# UTILIZATION OF (Musa textilis) IN FOOTWEAR MAKING IN ACCORDANCE TO PHILIPPINE FOOTWEAR FEDERATION INDUSTRY, MARIKINA CITY

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## ABSTRACT

*Marikina is one of the leading cities in high-grade shoe production. This study aims to assess the value and quality of footwear made by the researcher from Musa Textilis known as abaca in terms of the whole shoe test, bonding, upper material flex of abaca, rub fastness, Martindale abrasion, and din abrasion resistance. The parameters used were the common tests to determine the durability and quality of material for footwear production. This is developmental research in which the author's target is to create shoes from plant-based material such as abaca (Musa textilis). The developed footwear was also compared to the standard set by the Philippine Footwear Federation, Marikina City, Philippines. According to the findings of this study, some plant-based materials can be used for footwear making. The material science of the plant material should also be assessed for durability, flexibility, and compressibility for good and quality footwear.*

*Keywords: Creative Industry, Footwear, Quality,Marikina*

## INTRODUCTION

In 2004, the Philippine Congress and former president Gloria Arroyo approved RA 9290, also known as the "Footwear, Leather Goods and Tannery Industries Development Act," in order to promote quality footwear products known as Section 5 of RA 9290. From this law, Philippine Footwear was created. The Philippine Footwear Industries set standards for creating and manufacturing leather-type footwear that can compete in the international market.

As of the present, there are three places that produce Philippine footwear. Pili, Laguna is known for producing synthetic leather shoes, while Rizal is popular in making slipper sandals.

Meanwhile, Marikina is famous for manufacturing leather-type footwear and is one of the leading cities in high-grade shoe production (Footwear Industry, 2004).

The footwear making of different types was initiated by Don Laureano "Kapitan Moy" Guevarra of Marikina City in 1887. Because of the high demands for shoes made from Marikina, the Philippine Footwear Industry was created to protect shoemakers' rights and incentivize people involved in shoemaking production.

In the past decade, Scott (2005) pinpointed the root of the crisis in the shoe industry of Marikina. He revealed that Filipinos patronize Chinese-made shoes in the domestic

market. Another reason of the crisis is the manufacturers' inability or failure to distribute products globally. The study of Scott as proven by Kelly (2018) concluded that China's marketing and distribution of footwear made Marikina lose the footwear industry. Kelly (2018) also mentioned that MASIDO focused on promotional activities in the local market than funding, training, and finding linkages in the global market. Kelly's study found that automation and digitization were the prime causes of deindustrialization while Reyes (2017) emphasized that due to Trade Liberation Act, the capacity of *Marikeños* to trade footwear with other countries was reduced thus, settling in the local market. Lagos (2018) proved in his study that the footwear industry in Marikina has been localized rather than showcasing the talents of *sapateros* in the global arena.

Yassin, Hassan, and Sean (2018) highlighted the Philippines as the main producer of abaca and the largest producer in the world (Philfida, n.d.). Abaca is one of the interests of the US and Europe because abaca's material is natural and biodegradable.

Musa textilis known as Abaca or Manila Hemp (Lalusin, and Villavicencio, 2014) is abundantly grown in Bicol Region (V) and Eastern Visayas Region (VIII) (Saminovic, 2010). It is one of the strongest fibers because of the presence of tracheids. The tracheids are a xylem composed of cellulose and lignin of a plant. In a study conducted by Hao, , and Sheltami (2018) using the references of Jawaid, M., and Abdul Khalil H.P.S (2011), mentioned that abaca contains 56-63%cellulose, 20-25% hemicellulose, 7-9%lignin, 3-0%extract and 1-4% water soluble. Abaca is similar to banana (Cameo,2020) which belongs to the Musacea family.

Because of its tensile, strength, lustrous and durability, it is used for making bags, ropes, sack, boards and shoes. Waste abaca is used as teabags (Cameo, 2020) and pulps as papers (Mari, Austria, Torres, and Domingo, 2019).

The International Tripartite Rubber Council reported that due to climate change, pest and other disease makes rubber tress not available as a source of natural rubber. (Long, 2020). The source of natural rubber comes from the family of Moraceae better known as balete in Philippines and its scientific name is *Ficus elastica*. The latex or mucilage of rubber tree is used as natural rubber for making shoes, gloves, dress, catheters, masks, tyre and many other. It is also widely used as accessory and bags due to its benefits. However, the Ficus species is gradually diminishing. According to Hauer, Gemer, Marti and He (2015), changes in the ecosystem, quality of water and erosion only some of the challenges from the rubber plant production.

The gradual depletion and demand of Ficus elastic as raw material for making of rubber shoes is one of the reasons in searching for alternative materials rich in cellulose. Mooibroek and Cornish (2000) found alternative resources for rubber tree. It was established that Parthenium argentarium or Guayale has the same quality in terms of latex production.

Yassin, Hassan, and Sean (2018) produced a prototype lampshade from abaca inspired by the famous shrine of Shinto in Kyoto Japan. The different thicknesses and textures of the abaca fiber can be a potential source of products to boost local industry in Sabah, Malaysia. According to Poortraveler (2013), Shinto of Japan, the patron of rice, agriculture, fertility, commerce and general prosperity, is the main producer for polymer like polylactic acid. Saragih, Lubis, Wirjosentono and Eddyanto (2018) also studied abaca as potential source of bioplastic. In addition, Obmerga (2014) reported on DOST page about the interview of Dr. Diaz of DOST that the Mercedez Benz in Germany started to explore the technology of abaca as cover material for the inner compartment of Mercedez Benz.

Moreover, according to Armecin, Sinon, Moreno (2014) abaca is useful as pulp and paper while Mari, Austria, Torres, Domingo (2018) mentioned that abaca's residual waste is a potential source for paper production.

Quality is defined as an object's standard compared to another (Oxford

Dictionary). One quality of footwear can be measured through fitting. In the investigation conducted by Goonetilleke, Luximon, and Tsui (2000), the mismatching of the size of the foot with the shoes can bring discomfort to the consumers. They also emphasized the so called "break in." Break in is the period of the upper material to adjust in the shape and fit of the foot. They also highlighted the importance of mapping from feet to shoe for a quality of footwear, while Witana, Feng, Goonetilleke (2004) evaluated the quality of footwear using two-dimensional foot outlines. They used commercial laser for participants to determine the fitting of the shoe with the foot. Using two-dimensional design corrects the misfit design to shape and material. The footwear sizing systems in foot shape is also essential for the production of well-fitting footwear for consumers. (Kim and Do, 2019).

Janet, Douglas and Paul (2019) reported that in Kenya 20 footwear small microenterprise did not adopt the quality standards for footwear making set by the Kenya Bureau Standards. Furthermore, their study recommended to the SME's the importance of standards and quality of shoe fabrication management system.

In the new era, where quality of raw materials is also affected by sudden change of climate several organizations set standards to produce highly grade product especially in the sector of footwear industry.

## OBJECTIVE OF THE STUDY

This study aimed to assess the value and quality of footwear from Musa textilis, known as abaca, in terms of the Universal Testing or Bond test, Rub Fastness, Martindale Abrasion, Din abrasion resistance, Upper flex and Shoe Flex. The result of the parameter was also compared to the standards set by the Philippine Footwear Federation in footwear materials. The parameters used were the common tests to determine the durability and quality of material for footwear production. Furthermore, the study determined if the footwear made from abaca (Musa textilis) meets the standards of the Philippine Footwear Industry.

## METHODOLOGY

The researcher purchased abaca (Musa textilis) from a textile store in Quiapo, Manila. The researcher chose Musa textilis, also known as Manila hemp which belongs to Musaceae or banana family. The finer fibers, often 5 m (15 ft) long, are used for weaving cloth. The outer, coarser fibers are used in the manufacture of matting and durable cordage; the latter is widely considered the finest rope made.

This is developmental research in which the author's target was to create shoes based on plant material abaca (*Musa textilis)*. According to Yaakub (2009), developmental research is based on the existing knowledge gained from research to produce new materials.

The designs were carefully considered initially for people with disability. Musa textilis were turned over to Pando Shoe Shop for shoemaking. Two designs were created typically for casual purposes and another for school use, intended for people with disabilities.

Two pairs of shoes were also handed to Philippine Footwear Federation at Parang Concepcion Marikina for whole shoe testing, bonding test, upper material flex, rub fastness, Martindale abrasion, and din abrasion resistance testing.

The Whole Shoe Test, or Universal testing, is a test to determine the tensile strength and the compressive strength of the material. The bond test aims to determine the adhesive bond strength (Test Resources, 2020). Flex testing measures the modulus elasticity of the material before permanent deformation (Handbook of Advanced Ceramic, 2013). Rub fastness depends on the nature of the color and depth of the shade. This test is used to determine the pigment or color of the textile. In this case, abaca used has natural color. No dye was used to Musa textilis. Martindale abrasion determines the abrasion

resistance of the textile. And lastly, din abrasion testing determines the durability and quality of the material.

## RESULTS AND DISCUSSION

### 1. Test in Shoe A and Shoe B

**Table 1**
*Result of Test in Shoe A and Shoe B*

| Method of Testing | Item Description | Result |
|---|---|---|
| **Bonding or Universal Testing** | Shoe A | 15.603 kg-force /kgf |
| | Shoe B | 12.687 kg-force /kgf |
| **Rub Fastness** | Abaca Upper Material (Shoe A) | 0-150 rubbing cycle, splits are visible |
| | Abaca Upper Material (Shoe B) | 0-184 rubbing cycle the cracks are visible |
| **Martindale Abrasion Testing** | Abaca Upper Material | 0-220 cycle of rubbing color discoloration is visible at abrasion cloth |
| **Din Abrasion** | Outsole | Original weight 1, 215 mg<br>Average loss-0.112 mg |
| **Upper Flex** | Abaca Upper Material | 0-150,000 cycle no sign of split or cracks |
| **Shoe Flex** | Shoe A and Shoe B | 0-150,000 non crack |

The results showed that shoes A and b have an average of 14.145 kilogram-force (KGF) for universal testing. Universal testing is used to determine the quality of the product in terms of tensile strength and compressive strength of materials.

It was noticed that there was an appearance of splits in the 0-150 rubbing cycle of abaca material for shoe A. On the other hand, cracks were visible for shoe B in the 0-814b cycle. Rub fastness determines the color fastness of dye in the fabric. The abaca used has no color.

The discoloration is visible in Martindale testing in 0-220 cycles of rubbing the abaca cloth. Martindale abrasion measures the endurance or purpose of cloth for its various purposes.

*Figure 1: Shoe A*

*Figure 2: Shoe B*

The results showed that shoe A has a 15.603 Kgf breaking point while shoe B has a 12.687 Kgf breaking point. The standard reference of the Philippine Footwear Federation for the textile materials for footwear making is 25kgf. It reveals the toughness and hardness of abaca material or textile for footwear production.

Rub fastness depends on its color. The abaca material has a natural color that does not reach the standard set by PPFI. According to PPFI, at least 150,000 to 300,000 rubbing flex materials should have no visible cracks or splits.

With the pure abaca material used at 150 rubbing cycles, the splits are visible while cracks are visible at 814 rubbing cycles or flex.

## 2. Comparison of Shoe A and B with the standards of Philippine Footwear Federation Industry

**Table 2**
*Comparison of Shoe A and B with the standards of Philippine Footwear Federation Industry*

| Method of Testing | Result | Reference Standard |
|---|---|---|
| **Bonding or Universal Testing** | 15.603 kg-force /kgf (Shoe A)<br>12.687 kg-force /kgf (Shoe B) | 25 kg-force /kgf breaking point<br>25 kg-force /kgf-35 |
| **Rub Fastness** | 0-150 rubbing cycle, splits are visible<br>0-184 rubbing cycle the cracks are visible | 150,000-300,000 flexes |
| **Martindale Abrasion Testing** | 0-220 cycle of rubbing color discoloration is visible at abrasion cloth | 20,000 rubbing motion wet and dry |
| **Din Abrasion** | Original weight-1,215 mg<br>Average loss-0.112 mg | At least 0.8 mg loss of specimen |
| **Upper Flex** | 0-150,000 cycle no sign of split or cracks | At least 150,000-300,000 flexes |
| **Shoe Flex** | 0-150,000 non crack | 300,000-500,000 maximum flexes |

Table 2 shows the results of Martindale testing. The Philippine Footwear Federation Inc. set a standard of 20,000 cycles for footwear. However, the footwear made from abaca has a 0-220 cycles discoloration.

The original weight used for footwear is 1.215 mg. In the first trial, there was a loss of 0.115 mg; in the 2nd trial, weight loss was achieved at 0.110 mg; in the third trial, weight loss was at 0.110 mg. The average loss was 0.112, while the PFFI set a standard for an average loss of outsole at 0.8 mg loss of specimen. It showed that the sole meets the standard of PFFI, which was initially made in Marikina. Flexible sclereids or fiber of abaca shows no sign of splits or cracks at 150,000 cycles.

Lastly, the outsole footwear met the requirements of PFFI. After 150,000 cycles, no cracks were observed in the outsole intended for PWDs originally made from Marikina.

## CONCLUSIONS

The material used to develop footwear is very crucial, especially in the footwear industry. Most small micro-entrepreneurs look for footwear that will last, be trendy, fashionable, and possess quality and durability. The study assessed the value and quality of footwear using Musa textilis, known as abaca, in terms of the whole shoe, bonding, upper material flex of abaca, rub fastness, Martindale abrasion, and din abrasion resistance. It was also compared to the standards set by the Philippine Footwear Federation. The parameters used were the common tests to determine the durability and quality of material for footwear production.

In terms of Universal testing, rub fastness, Martindale abrasion, and shoe flex, Musa textilis, known as abaca, suffice as material for footwear. In terms of flexibility, abaca with multiple sclereids fibers showed modulus elasticity. In addition, the outsole made originally in Marikina meets the standards of the Philippine Footwear Industry.

However, the footwear made from abaca (*Musa textilis*) did not meet the standards set by the Philippine Footwear Federation Industry in terms of universal testing, bond test, rub fastness, Martindale abrasion, din abrasion, upper flex, and shoe flex. There is still a need to improve the materials through combination with other plant materials.

Environmental care is a hot topic all over the world. Scientist search and look for a plant material that can be an alternative as source of leather, synthetic leather, and textile for a sustainable environment. However, there

is a need to study deeply the material science of abaca.

According to the findings of this study, some plant materials can be used for footwear making. The material science of the plant material should also be studied for durability, flexibility, and compressibility for good and quality footwear. The quality of the material should not be taken for granted because if the raw material used for footwear making has less quality and durability, the product itself can be trash or waste in the ecosystem in the long run.

## RECOMMENDATIONS

Adaptation in green footwear technology innovation is the creative industry's most sustainable and latest principle. The creative industry invests in alternative fibers to produce quality-grade organic footwear material. Plant-based material is ideal and eco-friendly; however, there is still a need for abaca may be combined with other plants with sclereids or fiber to enhance or improve the raw materials for footwear development.

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