Scientific Evaluation of Some Aesthetical Properties for Women's Head Covering Scarves Fabrics

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Abstract:
Women's head covering scarf fabric plays an important role in women's life as it is an integral part of her appearance, and it needs to have aesthetical properties as well as the physiological comfort properties, where a large category of women living in Egypt, the Arab countries and North Africa wear a headscarf for social, religious or preventive reasons and sometimes for other reasons such as adornment. Therefore, it was necessary to find a relationship between the available aesthetical properties and the functional performance that should be distinguished. In this study we will be identifying the concept of aesthetical properties from different points of view and how to evaluate them by scientific objective methods. Most studies and researches on the aesthetic properties of fabrics are not dependent to objective scientific evaluation, but often dependent on subjective measurements (such as hand-touch, eye examination or pressure on the fabric) that lack accuracy and credibility of the results.
However, when evaluating aesthetical properties in an accurate scientific manner, based on a set of objective measurements (textile tests) that can be used as a measurable scientific concept, aesthetic requirements can be determined rather than subjective measurements. The study focuses on evaluating some aesthetical properties of the head coverings fabrics using objective scientific criteria rather than subjective evaluation. Also, the sample was carried out by using viscose /cotton/polyester microfibers/ spun polyester .16 samples were manufactured and tested.

Key words:
Head Coverings – Aesthetical Properties – Objective Scientific tests - Subjective Evaluation.

Introduction:
Many properties of fabrics (e.g., weight, construction, strength) are easily measured by physical tests. However, there may be no recommended system for measuring aesthetical and mechanical properties for fabrics. This is due to the subjective method used to describe these properties. Aesthetic concepts are basically people’s preferences and should be evaluated subjectively by people. Proper choice of questions, combined with mathematical analysis, leads to meaningful numerical values of these concepts [1-p435].

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1. Criteria for aesthetic concepts

Aesthetics, one element in the framework of total fabric character, it was defined as ‘the quality of a fabric assessed by the reaction obtained from the sense of sight [2-p1982], it can be broken down into several aesthetic concepts defined by the following criteria FIG 1:

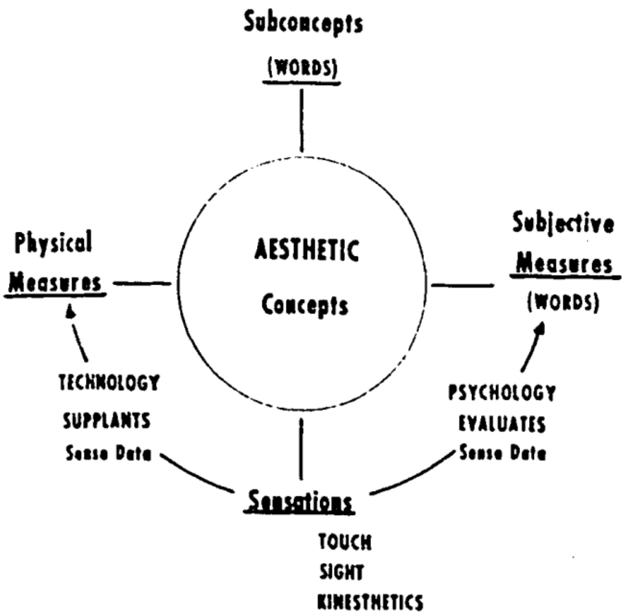

Fig.1. Show criteria for defining aesthetic concepts

(1) The concept must be related to at least one of three main physiological sensations, the visual, tactile, or kinesthetic sensation.
(2) The concept may be a composite of sub concepts, symbolized by words which are more explicit.
(3) Some concepts may be made technically explicit by physical measurements. These measurements attempt to quantify objectively and to supplant sense data.
(4) Aesthetic concepts or sub-concepts can always be evaluated subjectively. Subjective evaluation scales are represented by common words (quality words) which express the psychological value of the sense data associated with the concept. [1-P422, 423, 424].

2. Testing the aesthetic properties of fabrics

Fabric end uses can be roughly divided into industrial, household and apparel. Fabrics for industrial uses can be chosen on straightforward performance characteristics such as tensile strength, extension and resistance to environmental attack. However, fabrics intended for clothing have less emphasis placed on their technical specification and more on their appearance and handling characteristics such as luster, smoothness or roughness, stiffness and draping qualities. Handling the fabric is one of the ways of assessing certain of these properties [3-p256]. 'Handle', the term given to properties assessed by touch or feel, depends upon subjective assessment of the fabrics by a person [4]. Terms such as smooth, rough, stiff or limp depend strongly on the type of fabric being assessed, for instance the smoothness of a worsted suiting is different in nature from that of cotton fabrics [3-p256], [5-p1]. Fabric properties like thickness, compressibility, bending properties, extensibility, dimensional stability and surface properties are associated with fabric aesthetics generally; the aesthetical characteristics of fabrics can be measured by a mixture of subjective evaluation and objective tests.

When assessing fabric handle subjectively, the assessor usually strokes the fabric surface with one or several fingers and then squashes the fabric gently in the hand [1], [6-p5,6], [7]. Subjective characteristics are assessed by the sensations of smoothness or roughness, hardness or softness, stiffness or limpness. These feelings may determine whether a fabric is comfortable or uncomfortable to a wearer. However, many factors influence the characters of a fabric observed through handling, for instance, the type of fabric being assessed, which may be different in the material used, and differences in fabric structure made especially for apparel, upholstery or industrial uses. This subjective hand evaluation system requires years of experience and can obviously be influenced by the personal preferences of the assessor. A fabric may feel light, soft, mellow, smooth, crisp, heavy, harsh, rough, furry, fuzzy or downy soft. So there is a need to replace the subjective assessment of fabrics by experts with an objective machine-based system which will give consistent and reproducible results [8-p112].

Different approaches to evaluate the aesthetical properties of fabrics

Brand’s approach to textile aesthetics research consisted of four major steps: selecting polar word scales, establishing numerical scales with reference to specific fabric aesthetic components, relating the scales to the aesthetic concepts by statistical techniques, and relating the word scales to fabric physical properties or, if possible, replacing the word scales by fabric physical properties. [1], [2-p1982], [9-p601].

Table 1. Brand’s approach to textile aesthetics evaluation (concepts and sub concepts) [1-p426,427]:

Concept	Principal Sensory Preceptors	Sub Concepts	Sub Concepts Objective Techniques And Measures	Concept Qualities, Associated Polar Words (Subjective Value Scales)
COVER	Sight Touch	Top Cover Bottom Cover	1. Streak Meter 2. Light Transmission 3. Air Permeability 4. Surface Contact Area	Smooth-Thread Fuzzy-Clean Soft-Hard Dense-Sheer (Open, Sleazy) Full-Lean
BODY	Kinesthetic	Matter Substance Loft	1. Weight Per Unit Area 2. Volume Per Unit Area 3. Thickness 4. Weight Density (Bulk) 5. Volume Density Volume Fabric/Volume Fiber	Bulky-Sleazy Full-Lean Lofty-Thin (Crisp) Heavy-Light Firm-Soft. Hard-Limp

DRAPE	Sight Kinesthetic	Liveliness Fit	1. Hanging Heart 2. Cantilever 3. Drape Meter	Lively Dead Compliant-Stiff Limp-Crisp Clinging-Flowing Sleazy-Full Boardy-Supple
RESILIENCE	Kinesthetic	Compressional Extensional Liveliness	1. Fabric Fold 2. Tensile Work Recovery 3. Fabric Compression 4. Vibration Damping	Lively-Rubbery Lofty-Mushy Supple-Compliant Bounce-Limp Nervous-Dead Snappy-Stiff
SURFACE Texture	Touch Sight	Tactility Pattern	1. Fabric Friction 2. Friction Sounds 3. Strain Gauge "Feelers" 4. Optical Flying Spot Reflectance 5. Surface Contact Area	Dry-Clammy Warm-Cool Cottony-Waxy Slick-Greasy Scroopy-Smooth Fuzzy (Nap)-Clean Soft-Hard Wiry-Harsh Bitey (Scratchy) Picky(Snaggy) Shiny Bloom Streaky
STYLE	Sight	Pattern Fabric Type Coloration	1. Fabric (Weave) & Yam 2. Structure Analysis 3. Fiber Analysis: Type Linear Density Length	

Bogaty *et al*. used polar adjectives to evaluate sensory harshness on a 7-points scale; however, Winakor *et al*. used a 99-points scale because data on a scale with fewer than 9 intervals cannot be transformed to normalized ranks or normal deviates. The 99 points scale has the advantage of providing larger amount of information as compared with an 11-points scale or other scales with less fine gradations. They stated that the transformation is necessary because statistical analysis assumes that intervals on the scale are linear, whereas judges in sensory evaluation interpret the intervals on a scale as areas under the normal curve rather than as linear distances. Lundgren stated that, aside from the intrinsic structure and the properties of the fabrics, appropriateness of the fabric for a designated end-use should take into account hand preferences. He used judgments of a trained panel to determine consumer preferences which, according to Brand, can only be assessed by consumers. Whisney *et al*. used an effective instrument for evaluating consumer preferences related to fashion. The instrument was the full forced-choice paired comparison. They related the information on why judges preferred certain dress styles to judges' sensory responses to garment styles as measured by the semantic differential [10-p61,62].

Many researchers have been trying to develop a system for measuring the mechanical and aesthetical properties of textiles.

However, the most meaningful studies related to the hand of textiles were performed by Sueo Kawabata and Masako Niwa. They established the Hand Evaluation and Standardization Committee (HESC) to finally create the so-called Kawabata System (KES) [11], [12]. Japan's Textile Machinery Society has published standards incorporating samples of appropriate fabrics for the overall fabric hand called the Total Hand Value (THV) focusing on men's winter suiting. The Committee elaborated similar types of standards for fabric hand attributes or Primary Hand Value (PHV) considered important in the fabric hand evaluation of both men's winter and summer suiting fabrics and ladies' thin dress materials. The PHV attributes chosen by the HESC are koshi (stiffness), Shari (crispness) and fukurami (fullness and softness). These hand values relate to the shear and bending properties, and consequently to the inherent fiber properties and fabric geometry [3-p282], [13-p1459].

The Kawabata Evaluation System for Fabric (KES-F) consists of four specialized instruments: FB1 for tensile and shearing, FB2 for bending, FB3 for compression and FB4 for surface friction and variation. A total of 16 parameters are measured at low levels of force. The measurements are intended to mimic the fabric deformations found in use [8-p112]. From these measurements, properties such as stiffness, softness, extensibility, flexibility, smoothness and roughness can be inferred. Tensile property the tensile behavior of fabrics is closely related to the inter-fiber friction effect, the ease of crimp removal and load-extension properties of the yarn themselves [14-p31], [3-p279], [15-p35], [16].

A set of the Fabric Assurance by Simple Testing (SiroFAST) instruments developed in Australia is used to measure the mechanical properties of wool fabrics and to predict their tailoring performance. SiroFAST gives similar information on the aesthetic characteristics of fabric as KES-F does, but in a simple manner, and is more suited to a mill environment. The SiroFAST system includes SiroFAST-1 for thickness, SiroFAST-2 for bending. SiroFAST-3 for extensibility and SiroFAST-4 for dimensional stability. The SiroFAST Press Test has also been added to complement these tests.

Through the objective measurements of fabric and a data set on a chart or fingerprint, manufacturers can identify fabric faults, predict the consequences of those faults and identify re-finishing routes or changes in production [8-p112], [13-p1459].

Experimental work

In this study 16 samples were produced**.**

The warp yarns were constant polyester with count 100 denier /36 filaments.

Warp density 48 yarn/cm.

Four different weft materials were used

Rayon viscose count 30/1 English.

Cotton count 30/1 English.

Polyester microfiber count 150 /288 denier.

Spun Polyester count 30/1 English.
Weft density 20 Weft/cm.
The complete specification of samples under study is tabulated in table (1).
Table .2. Samples Specifications

no.	Weave type	Weft fiber type	Pick density/ cm	Weft Count	Warp fiber type	Warp density/ cm	Warp Count
1	Mock Leno Weave	Viscose	20	30/1 English	Polyester	48	100 Denier
2	Honeycomb weave 10						
3	Piqué Weave						
4	Crepe Weave						
5	Mock Leno Weave	Cotton	20	30/1 English	Polyester	48	100 Denier
6	Honeycomb weave 10						
7	Piqué Weave						
8	Crepe Weave						
9	Mock Leno Weave	Polyester Microfiber	20	150 denier	Polyester	48	100 Denier
10	Honeycomb weave 10						
11	Piqué Weave						
12	Crepe Weave						
13	Mock Leno Weave	Spun Polyester	20	30/1 English	Polyester	48	100 Denier
14	Honeycomb weave 10						
15	Piqué Weave						
16	Crepe Weave						

Structures Weaving Used

The following structures were used to produce the research samples

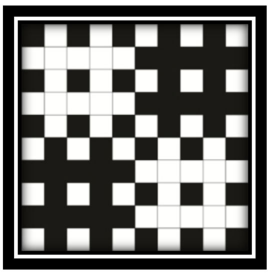

fig.2. Mock Leno Weave

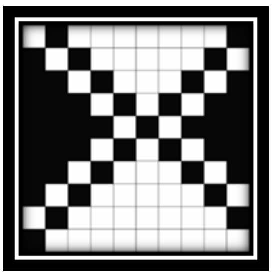

fig.3. Honeycomb weave

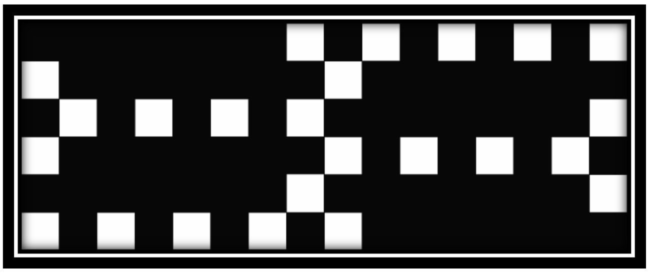

fig.4. Piqué Weave

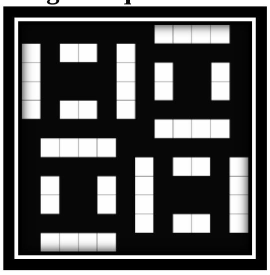

fig.5. Crepe Weave

Tests Methods

The samples were tested to evaluate aesthetical properties by objective methods, as illustrated in table .3.

Table .3. Standards Test methods of the properties measured in this study

Fabric property	Standard test method
Weight	ASTM D 3776 - 79
Thickness	ASTM-D-1777-1996
Crease Recovery	ASTM D 1295
Stiffness	ASTM D 1388-96
Pilling	ISO 12945-2:2000

Results and Discussions

The results of tests are listed in the following Table .4.

Table .4. The results of tests for produced samples

no.	Weave type	Weft fiber type	Weight	Thickness	Crease Recovery	Crease Recovery(Weft)	Stiffness	Pilling
1	Mock Leno Weave	Viscose	125.4	0.45	133	119	41.77	1
2	Honeycomb weave 10		126.4	0.38	138	138	59.5	2
3	Piqué Weave		121.1	0.44	133	127	40.8	5
4	Crepe Weave		119.8	0.42	113	127	40.44	5
5	Mock Leno Weave		112.3	0.41	118	113	37.6	5

6	Honeycomb weave 10	Cotton	110.1	0.43	138	134	45.1	4
7	Piqué Weave		110.6	0.38	125	98	37.2	5
8	Crepe Weave		115.9	0.45	133	123	37.6	5
9	Mock Leno Weave	Polyester Microfiber	95.3	0.28	123	124	35.1	5
10	Honeycomb weave 10		99.1	0.29	123	123	47.3	5
11	Piqué Weave		97.8	0.28	122	123	36.1	5
12	Crepe Weave		96.4	0.26	130	118	32.7	5
13	Mock Leno Weave	Spun Polyester	101.7	0.31	137	122	37.4	5
14	Honeycomb weave 10		99.4	0.28	143	119	50.1	3
15	Piqué Weave		93.8	0.27	134	130	35.3	5
16	Crepe Weave		97.6	0.27	125	127	33.2	5

Fabric weight

From figure (6) which represents the relationship between the difference of materials and fabric weight for different fabric structures.

- Sample no. (2) (Viscose) has the highest weight and Sample no. (15) (Spun Polyester) has the lowest weight,

The variance in weight between produced samples was related to specific density where this is a direct correlation between fiber specific density and the weight of fabric which produced from this fiber**,** where the specific density of rayon viscose is (1.5-1.53) g/cm^3 and polyester is (1.23-1.38) g/cm^3.

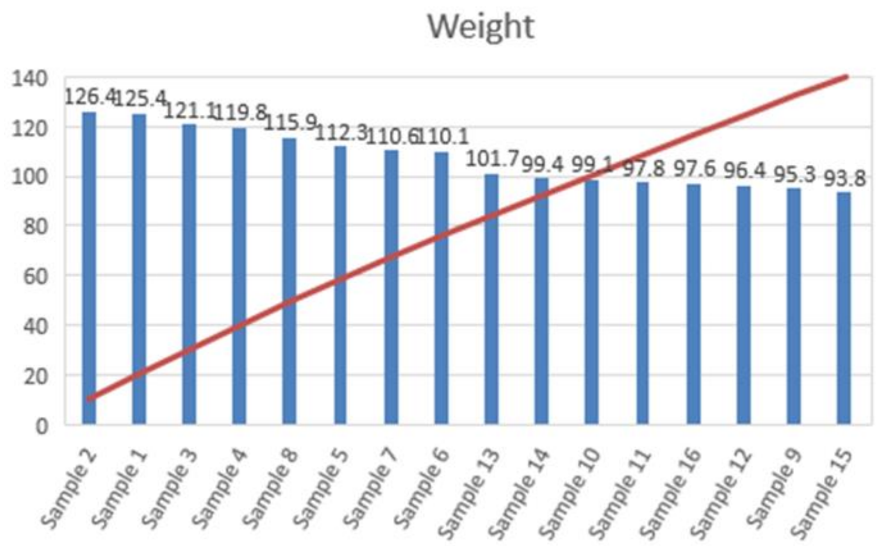

fig.6. Weight test results

Fabric thickness

As shown in figure (7), that represents the effect of different fabrics constructions on fabric thickness. It was found that viscose fabric with mock leno weave recorded the highest fabric thickness at sample no. (1). however, polyester microfiber fabric with crepe weave was recorded the lowest fabric thickness at sample no. (12). this is due to microfiber is more consistent than both natural fiber fabrics (cotton, viscose) and traditional spun polyester fabric. Because the fineness and uniform of microfibers in the yarn cross section.

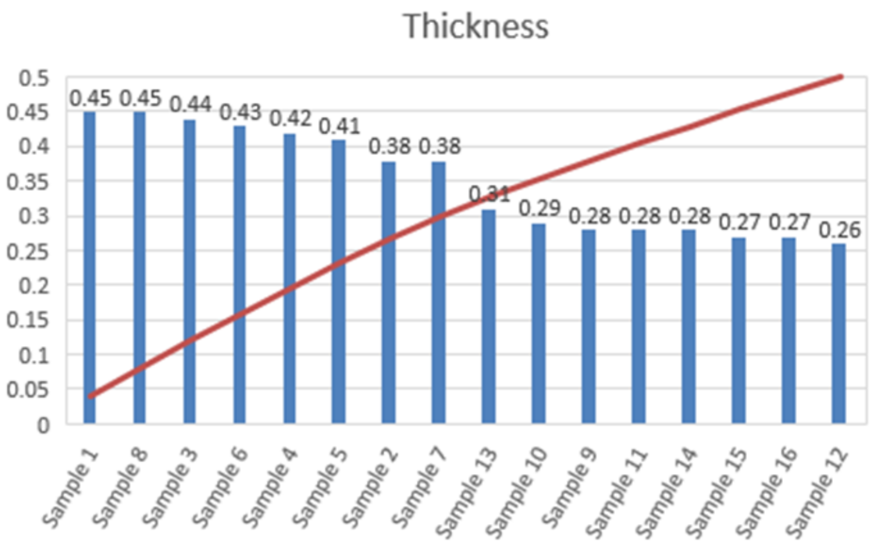

fig.7. Thickness test results

Fabric crease recovery:

As shown in figure (8), (9), that represents the effect of different fabrics constructions on fabric crease recovery in warp and weft direction.

In warp direction, it is noticed that the warp yarn is polyester for all samples, where sample no. (14) has the highest value of crease recovery in warp direction and sample no. (4) has the lowest value.

After analyzing the ANOVA results for crease recovery in the warp direction, as listed in table 5, the variance was found to be significant (F= 553.1 ≥ Fcrit =7.7). This result due to the spun polyester yarn in weft supports the warp recovery where it hasn't hairness on the surface of yarn as in natural fibers; which impedes recovery of fabric in the warp direction and hasn't many fibers in cross-section of weft as in polyester microfiber.

Table .5. ANOVA single factor for fabric crease recovery in warp direction

Groups	*Count*	*Sum*	*Average*	*Variance*
spun polyester	3	428	142.6667	2.333333
viscose	3	340	113.3333	2.333333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1290.667	1	1290.667	553.1429	1.94E-05	7.708647
Within Groups	9.333333	4	2.333333			
Total	1300	5				

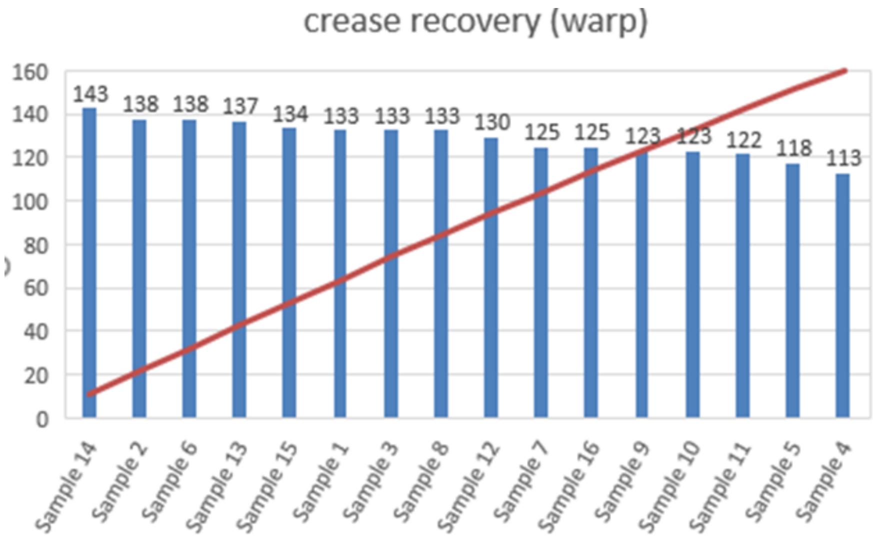

Fig.8. Crease warp° test results

In weft direction, it is noticed that the sample no. (2) has the highest value of crease recovery and sample no. (7) has the lowest value of crease recovery

After analyzing the ANOVA results for crease recovery in weft direction, as listed in table 6, the variance was found to be significant (F= 1028.5 ≥ Fcrit =7.7). This result due to the smoothness of viscose when compared to cotton and polyester.

Table 6 ANOVA single factor for fabric crease recovery (weft)

Groups	*Count*	*Sum*	*Average*	*Variance*
viscose	3	413	137.6667	2.333333
cotton	3	293	97.66667	2.333333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2400	1	2400	1028.571	5.63E-06	7.708647
Within Groups	9.333333	4	2.333333			
Total	2409.333	5				

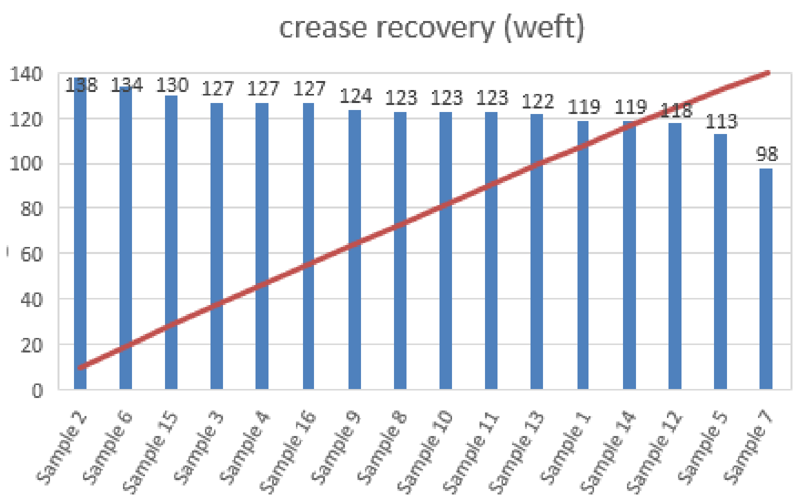

fig.9. Crease weft° test results

Fabric Stiffness

As shown in figure (10), that represents the effect of different fabrics constructions on fabric stiffness, indicates that Sample no. (2) recorded the highest stiffness, moreover Sample no. (12) recorded the lowest stiffness. After analyzing the ANOVA results for stiffnes of fabric, as listed in table 7, the variance was found to be significant (F= 1077.3 ≥ Fcrit =7.7). This result is due to two reasons:

The first reason is a cross-section of polyester microfiber has 288 fine and uniform fibers, these fibers have strong cohesion between each other in the cross-section of yarn, that makes fabric has short bending length,

The second reason is the fabric's weight of the sample (2) has the highest value of fabric weight, which reflects in the stiffness equation.

Stiffness= 0.1× fabric weight for square meter (g/m2) × bending length (cm).

Table 7 Stiffness of fabrics

Groups	Count	Sum	Average	Variance
Polyester microfiber	3	98.1	32.7	1
viscose	3	178.5	59.5	1

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1077.36	1	1077.36	1077.36	5.14E-06	7.708647
Within Groups	4	4	1			
Total	1081.36	5				

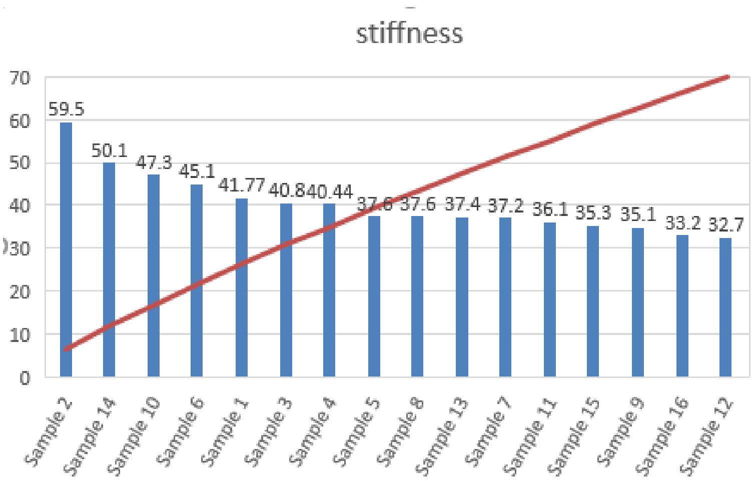

Fig.10. Stiffness test results

Fabric pilling:

As shown in figure (11), represent the effect of different fabrics constructions on pilling of fabric, indicates that the pilling of fabric recorded lowest value in Sample no. (1), viscose with Mock Leno weaves and sample no. (2). viscose with honeycomb weaves. This result is due to the viscose has the lowest strength when compared with cotton and polyester, where the pilling related to the increasing in strength of fibers.

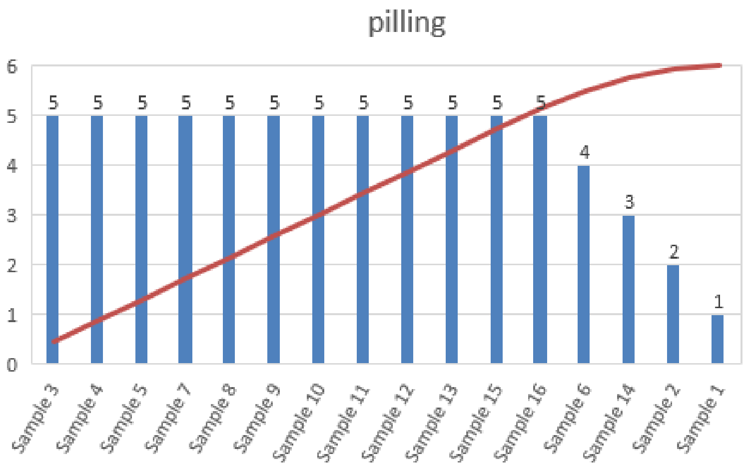

Fig.11. Pilling test results

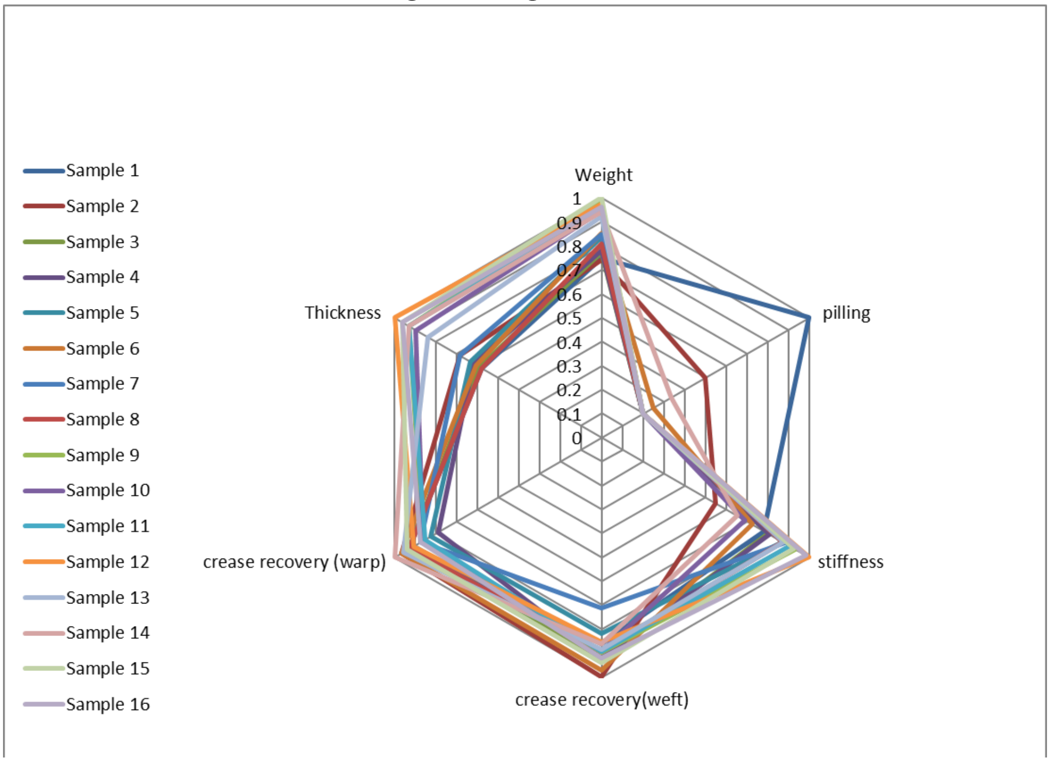

Fig.12. Radar chart of aesthetical properties

Figure (12) * shows radar chart of aesthetical properties for the produced samples, to determine the best samples. Sample no. (1) viscose mock leno fabric, and sample no. (12) Polyester microfiber crepe fabric recorded the highest ratio in scientific evaluation of aesthetical properties.

Conclusions:

It can be concluded that, the aesthetical properties can be measured and evaluated by objective method, to avoid the subjective evaluation and to achieve the reproduced results.

The aesthetical properties affected by fabric constructions, which may lead to improve the aesthetical properties by modifying some elements of fabric construction (materials, fabric density, fabric weaves, etc…) moreover, the best two samples which achieve aesthetical properties; The fabrics which have viscose and polyester microfiber in weft.

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