SUITABILITY AND END USE PERFORMANCE PROPERTIES OF DIFFERENT TYPES OF
KNITTING YARN SOLD IN KATIN KWORI MARKET, KANO, NIGERIA.

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Abstract
Different types of knitting yarn purchased from Katin Kwori market, Kano, Nigeria was studied for its suitability and end use performance. The target is the schools cardigan, where complaints of sub-standard were more and other users, especially the Nigeria security forces. Three different yarns were purchased from Katin Kwari, Kano, Nigeria. This includes: ‘Yeye’ as sample A, ‘OML Baby Wool’ as sample B, and ‘MH Beby Wool’ as sample C. The samples were knitted with plain pattern and were subjected to four chemical tests of perspiration, light fastness, wash fastness and rubbing tests. The samples were also subjected to mechanical tests of tensile strength and elongation. The result shows that sample ‘A’ produces the best result in both mechanical and chemical tests carried out, while samples ‘B’ and ‘C’ results are fair. Though sample ‘A’ market price is a little bit higher than the other samples, it will produce a good cardigan either for school children, security personnel and other household use, which will stand the test of time.

Keywords: Knitting, yarn, mechanical and chemical properties, tensile strength, fashion design.

Introduction
The production of textile materials can be achieved by different production methods, each has its own merits and demerits which affect their performance. The most common methods of fabrics production are weaving and knitting. Nonwoven fabrics, such as felting, laminating, and bonding, are used in other ways. On a loom, fabric is woven by interlacing two strands at right angles to one other.

Knitting is thought to have originated in the Mideast in the fifth century, and wool dealers brought it to Europe soon after. Knitting is one of the most common fabric-making techniques, with weaving and non-weaving as others. Knit fabric is made by interlacing yarn loops in the wale and course directions to make a fabric. Knitting’s popularity has skyrocketed in recent years; it may be done as a hobby or as a profession, it takes up little space, and it can be begun from the comfort of one’s own home and scaled up to large-scale production.

This is because of its simple production technique, low cost, the increased versatility of techniques, the adaptability of the new manmade fibers, and the growth in consumer demand for wrinkle resistant, stretchable, snug fitting properties, softer handle, bulkier nature and high extension at low tension particularly in the greatly expanding areas of sportswear, underwear and other casual wearing apparel. Nihat and Ebru (2008).

Knitting business enjoys a wide patronage and it is lucrative, the global knitted market size was valued at USD 23.8 Billion in 2018. Grand view research (2019). Aside from household applications such as cardigans, sweaters, baby shawls, caps, and socks, the growing importance of knitted fabric in the transportation, engineering, industrial, and healthcare sectors is likely to drive market demand.

Aim
Aim of the research is to carry out some of the mechanical properties and chemical properties of knitting yarns available in Katin Kwari Market, Kano and Sabo Market in Zaria, Nigeria.

Objectives of the study:

i. to Compare the mechanical properties of various knitting yarn
ii to Compare the chemical properties of various knitting yarn
iii. Establish the best knitting yarn in the overall performance
iv. Determine the most profitable type

Statement of the Problem
The use of cardigan in schools has been discouraged due to its substandard quality; the reason may likely be three, either the knitting pattern, the type of yarn used for the knitting or the cost price. This research focuses on the type of yarn to address the problem, as this would encourage the schools to use cardigan/sweater especially during the cold weather, this will prevent some diseases and illness like pneumonia, common cold, strep throat and flu.

Materials and Methods
Materials
1. Three different types of knitting yarn were purchased from Kantin Kwari market, Kano. They were produced by three different companies.

<table>
<thead>
<tr>
<th>YEYE</th>
<th>Sample A</th>
</tr>
</thead>
<tbody>
<tr>
<td>OML BABY WOOL</td>
<td>Sample B</td>
</tr>
<tr>
<td>MH BEBY WOOL</td>
<td>Sample C</td>
</tr>
</tbody>
</table>

2.Brothers knitting Machine

Methodology

Tensile strength
One of the most essential mechanical qualities of fabrics is tensile strength. The grab test and the strip test are two common procedures for determining the tensile strength of a piece of fabric. Each testing method has its own set of benefits and drawbacks. The grab test requires fewer specimens to prepare, and the testing setting is more similar to that of a real-world load application on a fabric. The results of the grab test may not be as reliable or interpretable as those of the strip test, but the strip specimen preparation normally takes longer. For the grab test, ASTM standard D5034-95 was established, and for the strip test, ASTM standard D5035-95 was established.

Procedure: The sample under investigation were cut 14cm by 4cm and placed on tensile strength machine. The samples were run three times and average breaking load and elongation were recorded.

Perspiration Test
Perspiration Test can be carried out under:
(a) Acidic: sodium chloride (NaCl 5g/l), disodium hydrogen orthophosphate dehydrate (Na2HPO4 2.5g/l), histidinemono hydrochloride monohydrate
(b) Alkaline: (C6H9O2N3.HCl.H2O 0.5g/l) brought to PH8 with 0.1N sodium hydroxide (NaOH) in a liquor ratio of 20:1.

Test Specimen's Preparation
A piece of coloured cloth measuring 12cm X 6cm is placed between two pieces of undyed fabric measuring 5cm X 4cm and sewn on both sides. A composite test sample is what it's called.

Procedure
The sample size is taken (12cm X 6cm). The sample is placed between two pieces of un-dyed cloth (6cm X 5cm). Sound edges measuring 6cm X 5cm are stitched together to hold three sections together. The composite specimen is soaked in sweat solution A and maintained at room temperature for 30 minutes. The liquor has been poured out. The specimen is then sandwiched between two glass plates (acrylic glass plates – 12.5cm X 7.0cm X 0.15cm) and subjected to 4.5kg of weight pressure for four hours at room temperature (incubator) (37° C).

Wash Fastness Test
Wash fastness test was carried out under the following condition:
- Soda ash 2g/l
- Soap 5g/l
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- Liquor Ration 50:1
- Temperature 60°C
- Time 30 minutes.

**Procedure**
The knitted samples were tested for wash fastness by placing them between un-dyed cotton and terylene textiles. Separately, the composite specimens were stirred in a 250ml beaker containing the soap solution (25ml), washing soda (15ml), and other additives as described previously.

The components were separated and dried after the composite specimens were removed, separated, and then rinsed again. The knitted specimens' color shift was measured using the appropriate grey scale.

**Test for Light Fastness**
Samples are subjected to extremely intense artificial light created by a Xenon arc lamp in our light fastness test. The light is passed through a succession of filters to ensure that its spectrum (wavelength make-up) closely resembles that of natural daylight passing through glass. The test environment's humidity and temperature are both controlled.

**Procedure**
Small samples of material, as well as a set of eight Blue Wool Standard fabrics 1-8, are all exposed to high intensity light at the same time. To see if fading develops steadily or at a different rate than the longer-term exposure, two exposure times are utilized.

The test requires evaluating samples twice: once throughout the test and once at the conclusion. By comparing the degree of fading, the assessment is accomplished.

The fading of the Blue Wool Standard materials is exhibited in the Light Fastness Test on the sample.

Each sample is given a light fastness grade based on the Blue Wool Standard number that corresponds to the same degree of color change.

A little piece of knitted fabric (about 1g) is cut and placed on a pattern card (Blue Wool Scale). The test sample was compared to the original samples after being subjected to a Xenon arc light.

**Fastness to rubbing test**
The capacity of coloured materials to resist rubbing or stains is determined by measuring their rubbing fastness. This type of test demonstrates the colors' bonding to the fabric. When the rubbing fastness of a cloth is discovered to be good, it also means that the fabric's wash fastness will be good.

The fabric's rubbing fastness is evaluated both dry and wet. By comparing the tested materials to the grey and staining scales, the rubbing fastness capabilities of the textile material are determined.

- Dyed fabric: 15cm x 5cm
- White Test Cloth: 5cm x 5cm.

**Procedure**
It is a sequential procedure for determining the rubbing fastness properties. The following procedure is used to test the material's rubbing fastness in both dry and wet forms.

- A white test cloth is suspended by steel wire on the grating.
- The sample is manually ran twenty times for ten seconds each time. The rubbing fastness of the sample fabric is also determined, as well as the degree of staining.
- To test rubbing fastness (wet), soak the rubbing cloth in water and squeeze it. The wet rubbing cloth is placed on the grating and coated with stainless steel wire, then manually ran 10 times to assess the abrasion on the rubbing fabric and the sample cloth's rubbing fastness is checked.

Lastly, the grey scale is used to determine the change in shade of the sample, and the Staining Scale is used to determine the degree of staining of the white test fabric.
Results and Discussion

The following test were conducted on the yarn before knitting:

1. Breaking kilometer (RkM): length of yarn in kilometers at which yarn will break of its own weight.
2. Count (Nm): length in metres per 1 gram of mass
3. Ply twist: process of twisting two or more spools of twisted yarn into a cord.
4. Elongation: Elongation of a yarn is the percentage increase in length that occurs before it breaks under tension.

<table>
<thead>
<tr>
<th>Samples</th>
<th>Product name</th>
<th>Colour</th>
<th>Ball weight (grams)</th>
<th>Count (Nm)</th>
<th>Ply twist</th>
<th>Rkm (g/tex)</th>
<th>Elongation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>YEYE</td>
<td>Brown</td>
<td>41.69</td>
<td>3/15.95</td>
<td>4.10</td>
<td>7.84</td>
<td>34</td>
</tr>
<tr>
<td>B</td>
<td>OML BABY WOOL</td>
<td>Brown</td>
<td>30.61</td>
<td>3/8.24</td>
<td>3.22</td>
<td>below the testing m/c standards</td>
<td>above the testing m/c standards</td>
</tr>
<tr>
<td>C</td>
<td>MH BEBY WOOL</td>
<td>Brown</td>
<td>41.21</td>
<td>3/9.80</td>
<td>4.30</td>
<td>4.57</td>
<td>27</td>
</tr>
</tbody>
</table>

Sample A and C have almost the same weight, while sample B has the lowest weight; an indication the length of the yarn in the ball is less than sample A and C, which is a disadvantage.

Count (Nm): The higher the numbers the more finer the yarn, hence the more easier to function well on the machine, coarse yarn in samples B and C may have difficulty in knitting. Sample A will produce good knitting efficiency.

Ply twist: The higher the twist the more stronger the yarn will be, though twist still depend on the end use. Sample ‘C’ has the highest ply twist, followed by sample A.
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Breaking Kilometer (RkM): Sample ‘A’ produce the highest RkM, followed by sample C, while sample B is above standard of the testing machine. All other things being equal, sample A will have a better strength.

Elongation percentage: A knitted fabric must have a fairly good elongation, samples A & C provides a good elongation. Sample B elongation is above standard of the testing machine.

Figure 1 Average Breaking Load (N) and Elongation (mm) Tensile Strength

The breaking strength and elongation are two prime quality attributes of any spun or knitted fabric, elongation is the change in length or width of the fabric. The factors affecting elongation are the fabric materials, knitting pattern, yarn twist and the count. Sitotaw and Adamu (2017) asserted that the type of yarn used in the knitted materials greatly influence the strength and elongation, the type of structure has its own influence in order to withstand the applied force in the lengthwise and widthwise direction of the fabric. In this research, the structure of the knitted samples were the same, the difference in the elongation and the breaking load may be as a result of the type of yarn, which has different qualities (Table 2), sample A has Rkm of 7.84g/tex while sample C is 4.57g/tex

Perspiration Tests

Perspiration fastness test is the ability not to fade and not to stain when dyed fabric is perspired. Peoples sweat consists of complicated composition, and it main composition is salt. The salt can be acidic or basic depending on individual. Textiles contact with sweat has a large impact on dyes, the degradation of fabrics by acidic perspiration proceeds initially at a slow rate, followed by a faster rate. Tensile strength decreases and yellowing increases. Bhat et.al. (1990). Sample A produces the best result, followed by sample C and sample B as shown in Fig.2.
Wash Fastness

The properties to stain the colour on the surface of textile materials during washing is called washing fastness. Colour fastness is word used in the dyeing of textile materials which include fading or bleeding of colour. Atalie and Nalankilli (2017). The colour fastness may also affected by processing technique and choice of chemicals and auxiliaries. Shore (2002). In Fig. 3, sample A has an excellent wash fastness, while sample B and C has a very good wash fastness, the three samples are not bad, but sample A is the best choice.
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Fastness to light
Colour fastness to light, refers to the ability of printed or dyed materials to resist fading or colour change when exposed to natural or artificial light. Other factors of fastness to light may include the choice of fabric used and the type of dye involved the procedure as well as the action of detergent. Li (2020). Under controlled temperature and humidity, samples are subjected to bright artificial light generated by a High intensity discharge lamp.

While sample B and C produces moderate and good result. Sample A can be recommended as well as sample C as shown in Fig. 4.

![Figure 4: light fastness](image)

Key : 8-Outstanding; 7-Excellent; 6-Very good; 5-Good; 4-Moderate; 3-Fair 2; Poor; -Very poor

Rubbing Fastness
During wearing, as well as cleaning or washing processes, the fabrics are subjected to abrasion. Due to friction, the abrasion of textile materials is a complex process, and take place under the action with one or more of the following: physical, chemical biological and mechanical and leads to an aggravation of minerals properties. Asanovic et.al. (2021)

Fabrics loses strength and weight as a result of abrasion, as well as peeling, colour change, and permeability, the abrasion resistance was carried out under two conditions, wet and dry. Sample A provide a very good result in both wet and dry condition, while other samples produces an averagely good result.
Key: 1- Very Poor; 2- Fair; 3- Good; 4- Very Good; 5- Excellent

**Figure 3: Rubbing fastness test**

**Conclusion**

Yeye (Sample A) produced the best result in both the mechanical and chemical properties tested. Using this yarn for knitting would produce a good cardigan which can stand the test of time. Though a little bit expensive than others, it is better to produce a standard product, especially those that wanted to start a knitting business, existing business owners and individual who wanted to take up knitting as a hobby. Yeye is manufactured locally in Nigeria by Nigeria Spinners and dyers, No 6, independence Road, Bompai, Kano, while sample B and C had no address on their labels, this means that if there is a problem in working with any of the samples, the manufacturers of sample A can be located and complaint will be lodged, this is not possible with simple B and C.

**Recommendation**

It is therefore recommended to use Sample A (Yeye) for knitting works, even if there is any complaint the manufacturing address can be traced. Standard Organization of Nigeria (SON) should make sure that all goods produced and marketed must have a traceable address. Peoples are encouraged to take knitting as a hobby or craft, as a money spinning venture. Government should encourage and support people who are interested in the venture of knitting.

**References**


