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Research Article

Biomass Innovation: Exploration of Waste Plantain Pseudo Stem Fiber for the Production of Hair Extension

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Abstract

Hair is often seen as an artist's canvas for style and fashion, reflecting one's artistic taste, social status, and individuality. Hence, modern Nigeria women spend endless hours in salons in the bid to make their hair beautiful in line with the modern trend. In order to satisfy the growing need of the modern Nigeria women's desire to be fashionable hair wise, the human and synthetic hair industries provided hair extensions in the form of weave-on, wigs or hair attachments. Advancement in modern technology has enabled the development of wide range of synthetic hair extensions that looks and feels like human hair. However, because they are products of hydrocarbons, they contain high level of metal and chemicals that could be harmful to the human body. They have low heat resistance and tend to tangle easily. They are also non- biodegradable, therefore contribute to environmental pollution when disposed by burning or thrown into the gutters. The study explores the use of waste plantain pseudo stem fiber as a sustainable alternative to synthetic fibers for the production of hair extensions. This will have advantage of being environmentally friendly, with minimal or no adverse health effects for the user as well as budget friendly. To achieve this aim, the fibers were extracted in an ecofriendly manner, the tensile strength of the fibers was tested to ascertain their suitability for the production of hair extensions. Hair Extensions in form of attachments, wigs and weave -on were produced with plantain fibers and the market potential and consumer acceptance of plantain fiber hair extensions were assessed. An online survey of 100% respondents found that 87% were willing to patronize plantain fiber hair extensions.

Keywords: Biomass, plantain, pseudo stem, fiber, hair extension

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Introduction

Hair is a significant aspect of fashion and everyone's overall self-esteem, this is applicable to both male and female. Women, in particular, pay attention to their hair, as good hairstyle is often seen as a symbol of beauty and crowning glory. As a result, people spend time in salons in the bid to make their hair beautiful. This could be done by plaiting, braiding or weaving the natural hair or by plaiting, braiding or weaving with the use of hair extensions. The use of hair extensions as a customizable

option for people seeking to change their hair style is increasingly popular now. Surprisingly the use of hair extension in enhancing hair beauty is actually not a recent development. Hair extensions have been used as crucial hair accessories that add more beauty and elegance to one's personal outlook for decades.

Apart from being used as fashion statement, hair extensions are also used as a solution for people with hair based problems such as baldness from hair loss, dry hair, split ends, thin hair. Belt (2023) affirming this, states that hair extension can also positively impact an individual's overall well- being by addressing the psychological and emotional aspects associated with hair loss or dissatisfaction with one's natural hair. Hair extensions in the form of wigs is an option for people who would want to regularly change their outlook without visiting the salon on a regular basis or without frequent chemical treatments. The use of wigs can change one's physical appearance in seconds, it is time-saving and convenient to wear. For many modern Nigerian women, hair extensions are an essential part of their lives, just like cosmetics, clothes and fashion accessories, it gives people the opportunity to explore new looks.

Hair extensions can be made from 100% human hair or from synthetic fibers. The human hair extensions made by hand are usually better because it has a natural look, are heat resistant and do not easily tangled. Synthetic hairs extensions are man- made fibers usually from polymers and plastics such as polyethylene terephthalate, polyvinyl chloride, acrylic, acrylonitrile, single filament polyester, silk, silicone and kanekalon. These fibres undergoes various chemical process that make them have a synonymous look, feel, luster, colour, smoothness and styling capacity as human hair. (Ijere, Okereke and Ezeji, 2022). However, because they are made from hydrocarbons they have low heat resistance and can tangle easily. They are also not bio degradable, therefore constitutes pollutions on the environments when disposed by burning or thrown into the gutters.

Data obtained from an online survey carried out for this research, showed that most Nigerian women go for these synthetic hair extensions. 46.8% of the respondents affirmed that they use more of synthetic hair extensions, because they are cheaper than the human hair extensions, not minding its chemical components and likely side effects on the environment and their health. This finding corroborates the assertions of Thomas (2023) that synthetic hair extensions tend to be used more frequently due to affordability. This study is focus on extracting fibers from waste plantain pseudo stem and its exploration as an alternative natural hair extension that will not only be budget friendly, but will have little or no negative effect on the user and the environment.

Aim of the study: This study aims to develop a sustainable alternative to synthetic fibers for hair extensions using waste plantain pseudo stem fibers.

The Research Problem/ Objectives of the Study

Modern technology has no doubt provided variety of options of synthetic hair extensions that are accessible for all budgets, since the human hair extensions are quite expensive. However, the facts remain that production and use of synthetic hair extensions has negative implications on the environment and as well as negative health implications on the user. On the environment it is a common sight in Nigeria to see these synthetic hair extensions in drainage channels constituting blockage to the water ways. On the other hand, those who dispose it by burning leaves behind carbon foot print that pollutes the environment. The most alarming problem of synthetic hair extension is the

discovery made in a recent study by Ijere, Okereke and Ezeji (2022) stating that high level of heavy metal and chemical substance found in the synthetic hair extensions analyzed, has the propensity to cause harm to the wearer/ user.

This has motivated the researcher to source for alternative hair extension that can be produced from natural fibers that will have advantage of being environmental friendly, with little or no negative health implication for the user as well as budget friendly. Therefore, the objectives of the research are:

i. To develop and optimize an ecofriendly extraction process for obtaining high quality fibers from waste plantain pseudo stem.
ii. To Assess the tensile strength and elasticity of fibers extracted from waste plantain pseudo stem to determine their suitability for hair extension production.
iii. To compare the properties and performance of waste plantain pseudo stem fiber hair extensions with those made from traditional materials (e.g., human hair, synthetic fibers)
iv. To produce wigs and braided wigs with fibers extracted from waste plantain pseudo stem dyed into different colours.
v. To assess the market potential and consumer acceptance of hair extensions produced from waste plantain pseudo stem.

Research Questions

i) How will the fibers from waste plantain pseudo stem be extracted to provide ecofriendly substitute of synthetic fibers?
ii) Is the tensile strength and elasticity of fibers extracted from waste plantain pseudo stem suitable for the production of hair extension?
iii) What is the similarity between the properties of and performance of waste plantain pseudo stem fiber hair extensions with those made from traditional materials (e.g., human hair, synthetic fibers)?
iv) How will fibers from waste plantain pseudo stem be used to produce wigs and braided wigs that could have different colours?
v) What percentage of the sample population are willing to buy hair extensions made from plantain fibers?

Methodology

The study adopted a mixed research design, which includes exploratory, descriptive, qualitative and quantitative research approach. The leaf sheaths of the waste plantain pseudo stem were separated, and fibers extracted from the outer and inner sheaths using the manual process which is more environmentally friendly. The extracted fibers were washed in clean water to remove dirt and combed to remove broken short fibers. Fibers from the inner and outer sheaths were separately collected and prepared for testing.

These samples were tested for tensile strength, fiber diameter as well as cellulose content. The fibers from the inner sheath exhibited desirable properties, such as smoothness, flexibility and slender diameter. Based on these properties, the inner sheath fibers were selected for hair extension production. Fibers were tied bit by bit on a string stretched across a frame. After the tying process, it was then

sewn on a sewing machine to rein enforce its hold on the string, turning it into a piece that could be sewn unto a weaved hair or sewn on wig cap to produce a wig.

Since females are the primary consumers of hair care products, for this research work, a subset of the targeted female population were used for the study. Which is a smaller, manageable version of a large group also known as sample. Purposive sampling, also known as deliberate sampling was used in selecting the respondents. This was to ensure that respondents selected are knowledgeable about the research topic to enhance the collection of relevant data. 100 female respondents with a minimum of a bachelor's Degree as their basic educational qualification within ages 20-60 years were used as the final sample size. Females with minimum of bachelor's degree are likely to be aware of the benefits of using environmental friendly fashion products. By focusing on this specific demographic group, the sample becomes more homogenous, reducing variability, while increasing the accuracy of the finding, Online google survey questionnaires were used to collect data from the target population. Through the google survey form, the researcher was able to collect data from the respondents about the type of hair extension they prefer using and why. Their level of awareness on the innovation of creating hair extensions from waste plantain pseudo stem fiber and their willingness to buy hair extension made from plantain fiber.

Background to the study

The earliest use of hair extension has been traced to Ancient Egypt. Fletcher (2002) asserted that discoveries made at the manual worker's cemetery at Hierakonpolis revealed the use of hair extensions as early as 3400 BC, with the earliest fragments of actual wigs dated to the very beginning of the dynastic period. John, Brandon and Jacob (2020) in an another study also agreed that hair extensions and wigs were important social markers of attractiveness, health and standing in ancient Egypt and Rome. The study however, noted that in addition to wigs, primitive sewn-in weaves were worn in Ancient Egypt as far back as 1300BC. While the Egyptians used hair extensions for protection and cultural identity, the Romans embraced them as a sign of luxury and power. It might be difficult to state the exact date for the commencement of the use of hair extensions, but it is clear that the use of hair extension for the enhancement of hair beauty has been in existence since ancient times. Various materials such as human hair, sheep's wool, plant fibers such as date palm fibers were used to create hair extensions that is often woven or braided into their natural hair. In some instance materials such as resin and beeswax were used to attach the extensions to their natural hair. According to Phan (2023) these extensions were used to enhance the appearance of their hair and showcase their social status.

It has been observed that the use of hair extension in Egypt became more popular during the time of Cleopatra, whose favorite coloured hair extension was peacock blue. However, it was only the wealthier class like Pharaohs, kings and queens that could afford hair extension. According to the documentation of history of hair extension, the 16th century was remarkable as a period of affluence and inventiveness. The Renaissance period witnessed the use of elaborate hairstyles as fashion statement. The use of wigs and hairpieces made from human or animal hair was common with both men and women of high social status during this period. The affluent hairstyles serve as a means to display one's artistic taste, prestige and individual difference. By the 18th century the use of wigs and hairpieces gained more popularity in Europe. As a result, elaborate

and towering wigs often decorated with different ornament that helps to achieve the desired appearance became fashionable among the wealthy and noble classes.

The 20th century witnessed various trends of hair extensions, for instance the flapper-style bobs and short haircuts became popular in 1920 which resulted in the use of hair extension to add length and volume. By 1940, long hair trended and thus the demand for hair extension and wig increased. The 1960s and 1970s saw the use of hair extensions to achieve the flowing, long-hair look that was the typical of that time (Phan, 2023). In an earlier study John *et al*. (2020) noted that an African American woman named Christina Jenkins invented "Hairweave" in 1952. Jenkins patented a method and apparatus by which hair extensions made from human hair could be securely attached to the live hair on the head by sewing hair weaves into braided hair on the scalp. Thus it was Jenkins that invented what is known today as weave-on. From that period till the present time, weave-on hair extension has gained more popularity, with prominent black American women such as Janet Jackson, Lisa Bonet, Naomi Campbell and Tyra Banks embracing artificial hair extensions (John *et al*, 2020)

Patzer, cited in Belt (2023) describing the social benefits of hair extensions, asserted that hair extensions can boost an individual's confidence by providing solution to various hair related concerns, such as thinning hair, slow hair growth or the desire for a new look. The study stated that people who feel confident about their appearance are more likely to engage in social interactions and display a positive attitude. Belt (2023) affirmed that hair extensions can contribute to a sense of empowerment and self- assurance that extends beyond physical appearance and impacts various aspects of an individual's life. Hair extensions is a medium of self-expression and creativity, because people can use their hair as canvas to tryout different styles, colours and textures that express their uniqueness without long term commitment (Bryant, cited in Belt 2023). The study concluded that hair extensions apart from enhancing one's physical appearance, can play significant role in any individual's social and emotional health.

Ijere *et al.* (2022) in a study examined the potential hazards associated with wearing synthetic hairs (wigs, weavons, hair Extensions/attachments) by female folks in Nigeria using 10 different samples of synthetic hair extensions that were obtained from 10 different outlets. The presence and concentration of heavy metals such as cadmium, iron, silver, zinc, lead, chromium, manganese, copper, nickel, tin and vanadium including high levels of acidity and nitrate in the synthetic hairs were determined using atomic Absorption Spectrophotometer (AAS) according to the methods by American Public Health Association (APHA) and Federal Environmental Protection Agency (FEPA). The Gas Chromatograph (GC) was used to determine the chemical substance (which were mostly Polychlorinated biphenyls) present in the synthetic hairs. It was discovered that high significant level of heavy metals and chemical substances were present in the synthetic hair extensions which have the tendency to cause harm to the wearers or users. In conclusion the study stated that chemical substance and heavy metals can induce toxicity to human body even at low level. Therefore, it is important that users of synthetic hair extension become aware of the health implication of buying and wearing these hairs.

The history of hair extension in 21st century is characterized by innovation, diversity and accessibility. Human hair extensions made from 100% human hair gives a natural look, are heat resistant and does not tangle easily. Advancement in modern technology has also enabled the development of wide range of synthetic hair extensions that looks and feels like human hair. However, because they are products of hydrocarbons, they contain high level of metal and chemicals that could be harmful to the human body. Ijere (2024) asserted that lead, one of the heavy metals found in

synthetic hair extension could affect the membranes, DNA, and antioxidant defense system cells. And could also interfere with the normal development of a child's brain and nervous system. Synthetic hair extensions have low heat resistance and tangles easily. They are also not bio degradable, therefore constitutes pollutions on the environments when disposed by burning or thrown into the gutters.

It is pertinent therefore, to source for an eco-friendly alternative fiber that could be used for hair extensions that will have little or no harmful effect on the human body, the environment as well as budget friendly.

Methods of Extracting Eco-friendly Fibers from Waste Plantain Pseudo stem

There are different methods of extracting fiber from the pseudo stem, such as chemical, biological or microbial retting and physical extraction which is done manually or with the aid of a machine. The researcher adopted the physical extraction method with no chemical addition, which is more environmentally friendly. This is because according to Swami, (2011) natural fiber like cotton does not decompose as it should naturally after being treated with chemicals. The fibers extracted from the innermost part of the pseudo stem were found to be soft, flexible and absorbent. They have smooth shinny appearance and strong affinity to dye. Because of its silky nature and ability to withstand strain it was used for the production of hair extensions in form of wigs and braided wigs

Description of Processes Used in Extracting the Plantain Fiber

The pseudo stems were cut out from the corm (Plate 1a and 1b) Plantain pseudo stem is made up of between 14-18 closely layered leaf sheaths. Each leaf sheath is made up of 3 distinct layers, the outer layer including the epidermis, contains bundles of fiber dispersed in soft matrix. The middle layer consists of water transporting fiber vascular tissue and the inner layer consists of soft cellulose tissue. The fibers were extracted manually following these procedures.

Step 1: The plantain trunk is cut down from the corm region after harvesting the fruit (Plate 1a)

Step 2: The first outer layer of sheaths was removed and discarded. Then the remaining sheaths were de-sheathed until the high percentage of pulpy matter is reached (Plate 1c)

Step3: The sheaths were arranged on a flat table and a blunt knife was used to scrap the sheath until all the pulpy cellulosic tissues were removed to ease out the fiber. This process is known as decortication, (Plate 1d) the fiber were combed to remove short broken fibers.

Step 4: The strands of fiber extracted were gathered and washed in clean water to remove dirty and broken fibers

Step 5: After washing, the fibers were combed to detangle any tangled fiber (Plate 2)

Step 6: The fibers were then spread under a shaded but airy place to dry, and they were ready to receive dye



Plate 1a: Cutting out the Pseudo stem from the Corm (Researcher's field work (2019)



Plate 1b: Cut out Pseudo Stems of Plantain, (Source Researcher 2019)



Plate 1c: Researcher Separating of Leave Sheaths



Plate 1d: Researcher Scrapping of Sheaths of Pseudo Stem to Extract the Fiber

(Photos Courtesy Amankwe, 2019)



Plate 2: Researcher combing of the Fibers after washing in clean water to remove tangled Fibers (Photos Courtesy Amankwe, 2019)

The extracted fibers were dried by means of natural air and were dyed using narula organic dye with no chemical addition.

Assessment of the tensile strength and elasticity of fibers extracted from waste plantain pseudo stem to determine their suitability for hair extension production.

Omotoso, and Ogunsile, (2009) investigated the physical and chemical properties of musa species namely; musa nana and musa sapientum widely culitivated in South – Western Nigeria. Samples of the species were taken at different levels namely the mid-ribs, the pseudo stem and the stalk. It was discovered that all the musa species had low specific gravities with values ranging from 0.22 to 0.43. The length of the fiber, were within medium to long fiber class. There was a significant variation across species and plant parts from an average of 1.92 to 4.17mm. The stalks gave the highest fiber diameter (28.11-37.5 µm) and lumen width (13.4-22.4µm). fiber slenderness was slightly higher in the pseudo stems (99- 160) than the mid – ribs (91-125) and the stalks (80-119) The chemical analysis showed that cellulose contents were moderately high and tolerable. The plants were also high in their ash and extractives contents. At the end of the experiment, it was discovered that the Nigeria-grown musa species are potential sources of long fiber pulp. This confirms that plantain fiber can withstand weaving or braiding and as such can be used to produce fashion accessories and interior decoration material.

Plantain pseudo stem is classified as ligno- cellulosic material. Ligno- cellulosic materials are composed of three natural polymers namely; cellulose, lignin, and hemicelluloses. However, the proportion of the polymers varies according to the specific plant from which they are obtained. (Akpabio, Udiong, and Akpakpan, 2012) The pseudo stem is made up of a compact mass of overlapping and spirally arranged leaf sheaths, and the intercellular openings are filled up water. The

fibers extracted from the outermost shoots of the plantain were found to be coarse, strong and absorbent.

In order to validate the tensile strength analysis previously carried out by other researchers, the tensile strength tests were also conducted on the fibers in this research. The tensile strength analysis result of the samples of fibers sent by the researcher to National Research Institute for Chemical Technology, Zaria, on 25th October 2024, for fiber with diameter of 0.04mm, length of 50mm and Area of 2mm^2 shows the Maximum Force (N) to be 777, which indicates that the fiber can withstand a significant amount of force before breaking. The Tensile strength of the fiber is (Mpa) 388.51 and this indicates that the fiber has moderate to high tensile strength, suggesting that it has good resistance to stretching and breaking. While Displacement (mm) is 1.53. indicating that the fiber can stretch slightly before breaking. Based on the tensile strength analysis result, plantain pseudo stem fiber, promises to be a good alternative to synthetic fiber for production of hair extensions and wigs.

Comparison of the properties and performance of waste plantain pseudo stem fiber hair extensions with those made from traditional materials (e.g., human hair, synthetic fibers)

Waste plantain pseudo stem fiber can be processed into a slender silky filament of sufficient length, and strength just like the human hair and synthetic hair extensions.

The fibers extracted from the inner sheaths of waste plantain pseudo stem are silky and light in weight just like the human hair and lighter than some synthetic hair extensions. The fibers have a smooth shinny appearance just like the human hair, hair extensions and the synthetic hair extensions. Fibers are long and strong enough to withstand the mechanical operation of twisting, braiding, and weaving without breaking, just like the human hair and synthetic hair extensions.

However, unlike the synthetic hair extension that has low heat resistance, plantain fiber hair extensions like the untreated human hair have a higher heat resistant. Synthetic hair extensions are not bio degradable, therefore are disposed by burning after sustained use, which pollutes the environment leaving carbon foot prints. Plantain fiber hair extensions like the human hair are bio degradable, hence can be discarded to decompose after sustained usage without any need for burning. Plantain fiber hair extensions like the human hair or the human hair extensions absorbs and drains water easily unlike synthetic hair extension that cannot absorb water, because they are made from polymers and plastics.

Exploration of waste plantain pseudo stem fiber as a sustainable alternative to synthetic fiber for the production of hair extension.

The fibers extracted from the soft inner sheath of the plantain pseudo were soft and silky. Hence it was dyed and used to produce hair extension in wigs and braided forms of different colour.

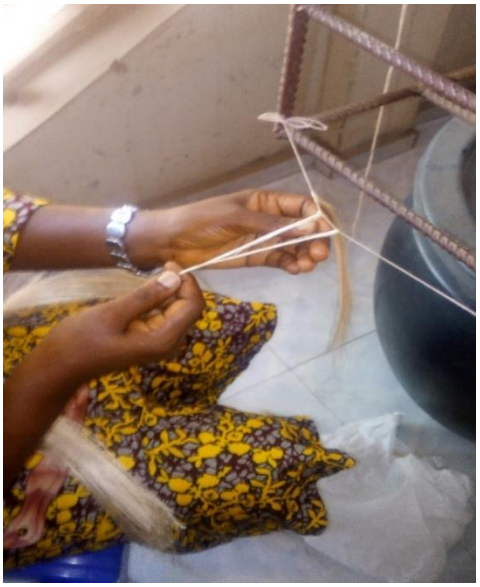


Plate 3a



Plate 3b

The Researcher tying srands of fiber on a string tied to a frame to produce a weaveon piece that could be attached weave hair or on wig cap

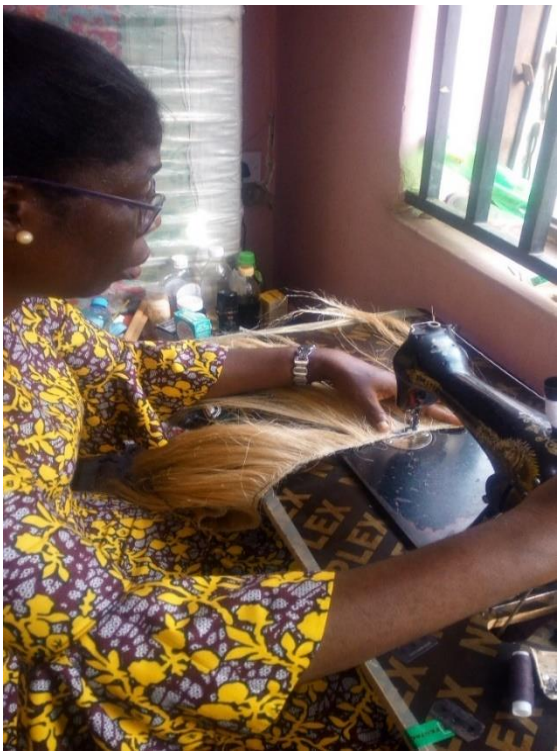


Plate 4: Final stage of weave-on production with plantain fibre; The researcher sewing the knotted fibres to attach it firmly to the string (Photos Courtesy Amankwe, 2021)

After this stage, the sewn knotted fiber can be used as a weave-on, attached onto the wearer's weaved hair. It can also be sewn onto a wig cap to create a wig, as shown in Plate 5a. Unsewn Strands of fiber, can be braided and attached to a wig cap. See plate 5b.



Plate 5a: Wigs produced with dyed plantain fibre (Okeke, 2019)



Plate 5b: Braided wigs produced with dyed plantain fibre (Okeke, 2019)

Assessment of the market potential and consumer acceptance of hair extensions produced from waste plantain pseudo stem.

Representation of questionnaire distribution and the target population.

To provide balance between feasibility and statistical power, 100 respondents were considered sufficient for the study which is mainly exploratory and descriptive. 100 female respondents with at least first Degree as their basic educational qualification within ages 20-60 years were used as the final sample size. Although some female below these age range still make use of hair extensions, these age range were considered the major targets that are matured enough to make informed decisions about product choices, considering factors such health and environmental implications. It is also believed that females with minimum of first degree are likely to have certain level of awareness and understanding of environmental friendly products and their benefits. Online google survey questionnaires were used to collect data from the target population. 62 out of the 100 respondents responded to the online survey questions. Below is the distribution of the respondents age and percentage of their response. The data from the questionnaire was collected with fixed/structured response which the respondents had to choose from. 62 out of the 100 females that were sent the google survey responded, representing 62% of the target population.

Age	No that responded	%
21-30	16	26.2%
31-40	7	11.5%
41-50	17	27.4%
51 &above	22	36.07%
	62	

Data collected from the survey questions indicated that 94.7% of the respondents use one form of hair extension or the other. This corroborated the survey report carried out by NANS in 2019 which states that at least eight out of every ten Nigeria women wear wigs as part of their fashion items for their day to day activities. On the question about which type of hair extension they use more, 60.5% of the respondents indicated that they use synthetic hair extension often, 35.5% indicates that they use human hair while 28.9% said the use wool.

The survey also showed that 50% of the respondents use hair extensions as attachments for braiding, weaving or plating of hair. 19.4% wear it as wigs, 5.3% use as sew in weave-on while 44.7% make use of hair extensions for braiding, sewn in or weave-on and wigs. Responding to the question on preferred type of hair extension, 45% choose human hair, 16.2% choose wool while 46.8% choose synthetic hair, stating affordability and variety of options as their reason. Response to the survey questions also showed that 67.8% of the respondents are not aware that hair extensions can be produced from plantain fiber. while

32.3% indicated that they are aware. It was also discovered that 87% of the respondents will be willing to buy hair extensions made from plantain fiber, while 13% are not willing to buy. However,67.8% will prefer to use it as attachment for braiding, weaving or plaiting. While 34.1.7% say they will prefer it as wigs, 11.3% also indicated preference to use it as sewn in or weave-on. The respondents also indicated the amount they are willing to pay for each type of hair extensions made from plantain fiber. However, these price rates are subject to change based on the prevailing market conditions, including fluctuations in the economy and inflation rate at the time of purchase. It is also noteworthy that 96.7% of the respondents feels that the innovation of creating hair extension from waste plantain pseudo stem fiber is a good and have good market prospects, while about 3.3% thinks otherwise.

Conclusion

Based on the tensile strength result obtained from this experiment, and the results of the survey questions, plantain pseudo stem fiber hair extension, promises to be an alternative that will shift the boundaries of hair extensions in Nigeria. It is obvious from the data obtained from the survey, that the demand for hair extension is high among Nigerian women and even among other black African women. Hair extensions are regarded as crucial hair accessories that adds more beauty, style and new look to one's overall personal outlook. Therefore, Nigeria is a fertile market for manufactures of hair extension. However most of the hair extensions in Nigeria market are mostly imported from China, India, Brazil, Vietnam and Cambodia. These foreign companies have taken advantage of the large pool of existing and potential hair extension customers in Nigeria to cat away billions of dollars out of Nigeria.

According to report from Statista in 2021, the global hair care market generated approximately $84.4 billion. The Nigeria hair care industry was valued at about N116.4 billion in 2017, which increased to a whooping sum of N457 billion by 2019. Thomas (2023) speculated that by 2028, global hair wig and extension market is expected to surpass USD 19.12 billion. The study further asserted that black women are the largest consumer group of hair extension industry. It is predicated that with an increasing number of working women and sophisticated youth seeking new way to present themselves, the value of hair extension market in Nigeria will keep increasing (Babatunde-Lawal, 2022). The most unfortunate aspect however, is that majority of these are made from synthetic fibers. Their heat resistance is not as good as those made from natural fiber, this is outside its health implications and the pollution it brings to the environment. Since the market viability of plantain fibre hair extension is high, as well as its having a high tensile strength, according to data obtained from the survey, tapping into this new innovation will not only provide the large pool of existing customers with affordable hair extensions. It will also provide hair extensions that is environmentally friendly, provide extra income for plantain farmers and add to the country's gross domestic product.

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APPENDICES

Sample of Google Survey Questions and analysis of response in percentage.

S/N	Questions	No. of shared questionnaires (100)	No of Response	%
1.	Do you make use of hair extensions (wool, attachment or wig)?			
	i) **Yes** tick in the box ☐		59	94.7%
	ii) **No** tick in the box ☐		3	5.3%
2.	What type of hair extension do you use? ☐ :			
	i) 100% human hair ☐		22	35.5%
	ii) Synthetic hair ☐		38	60.5%
	iii) Wool ☐		17	28.9%
3.	How do you prefer using the hair extensions? ☐			
	i) Attaching to hair for braiding, weaving or plaiting ☐		31	50%
	ii) Fixing on Braided hair as weave-on ☐		3	5.3%
	iii) Wearing as wigs ☐		12	19.4%
	iv) All of the above ☐		27	43.5%
4.	Which type of hair extensions do you patronize more?			
	i) 100% Human Hair ☐		28	45.16%
	ii) Synthetic Hair ☐		29	46.8%
	iii) Wool ☐		10	16.12%
5.	State the reason for your choice of response in question 4 above?			
	i) Cheaper and affordable price ☐		29	46.8%
	ii) Feels better ☐		23	37.1%
	iii) Has variety of options ☐		18	29%
6.	Are you aware that hair extensions can be produced from plantain pseudo stem fiber?			
	i) **Yes** tick in the box ☐ ii) **No** tick in the box ☐		20 42	32.3% 67.8%
7.	Will you be willing to buy hair extensions made from plantain pseudo stem fiber?			
	i) **Yes** tick in the box ☐		54	87.1%

	ii) **No** tick in the box ☐		8	13%
8.	In which form would you prefer the plantain fiber hair extension			
	i) As attachment for braiding, weaving or plaiting ☐		42	67.8%
	ii) As weave-on ☐		7	11.3%
	iii) As wigs ☐		21	34.1%
9a.	How much would you be willing to pay for hair extensions in form of attachments made from plantain fiber per pack?			
	i) #1,500.00 ☐		38	61.3%
	ii) #2,000.00 ☐		10	16.1%
	iii) #2,500.00 ☐		13	21.1%
	iv) #3,000.00 ☐		8	13%
9b.	How much would you be willing to pay for hair extensions in form of weave-on made from plantain fiber per pack?			
	i) #3,000.00 and above ☐		35	56.5%
	ii) #5,000.00 and above ☐		22	35.5%
	iii) #15,000.00 and above ☐		6	9.6%
	iv) #20,000.00 and above ☐		6	9.6%
9c.	How much would you be willing to pay for hair extensions in form of wigs made from plantain fiber per pack?			
	i) #5,000.00 and above ☐		36	58%
	ii) #10,000.00 and above ☐		20	32.3%
	iii) #15,000.00 and above ☐		8	13%
	iv) #25,000.00 and above ☐		4	6.5%
10	Do you think that the innovation of creating hair extensions from plantain fiber has good market prospect?			
	Yes ☐		60	96.8%
	No ☐		2	3.2%
	Total number of respondents	62		