QUALITATIVE INVESTIGATION OF SOME LOCALLY PRODUCED PRINTED FABRICS AND FOREIGN PRINTED FABRICS MARKETED IN NIGERIA

*M. B. Musa, M. K. Yakubu, and E. Danfulani
Department of Textile Science & Technology, Ahmadu Bello University, Zaria, Nigeria
*Correspondence author: mmbukharisal@yahoo.co.uk

ABSTRACT
Qualitative analysis of some selected locally produced fabrics and foreign fabrics marketed in Nigeria was carried out. The comparative study of the Physico – mechanical properties of the fabrics were made. The results obtained showed that the locally produced fabrics exhibited comparably better end – use performance characteristics in terms of fabric weight per square meter, fabric flammability, and linear density. While the foreign fabrics are better in terms of Crease recovery, fabric handle, fabric sett, fabric shrinkage, and aesthetics. However, both the foreign and homemade fabrics exhibited similar characteristics in terms of abrasion resistance, tensile strength, air permeability, yarn crimp, fabric thickness, and colour fastness.
Keywords; foreign-fabrics, home-made fabrics, quality characteristics.

INTRODUCTION
Nigerian people generally prefer foreign (textile) goods over the homemade materials. This is because of the belief that the performance properties of the foreign made textiles are better than those produced locally (Raji *et al.,* 2007).

The quality (value) of a textile material is often determined by the feel (handle), aesthetic properties, comfortability during use, serviceability and probably past experience.

This study is a comparative analysis between some local wax printed textile product and their foreign counterparts marketed in Nigeria bearing in mind their technical properties which give rise to the market values.

The overall objective of this work is to determine the basis or other wise for the Nigerian's preference of foreign goods over locally made materials from technical point of view.

MATERIALS AND METHODS
Six materials were analysed, three foreign textiles and three locally produced goods. All the fabrics are cotton materials, containing staple length of fibres of about 1 inch. The test materials are throughout the work referred to as ; I, II, III, IV, V, VI. Thus;-

I	Hollandaise	
II	English wax	*Foreign Textiles*
III	Cote d'voire	
IV	Nigerian wax	
V	Diamond wax	*Local Textiles*
VI	Super print	

Instruments/ Equipment
Shirley air permeability tester, Martindale wear Abrasion tester, Shirley Crease recovery instrument, Cussicle drape tester, Shirley Crimp tester, Essdiel Thickness gauge, Instron tester model 1026, Digital weighing balance, Grey scale for assessing change in colour, Grey scale for assessing stain, Microscopic lens, Beakers, Stop watch, Counting glass, Stirring rods, Bunsen burner, Meter rule, Scissors, Dissecting needle, Thermometer.

Fabric Testing
The six samples were evaluated for those properties required for satisfactory end use performance as apparel fabric. All the tests were carried out in accordance with the British standard hand book II (1974), after conditioning the fabrics in an atmosphere of 65% relative humidity (RH) and Temperature of 20 ± 2°C for at least 48 hours.

Air Permeability
The air permeability test of the samples was carried out in accordance with the British Standard Hand book II (1974). The apparatus used was the *Shirley air permeability tester.* For each sample, six tests were carried out on different portions. The test area was 5.02cm^2 and at the pressure head of 10mm of water. The air permeability was obtained using the following formula;

Fabric air permeability = $\dfrac{\text{mean rota meter reading}}{\text{Test area}}$

The average values of the rotameter readings was calculated and the average volume of air and the air resistance was calculated and used for Figure 1.

Abrasion Resistance

The abrasion resistance test of each sample was carried out using the break method as outlined in the British Standard Hand book II (1974). Using the *Martindale abrasion tester.* The average loss in weight per 10,000 rubs was obtained and the reciprocal of percentage loss in weight was used as the resistance to Abrasion. The result is shown in Figure 3.

Crease Recovery

This test was carried out in accordance with the British Standard Hand book II (1974) with the aid of *Shirley Crease recovery Instrument.* 12 rectangular strips of 5cm × 2.5cm dimensions were cut from each of the sample in both weft and warp directions. The Creasing load was 20 Newton for 60 seconds, the results is shown in Figure 4

Fabric Handle

The pieces of the six different samples were given to about 30 people to comment on the feel and physical appearance. Their views were compared and used to determine the fabric handle and visual assessment.

Fabric Drape

Two fabric pieces 30cm diameter each were cut out from each sample and tested for drape characteristics on a *Cussick drape tester* according to British Standard 5058 specification. The fabric pieces were allowed to hang under the action of gravity , then the shadow of the fabric on the ring paper was traced out. The weight of the ring Paper (M_2) was determined. The outline was traced and then cut and the inner part weighed to give (M_1). Two tests were carried out for each fabric at different places and the average values of M_1 and M_2 were obtained. The drape coefficient was therefore calculated thus:

Drape coefficient = M_2/M_1 × 100 (%)
The values were used to obtain Figure 6

Fabric Sett

The *1cm counting glass* method as outlined in British Standard Hand book 11 (1974) was used. With this method, the number of warp and weft threads/centimeter for each fabric under analysis were determined by placing the glass on the fabric before counting. Twelve determinations were carried out on each sample and the mean values were calculated and recorded and shown in Table 3..

Yarn Crimp

The test was carried out in accordance with British standard Hand book II (1974) using the *Crimp tester* and *Dissecting pin.* The fabrics were laid flat, free from tension and creases. A rectangular strip of about 20cm × 20cm was marked out along the warp and weft directions, the yarn samples were carefully removed using a dissecting needle.
The yarns were tensioned as recommended, twenty readings were taken for each series of threads and the mean calculated. The percentage crimp was calculated as follows;

% Crimp = $\dfrac{\text{Straightened yarn length} - \text{length of yarn in fabric}}{\text{Length of yarn in fabric}}$ × 100

The result obtained was used for Figure 2.

Fabric weight/ area

The fabric was cut to a dimension of 10cm × 5cm and weighed. The weight/square meter was then calculated and used for Figure 5

Fabric flammability

The vertical strip test principle was employed in this work. The test fabric was cut to a dimension of 4cm x 1cm and was suspended in a drought free cabinet (where air does not flow freely) and held at the top end over the top most wire by clips. The flame from a candle stick was put below the lower end of the fabric. Using a stop watch, the time (seconds) it took the flame to consume the fabric from its lower to top end was noted and used for fabric flammability grading. The results for the six fabric samples were as shown in Table 5.

Tensile Strength

The Tensile strength test was carried out in accordance with British Standard Hand book II (1974), using *the Instron model 1026.* For each test fabric, five strips from warp and weft directions were cut out each of dimension 15cm x 15cm. Each sample was axially extended until it broke under the applied load. Two readings were taken and the mean values used for Figures 7 and 8.

Fabric Thickness

The test for fabric thickness was carried out in accordance with British Standard Hand book II (1974), the apparatus used was *Essdiel Thickness gauge.* Ten tests were carried out for each fabric and the mean value calculated, the standard deviation and coefficient of variation were also calculated and recorded in Table 2

Yarn Count

This was carried out in accordance with British Standard Hand book II (1974). The apparatus used was the *Digital weighing Balance* and *Dissecting pin.* Here 20cm x 20cm strips of the samples were prepared from the fabrics under investigation. Five threads each from warp and weft directions were removed from the strips using *the dissecting pin*. The crimp of the yarn was removed by *the crimp tester.* The weight of each group was determined and this was used to calculate the yarn count as follows;

Tex count = W/L x 100
Where *W* = weight of yarns (grams)
 L = Length (meters)

The results are shown in Table 4.

Water Resistance

The test for water resistance for the six fabric under study were carried out in accordance with British Standard Hand book II (1974). The test (sample) Fabric was mounted onto an embroidery hoop and placed to face upper most on the hoop support. 250ml of water contained in a beaker was poured onto the surface of the fabric inclined at an angle of 45° through a funnel with tiny holes. The water was poured quickly and steadily to ensure a continuous flow of spraying once it has commenced.

After the spraying from the funnel had stopped, the test fabric was tapped twice with a solid object with the fabric faced down in a horizontal position.

After the tapping, with the fabric still on the hoop, a spray rating was then assigned to the tested fabric by visually comparing the appearance of the sprayed sample with that of the nearest corresponding standard ratings given. The results were used for Table 6.

Colour Fastness to washing

The Colour fastness test for the six fabric (samples) under investigation were carried out in the *linitest machine to the ISO recommendation No. 3.* The test specimen of dimension 5cm x 4cm was placed between two specified pieces of undyed cloth of dimension 10cm x 5cm. The three pieces were stitched together to form a composite. The composite specimen was placed in a container containing 5g/L soap and 2g/l Na_2CO_3 solution previously heated to a temperature of 60 ± 2^0C, so as to give a liquor ratio of 50:1. The composite specimen was removed, rinsed and assessed. Assessment of change in colour of the specimen and the staining of the adjacent fabric was carried out using a Grey scale fatness rating of the samples, the result obtained was shown in Table 7.

Fabric Shrinkage

The specimen was conditioned and a pen was used to mark out the dimensions of 10cm x 10cm. The sample was immersed in a trey of $10cm^3$, 2cm deep containing water at room temperature. The specimens were submerged in boiling water for 2hours and were carefully removed and each laid on a piece of glass dabbed with an absorbent cloth so as to remove excess water. It was then allowed to dry naturally. After being thoroughly dried, the dimensions were measured for each sample and the % shrinkage for warp and weft directions were calculated and recorded in Table 1

RESULTS AND DISCUSSION

Air Permeability

Air permeability affects the comfort properties of a garment in terms of air passage across the fabric. Too high air permeability per unit area of a fabric gives lower protection against winds especially for outer wear garments, while too low air permeability affect body perspiration (Danfulani, 2006).
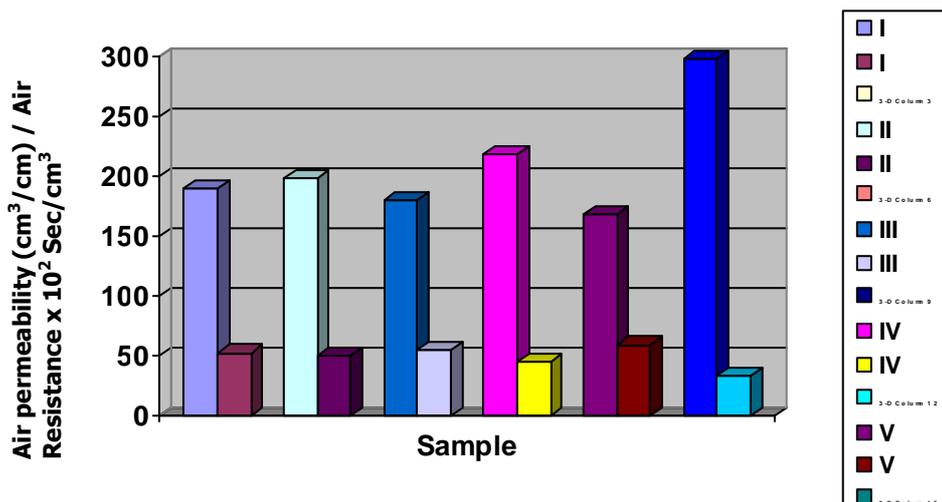
Figure 1: Air Permeability

Figure 1 showed that the air permeability of samples I, II, III, IV, V are at close range with sample VI having the highest value and sample V the lowest, hence the foreign fabrics in between them.

The large number of opening per unit area of sample VI is as a result of its construction for a relatively lower quality material.

It has generally been demonstrated that air permeability decreases as thickness, weight or fabric density increase (Omar, 2006). This is in agreement with the result comparing Figure1, Tables 2 and 3, and Figure 5.

Yarn Crimp

It may be observed from Figure 2 that the weft crimp is generally higher than the warp crimp as expected. This is due to the fact that the warp yarn was under greater tension during weaving process on the loom as compared to the weft yarn. So also the weft yarn was more flexible relative to the stiffer warp yarn which was coated with size so as to withstand tension and frictional effects of the healds during weaving action.

The crimp of samples I, II, & V are higher given the fabrics a fuller and more compressible feel. It must be noted that sample V was deliberately produced to simulate foreign fabrics, thus its ability to compete favorably in this property with the foreign materials.

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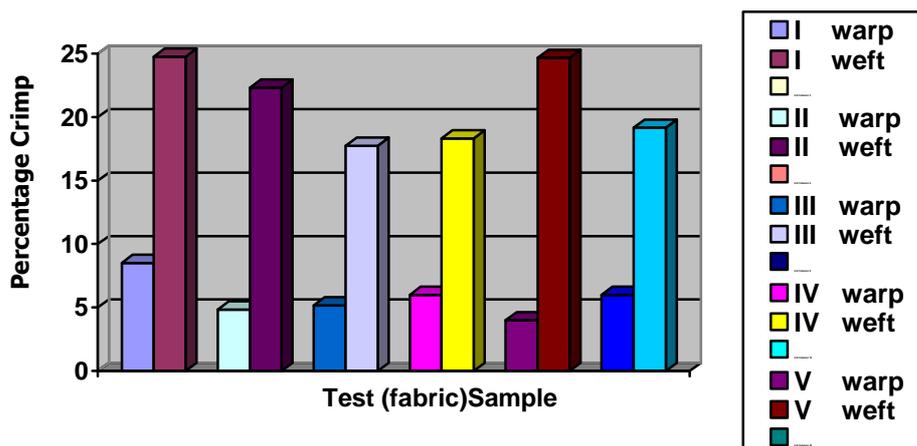
Figure 2: percentage crimp of the samples

Abrasion Resistance

Abrasion resistance is a parameter which is related to rubbing action, which affects the durability, and also its performance characteristics. The assessment of abrasion of fabrics, usually provides the fabrics with conditions similar to those it will be subjected to, while in use.
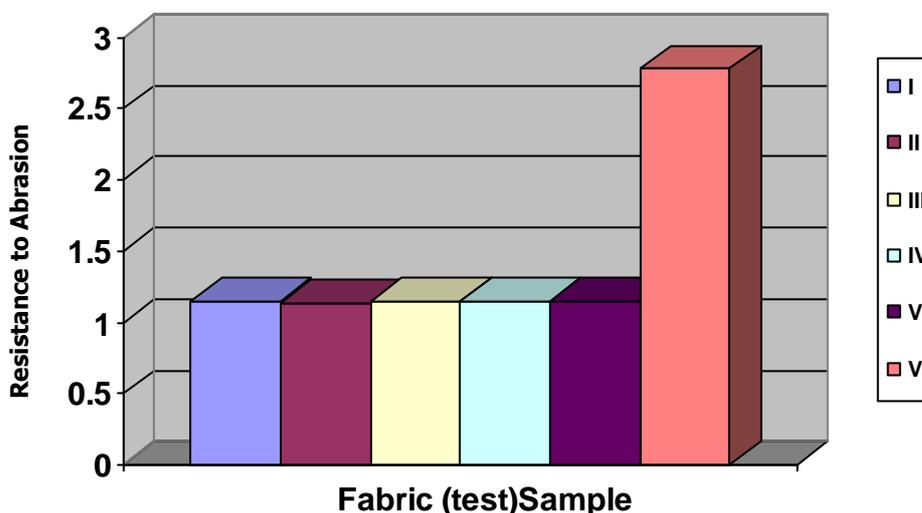
Figure 3: Abrasion resistance

The results obtained in this work is very remarkable (figure 3), as it indicates that all the wax materials (foreign and local) exhibit similar abrasion resistance, thus it will be expected that under same conditions of usage samples I, II, III, IV, and V will be equally durable.

The high abrasion resistance for sample VI may be attributed to the class of its consumers, as this class will tend to persistently use a particular garment for a very long period of time.

Fabric Shrinkage

The percentage shrinkage of a fabric is an indication of its dimensional stability.

Table 1: %Fabric Shrinkage

TEST SAMPLE	WEFT Initial length (cm)	Final length (cm)	Shrinkage (%)	WARP Initial length (cm)	Final length (cm)	Shrinkage (%)
I	10.00	9.80	2.0	10.00	9.70	3.0
II	10.00	9.70	3.0	10.00	10.00	0.0
III	10.00	10.00	0.0	10.00	10.00	0.0
IV	10.00	9.50	5.0	10.00	9.50	5.0
V	10.00	9.90	1.0	10.00	9.85	1.5
VI	10.00	9.80	2.0	10.00	9.60	4.0

Table 1 indicates that sample IV had the highest % shrinkage in both warp and weft directions. While sample III had no shrinkage in both warp and weft directions, and sample II had zero shrinkage in the warp direction. It can be inferred that the foreign fabrics were dimensionally more stable.

Crease Recovery
Those materials which recovered best from creasing in both warp and weft directions, have good easy care properties and do not require much ironing before use (Danfulani, 2006).
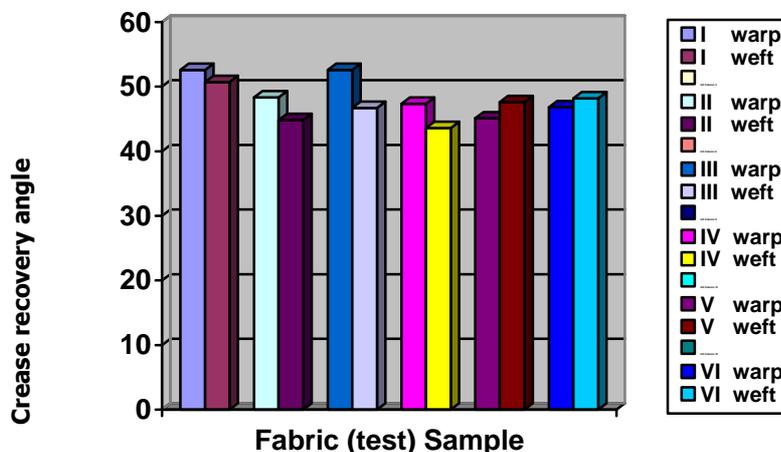
Figure 4: Crease recovery

Figure 4 showed that, the foreign fabrics have better crease recovery properties with sample I having the highest Crease recovery angle in both warp and weft directions, and sample IV the lowest.

Fabric Thickness
The thickness of a fabric depends on the mass/unit area, fabric (sett) density, and the nature (count) of yarns used. Various properties such as abrasion resistance, dimensional stability, stiffness and thermal insulation are affected by fabric thickness (Danfulani, 2006).

Table 2: Fabric thickness

TEST SAMPLE	MEAN THICKNESS (X103) (mm)	STANDARD DEVIATION S.D	COEFFICIENT OF VARIATION C.V (%)
I	2.856	0.093	3.26
II	2.658	0.049	1.85
III	3.100	0.316	10.20
IV	3.046	0.103	3.38
V	3.048	0.143	4.70
VI	2.434	0.042	1.73

It can be observed from Table 2 that, though sample (I) has the highest fabric thickness, the locally produced fabrics are generally thicker than the foreign fabrics.

Fabric Sett
The fabric density has a direct influence on the cover factor and may be dependent to a certain extent on the yarn count. It may also be related to the fabric handle and appearance especially in terms of fabric thickness (Danfulani, 2006).

Table 3: Fabric density

TEST SAMPLE	END PER CENTMETER (epcm)	PICKS PER CENTMETER (ppcm)	epcm x ppcm
I	17	15	225
II	16	14	224
III	18	14	252
IV	16	12	192
V	19	16	304
VI	14	11	154

Table 3 showed that samples I, II, III, IV, & V. have similar values of epcm and also samples I, II, III, & V have very close ppcm. The low values of epcm & ppcm for sample IV is as a result of the fact that it's construction was design for a relatively low quality material.

Yarn Count
The yarn count may affect the feel and the appearance of a fabric to a certain extent its durability in use. It may also be related to the fineness of the material in terms of use and comfort.

Table 4: Yarn Count (Tex)

TEST SAMPLE	WARP MEAN Tex	S.D	C.V %	WEFT MEAN Tex	S.D	C.V %
I	23.05	2.6389	0.0012	20.90	0.0003	0.6330
II	24.55	3.0583	0.0015	20.50	0.0042	0.9813
III	24.35	0.9521	0.0005	20.80	0.0001	0.2404
IV	23.85	0.5547	0.0003	21.00	0.0001	0.5200
V	27.10	.07718	.0014	23.70	0.0013	0.7909
VI	21.60	0.6124	.0003	21.20	0.0003	0.6876

Key: CV = Coefficient of Variation, S.D. = Standard deviation

Table 4 showed that both the local and foreign fabric under investigation contain more or less the same kind of yarns in terms of yarn count for both warp and weft. Never the less sample V has higher yarn count for both warp and weft which may be partly responsible for its higher stiffness as indicated in figure 6.

Fabric weight per square meter
The area density of a fabric is a very important parameter as it gives an indication of the amount of material it contains. It is also related to the fineness of the material in terms of use and comfortability (Booth, 1974).
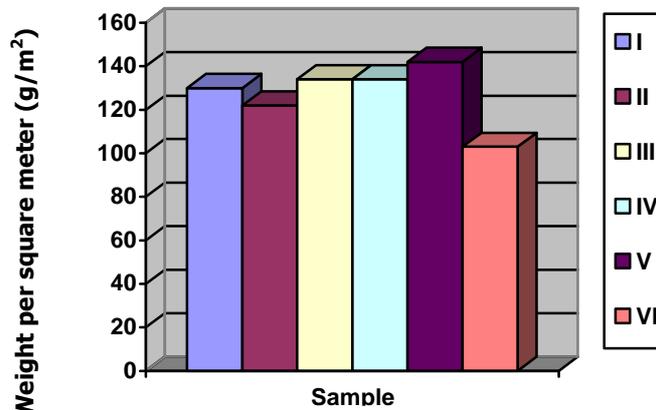
Figure 5: Weight of fabric samples

Comparing Figure 5 with Tables 3 and 4, it can be inferred that sample V is heavier in terms of material content, firmer in terms of fabric density, and finer in terms of yarn count, thus better than even the foreign fabrics. However, samples I, III, & IV showed similar characteristics in terms of fabric area density.
The relatively low weight per square meter of sample II may be partly responsible for its better drapeability

Fabric Drape
Fabric drape is the extent to which a fabric will deform, when it is allowed to hang under its own weight. It is largely affected by the yarn twist. The drape coefficient expresses the drapeability of the fabric, and the higher the value of drape coefficient, the poorer its drapeability.
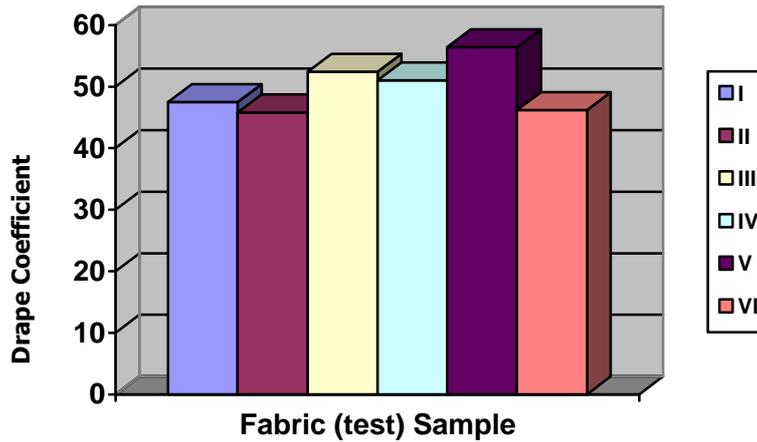
Figure 6: Fabric Drape

Figure 6 showed that sample V is the stiffest which could be attributed to its higher fabric density and probably higher yarn twist. Sample II is the smoothest with the list drape coefficient, and will therefore assume a graceful appearance in use.

***Tensile Strength* (Braking load)**

Breaking load is often defined as the maximum load applied to a specimen in stretching it to rupture, and the extension at this breaking load is referred to as the breaking extension. The strength of the yarn and other additional effects due to fabric structure determines the breaking load of the fabric in either warp or weft direction.

Figure 7 shows the breaking load of the six samples being investigated and Figure.8 the corresponding extensions at break. It may be observed that generally the warp yarns are stronger than the weft yarns in each sample, this indeed is expected since the warp yarns under go greater stresses particularly during weaving processes than the weft yarns.

The results also shows that the weft are more elastic than the warp for individual samples, this is attributed to the sizing and desizing processes the warp yarns were subjected during the production processes, in addition to other factors that affect the yarn and the fabric tensile properties.

Figure 7 showed that there is a slight difference in the breaking load of the six fabric samples, which may obviously be attributed to the variations in the strength of the yarns components in the individual samples.
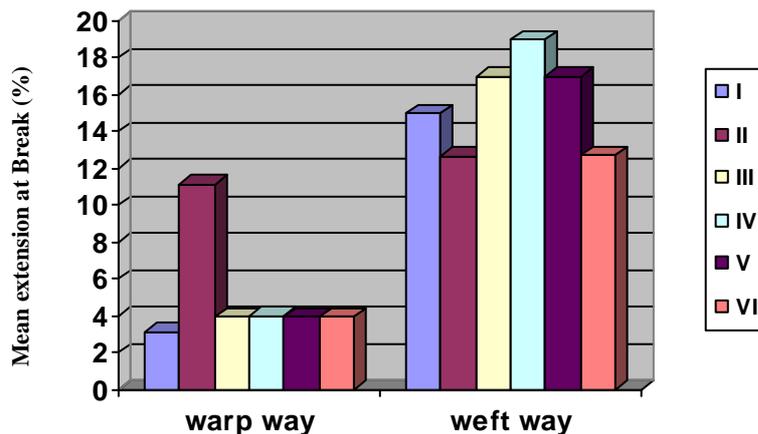
Fabric (test) sample
Figure 7: Stress at break

Figure 7: Stress at break

Fabric (test) sample

Fabric Flammability

It can be observed that sample (VI) is highly flammable, samples (II & III) are flammable, while samples (I, IV and V) are flame proof self extinguishing. Thus, the local fabrics are shown to have better flammability ratings than the foreign ones.

Table 5: Fabric flammability

TEST SAMPLE	AVERAGE BURNING TIME (Seconds)	FLAMABILITY GRADE
I	12.56	D
II	6.24	B
III	9.84	B
IV	15.38	D
V	16.76	D
VI	5.93	A

Water Resistance

The results in Table 6, obtained from a scale mock rain shower produced by pouring water through a spray nozzle. Samples (I, II, III, & IV), gave a spray rating of 50, indicating wetting of about half of the sprayed surface. Sample (V), gave a spray rating of 75 which indicates that the sprayed surface is wetted only at small discrete areas, while sample (VI), gave a spray rating of '0' indicating a complete wetting of the whole sprayed surface, that is, it has very poor (low) water resistance.

Table 6: Water resistance

TEST SAMPLE	SPRAY RATING
I	50
II	50
III	50
IV	50
V	75
VI	0

Colour Fastness

The resistance of a dye to agencies such as heat, water, light, soap, detergent mechanical action, as employed in domestic laundering according to Nkeonye[4] is an important feature in the use of coloured textiles. This is because these are the major areas in which serviceability of coloured textiles are most important to customer. Colour fastness is therefore a major consideration by custormers when deciding what product to buy[1]. Observing results Table 6, there was no much differences between the foreign and the locally produced fabrics, this is because all the six samples showed remarkable fastness ratings on washing. However, sample (I) shows an exceptional wash fastness.

Table 7: Wash fastness rating

TEST SAMPLE	WASH FASTNESS RATING	
	CHANGE IN COLOUR	STAINING
I	5	5
II	4 – 5	4
III	4 – 5	5
IV	4 – 5	5
V	4 – 5	5
VI	4 – 5	5

Fabric Handle

Fabric handle deals with subjective ranking of fabric samples, in terms of appearance, aesthetics properties and comfort.

From the test carried out it was observed that different strokes for different folks in terms of their individual judgment when they felled the fabric with their hands.

The results rating were largely in favour of the foreign fabrics in the following order.

I > II > IV > III > V > VI

The sense of judgment varied among softness, thickness, fading, comfort, smoothness, and coarseness. Also the colours of textile fabrics influenced this test.

Conclusion

From the investigation carried out,z it can be said that the locally produced fabrics are comparably similar to the foreign fabrics in terms of durability, tensile strength, colour fastness and comfortability (especially the air permeability), considering the nature of this environment. However, it is deficient in terms of dimensional stability, aesthetic properties and crease recovery as compared to the foreign materials. Aesthetic property and fabric handle are more of subjective assessments therefore, other factors such as psychological belief may influence individuals.

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