 41.92915 | 5.668307 | 0.000285 | 2.38607 |
| Within Groups | 399.4445 | 54 | 7.39712 | | | |
| Total | 609.0902 | 59 | | | | |

The analysis of variance (ANOVA-one way) had been performed to justify the goodness fit form F-test result as shown in Table (4) .It was also seen that form the P values of parameter, far less than 0.05 were significant differences for effect of type of fibers and fabric explosion ( acrylic fiber 100%) recorded the highest rate of resistance to the burst, either stent produced ( microfibers acrylic-viscose / 50:50 % ) recorded the lowest percentage of resistance to the burst.

The analysis of variance (ANOVA-one way) had been performed to justify the goodness fit form F-test result as shown in Table (5) .It was also seen that form the P values of parameter, far less than 0.05 were significant for effect the type of fibers on fabric air permeability ( 100% acrylic fibers ) recorded less permeable to air, either stent produced ( micro fiber Acrylic / 92:8 lycra % ) recorded the highest permeability to air.

The analysis of variance (ANOVA-one way) had been performed to justify the goodness fit form F-test result as shown in Table (6,7) .It was also seen that form the P values of parameter, far less than 0.05 were significant of raw materials of types of fibers on fabric shrinkage (cotton fiber 100%) recorded the highest percentage of shrinkage, either stent produced (micro fiber Acrylic / 92:8 lycra %) recorded less shrinkage.

**TABLE 4. One-way ANOVA Analysis test of resistance of burst experiment.**

| Source of Variation | SS | Df | MS | F | P-value | F crit |
|---|---|---|---|---|---|---|
| Between Groups | 153.5528 | 5 | 30.71056 | 18.06741 | 6.72E-08 | 3.105875 |
| Within Groups | 0.198232 | 12 | 0.016519 | | | |
| Total | 153.751 | 17 | | | | |

**TABLE 5. One-way ANOVA Analysis test of air permeability experiment.**

| Source of Variation | SS | Df | MS | F | P-value | F crit |
|---|---|---|---|---|---|---|
| Between Groups | 639.6915 | 5 | 127.9383 | 49.71422 | 1.99E-19 | 3.105875 |
| Within Groups | 0.312635 | 12 | 0.026053 | | | |
| Total | 640.0042 | 17 | | | | |

**TABLE 6. One-way ANOVA Analysis test of vertical shrinkage experiment.**

| Source of Variation | SS | Df | MS | F | P-value | F crit |
|---|---|---|---|---|---|---|
| Between Groups | 16.81318 | 5 | 3.362636 | 1820.706 | 1.87376E-09 | 4.387374 |
| Within Groups | 0.011081 | 6 | 0.001847 | | | |
| Total | 16.82426 | 11 | | | | |

**TABLE 7. One-way ANOVA Analysis test of horizental shrinkage experiment)**

| Source of Variation | SS | Df | MS | F | P-value | F crit |
|---|---|---|---|---|---|---|
| Between Groups | 41.46391 | 5 | 8.292783 | 101.5537 | 1.06795E-08 | 4.387374 |
| Within Groups | 0.04885 | 6 | 0.008142 | | | |
| Total | 41.51276 | 11 | | | | |

The analysis of variance (ANOVA-one way) had been performed to justify the goodness fit form F-test result as shown in Table (8) .It was also seen that form the P values of parameter, far less than 0.05 were significant for effect of the type of fibers on fabric pilling ( acrylic fiber 100%) recorded the highest percentage of pilling , either stent produced (microfiber acrylic / Viscose 50:50 % ) recorded less pilling.

The analysis of variance (ANOVA-one way) had been performed to justify the goodness fit form F-test result as shown in Table (9) .It was also seen that form the P values of parameter, far less than 0.05 were significant for effect of type of fibers on fabric static electricity ( acrylic fiber 100%) recorded the highest percentage of static electrification , either stent produced ( microfiber acrylic / Viscose 50:50 % ) recorded the lowest percentage of static electrification.

**TABLE 8. One-way ANOVA Analysis test of pilling experiment.**

| Source of Variation | SS | Df | MS | F | P-value | F crit |
|---|---|---|---|---|---|---|
| Between Groups | 22.66667 | 5 | 4.533333 | 27.2 | 0.000472 | 4.387374 |
| Within Groups | 1 | 6 | 0.166667 | | | |
| Total | 23.66667 | 11 | | | | |

**TABLE 9. One-way ANOVA Analysis test of electro static experiment.**

| Source of Variation | SS | Df | MS | F | P-value | F crit |
|---|---|---|---|---|---|---|
| Between Groups | 664.4167 | 5 | 132.8833 | 177.1778 | 1.98288E-06 | 4.387374 |
| Within Groups | 4.5 | 6 | 0.75 | | | |
| Total | 668.9167 | 11 | | | | |

The Area of shape is 16800.78 the percentage of quality factor 79.54% in (50% microfiber Acrylic-50%viscose) (Fig. 7)

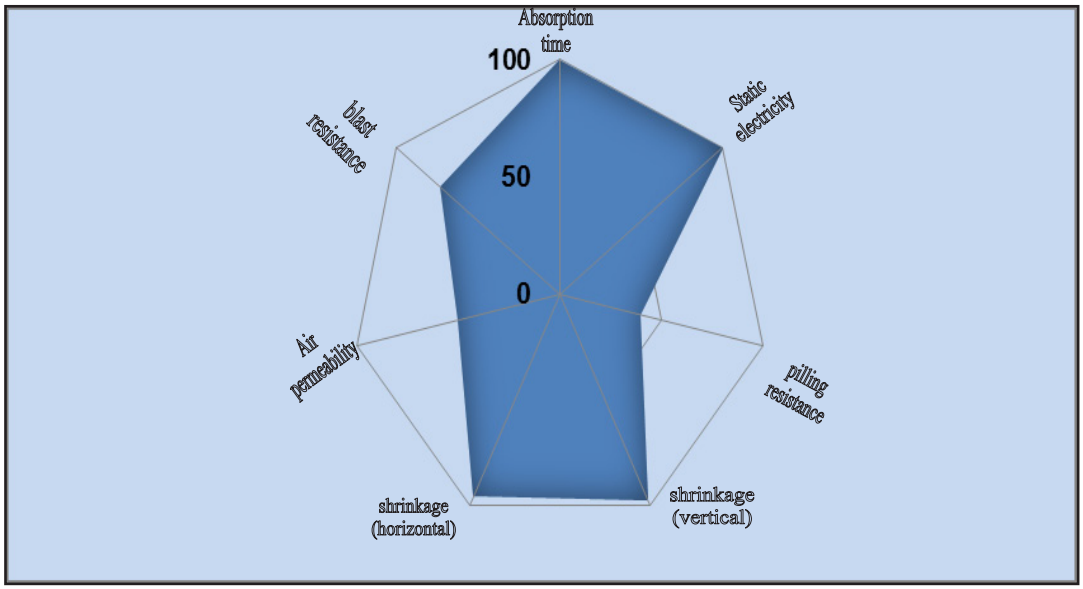



**Fig. 7. Radar charts of sample properties (50% microfiber Acrylic-50%viscose.**

The Area of shape is 11667.04 the percentage of quality factor 42.74% in (92% microfiber Acrylic-8% Lycra)

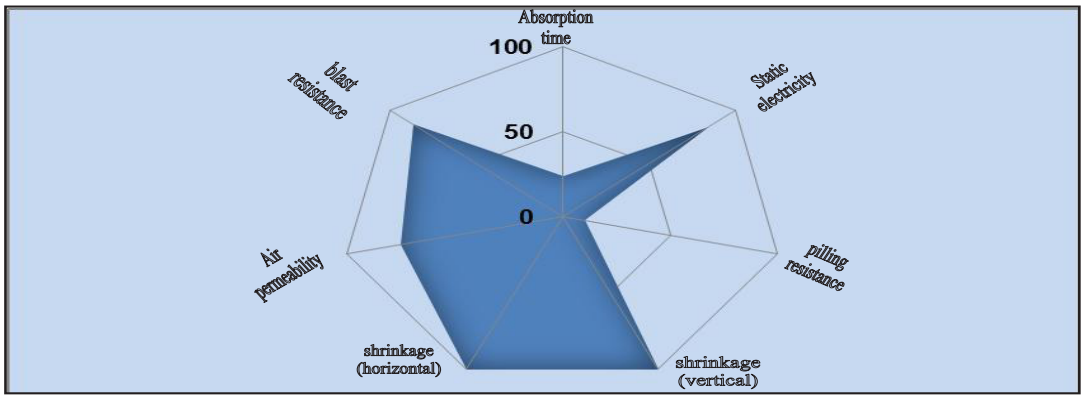



**Fig. 8. Radar charts of sample properties (92% microfiber Acrylic-8%Lycra)**

The Area of shape is 10103.23 the percentage of quality factor 37.01% in microfiber Acrylic 100%

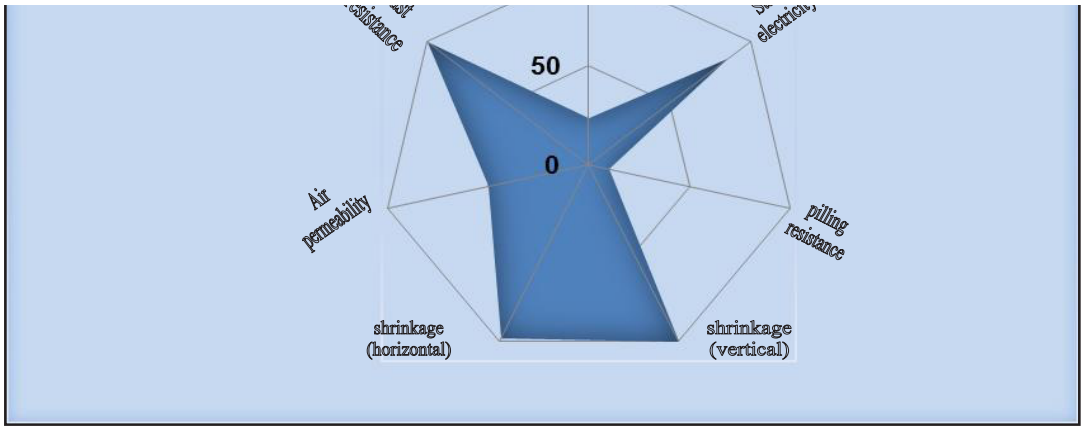



**Fig. 9. Radar charts of sample properties (%100 microfiber Acrylic)**

The Area of shape is 22714.59 the percentage of quality factor 80.2% in cotton100% sample

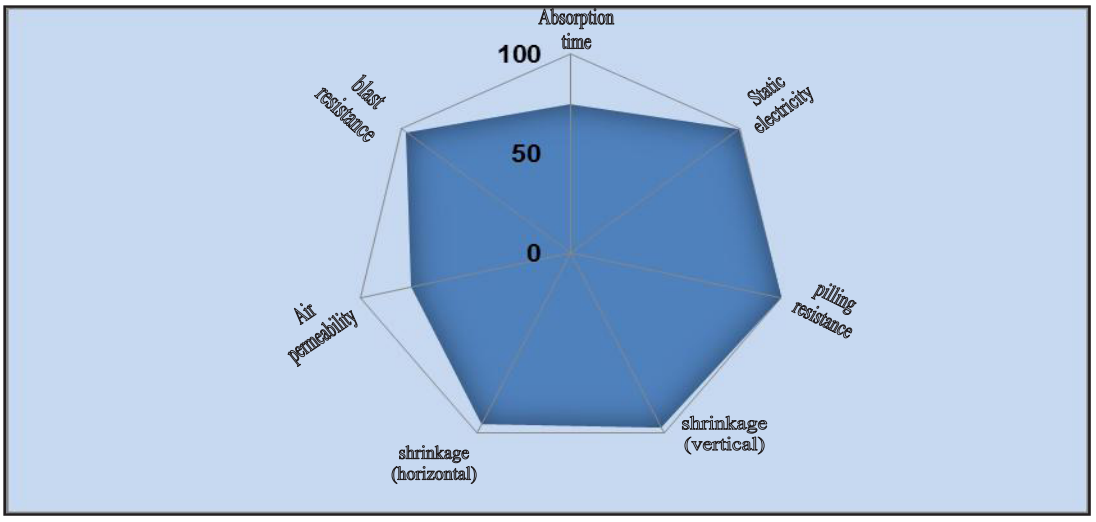



**Fig. 10. Radar charts of the sample properties (%100 Cotton)**

The Area of shape is 17722.29 the percentage of quality factor 64.92% in cotton 100% sample

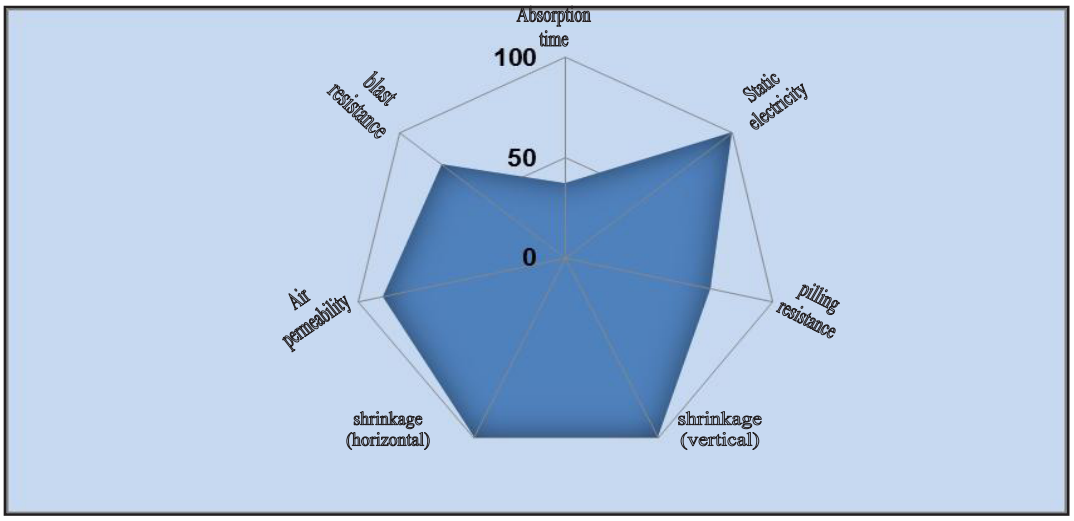



**Fig. 11. Radar charts of sample properties (55%Acrylic-45%Cotton)**

The Area of shape is 16414.69 the percentage of quality factor 35.13% in (100% Acrylic)

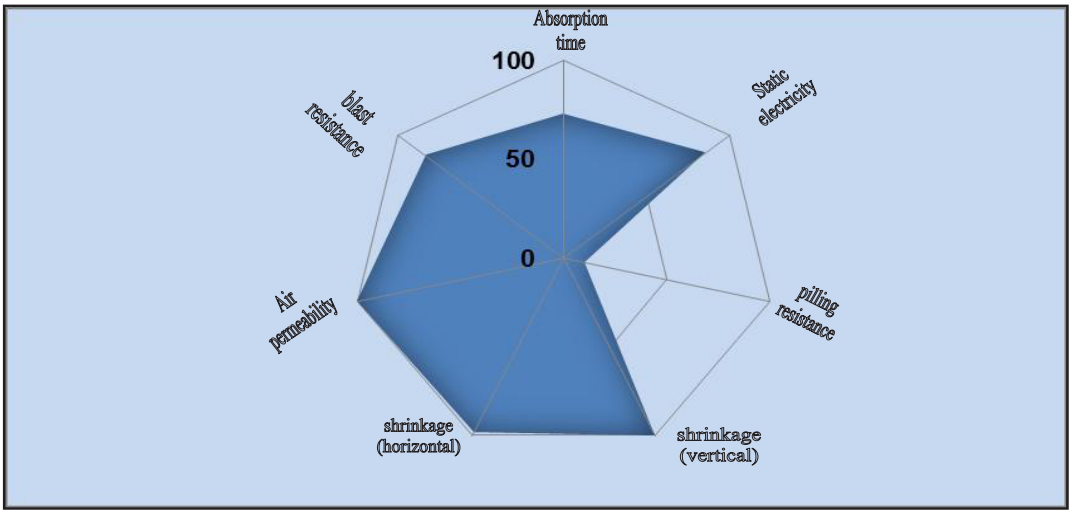



**Fig. 12. Radar charts of sample properties (100%Acrylic)**

## Conclusion

The types of fibers recorded a significant effects on the fabric properties (absorption-compression-bursting -pilling-air permeability-shrinkage- and static electricity).

According to the quality assessment by radar chart for all measuring, it was found that sample cotton100% and the sample microfibers acrylic-viscose 50%:50 % recorded the high quality factor.

The knee support (cotton100%) is the best sample because it was recorded 80.2in percentage of quality factor

The second sample (microfibers acrylic-viscose 50%:50 %) it was recorded 79.54in percentage of quality factor.

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**استخدام بعض الالياف التقليديه وألياف الميكروفيبر في انتاج دعامات ركبه للسيدات لتحسين الأداء الوظيفي**

**دينا حمودة**
**المركز القومى للبحوث ـ الجيزة ـ مصر**

يهدف البحث الي الحصول علي أفضل خامه من الالياف النسيجية لانتاج دعامات للركبه وذلك السيدات اللاتي يعانين من خشونه في الركبه مما يؤدي لصعوبه الحركه خاصه في الاعمال المنزليه وغيرها ،وذلك لتحسين الأداء الوظيفي لدعامة الركبه بتحسين خصائصها الفيزياءيه والميكانيكيه وقد تم قياس الخصائص التاليه للعينات المنتجه:
(الامتصاص-مقاومة الانفجار- مقاومة الانضغاط- التوبير-نفاذيه الهواء (التنفيس)-الكهرباء الاستاتيكيه)

تم اجراء جميع الاختبارات السابقه في معامل المركز القومي للبحوث وذلك لقياس مدي كفاءة الدعامات .
وقد تم استخدام الخامات الاتيه في الدعامات المنتجه :(١٠٠٪ قطن)-(١٠٠٪أكريليك)(٥٠٪فسكوز-٥٠٪أكريليك) (١٠٠٪ ميكروفيبر اكريليك) - (٥٠٪فسكوز-٥٠٪ميكروفيبرأكريليك) - (٩٢٪ ميكروفيبراكريليك-٨٪ليكرا).

وبعد اجراء الاختبارات السابق ذكرها لقياس الخصائص السابقه وتسجيل النتائج تم عمل التحليل الاحصائي للنتائج وقد حققت عينة ١٠٠٪ قطن أفضل النتائج والعينه (٥٠٪ فسكوز-٥٠٪ ميكروفيبرأكريليك) وذلك بعد حساب معامل الجوده للعينات باستخدام الاشكال الردارية لجميع العينات وذلك لتقييم الاداء الوظيفي لها اي ان هذه العينات قد حققت خصائص الراحه الملبسيه كما أنها تغلبت علي بعض المشاكل التي كانت في الدعامات الطبية المتداولة.