Evaluation of the quality attributes of three selected imported fabrics in Ghana

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ABSTRACT

The research investigated the performance characteristics of three imported wax prints available in the Ghanaian market. Laboratory tests were conducted on the chosen fabrics using standard testing procedures. The evaluated parameters included tensile strength, elongation, dimensional stability, colourfastness, abrasion resistance, and thread count. The collected data were analysed using the Statistical Package for the Social Sciences (SPSS) for Windows version 25. The results indicated that, while the initial tensile strength of the fabrics complied with the specifications of the Ghana Standards Authority, noticeable reductions were observed after washing, particularly in the weft direction. The colourfastness findings were generally satisfactory, although some samples exhibited lower resistance to staining. The selected fabrics met the standard requirements for dimensional stability, but they did not meet the specified standards for fabric weight and yarn count. ANOVA results highlighted significant differences between the three selected fabrics in key quality parameters, including thread count (warp and weft) and mass per unit area. The post-hoc analysis identified Fabric "A" as significantly different from the other fabrics in thread count (warp and weft) and mass per unit area, indicating unique structural features. In summary, the study confirms that while a fabric may initially meet industry standards, its properties may change after washing, particularly in terms of strength and elongation, raising concerns about long-term durability. It is suggested that extensive performance tests be carried out on other fabrics in the market to help meet consumer expectations.

Keywords: Abrasion Resistance, Elongation, Fabric Quality Attributes, Ghanaian Market, Imported Fabrics, Tensile Strength

I. INTRODUCTION

The Ghanaian textile industry rely on imported fabrics. These fabrics have become essential to everyday life because they are affordable and offer a variety of designs. The arrival of these textiles has changed the local market, giving consumers many choices in colours, patterns, and textures. Many individuals and businesses, especially in fashion and tailoring, prefer imported fabrics (Adam, 2019). This preference comes mainly from their lower cost compared to locally made textiles, appealing to consumers of all income levels. Recently, imported textiles have taken a large share of the Ghanaian market, creating tough competition for local manufacturers (Adam, 2019). The competitive pricing of these fabrics makes them the top choice for many shoppers, as they provide stylish options at lower prices. However, this trend raises concerns about the future of the local textile industry, which struggles to compete with cheaper foreign products (Tsekpo, 2020). The prevalence of imported textiles also affects local production, as manufacturers try to replicate foreign designs while dealing with high production costs and limited access to raw materials (Tsekpo, 2020).

Despite the increased demand for imported textiles, worries have arisen about their quality and whether they meet consumer needs. Many shoppers care about not just price, but also durability and the ability to withstand regular washing and wear. Poor fabric quality can lead to early wear and tear, frustrating consumers who expect their clothing to keep its shape and look over time (Abla, 2023). The push for quality assurance in imported textiles has become urgent, as consumers look for fabrics that balance cost with lasting usability. Understanding the performance of imported fabrics is crucial for assessing their overall suitability for various uses. Key performance properties like tensile strength, elongation, and abrasion resistance indicate fabric durability (Ayentimi & Burgess, 2023; Whitfield, 2022). These traits show how well a fabric can resist stretching, friction, and repeated washing. Fabrics with low tensile strength are more likely to tear, while those with low elongation rates may lack the necessary flexibility for clothing and upholstery (Adam, 2019; Bruce-Amartey & Amissah, 2021).

In addition to tensile strength and elongation, other important fabric qualities like colourfastness and dimensional stability impact consumer satisfaction. Colourfastness measures a fabric's ability to keep its colour without fading from washing, sunlight, or sweat. Dimensional stability determines whether a fabric maintains its size and shape after repeated washes. Poor-quality fabrics that lack these qualities are prone to fading, staining, and shrinking, leading to aesthetic issues and decreased usability (Ahorsu & Eyram, 2023; Monnie & Sappor, 2020). Such problems have led some consumers to question the worth of imported textiles, especially when cheaper options require frequent replacements and higher long-term costs. Consumer views on fabric quality greatly affect buying choices, influencing the ongoing demand for imported textiles. Many shoppers link low-cost fabrics to poor quality, prompting some to choose local products despite their higher prices. Still, a portion of the market values affordability more than durability, preferring trendy fabrics at lower prices and replacing them often (Sarpong et al., 2023). This difference in consumer preferences shows that while quality issues are real, price remains the leading factor in purchasing decisions.

The discussion over imported textiles versus local production also has wider economic and policy implications. The decline of Ghana's local textile industry is tied to problems like lack of government support, competition from smuggled goods, and the inability to increase production to meet demands. Policymakers have tried to implement measures such as import restrictions and local manufacturing incentives to revive the sector. However, these attempts have had limited success due to the ongoing consumer demand for affordable imported fabrics (Tsekpo, 2020). Solving this issue requires a comprehensive approach that balances consumer needs with strategies to improve local textile production.

In conclusion, while imported textiles provide affordability and a variety of designs, concerns about their durability and quality are significant. The dominance of foreign fabrics in the Ghanaian market creates challenges for local manufacturers, who find it hard to compete with low-cost alternatives available to consumers (Tsekpo, 2020). Key performance features like tensile strength, elongation, colourfastness, and dimensional stability are vital in determining how long a fabric lasts and how satisfied consumers are. As Ghana navigates the complexities of textile imports and local industry growth, a balanced approach that considers both cost and quality will be crucial for maintaining a vibrant textile market.

1.1 Statement of the Problem

Quality standards for fabrics have been set by the Ghana Standards Authority (GSA), such as GS 124:2019: Standard specification for African Prints. However, enforcing these standards is weak. Many imported textiles enter the Ghanaian market without proper quality checks, raising concerns about their durability and suitability for consumers (Adam, 2019; Tsekpo, 2020). As a result, low-quality textiles continue to flood the market, affecting consumer satisfaction and harming the reputation of Ghana's textile industry. One major challenge to enforcing these quality standards is the lack of thorough assessment data on imported fabrics. Limited testing and evaluation of textile performance make it hard for regulatory authorities to monitor compliance effectively (Ayentimi & Burgess, 2023). Without reliable data on factors like tensile strength, colourfastness, and shrinkage rates, policymakers and industry stakeholders struggle to take corrective actions. This problem is compounded by the informal nature of much of the textile trade, where fabrics are imported and distributed without proper checks. This increases the chances of low-quality products reaching consumers (Ayentimi & Burgess, 2023).

Moreover, the shortage of research on the physical performance of imported fabrics limits consumer knowledge. Many buyers rely on price and appearance instead of performance measures when choosing fabrics. This often leads to disappointment when textiles wear out quickly after purchase (Whitfield, 2022). Without publicly available quality assessments, consumers cannot reliably distinguish between high and low-quality imported fabrics. This lack of information not only affects individual buying experiences but also affects businesses like fashion designers and tailors, who rely on consistent fabric quality for their products.

This study aimed to fill this gap by analysing the performance characteristics of selected imported fabrics in Ghana and comparing them to the standards set by the GSA. By evaluating key performance properties such as tensile strength, elongation, and abrasion resistance, this research sought to provide data that can inform both consumers and policymakers. The findings could indicate whether imported textiles meet regulatory standards and highlight areas where stricter enforcement may be necessary. Ultimately, this study contributes to a broader discussion on quality control in Ghana's textile industry, stressing the need for better regulatory oversight and increased consumer awareness.

1.2 Research Objectives

The objectives of the study were to:

i. Determine the quality performance characteristics of three selected imported fabrics.
ii. Compare the quality performance characteristics of three selected imported fabrics.
iii. Establish if the observed performance characteristics of the selected fabrics meet the Ghana Standards Authority specifications (GS 124:2019) to ascertain compliance levels.

II. LITERATURE REVIEW

2.1 Theoretical Review

This study used the garment quality model developed by Fan and Hunter in 2004. The Garment Quality Model (Fan & Hunter, 2004) offers a way to assess the quality characteristics of fabrics. It suggests that clothing quality is affected by three main factors: physical performance, aesthetic appeal, and consumer perception. According to Fan and Hunter (2004), high-quality garments must demonstrate strength, durability, and comfort while maintaining their aesthetic properties after repeated wear and washing. This theory is relevant to the study as it helped assess the selected imported fabrics based on some physical and mechanical properties such as tensile strength, elongation, dimensional stability, colourfastness, and abrasion resistance.

2.2 Empirical Review

2.2.1 The Quality Performance Characteristics of Fabrics

The quality performance of fabrics is often assessed through various properties, including tensile strength, elongation, dimensional stability, colourfastness, abrasion resistance, and thread count. These attributes determine the durability and usability of textiles, especially in consumer applications such as clothing and upholstery (Pizzuto, 2012). Pizzuto (2012) indicates that tensile strength is a key measure of a fabric's ability to resist stress without tearing and elongation is the extension at break expressed in percentage. Dimensional stability is also important for assessing shrinkage and shape retention after washing. This factor has a big impact on consumer satisfaction (Ahorsu & Eyram, 2023).

Another vital aspect of fabric quality is colourfastness. This property ensures that textiles keep their original colours without fading or staining after being washed, exposed to sunlight, or subjected to sweat (Monnie & Sappor, 2020). Abrasion resistance is another key factor; it indicates how well a fabric withstands repeated friction without showing signs of wear or pilling. Poor abrasion resistance can cause fabric to deteriorate quickly, making it less ideal for frequent use (Sarpong et al., 2023). Thread counts and mass per unit area also play a role in determining fabric density and texture, which in turn affect overall strength and comfort (Adam, 2019).

2.2.2 Quality Performance of Fabrics

The quality of fabrics can be assessed through their performance characteristics. Performance characteristics of fabric include strength, dimensional stability, weight, and resistance to fading from various agents (Retief & de Klerk, 2003). Various elements, such as the type of raw material (fibre type), yarn twist, yarn count, cover factor, dye type, and fabric construction technique, affect these performance characteristics. The spectrum of performance characteristics is broad and varies depending on the type of fabric examined, the objectives of the study, the environment in which it will be worn, and the individual wearing it (Masteikaile et al., 2013). To enhance sales and effectively compete with consumers and other companies, industries or businesses must ensure a certain standard of quality in the products they offer. Quality can be described as the degree of acceptance of goods or services by the consumer (Rahman, Baral, Chowdhury & Khan, 2009). Adhering to specifications is what defines quality (Kadolp, 2007).

According to Kadolph (2007), textile quality assurance involves a process in which companies design, produce, evaluate, and assess their products to ensure they meet the expected quality standard for the target market. Quality is an inherent attribute that is integrated into the product throughout the stages of development, production, and marketing (Kadolph, 2007). As noted by Kadolph (2007), several factors influence the quality fitness of the garment industry. These factors encompass performance, reliability, durability, conformance, serviceability, aesthetic features, and the perceived quality of the garment. Key fabric properties that are considered for garment manufacturing intended for export include the garment's overall appearance, colourfastness, abrasion resistance, tensile strength, and dimensional stability of the fabric (Dinesh Exports, 2024).

2.2.3 Standards and Specifications of Performance attributes of Fabrics

Consumers are entitled to inspect and test products to establish conformance to requirements before payment. However, specifications and standards need to be written to ensure disagreements are easily resolved (Kadolph, 2007). In view of this, there are several standard developing organisations around the globe (Mehta & Bhardwaj, 1998). Such as American Society for Testing and Materials (ASTM), American Association of Textile Chemist and Colorist

(AATCC), American National Standards Institution (ANSI), British Standards Institute (BSI), and International Organisation for Standardization (ISO) (Glock & Kunz, 2005; Kadolph, 2007; Mehta & Bhardwaj, 1998).

In Ghana, the Ghana Standards Authority which is a government agency is also involved in the development of standards related to performance characteristics of products. For example, the Ghana Standards Authority (GSA) has established specific benchmarks, such as GS 124:2019, to ensure that textiles meet minimum quality standards for durability, serviceability and consumer satisfaction. What is needed is to ensure that manufacturers comply with the set standards to meet consumer expectations. To establish manufacturers' compliance, there is the need to carry out tests especially on imported fabrics to create consumer awareness and help them make informed decisions.

III. METHODOLOGY

3.1 Research Design

The study adopted laboratory evaluation to conduct a comparative analysis of the quality characteristics of three selected imported fabrics in the Ghanaian market. Major textile markets where imported textiles are widely available and frequently purchased by consumers were visited for the selection of sampled fabrics. The laboratory analyses were undertaken at the Ghana Standards Authority Textile Testing Laboratory. The laboratory tests used were appropriate for this study as merely relying on inspection is insufficient to guarantee quality of fabrics for consumers. Consequently, it is necessary to incorporate testing procedures. As noted by Kadolph (2007), exposing products to physical or mechanical assessments is crucial for evaluating quality. Mehta and Bhardwaj (1998) pointed out that testing serves as a method for assessing an item's ability to fulfil defined criteria by placing the item under various physical, chemical, environmental, or operational influences and conditions.

3.2 Materials

The study employed three yards each of three different brands of imported African print fabrics sold in the market. The selected fabrics were labelled A, B and C for easy identification. The Standard soap (a soap without optical brightener) used by Ghana Standards Authority for such tests was used for the wash tests.

3.3 Data Collection

The data collection procedures followed test methods prescribed by the International Organization for Standardization (ISO), and adopted by the Ghana Standards Authority (GSA). Fabric specimens were conditioned for 24 hours in a relaxed state under controlled conditions, maintaining a relative humidity of 65 ± 2% and a temperature of 21°± 1°C, in accordance with ISO 139 (1973) before the laboratory analysis. The performance characteristics evaluated are as follows:

3.3.1 Fabric Yarn Count

To establish the yarn density of the selected fabrics, three fabric specimens, each measuring 2.5 cm in the warp direction and 2.5 cm in the weft direction, were cut from each fabric sample and labelled for easy identification. The tool used for yarn count analysis was a magnifying glass to count the number of yarns in both the warp and weft directions. Counting was repeated five times for each specimen, and the recorded values were calculated to establish the average yarn count for both warp and weft directions for each fabric type.

3.3.2 Fabric Weight/ Mass per Unit Area

The weight of the fabrics were determined by cutting five specimens each with an area of 0.015 m^2, from each fabric type. The cutting of the specimens were carried out using a sample cutter. Each specimen was weighed using an Adams Equipment Weighing Balance (Model No. B215846278). The average weight of the five specimens from each fabric type was calculated and recorded in grams per square meter (g/m^2).

3.3.3 Colourfastness to Washing

For colourfastness determination, two fabric specimens, each measuring 10 cm × 4 cm, were cut from each fabric type and labelled. A multi-fibre fabric of the same dimensions was attached to each specimen. The specimens were then washed using standard soap in a Standard Launder-Ometer (Gyrowash 315) and dried at room temperature. Colourfastness assessment analysis was carried out using the ISO Grey Scale for Colour Change. To assess fastness to staining, the ISO Grey Scale for Staining was used. Five separate readings were recorded under a colour assessment chamber through visual inspection.

3.3.4 Dimensional Stability (Shrinkage) to Washing

In terms of fabric shrinkage, two specimens measuring 15 cm × 15 cm were cut from each fabric, ensuring the yarns in both warp and weft directions were parallel to the edges. Each specimen was labelled for easy identification. Two parallel lines were marked 10 cm apart and 2.5 cm from the edges of each specimen. The specimens were washed using the Standard Launder-Ometer (Gyrowash 315) and evaluated for dimensional stability.

3.3.5 Abrasion Resistance Testing

Abrasion resistance of the sampled fabrics was determined using the Martindale Abrasion Tester as indicated in ISO 12947:1998 standards. Circular fabric specimens (38 mm or 140 mm in diameter) were cut from each fabric and conditioned for 24 hours at a controlled temperature of 21 ± 1°C and relative humidity of 65 ± 2%. The specimens were then mounted on the lower plate of the tester, with a standard abrasive fabric fixed on the upper rotating plate.

A specified load of 9 kPa (for apparel fabrics) was applied, and the specimens were subjected to cyclic abrasion in a motion to simulate real-life wear. The test continued until either yarn breakage, hole formation, or a predefined number of rubs was reached. At regular intervals, the fabric specimens were inspected for surface changes, mass loss, and visible damage such as pilling and fuzzing. The endpoint of failure was determined based on mass loss percentage, thread breakage, or hole formation. The number of abrasion cycles before failure was recorded to assess the durability of the fabrics.

3.4 Data Analysis

To analyse the gathered data, the Statistical Package for the Social Sciences (SPSS) for Windows version 25 was employed. Descriptive statistics such as means were calculated and inferential statistical analyses (ANOVA with a significance level set at $p < 0.05$) were also conducted on the quality characteristics of the selected fabrics, such as tensile strength, elongation, dimensional stability, colourfastness, abrasion resistance, and thread count. Where significant differences were identified, a post-hoc test Honestly Significant Difference (HSD) was used to determine the specific fabrics that showed differences. The analysis also covered comparisons against the Ghana Standards Authority (GS 124: 2019) specifications to determine compliance for attributes such as tensile strength, colourfastness, and thread count.

IV. FINDINGS & DISCUSSION

4.1 Quality Performance Characteristics of the Selected Imported Fabrics

4.1.1 Yarn Count Characteristics of the Selected Fabrics

The mean yarn count values for the warp and weft directions of the sampled fabrics are presented in Table 1. The results showed differences in yarn density across the fabric samples. Samples B and C recorded the highest warp yarn count (37), while sample A had the lowest count of 31. The results indicate that Samples B and C had high yarn density in the warp direction, which is likely to influence their strength and durability along the lengthwise direction. However, the sample A had the highest yarn count in the weft direction (38), significantly surpassing both Fabric C (27) and Fabric B (22). This outcome could mean that Fabric A probably has tighter weave structure in the weft direction and this can enhance its stability and resistance to distortion in that direction. Fabric B had the lowest weft thread count (22), implying a more open weave structure that may affect its overall dimensional stability and flexibility. Even though, the fabrics performed differently in terms of yarn count, their values did not meet the standard specifications set by the Ghana Standards Authority, which range from 68 to 80 for the warp direction and 64 to 72 for the weft direction. Contrary to this finding, Monnie (2018) evaluated both imported and locally produced fabrics and found that the imported fabrics exceeded the specified yarn count standards. This emphasizes the importance of enhanced monitoring to assess and guarantee the quality of textiles available in Ghana. The variations in yarn count indicate that each fabric is designed for specific performance. Fabrics with increased warp counts, such as B and C, might be more appropriate for uses that demand strong durability in the lengthwise direction; conversely, the greater weft count of Fabric A could enhance its resistance to stress and distortion in the crosswise direction.

Table 1

Mean Values for the Selected Fabrics Yarn Count

Parameter	Fabric A	Fabric B	Fabric C
Thread Count (Warp)	31	37	37
Thread Count (Weft)	38	22	27

4.1.2 Mass per Unit Area (Weight) of the Selected Fabrics

The results for Mass per Unit Area of the fabrics are presented in Table 2. The indication from Table 2 shows that Fabric A had the highest weight value of 102g/m², while Fabrics B and C had lower values at 93g/m² and 92g/m², respectively. Indicating sample A is the heaviest among the three selected samples depicting overall higher yarn count as seen in Table 1. Variations were observed in the weight values of the sampled fabrics, however, the sample with the highest value did not even meet the standard specification for such fabrics indicated by Ghana Standards Authority (GS 124:2019) (107 g/m², min), suggesting that the fabrics may not fully meet the typical requirements for general use in terms of weight. The relatively low standard deviations indicate that the weights within each fabric category are stable, highlighting a well-regulated production process. The information also suggests that Fabric A, as the heaviest, may provide greater durability and strength, whereas Fabrics B and C present a lighter option that may offer distinct comfort and flexibility attributes.

Table 2

Results for Mass per Unit Area of the Selected Fabrics

Fabric	Mean (g/m²)	SD
A	102	0.4115
B	93	0.4145
C	92	0.4123

Abla (2023) indicated that weight is a crucial factor when it comes to drape, handle and overall performance of fabrics. It was further noted that weight influence fabrics suitability for different end uses. Weight of a fabric is also observed to influence durability as heavier fabrics tend to exhibit better resistance to wear and tear. Kantiwal et al. (2021) observed that laundering could result in the loss of fibres and alterations in fabric structure, which can ultimately affect the material's mechanical properties. When utilizing fabrics, consumers should take into account the care guidelines and fabric makeup to preserve the desired characteristics after washing.

4.1.3 Mean values for Tensile Strength and Elongation of the Three Fabrics Before and After Wash

The results for the wash tests are presented in Table 3. The parameters assessed after washing were tensile strength, elongation, and mass per unit area of the sampled fabrics. Sample A had high warp (453N) mean tensile strength before washing compared to fabric B (warp = 433N). The results in Table 3 also showed a wide variation in elongation and strength values after washing. Fabric C had the highest tensile strength value in the warp direction (480N) for the unwashed and washed (309N) specimens among the three samples. However, fabric C's elongation varied considerably after wash. In all, the results in Table 3 show that Fabric C had the highest tensile strength, but showed variability in elongation. Contrary to this finding for Fabric C, Fabric B demonstrated some steady tensile strength and elongation behaviour. The outcome of this study depicts the need for consumers to consider the tensile strength and elongation of fabrics during selection especially for applications where washing stability is critical.

Interestingly, even though the yarn counts did not meet the required standards, the tensile strength measurements for the *warp* directions of the fabrics prior to and after washing were higher than the minimum requirements established by the Ghana Standards Authority (240N for the warp and 220N for the weft). This indicates that the low yarn count did not initially affect the strength of the fabrics in the *warp* direction. Following the initial wash, all three types of fabric showed a notable decline in tensile strength, especially in the weft direction. This suggests that although the fabrics might seem to be intact prior to use, their functionality significantly declines after laundering, which raises questions regarding their long-term durability and appropriateness for frequent use. The results for tensile strength show a reduction in both warp and weft strengths following the initial wash. For example, the average warp tensile strength decreased from 480N (before washing) to 242N (after the first wash), indicating that the washing process negatively affects the fabric's structural integrity. This observation is consistent with the study by Kim et al. (2022), which demonstrated that repeated washing significantly diminishes the tensile strength of fabrics, mainly due to fibre degradation and a loss of cohesion in the fabric. Furthermore, the percentages of elongation showed different patterns, with both warp and weft elongation increasing after washing. This may suggest that the fabric's construction provides greater flexibility after washing, supporting the observations made by Ghosh and Mal (2019) who highlighted that fabric stretch is usually affected by the release of internal tensions in the fibres during washing processes.

Table 3
Tensile Strength & Elongation (No Wash and 1st Wash)

Fabric	Tensile Strength (Warp) - No Wash (N)	Tensile Strength (Weft) - No Wash (N)	Elongation (Warp) - No Wash (%)	Elongation (Weft) - No Wash (%)	Tensile Strength (Warp) - 1st Wash (N)	Tensile Strength (Weft) - 1st Wash (N)	Elongation (Warp) - 1st Wash (%)	Elongation (Weft) - 1st Wash
A	453	138	20.80	12.01	281	78	23.10	16.90
B	433	251	20.42	8.70	242	77	23.40	19.70
C	480	167	17.26	6.97	309	73	36.26	17.13

The observed elongation values after wash indicates increase in elongation in both directions (warp and weft) of all the sampled fabrics. However, for strength, decrease in both directions (warp and weft) was observed for all the fabrics after washing. This result could be attributed to changes in the fabric structural characteristics during washing as stated by Mather et al. (2023) who asserted that washing leads to a weakening of fibre bonds, ultimately affecting the performance characteristics of fabrics.

4.1.4 Dimensional Change on Washing of the Sampled Fabrics

Table 4 provides the results for dimensional stability of the sampled fabrics after washing. The observation is that the fabrics experienced minor dimensional changes, in the warp direction with the average shrinkage of 1%. However, the weft direction of the fabrics portrayed relatively stable behaviour in terms of shrinkage exhibiting either zero or negligible shrinkage across the samples. The findings suggest that the fabrics relatively maintained their dimensions after wash especially in the weft direction where minimal shrinkage was observed.

The -1% average shrinkage seen in the warp direction shows a slight reduction in length probably due to fibre relaxation or slight contraction during washing. The change however, is within the standard acceptable level of ±5% (GS 124:2019), showing that the fabrics will have good dimensional stability after washing.

Table 4
Dimensional Change on Washing Values for the Selected Fabrics

Fabric	Dimensional Change - Warp (%)	Dimensional Change - Weft (%)
A	-1	0
B	-1	-0.6
C	-0.6	-0.5

The minimal shrinkage levels observed particularly in the weft direction of the fabrics could be due to pre-shrinking treatments applied to the fabrics. The fabrics demonstrated very good dimensional stability properties after washing with their shrinkage levels within the acceptable limits even though their yarn counts were below the set standards. This could probably be due to the fibre structure and finishing applied as indicated earlier. The findings of this study on dimensional stability align with the findings of Bilisik (2016) who noted that fabric construction is a critical factor in determining dimensional stability.

4.1.5 Colourfastness to Washing and Staining of the Sampled Fabrics

The average colourfastness values of the sampled fabrics after washing is presented in Table 5. A standard scale of 1 – 5 was used for the assessment with 1 representing poor resistance and 5 indicating excellent colour retention. Variations were observed in the colourfastness ratings among the sampled fabrics with B(4 - 5) exhibiting the best performance, followed by A(3 – 4) and C(3 – 4) which displayed moderate resistance to fading and staining. The results suggest that probably sample B has a better dye fixation making it perform better in terms of colourfastness after washing. However, the rating of 3 – 4 for samples B and C though acceptable, shows the fabrics are likely to experience lack of colour retention especially after repeated washing.

Table 5
Colourfastness and Staining to Washing for the Selected Fabrics

Fabric	Change in Colour	Colour Staining
A	3-4	3-5
B	4-5	3-4
C	3-4	3-4

In relation to colour staining, Fabric A had a rating of 3 – 5, while B and C had slightly lower rate of 3 – 4. Meng et al. (2023), indicated that high colourfastness ratings are essential for ensuring that fabrics maintain their aesthetic appeal after multiple washes. Excellent colourfastness in fabrics according to Pizzicato et al. (2023) depends on the choice of dye and the application methods employed. While the colourfastness results observed in this study looks generally good, continuous improvement in dyeing processes is necessary to meet evolving consumer expectations regarding colour retention in fabrics.

4.1.6 Abrasion Resistance of the sampled fabrics

The abrasion resistance result of the selected fabrics is presented in Table 6. The results show differences in how each fabric is able to withstand wear, with Fabric C depicting the highest resistance, followed by B, and A portraying the greatest mass loss. It was further noted that Fabric C with the lowest mass loss (0.0961 g), shows superior durability against abrasion. The results for Fabric C probably is due to its fibres being densely packed, making it more resistant to fibre shedding over time. On the other hand, Fabric A showed the highest mass loss (0.1057 g), which means it experienced slightly more wear compared to the other two fabrics. Fabric B however, performed slightly better than A, with a mass loss of 0.1053 g, implying slightly improved abrasion resistance but still falling short of Fabric C's performance.

Although there were variations in the fabrics mass loss, all the three fabrics maintained a consistent appearance rating of 4 across the abrasion cycles. In all it could be indicated that Fabric C had the most resistance to abrasion, making it a suitable choice for applications requiring long-lasting durability. However, since all the sampled fabrics maintained their aesthetic appeal despite fibre loss, they are likely to be useful for applications where appearance retention is valued.

Table 6
Abrasion Resistance of the Selected Fabrics

Fabric	Loss of Mass (g)	Appearance Rating
Fabric A	0.1057	4
Fabric B	0.1053	4
Fabric C	0.0961	4

Final recorded mass at 25,000 cycles

The findings of the current study on abrasion resistance is in agreement with the work of Cooper and Claxton (2022) who observed that a lower mass loss during abrasion tests is suggestive of a robust fabric structure, which is important for garments subjected to frequent wear and tear.

The appearance retention of the sampled fabrics is essential for consumers and emphasises the findings by Aakko and Niinimäki (2021) who opined that the longevity of a fabric's appearance is an essential criterion for consumer satisfaction and product quality. Even though the fabrics have proved reliable in terms of appearance retention, there is still the need for manufacturers to ensure that textile products continue to maintain their aesthetic appeal after several use. Acharya et al. (2024) stated that advancements in textile technology, such as the incorporation of high-performance fibres and specialized coatings, could significantly improve abrasion resistance, providing durable and longer-lasting fabrics.

4.2 Comparison of the Quality Performance Characteristics of the Sampled Fabrics

4.2.1 Statistical Differences among the Three Selected Fabrics

Table 7 provides the ANOVA results for the sampled fabrics on key performance attributes, thread count, weight and dimensional stability. The results depict differences in fabric yarn count and weight among the fabrics. Statistically significant differences were observed among the fabrics in terms of yarn count in both the warp ($p = 0.002.$) and weft ($p = 0.001$) directions. This result confirms the outcome in Table 1, which indicates that the fabrics had different yarn count values.

With regard to the weight of the fabrics, significant differences ($p = 0.001$) were observed among the fabrics, confirming that the fabrics had varying weight values. As a fabric's weight affects its drape, comfort, and durability, the differences suggests that the fabrics are likely designed for different end uses.

For dimensional change in both the warp ($p = 0.294$) and weft ($p = 0.224$) directions, no statistically significant differences were established and confirms the results in Table 4. This indicates that all three fabrics exhibited similar shrinkage behaviour after washing. The absence of statistically significant difference among the fabrics with regard to dimensional stability, suggests that while structural attributes like thread count and mass per unit area (weight) affect fabric performance, they may not directly influence the fabric's dimensional stability as seen in the current study. The consistency observed in stability across the sampled fabrics indicates the significance of other factors, such as fibre type, finishing treatments, and fabric care, in determining overall fabric quality.

Table 7
ANOVA Results Comparing the Selected Fabrics Properties

Parameter	F	*p-value*
Thread Count (Warp)	27.61	0.002*
Thread Count (Weft)	143.54	0.001*
Dimensional Change (Warp, %)	1.29	0.294
Dimensional Change (Weft, %)	1.67	0.224
Mass Per Unit Area (g/m²)	19.15	0.001*

**Significant* = $p < 0.05$

Also, the post-hoc analysis in Table 8 revealed that the fabrics differ significantly in thread count (both warp and weft) and mass per unit area, with two pairwise comparisons showing no significant differences. These findings are consistent with that of Bilisik (2017) who emphasized that variations in thread count, and fabric weight contribute to the overall quality and performance of textiles. However, the lack of significant differences between Fabric B and Fabric C highlights the importance of understanding the subtle factors that influence fabric performance. While thread count and weight are critical, other factors such as fibre type, finishing treatments, and textile processing methods play essential roles in determining fabric quality (Ghosh & Mal, 2019).

The outcome of the study calls for the analysis of other fabric characteristics such as texture, feel, and moisture management, which are equally important in selecting fabrics for various uses. The findings also underline the importance of a holistic approach in evaluating fabric quality, one that considers not only physical parameters but also broader considerations such as sustainability, durability, and end-use application (Cooper & Claxton, 2022).

4.2.2 Post-hoc Comparisons of the Quality Parameters among the Three Sampled Fabrics

The results presented in Table 8 on the post-hoc results show the pairwise comparisons of the quality attributes of the sampled fabrics. The results in Table 8 show that for the yarn count in the warp direction, Fabric A significantly differed from the other two samples. However, fabrics B and C did not show any significant difference between them. For the weft direction, in terms of yarn count, Table 8 shows distinct differences between all the sampled fabrics. With regard to the fabric weight, significant differences were noted between Fabric A and the other two fabrics, but Fabric B and C showed no significant difference. The findings from the post-hoc analysis indicates the areas where the sampled fabrics differ, confirming the variability in their performance attributes.

Table 8
Post-Hoc Results for the Selected Fabrics' Characteristics

Comparison	Mean Difference	p-Value
Thread Count (Warp)		
Fabric A vs. Fabric B	-6.8	0.001*
Fabric A vs. Fabric C	-6.4	0.001*
Fabric B vs. Fabric C	0.4	0.955
Thread Count (Weft)		
Fabric A vs. Fabric B	16.0	0.001*
Fabric A vs. Fabric C	11.6	0.001*
Fabric B vs. Fabric C	-4.4	0.001*
Mass Per Unit Area (g/m²)		
Fabric A vs. Fabric B	9.3	0.001*
Fabric A vs. Fabric C	10.3	0.001*
Fabric B vs. Fabric C	1.0	0.925

**Significant* = $p < 0.05$

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The outcome of the study has indicated significant variations in the structural and performance attributes of the selected fabrics, which shows their variability for different end uses. The results on yarn count revealed Fabric B and C had higher warp yarns contributing to greater tensile strength in their lengthwise direction, whereas Fabric A had a higher weft yarn count supporting its performance across the width. The fabrics however, did not meet the set specification for yarn count by Ghana Standards Authority for such fabrics. Fabric A emerged the heaviest in relation to weight, even though none of them met the required GSA standard specification for weight, while B and C can be described as lightweight. Suggesting their suitability for different end uses. In relation to tensile strength and elongation, Fabric C had the highest tensile strength but also the greatest variability post-wash, while Fabric B demonstrated consistency, making it a reliable option for applications requiring stability after laundering.

For dimensional stability, all fabrics maintained acceptable shrinkage levels, with minimal changes post-wash, indicating good structural integrity. The fabrics met the set standards for shrinkage set for such fabrics. The colourfastness test showed that Fabric B is most resistant to fading and staining among the three fabrics. With regard to the abrasion resistance test, it can be concluded that Fabric C had the lowest mass loss indicating its durability, however, all the three fabrics maintained their aesthetic appeal despite the fibre loss observed.

In all the study has revealed that each of the selected fabrics has its unique characteristics, with Fabric C performing best in tensile strength and abrasion resistance, B providing a balanced durability and A having a higher weft yarn count and weight. With the variations in fabric performance attributes and some attributes not meeting the standard specifications, it is important to enhance monitoring to assess and guarantee the quality of textiles available in Ghana.

5.2 Recommendations

Based on the outcome of the study, it is recommended that consumers consider the performance attributes of each fabric they select for specific applications. For this study, Fabric C can be described as best suited for high durability applications due to its tensile strength and abrasion resistance compared to the other fabrics and Fabric B for products demanding stability and consistent post wash quality. Fabric A on the other hand, would be ideal for applications needing enhanced width wise strength and weight due to its higher weft yarn count observed in the study.

Additional research is suggested to determine the influence of repeated washing cycles on the performance attributes of the sampled fabrics as well as other fabrics on the Ghanaian market to establish their long-term performance.

Moreover, exploring how various fibre compositions and fabric mixtures affect performance characteristics of fabrics might offer valuable information for enhancing the durability and functionality of textile fabrics.

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