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An Appraisal of Washing Cycles on the Colours of Akosombo Textile Limited and Dong Yu Textile Company Limited Kente Printed Fabrics in Ghana

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Abstract

This study was centred on washing cycles using Key and Sunlight Soaps on the colours of attributes of Akosombo Textile Limited (ATL) and Dong Yu Textile Company Limited (DYTCL) Kente fabrics. A factorial design was used for the study. Two printed Kente fabrics from Akosombo Textiles Limited (ATL) and Dong Yu Textile Company Limited (DYTCL) were sampled for the study. The lottery method sampling technique was used to sample 164 specimens from the two selected fabrics. The main instruments for the data collection were a pair of scissors and a pattern cutter. The washing of the fabrics were done in three cycles. The data were first coded and entered into Statistical Package for Service Solutions (SPSS) software version 16.0. The data were presented using tables of frequencies and percentages. Descriptive statistics, inferential statistical analyses were undertaken to assess the statistical significance of the observed differences in the colourfastness and tensile strength of the two fabrics as they underwent washing in Key and Sunlight soap solutions for three washing cycles. A one-way Analysis of Variance (ANOVA) was used to test for significant differences in colourfastness and tensile strength between the two fabrics after undergoing three washing cycles in Key and Sunlight soap solutions. An independent sample t-test was used to test for significant difference between ATL and Dong Yu fabrics. An error margin of 0.05 was used for all inferential analyses. The study concluded that, ATL Kente print performed better with Key soap than with Sunlight soap, whereas Kente print from DYTCL performed virtually the same with the two soaps. It is recommended that, Consumers of printed Kente fabrics are advised to use Key soap to wash instead of Sunlight soap.

Keywords

Washing Cycles, Key and Sunlight Soaps, Kente, Akosombo Textile Limited, Dong Yu Textile Company Limited

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1. Introduction and Background

This paper results from an appraisal of washing cycles using key and sunlight soaps on the colours of attributes of Akosombo Textile Limited (ATL) and Dong Yu Textile Company Limited (DYTCL) printed Kente fabrics in Ghana**.** The paper is structured into five (5) main sections namely; the Introduction and Background, Review of the Literature, Methodology, Findings and Discussion and the Conclusion. The first section introduces the structure of the paper, the context and aims and objectives of the paper. The literature review section reviews the relevant literature. Colours of attributes of Akosombo Textile Limited (ATL) and Dong Yu Textile Company Limited (DYTCL) Kente printed fabrics

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were examined. The methodology section presents a broad description of the methodology and procedures adopted in the conduct of the study. Findings resulting from the study are presented and discussed in the section following the methodology, and further with conclusions and recommendations.

Structural attributes of the Kente prints were assessed to guarantee quality and durability specifications. Improvement in the structural attributes of the Kente print from DYTCL can be in the form of increasing the number of thread counts in the fabrics, and the arrangement of yarns. This will help to improve the durability of Kente print from DYTCL in their daily use. Since non-woven fabrics are increasingly being used in many technical applications, it is very important for consumers to understand their specific properties [1]. Primary properties of textile fibres are the essential characteristics that are necessary to make a polymeric material an adequate fibre or suitable substance for use in forming textile fibres. The properties of textile fibres or fabrics, particularly cotton, are many but may be grouped under primary and secondary properties. Alternatively, secondary properties of textile fibres are those characteristics that increase fibre value, desirability in its intended end-use, and often improve consumer satisfaction. Such secondary properties include physical shape, density or specific gravity, lustre, moisture regain and absorption, elastic recovery, elongation, resiliency, thermal behaviour, flammability, and resistance to biological, chemical and environmental conditions [2].

The use of colour in textile design is also important in a consumer's decision on the type of fabric to acquire. The reasons outlined that the consumer values the beauty of the colour of the fabric, smartness of the fabric colour, and the conditions in which the fabric will be used to satisfy test in washing, ironing, steaming, perspiration, strong light, crocking, and dry cleaning. This means the consumer is interested in testing fabrics for colourfastness in many processes [3]. Consumers make decisions concerning the properties of a fabric in relation to its performance and maintenance before and during purchase of the fabric [1]. Consumer washing processes and inputs such as soap used and laundering regimes also play a major role in the ability to retain fabric performance. Laundry soaps can be in the form of solid or liquid. Fabrics last longer when washed with residue-free soaps. Residue-free soaps enhance the preservation of the appearance, value and life of the fabric. Thus, washing results depend on a great number of influential factors related to soaps, water, washing cycles, soiling characteristics of textiles [4].

Soaps are cleaning ingredients that are able to remove oil particles from surfaces because of their unique chemical properties. They are used for most cleaning needs, including personal hygiene, laundry and dish washing. The cleaning action of soaps is as a result of their ability to surround oil particles on a surface and disperse it in water. Bar soaps have been used for centuries and continue to be an important product for bathing and cleaning [4]. Irrespective of the colour composition of fabrics, colour fades over time. Hence, consumers are more interested in fabrics that fade gracefully over time. Textile industries both in Ghana and outside therefore exploit colour in many ways to attract consumers' interests and boost purchases of the fabrics such as printed Kente. The industries invest large amounts of time into getting fabric colour right, and pay much attention to the quality of yarns and threads used in the production of fabrics to resist the wear and tear that they are subjected to during washing and drying. Printed Kente fabrics are of various colours and textures. Ghana's most popular soaps, Key soap and Sunlight, are normally used in washing the printed Kente fabrics [5].

Both local and imported printed Kente fabrics are exposed to the same or similar stress and soaps during use and care which are likely to affect their tensile strength and colourfastness. However, the wear and tear of both fabrics depends on their basic fibre properties [2]. Washing, state of stress and loading rates are likely to cause variations in tensile strength and colourfastness of fabrics [6]. It is noted that not much studies have been carried out on Kente fabric. A study on Ghanaian Kente focused on the history and socio-economic importance of the fabric to its users and producers, but not on the performance of the fabric during their new found use and the care that go with these [7]. The study was to examine differences in the two Kente fabrics as they undergo three washing cycles by the use of Key and Sunlight soaps. The purpose of the study was to assess the performance, of Ghanaian ATL and Chinese DYTCL printed Kente fabrics after three washing cycles with key and sunlight soaps. The study was guided by these two (2) research questions - (1) investigate the effects of Key and Sunlight soaps on the colour of ATL Kente fabrics after three washing cycles; (2) examine the effects of Key and Sunlight soaps on the colour of DYTCL Kente fabrics after three washing cycles. Two hypotheses were also formulated to test the differences in colourfastness of the two tested fabrics between Key and Sunlight soaps- The first hypothesis on colourfastness stated that there is no significant difference between the colourfastness of ATL and DYTCL Kente prints after three washing cycles with Key soap. The second hypothesis stated that 'there is no significant difference between the colourfastness of ATL and DYTCL Kente prints after three washing cycles with Sunlight soap.

2. Review of the Literature

Key Soap and Sunlight Soap

Key soap is the first ever product to have come out of the then Lever Brothers Factory in 1963 [8]. Before then, the product had gained popularity with the Ghanaian consumer from the days when United Africa Company was importing Key Soap (both the carbolic and pale variants) from Port Sunlight in the United Kingdom. For almost half a century, the multipurpose Key soap has not only stuck a bond with its users, but has given comfort to consumers, especially home makers. Key soap has offered freshness when it is used. It is used in washing clothes, dishes, make floors clean and hygienic since the 1950s and continues to do other chores in many homes and institutions. As a true dependable partner, Unilever reported that Key soap has been passed on from generation to generation hence the name "Key" which opens doors and has remained a generic name with Ghanaian consumers. Sunlight soap was the world's first packaged, branded laundry soap [9]. It makes hygiene and cleanliness affordable around the world. Unilever founder William Hesketh Lever launched the Sunlight soap brand in the United Kingdom in 1885. At the time, Victorian England was plagued by poverty and ill health, and wanted to revolutionise hygiene, he brought Sunlight soap to the reach of ordinary people. Formulated with fresh lemon extracts to cut through grime and grease, Sunlight soap harnesses the power of natural ingredients. More than 100 years later, Sunlight soap is now found around the world, and is used for cleaning dishes, clothes and skin.

Laundering and Fabric Performance

Laundering is required for many textile goods, but in some cases lead to deteriorations of fabric performance. During laundering, the fabric is subjected to complex thermal, mechanical and physical actions in both wet and dry conditions. Most textile products must be able to withstand a reasonable number of laundering cycles. For shirts, the average life expectancy is approximately 30 to 40 launderings [10]. For hygienic reasons, garments need to be washed, so they should be durable against washing [11]. However, some properties of fabrics like keeping warm and bulkiness, also depend on the thickness of the fabrics. Since thick and porous fabrics contain more air, form a thicker layer between human body and surrounding, and make the heat transfer difficult, they keep warmer [12]. The determination of the thickness of fabric consists of precise measurement of the distance between two plane parallel plates when they are separated by the fabric, with a known arbitrary pressure between the plates being applied and maintained [13]. Since fibre, yarn, fabric and finishing processes have an effect on fabric stiffness, it is assumed that repeated laundering and enzyme processes have an effect on fabric stiffness.

Colourfastness of Fabrics

To make a satisfactory textile choice for a particular use, consumers must not only understand the properties of the textile fibres but also the comparative elemerits of the fibres. This is because the commercial value of any fibre depends largely on the extent to which it possesses certain characteristics such as tensile strength, elasticity, fineness and cohesiveness. The consumer is also concerned about the serviceability, performance and ease of care. The use of colour in textile design has its own magic and creates its own special problems and frustrations. As an aspect of textile design, colour is influenced by many factors. Colour poses problems for designers that are not shared by fine artists, and it is in the experience of colour that commercial textile design moves for the painter [14].

The symbolism of colour is used world-wide to signify certain events or states of mind and spirit, and it must be recognised that the significance of a colour in one country may not be the same as the significance of the same colour in another country [15]. A colour that may be used for a ceremony of life or rebirth in one culture may be seen as a symbol of death, and used during funeral occasions in another, in yet another, it may symbolise a season. Colour also signifies political allegiances, national events and religious and secular celebrations. Colours may provoke a strong physical or physiological reaction. Certain colours may suggest weight or lightness, they may appear to advance and encroach or to recede, and they can make us feel warm or cold, restful or agitated [16]. Of all the considerations that affect colour in the area of textile design, fashion is the most intriguing. In fashion, colour comes and each cycle should be noted and understood by the designer.

Colourfastness of a fabric refers to the ability of the fabric to retain its colour or remain unchanged when washed or worn. Colourfastness of a fabric to washing is very important for the performance of the fabric. This is because washing conditions vary from one country to another and various methods are used for dyeing fabrics. Colourfastness of a fabric may be affected by factors such as perspiration, dry cleaning, bleach, salt water, swimming pool additives, atmospheric gases or air pollutants. Colourfastness to washing is important in dress fabrics and household linens because they must undergo frequent washings. Basically, the degree of fading and staining of dyed goods for washing depends upon the following factors;

1) Temperature range which may be from 40°C to 95°C.

2) The type and amount of detergent added to the washing bath.
3) The rinsing, drying, or pressing methods used to restore the sample after the washing test.
4) The extent of mechanical action which can be varied by changing the agitation speed in a washing machine or by adding steel ball to the revolving bath.
5) The washing liquor to goods ratio which is 50:01.
6) The hardness of the washing water [5].

The effect of washing on naturally coloured cotton found out that the reaction to washing of natural colours is quite different from that of synthetic colours. Dyed fabrics more or less fade with each washing. On the contrary, fabrics from naturally-coloured cotton improve its fastness and colour intensity with each washing. Experiments have shown that washing fabrics from coloured cotton intensifies its colour. The idea that the natural colour intensifies with the exposure to sunlight may be true for specific colours but is certainly not applicable to all colours of cotton [6].

3. Methodology

3.1. Research Design

Factorial design was used for the study. Two washing soaps, namely Key soap and Sunlight soap were used in three washing cycles of 30 minutes, 60 minutes and 90 minutes, respectively. Factorial design allows subtle manipulations of a larger number of interdependent variables to assess their effect on dependent variables [17]. The authors further indicated that factorial design allows researchers to judge whether there is a link between variables, whilst reducing the possibility of experimental error and confounding variables. The independent variables in the study were the two printed Kente fabrics, two washing soaps and three washing cycles, whereas colour and strength constituted the dependent variables.

3.2. Population of the Study

The study population comprised locally printed Kente fabrics from Akosombo Textiles Limited (Ghana) and China printed Kente fabrics from the Dong Yu Textile Company Limited. The label on ATL printed Kente fabric was ‘Guaranteed Superb Prints RSP2993’ and that of DYTCL printed Kente fabric was ‘Guaranteed Superb Prints 29848’. Six yards of DYTCL and six yards of ATL printed Kente fabrics (same colours) were obtained from the market from which the samples were obtained and from each of the prints, a total of 409 specimens were obtained. The total sample frame for the study was therefore 918 specimens from the two selected fabrics. The two soaps used in the study were Key soap and Sunlight soap. This was because Key soap and Sunlight soap have gained popularity among Ghanaian consumers [8, 9]. Key soap and Sunlight soap were therefore the most common laundry soaps available on the Ghanaian market. Two cakes of each of the soaps were obtained from the same source. This was to make sure that storage characteristics, such as temperature, were as close as possible.

3.3. Sample and Sampling Procedure

A total of 409 specimens were obtained from each fabric, giving 918 specimens in all. The measurement for each of the cut samples was 10cm by 7cm with the 7cm being fringed to a length of 5cm to meet the Ghana Standards Authority’s requirement for tensile testing. A population of 918 required a sample size of 269 to satisfy the principle of representativeness [18]. However, due to similarities in the physical characteristics of the two fabrics, such as weave pattern and colours, 164 specimens (82 warp and 82 weft) were sampled for the study. This comprised 82 (41 warp and 41 weft) ATL printed Kente specimens and 82 (41 warp and 41 weft) DYTCL printed Kente specimens. Both fabrics had plain weave pattern and red, yellow and green colours. Twenty of the sampled specimens were used as control. Twenty each of the rest of the specimens were used to test validity. This was conducted and care was taken to use the same characteristics that were used for the study, which were plain weave pattern. and red, yellow and green colours.

Multi-stage sampling technique was used to sample the specimens. The specimens were first grouped into two categories, which were specimens from ATL printed Kente and specimens from DYTCL printed Kente. Each category contained 409 specimens and then each category was further grouped into warp and weft specimens. Equal proportions were assigned to warp and weft specimens and the lottery method was used to sample 82 specimens from each category. The lottery method was used to give every specimen equal chance of being selected into the sample. The specimens were put into a box, shaken and then one picked at a time without replacement until the required number, 409 was obtained for each specimen. After each selection, the specimens were mixed again to make sure each of them had equal chance of being picked. Table 1 shows the distribution of the specimens between the two fabrics after the sampling and as they underwent the various tests.

Table 1. Distribution of the Specimens from the Two Fabrics.

Tests	ATL fabric		DYTLC fabric		Total
	Warp	Weft	Warp	Weft	
Control	5	5	5	5	20
Washing in Key soap	15	15	15	15	60
Washing in Sunlight soap	15	15	15	15	60
Thread count	5	5	5	5	20
Fabric weight	1	1	1	1	4
Total	41	41	41	41	164

Source: Laboratory Results, 2019

The 20 sampled specimens used as control comprised 10 (5 warp and 5 weft) from the ATL printed Kente fabric, and 10 (5 warp and 5 weft) from DYTCL printed Kente fabric and were not laundered. One hundred and twenty sampled specimens, which were used for uniaxial testing also comprised of 15 specimens each from ATL warp, ATL weft, DYTCL warp and DYTCL weft. These were the sampled specimen undergoing washing in Key soap and Sunlight soap, respectively. Thus, 60 specimens each were washed with Key and Sunlight soaps separately. Four of the sampled specimens made up of ATL, 1 warp, 1 weft, and DYTCL, 1 warp, 1 weft, were randomly selected to be used for measuring the weight of the fabrics. Twelve out of the 120 washed samples were randomly sampled for the testing of colourfastness to washing. The random sampling was done by selecting every other sample that passed by through a space purposely provided in a box for the purpose.

3.4. Instruments

A pair of scissors was used in cutting the specimens for the two fabrics, while a Pattern Cutter was used to cut the fabrics into uniform round shapes for use in determining their weights. Weighing scale T×L/A12/WGSO (Adams Equipment) was used in weighing the cut specimens, as well as measuring the weight of required soap. This was because the amount of soap required for the washing was determined by the weight of the specimens. Water and soap to be used were heated on the Eyela water bath to dissolve the soap faster and for uniformity. The soap solution and specimens were put into canisters which were then put into the Standard Launder-Ometre (Gyrowash 315) for laundering. A drying rack was used to dry the washed specimens. The Grey Scale (Verivide) was used to test for the colourfastness to washing.

Glass cutter (eye piece) was used to determine the weave type of the fabrics. The Manual Lens was used to assess the thread count in each fabric type. Hounsfield H5K–S (universal standardised tensile testing machine) was used to test for the tensile strength of the fabric. The machine has two crossheads; one adjusted for the length of the specimen and the other driven to apply tension to the test specimen. The test process involved placing the test specimen in the testing machine and applying tension to it until it fractured.

3.5. Preparation of Soap Solution and Washing of Specimens

For the 120 samples that were laundered, the soap solution used for the laundering was made up of 56.25gms each of grated key soap and sunlight soap for each fabric, and 12,000 litres of water. As indicted already, the quantity of soap was determined by the weight of the specimens, according to standard testing practices. The cut specimens were preconditioned at a temperature of 28°C to 30°C for 24 hours to meet the GSA specification EN20139. This was done to ensure that both fabrics had uniform temperature. The specimens were then weighed using the Adams Equipment to determine the weight of the specimens which in turn determined the amount of soap and water needed. The soap solution was then put on the water bath to dissolve and was also allowed to cool. One gram of soap was mixed in 213.3 litres of water. The washing machine (Gyrowash 315) was pre-heated for 30 minutes to attain a conducive temperature of 28°C to 30°C for the tensile strength testing.

3.6. Method of Data Collection

The washing of the fabrics were done in three cycles. At each cycle of washing, 40 specimens were washed. After each cycle of washing, the specimens were rinsed and dried indoor under temperature condition between 28°C and 30°C overnight. Duration for the first washing cycle was 30 minutes and the summary is presented in Table 2.

Table 2. Summary of Specimen Requirement for each Cycle of Washing.

Yarn	ATL		DYTCL		Total
Direction	Key soap	Sunlight soap	Key soap	Sunlight soap	
Warp	5	5	5	5	20
Weft	5	5	5	5	20
Total	10	10	10	10	40

Source: Field Data, 2019

The next 40 specimens were also washed for 60 minutes, rinsed and dried in the cooling rack whilst the last 40 specimens were washed for 90 minutes, rinsed and dried in the cooling rack overnight at a temperature of 28. The washing periods were varied to examine whether the length of washing had effect on the performance of the fabrics in terms of the tensile strength and colourfastness. The drying conditions were however the same. The dried specimens were then tested for their strength using the Honsfield H5K-5 machine. This machine has upper and lower jaws which were tightened when the samples were fitted into them. Thereafter, the samples were broken at the weakest points. The interval between the upper jaw and the lower jaw of the machine was 20cm for each break. Tarpaulins were also placed at the ends of the specimen that were fixed into the machine to keep the specimen in a firm position and also avoid slippage of the specimen. The fabrics were then tested for strength in the testing machine with the control group being tested first. For each cycle of breaking, the result for each break (warp and weft) was recorded using the recorder machine. If during the testing, the specimen broke at the centre, it was recognised as a very good break, but before or beyond, it was recognised as a bad or jaw break.

In testing for the colourfastness to washing, the Grey Scale or Verivide machine was used. The Grey scale was calibrated into 1, 1-2, 2, 2-3, 3, 3-4, 4, 4-5, 5. per the GS 124 (2005). A cotton fabric passes the colourfastness test when it is able to maintain at least 3-4 units of its colour on the Grey scale. Samples from the various fabrics washed were assessed and the results recorded. The Standard Control for colourfastness used was 4-5 on the Grey Scale. If after visual inspection the result obtained was below 3-4, it meant the fabric had failed or faded. Before the specimens were tested, visual inspection was used to assess the type of weaves in the two printed Kente fabrics, and from the inspection, both fabrics were found to be of the plain weave. The patterns of the weave in both fabrics were examined by observing them under the manual lens. The observation showed one-over- and one-under-one plain weave design. Twenty specimens were used for the yarn count. These included 5 warp, 5 weft for ATL printed Kente specimens and 5 warp, 5 weft for DYTCL printed Kente specimens. The Manual Lens was used in counting the number of threads per one cut sample and the result recorded. Four samples were randomly cut into round shapes with the Pattern Cutter and weighed for the fabric weight.

3.7. Data Analysis

The experiment was a 2:2:3 factorial design. The first factor in the study was the number of fabrics, which were ATL and DYTCL Kente prints. The second factor was the number of washing soaps, which were Key and Sunlight soaps. The third factor was the number of washing cycles which were three and made up of 30, 60 and 90 minutes. The data were first coded and entered into Statistical Package for Service Solutions (SPSS) software version 16.0. The data were presented using tables of frequencies and percentages. Also, means and standard deviations were employed to describe the structural attributes (weave type, thread count, fabric weight, colourfastness and tensile strength) of the two fabrics as well as the chemical compositions of the two soaps. With the examination of the thread counts and fabric weight, the counts and the weights were taken five times and the means and standard deviations were calculated. This was to minimise losses in the measurements taken as much as practicable.

In addition to the descriptive statistics, inferential statistical analyses were undertaken to assess the statistical significance of the observed differences in the colourfastness and tensile strength of the two fabrics as they underwent washing in Key and Sunlight soap solutions for three washing cycles. A one-way Analysis of Variance (ANOVA) was used to test for significant differences in colourfastness and tensile strength between the two fabrics after undergoing three washing cycles in Key and Sunlight soap solutions. An independent sample t-test was used to test for significant difference between ATL and Dong Yu fabrics. An error margin of 0.05 was used for all inferential analyses.

4. Findings and Discussions

4.1. Effects of Key and Sunlight Soaps on the Colour of ATL KentePrint After Three Washing Cycles

This section focuses on assessing the effects of Key and Sunlight soaps on the colour of ATL Kente print after three washing cycles. The main emphasis was to examine the ability of the ATL Kente print to maintain its colour after undergoing washing. The importance of this test was that it was concerned with measuring the quality or durability of the ATL printed Kente fabric in its usage. The structural attributes of textile fabrics is known to play a critical role in the ability of fabrics to resist the abrasive power of soaps. The Grey Scale was used to test for colourfastness in the Kente fabrics from the two textile manufacturing companies. Details of the variations in colourfastness of ATL Kente print after three washing cycles with Key and Sunlight soaps are presented in Table 3.

Table 3. Variations in Colourfastness of ATL Kente Print after Three Washing Cycles with Key and Sunlight Soaps.

Soap Type	Mean colourfastness (N) of fabrics Control			
	30 minutes	60 minutes	90 minutes	
Key soap	4-5	4-5	4	4-5
Sunlight soap	4	4	4	4-5

Source: Laboratory Results, 2019

An examination of Table 3 reveals that the control colour, being the original colour before undergoing washing of the

Kente fabric from ATL with both Key and Sunlight soaps, measured 4-5 on the Grey Scale. The result implied that the ATL Kente print passed the ISO Grey Scale Standard for African textiles of 4-5. The confirmation is drawn from the fact that, the original colourfastness of textile fabrics for African condition should measure 4-5 on the Grey Scale [19]. The mean colourfastness of the ATL Kente print after 60 minutes of washing measured 4-5 on the Grey Scale. The results indicated that the fabric maintained its original colourfastness between the first two washing cycles with Key soap. The results also meant that the structural attributes of the ATL Kente print were able to contain the abrasive power of Key soap within 60 minutes of washing, since according to the basic fibre theory, the ability of textile fabrics to resist the abrasive power of chemical elements is determined by the structural attributes of the fabrics [2]. A researcher buttressed the issue of chemical elements in washing soaps possessing some abrasive properties, which when applied to textile fabrics, cause their colours to fade [6]. On the other hand, a study argued that the extent to which the abrasive qualities of soaps had influence on the colour of a textile fabric was determined by the physical properties of the fabrics. The physical properties being referred to include the type of yarn, absorbency level of the yarn, thickness of the yarn, number of yarns, weight and weave type. Lilley also included the fact that the influence each abrasive quality of soap has on the physical properties of the fabric depends on the quality of dyes used as well [5]. In this study, an inference one could consider was that the colour changes depended on several factors which could not have been studied in just one study.

At the end of the third washing cycle with Key soap, the colourfastness of the ATL Kente print recorded 4 on the Grey Scale. Thus, the ATL printed Kente fabric lost 0.5 units of colour on the Grey Scale over the three washing cycles with Key soap. The loss of colour was in consonance with the failure theory which stated that the quality of textile fabrics, in terms of their colourfastness, did fail or reduce as they were subjected to a more stress test like washing. Where a textile fabric passed a colourfastness test when it maintained at least 3-4 units on the Grey scale after it underwent the test implied that the ATL Kente print passed the colourfastness test after three washing cycles with Key soap. Table 3 further shows the results after using Sunlight soap on ATL Kente print. The ATL Kente print recorded a mean colourfastness score of 4 on the Grey Scale after the first 30 minutes of washing with Sunlight soap. The result showed that the ATL Kente print lost 0.5 units of colour after 30 minutes of washing with Sunlight soap. The result was in corroboration with the main thrust of the failure theories that the more materials underwent stress test such as washing, the more their quality of their colour reduced or failed. Furthermore, the ATL Kente print recorded mean scores of 4 each after 60 and 90 minutes of washing with Sunlight soap.

The implication of the results was that the ATL Kente print maintained a constant colourfastness score over the three washing cycles with Sunlight soap. The initial 0.5 units of colour loss after 30 minutes may therefore be interpreted as the removal of excess dye from the manufacturing process. The ATL Kente print therefore passed the colourfastness test after three washing cycles with Sunlight soap. This conclusion is derived from the fact that, a textile fabric passed the colourfastness test when it maintained at least 3-4 units on the Grey scale after it underwent a test [19]. The results from Table 3 also show that the ATL Kente print passed the colourfastness test after three washing cycles each with Key and Sunlight soaps. This finding may be attributed to the structural attributes of the ATL Kente print which include high number of yarns, cotton yarns, and heavy fabric. These factors did contribute to the retention of dye to maintain the colourfastness of the ATL Kente print over the washing cycles with Key and Sunlight soaps. However, the ATL Kente print performed better in Key soap than in Sunlight soap. After the first two washing cycles, the ATL Kente print retained more colour with Key soap than with Sunlight soap. Nevertheless, the fabric retained the same amount of colour between Key soap and Sunlight soap after the third washing cycle. This implied that the abrasive elements of Sunlight soap could have been much higher than those of Key soap. This view is based on the assertion that chemical elements in washing soaps possess some abrasive properties which when applied to textile fabrics cause their colours to fade [6].

4.2. Effect of Key and Sunlight Soaps on the Colour of DYTCL Kente Print After Three Washing Cycles

This section also was to examine the effects of Key and Sunlight soaps on the colourfastness of DYTCL Kente print after three washing cycles. This was to help assess the ability of the Kente print from DYTCL to resist the abrasive powers of Key and Sunlight soaps after three washing cycles. Table 4 presents the colourfastness measurements of the Kente print from DYTCL for both Key soap and Sunlight soap over the three washing cycles.

Table 4. Variations in Colourfastness of DYTCL Kente Print after ThreeWashing Cycles with Key and Sunlight Soaps.

Soap Type	Mean Colourfastness (N) of FabricsControl			
	30 minutes	**60 minutes**	**90 minutes**	
Key soap	4-5	4	4	4-5
Sunlight soap	4	4-5	4	4-5

Source: Laboratory Results, 2019

Data in Table 4 show that the control of original colourfastness of the Kente print from DYTCL measured 4-5 on the Grey Scale before washing with both soaps. The controls were not subject to washing. The results revealed that the printed Kente fabric from DYTCL passed the ISO Grey Scale Standard of 4-5 for African textiles. This inference is in reference to the original colourfastness of textile fabrics for African conditions should measure 4-5 on the Grey Scale. In other words, the original colourfastness of textile fabrics should test 4-5 on the Grey Scale to be able to resist the environmental conditions in Africa [19].

Table 4 further shows that the mean colourfastness of the Kente print from DYTCL measured 4-5 on the Grey Scale after 30 minutes of washing with Key Soap. This meant that there was no colour loss in the Kente print of DYTCL after the first washing cycle with Key soap. The implication was that the Kente print from DYTCL was able to resist the abrasive power of Key soap after 30 minutes of washing. After 60 minutes of washing with Key soap, the Kente print from DYTCL recorded a mean colourfastness score of 4. This meant that the Kente Print from DYTCL shed 0.5 units of colour after the second washing cycle with Key soap. This was in line with the failure theories that as more and more materials were subjected to stress, their quality, in terms of colourfastness began to fail or reduce. After 90 minutes of washing with Key soap, the Kente print from DYTCL recorded a mean colourfastness score of 4 on the Grey Scale. The score showed that there was a colour loss of 0.5 units on the Grey Scale after 90 minutes of washing with Key soap. Whereas a textile fabric passed a colourfastness test when it maintained at least 3-4 units on the Grey scale after it underwent a test [19]. It could be inferred that the Kente print from DYTCL passed the colourfastness test after three washing cycles with Key soap.

Table 4 further showed that the Kente fabric from DYTCL recorded a mean score of 4 on the Grey Scale after 30 minutes of washing with Sunlight soap. The score showed that the tested fabric lost an average of 0.5 units of colour after the first washing cycle with Sunlight soap. However, the Kente print from DYTCL maintained its original colour after the second washing cycle by recording 4-5 colourfastness on the Grey Scale. The difference implied that the structural attributes of the Kente print from DYTCL were able to resist the abrasive power of Sunlight soap for causing colour loss in the fabrics within 60 minutes of washing. This explanation confirms the argument that, the basic fibre theory that the ability of textile fabrics to resist the abrasive power of soaps depended on the quality of dye as well as its structural attributes [20]. After 90 minutes of washing, the mean colourfastness score of the Kente print from DYTCL was 4. This result meant that the fabric shed 0.5 units of colour on the Grey Scale after the third washing cycle. The finding agreed with the failure theories that the more textile fabrics were subjected to stress their quality in terms of colour would begin to fail or reduce. A textile fabric passed a colourfastness test when it maintained at least 3-4 units on the Grey scale after it underwent a test [19]. This implies that, the Kente print from DYTCL passed the colourfastness test after three washing cycles with Sunlight soap. Thus, Table 4 revealed that the Kente print from DYTCL passed the colourfastness test in both Key and Sunlight soaps after 90 minutes of washing. A comparison of the performance of the Kente fabric from DYTCL between the two soaps showed that the fabric performed virtually the same in colourfastness in both soaps.

4.3. Testing of Hypotheses in Colourfastness

This section focuses on the testing of hypotheses on differences in colourfastness of the two tested fabrics between Key and Sunlight soaps. The test was necessary to ascertain whether there were significant differences in the observed colourfastness scores of the fabrics between Key soap and Sunlight soap after three washing cycles. A One-way Analysis of Variance (ANOVA) was used to test the hypotheses, to assess significant difference over one independent variable and three or more dependent variables [21]. The independent variables were Key and Sunlight soaps, whereas the dependent variables were the colourfastness scores of the Kente prints from ATL and DYTCL over the three washing cycles. The first hypothesis on colourfastness stated that there is no significant difference between the colourfastness of ATL and DYTCL Kente prints after three washing cycles with Key soap. Table 5 presents a comparative analysis on the colourfastness between the two tested fabrics over three washing cycles with Key soap.

Table 5. Comparative Analysis on Colourfastness between Kente Prints from ATL and DYTCL over Three Washing Cycles with Key Soap.

Fabric	Mean colourfastness (N) of fabricsMean Standard dev.				
Type	**30 minutes**	**60 minutes**	**90 minutes**		
ATL	4-5	4-5	4	4.33	0.29
DYTCL	4-5	4	4	4.17	0.29

Source: Laboratory Results, 2019

From Table 5, the difference in colourfastness between the two fabrics were that the ATL Kente print was able to maintain the original colour over two washing cycles, while the Kente print from DYTCL shed 0.5 units of colour at the second washing cycle. The results presented in Table 3 further indicated that the Kente print from ATL had a mean score of 4.33 units of colour after three washing cycles with Key soap, whereas the Kente print from DYTCL had a mean score of 4.17. The difference in means showed that the ATL Kente print maintained more colour over the three washing cycles with Key soap than Kente print from DYTCL. In other words, the ATL Kente print was able to resist the abrasive power of Key soap more than the Kente print from DYTCL. The difference in the colourfastness of the Kente prints from the two textile manufacturing companies could be attributed to the differences in the structural attributes of the prints such as thread count and weight. The finding agrees with the assertion that differences in the structural attributes of textile fabrics may result in differences in their performance when subjected to stress test [2].

4.4. Tests of Significant Difference in the Mean Colourfastness Scores Between the Two Test Fabrics with Key Soap

After the results had indicated that there were differences in the mean scores, it was found necessary to test if the differences were significant statistically. Tables 6 and 7 present the results of the difference in the mean colourfastness scores between the two test fabrics over the three washing cycles with Key soap.

Table 6. A One-way ANOVA of Colourfastness between ATL and DYTCL Kente Prints after Three Washing Cycles with Key Soap.

Source	Sum of squares	df	Mean of squares	Eta square	F	P-value
Treatment	0.04	1	0.04	0.03	0.50	0.52
Error	0.33	4	0.08			
Total	0.37	5				

Source: Laboratory Results, 2011Significant at P-value of 0.05

From Table 6, a p-value of 0.52 compared to the acceptable margin error of 0.05 shows that the observed difference in the mean colourfastness scores of the Kente prints from the two textile manufacturing companies over the three washing cycles with Key soap was not statistically significant. This was because the p-value of 0.52 was less than the acceptable margin error of 0.05. As a result, the null hypothesis, which stated there was no significant difference in the colourfastness between ATL and DYTCL Kente prints over three washing cycles with Key soap is accepted. The eta square was then computed to assess the effect of size of Key soap on the two Kente fabrics. An eta square value of 0.03 meant that the magnitude of the differences in the means was very small, since an eta square value of 0.03 is a small effect, 0.06 is moderate effect and 0.14 is large effect [21]. This meant that the colour loss between the Kente prints from the two textile manufacturing companies after the three washing cycles with Key soap was small.

The second hypothesis stated that 'there is no significant difference between the colourfastness of ATL and DYTCL Kente prints after three washing cycles with Sunlight soap'. Table 7 presents a comparative analysis on the colourfastness between the two tested fabrics over three washing cycles with Sunlight soap.

Table 7. Comparative Analysis on Colourfastness between Kente Prints from ATL and DYTCL over Three Washing Cycles with Sunlight Soap.

Fabric	Mean colourfastness (N) of fabrics Mean Standard dev.				
Type	30 minutes	60 minutes	90 minutes		
ATL	4	4	4	4.0	0.0
DYTCL	4	4-5	4	4.2	0.29

Source: Laboratory Results, 2019

The results, as presented in Table 7, show that the mean colourfastness of ATL Kente print over three washing cycles with Key soap was 4 with a standard deviation of 0, whereas that of DYTCL was 4.2 with a standard deviation of 0.29. The difference in colourfastness between the Kente prints from the two textile manufacturing companies was that the Kente print from DYTCL maintained the original colour after 60 minutes of washing, while the ATL Kente print shed an average of 0.5 units of colour on the Grey Scale. The mean colourfastness scores of the Kente prints from the two textile manufacturing companies showed that those from DYTCL maintained 4.2 units of colour out of the original, whereas the ATL Kente print maintained 4. The difference showed that the Kente print from DYTCL performed better in terms of colourfastness over the three washing cycles with Sunlight soap than the ATL Kente print.

4.5. Test of Significant Difference in the Mean Colourfastness Scores Between the Two Test Fabrics with Sunlight Soap

Again, just as in the case of Key soap, tests of significant differences in the mean colourfastness scores between the two fabrics were carried out with Sunlight soap. Table 8 shows the results from the tests.

Table 8. A One-way ANOVA Test of Colourfastness between ATL and DYTCL Kente Prints after Three Washing Cycles with Sunlight Soap.

Source	Sum of squares	df	Mean of squares	Eta square	F	P-value
Treatment	0.04	1	0.04	0.09	1.0	0.37
Error	0.17	4	0.04			
Total	0.21	5				

Source: Laboratory Results, 2019Significant at P-value of 0.05

From Table 8, a p-value of 0.37 in relation to the alpha value of 0.05 shows that the p-value was less than the alpha value of 0.05. The implication of the result was that the observed difference in the mean colourfastness scores of the Kente prints from the two textile manufacturing companies over the three washing cycles with Sunlight soap was not statistically significant. Consequently, the null hypothesis that there was no significant difference in the colourfastness between ATL and DYTCL Kente prints over three washing cycles with Sunlight soap is not rejected. An eta square was calculated to assess the size of effect of Sunlight soap on the two Kente fabrics. An eta square value of 0.09 meant that the magnitude of the differences in the means was moderate. In effect, the colour loss between the Kente prints from the two textile manufacturing companies after the three washing cycles with Sunlight soap was moderate.

5. Conclusions and Recommendations

The study concluded that, ATL Kente print performed better with Key soap than with Sunlight soap, whereas Kente print from DYTCL performed virtually the same with the two soaps. However, there was no significant difference in the colourfastness between ATL and DYTCL Kente prints over three washing cycles with Key soap. The study also revealed that, Kente print and DYTCL performed virtually the same in both soap types. There was no significant difference in the colourfastness between ATL and DYTCL Kente prints over three washing cycles with Sunlight soap.

It is recommended that, ATL and DYTCL should continue with the formula for using their dyes in the Kente prints. This was because the Kente prints from the two companies met the colourfastness test over the three washing cycles with the Key and Sunlight soaps. Since Key and Sunlight soaps are the most popular soaps on the Ghanaian market, continuous use of the dye will help to maintain the aesthetics in the Kente prints for many textile consumers.

It is also recommended that, Consumers of printed Kente are advised to use Key soap to wash instead of Sunlight soap. This is because Sunlight soap had greater effects on the tensile strength of both Kente prints than Key soap. The use of Key soap in washing printed Kente will help to reduce the abrasive power of soaps on their tensile strength which will also contribute to increase in durability. There should be collaboration between textile manufacturing companies and soap manufacturing companies. This will enable soap manufacturing companies to produce soaps with the right chemical compositions for specific fabric types to ensure the longevity of fabrics.

References

[1] Ampong, I., Amankrah, V., D., & Nyadroh, A. A. P. (2020). Comparative Analysis of Fabrics: Structural Attributes of Akosombo Textile Limited (ATL) and Dong Yu Textile Company Limited (DYTCL) Kente Prints. *American Journal of Business and Society, 5* (4), 178-185.

[2] Joseph, M. L. (1988). *Essentials of textiles* (4th ed.). New York: Holt, Rinehart and Winston.

[3] Corbman, B. P. (1983). *Textiles: Fibre to fabric* (6th ed.). New York: McGraw-Hill, Inc.

[4] Toshikj, E., & Mangovska, B. (2011). *Effect of laundering of cotton knitted fabrics with different detergents on the dimensional stability and colourfastness*. Retrieved August 17, 2011, from http://www.fibre2fashion.com/industry-article/36/3525/effect-of-laundering-of-cottonknitted-fabrics-with-different-detergents1.asp

[5] Lilley, K. (2011). Colour and light fastness. Retrieved August 15, 2020, fromhttp://www.nzexplorer.co.nz/design_scope/colour_light_fastness.php

[6] Singh, K. V. P. (2004). *Introduction to textiles*. New Delhi: Kalyani Publishers.

[7] Fianu, D. A. G. (2007). *Ghana's Kente and adinkra: History and socio-cultural significance in a contemporary global economy*. Accra: Black Mask Ltd.

[8] Unilever. (2012a). *Key soap: Amansan boafo*. Retrieved August 17, 2020, fromhttp://www.unileverghana.com/brands/homecarebrands/Keysoap. aspx

[9] Unilever. (2012b). *Sunlight*. Retrieved August 17, 2019, from http://www.unilever.com/brands-in-action/detail/Sunlight/292058/

[10] Shurkian, O., Amirbayat, J., & Gong, R. H. (2002). Effects of repeated laundering and crease-resistant treatment on fabric properties. *Journal of Textile Engineering*, *58* (1), 1-4.

[11] Lau, L., Fan, J., Siu, T., & Siu, L. Y. C. (2002). Comfort sensations of polo shirts with and without wrinkle-free treatment. *Textile Research Journal*, *72* (10), 931-937.

[12] Yang, C. Q., Zhou, W., Lickfield, G. C., & Parachura, K. (2003). Cellulose treatment of durable press finished cotton fabric: Effects of fabric strength, abrasion resistance and handle. *Textile Research Journal*, *73* (12), 10571062.

[13] Ozdil, N., Ozdogan, E., & Oktem, T. (2003). Effect of enzymatic treatment on various spun yarn fabrics. F*ibres and Textiles in Eastern Europe, 11* (4), 58-61.

[14] Alpay, H. R., Becerir, B., & Akgun, M. (2005). Assessing reflectance and colour differences of cotton fabrics after abrasion. *Textile Research Journal*, *75* (4), 357-361.

[15] Kanchagar, A. P. (2001). Effect of enzymatic treatment of cotton on colour yield in dyeing. *Colourage Annual*, *48*, 29-32.

[16] Flower, L. (1986). *Ideas and techniques for fabric design*. New York: Longman Inc.

[17] Box, G. E., Hunter, W. G., & Hunter, J. S. (2005). *Statistics for experimenters: Design, innovation, and discovery* (2nd ed.). New York: Wiley & Sons, Inc.

[18] Krejcie, R., V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, *30*, 607-610.

[19] Kašiković, N., Vladić, G., Milić, N., Novaković, D., Milošević, R., & Dedijer, S. (2018). Colour fastness to washing of multi-layered digital prints on textile materials. *Journal ofthe National Science Foundation of Sri Lanka, 46* (3), 381-391.

[20] Teli, M. D., Khare, A. R., & Chakrabarti, R. (2008). Dependence of yarn and fabric strength on the structural parameters. *AUTEX Research Journal, 8* (3), 63-67.

[21] Pallant, J. (2005). *SPSS Survival Manual*. Berkshire: Open University Press.