



Utilization of banana tree natural dyes with high print and marbling techniques in artwear

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ABSTRACT

The rapid development of the fashion industry encourages a variety of raw fabric processing through various textile techniques and raw materials. Natural resources in Indonesia have great potential for the manufacture of natural textile dyes. This research was conducted in a holistic manner, where the researcher also acted as an actor directly involved in the experiment: pre-experiment, experiment implementation, and post-experiment evaluation. The holistic objectives of this research were: (1) to find natural dyes that support the use of environmentally friendly materials; (2) to produce natural dyes from banana trees; and (3) to find appropriate high-printing and marbling procedures according to the characteristics of natural dyes from banana trees on textile media. The achievement of the greater goal of this research is to contribute to the development of alternative natural textile dyes that are more environmentally friendly and sustainable. This research uses an experimental method with the support of observation, literature study, and interviews. The results showed that to increase the durability of the color on the fabric fiber so that it does not fade easily, materials such as rice washing water, alum, and salt are needed. The color produced from banana trees becomes more intense if fixation is done with alum and quicklime. The combination of high print and marbling techniques proved suitable for application in artwear fashion products. The use of these natural materials was deemed feasible and affordable as alterations.

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1. Introduction

This research has the following objectives: (1) to find natural dyes that support the use of environmentally friendly materials; (2) to produce natural dyes from banana trees; and (3) to find the right procedure for high printing and marbling techniques according to the characteristics of natural dyes from banana trees on textile media. This research framework supports the achievement of the larger goal of contributing to the development of alternative natural textile dyes that are more environmentally friendly. In addition, it provides solutions for the fashion industry, especially the medium textile industry that is looking for more sustainable raw material options to achieve these goals, the researcher used an experimental research methodology with data collection techniques through observation and literature



study. The researcher hopes that this research can be considered feasible and affordable as an alternative in fashion production for the medium textile industry and in the development of natural textile dyes. The rapid development of the fashion industry provides a great opportunity to improve the quality of life and the country's economy. Based on data from the Central Statistics Agency (BPS), the fashion industry sub-sector contributed to national economic growth of around 19.28 percent. Based on data from the Ministry of Industry, the achievement of investment realization shows an increase in the textile and apparel industry sector, as well as the leather and footwear industry. Investment in these sectors continues to increase with a value of IDR 24.6 trillion in 2022 and 27.9 trillion in 2023. In the first quarter of 2024, the investment value amounted to 6.9 trillion, if the average proportion of investment is around 40 persen (Firman, 2024). However, behind this progress, there are negative impacts that need to be watched out for. These include the use of materials that are not environmentally friendly.

The production process generates risky waste and unfavorable impacts on skin health and low recyclability. The synthetic dyes used can be toxic and have negative side effects on living things (Bancroft and Layton, 2007). Mineral-based dyes such as potassium dichromate and copper sulfate can cause serious health problems (Rymbai, et al, 2011). Given that many large fashion industries contribute to large waste, this issue needs to be addressed seriously. Indonesia ranks second highest in terms of water pollution from the textile industry among the G20 countries, with an estimated textile effluent production of 3.9 million tons by 2030 (Achmad, 2024). The fashion industry is expected to contribute 25% of global carbon emissions by 2050 (Phima et al, 2024). To address the issue of environmental damage, the fashion and design industry is currently adopting concepts such as eco design, eco fashion, and green fashion. According to Sass Brown, eco fashion focuses on conserving life by maintaining a balance between people, animals, plants and the planet. This includes the use of raw materials that do not pollute the environment and production processes that can be recycled at the end of the product life cycle (Brown, 2010). The use of synthetic dyes must be strictly controlled, and requires innovation in the development of fabric dyes that are more environmentally friendly. With abundant natural resources, Indonesia has many plants that can be processed into various fabric dyes. Natural dyes are not only safe and environmentally friendly, but also have distinctive characteristics compared to synthetic dyes. In this case, natural dyes are understood as alternative dyes derived from nature that are renewable, non-toxic, and easily biodegradable and environmentally friendly. The experimental results in the form of natural dyes are specifically presented in artwear clothing. In the realm of making motifs or patterns, these natural dyes are reprocessed using two techniques, namely graphic techniques and marbling techniques. Artwear fashion is a type of clothing that emphasizes aesthetics over functionality and is produced manually through handwork instead of machines. High print technique involves the manual process of converting an artist's freehand drawing into a mold using certain materials, with the aim of producing multiple copies of the work (Susanto, 2002:47).

2. Method

This creation research was conducted thoroughly with a qualitative approach through an experimental method. In this approach, the researcher also acts as an actor who is directly involved in the entire experimental process, including the pre-experiment stage, experimental practice, and evaluation of experimental results. Moleong states that qualitative research must be based on valid sources (Moleong, 2007:54). The experimental method is considered appropriate in this research because it allows the author to obtain accurate data, both in the innovation of making natural dyes and in the aesthetic experience of the application of these dyes using high print and marbling techniques in artwear fashion artworks. The focus on aesthetic value relates to the additional qualities that the object has (Dharsono, 2004:15). Furthermore, to complement the data needed to analyze and formulate findings, the author

also conducted a literature study, observation, and documentation. Descriptive qualitative data collection aims to explain and describe the use of natural dyes in fashion works, with a focus on artwear and analyze the impact caused by the fashion industry. Literature study activities are carried out through the review of articles, books, and the internet. The observation method is about the phenomenon of using artwear and natural coloring materials. Furthermore, documentation was carried out by researchers when conducting experimental activities

3. Results and Discussion

3.1. Pre Experimental

The first stage of the process involves exploration, which includes problem identification and formulation. This step was undertaken to strengthen the reference base for the creation of the work. Natural dyes are non-toxic, renewable, easily degradable and environmentally friendly alternatives (Bancroft and Layton, 2007). These dyes are obtained from various parts of plants such as leaves, fruits, bark, stems, and flowers. One example is the banana tree, whose sap contains tannins and gallic acid. Tannins are natural coloring pigments that give a brown color and are known as soil acids, which are aromatic and give a astringent taste. Tannins can precipitate alkaloids, mercury chloride, and heavy metals (Visalakshi, M., and Jawaharlal, 2013). Tannins form dark blue or black solutions with ferric, and react with oxygen in solution in base (Pudjatmoko, 2004). The advantages of natural dyes include unique color variations and tend to be soft, giving a soothing and comfortable impression. In this study, researchers are also interested in the development of fashion, especially trends among young people.

3.1.1. Preparation Stage

At this stage, the process carried out by researchers is observation to examine alternative natural coloring materials available in the surrounding environment. Materials and tools that need to be prepared include; tools (carving tools, bowls, pots, cobek or blender, filter cloth, measuring cups, chopsticks, spoons, basins, buckets, and bottles). The materials used include; cloth, lino rubber, aqua water, rice washing water, and cornstarch, banana trees, alum, glycerin, arbor, and salt.

3.1.2. Initial Mordan Process

Mordants serve to strengthen or activate the colors in the fabric. This process aims to improve fabric fiber bonding and reduce shrinkage. Mordants fall into two categories: chemical and natural. Chemical mordants include tin, copper, iron, zinc, and chrome, while natural mordants consist of alum, vinegar, lime, tamarind sugar, lime water, rock sugar, pisang klutuk, tape, jambu klutuk, and vinegar (Susanto S, 1980). The use of various types of mordants can produce more diverse color variations (Failisnur et al, 2017). In this study, the mordants chosen by researchers were alum and arbor. The process was carried out by soaking the fabric in water used for washing rice, alum, glycerin, and salt for 2 hours, then the fabric was dried or aerated.

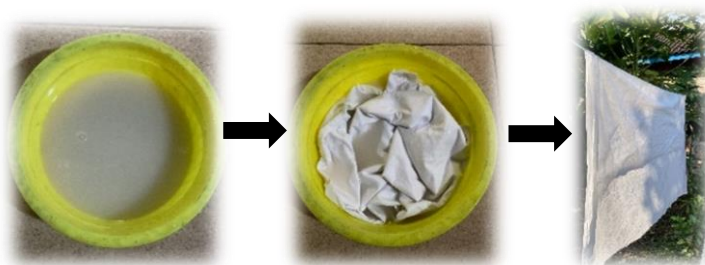


Fig. 1. Initial Mordan Process

3.2. Exsperimental Practice

3.2.1. Gel Making Process

The gel in the marbling process serves as a mediator so that it can be shaped into the

desired motif. There are many viscous materials that can be used in making gels, including wheat flour, agar powder, cornstarch, and tapioca flour. Researchers limit the selection of gel making using cornstarch. The process carried out by researchers is to cook 1 liter of water mixed with $\frac{1}{2}$ kg of cornstarch in a saucepan. Cook for 5 minutes while stirring and wait for the flour to thicken slightly. The stirring process is done so that there are no lumps and know the texture of the flour.



Fig. 2. Making Gel Process

The effect of settling time on the color of the sap on the fabric shows that the longer the settling time, the better the color produced. In this experiment, the researcher conducted the deposition for several days to evaluate the color results. The stages of the extraction process carried out by the researcher are as follows: 1) Take 5 banana stems that have just appeared small buds. 2) Cutting the banana stems into small pieces. 3) Pounding the banana stems so that the sap can be squeezed. 4) Preparing a filter cloth and a container to squeeze the sap. 5) Filtering the sap from the banana stems to separate it from the pulp.

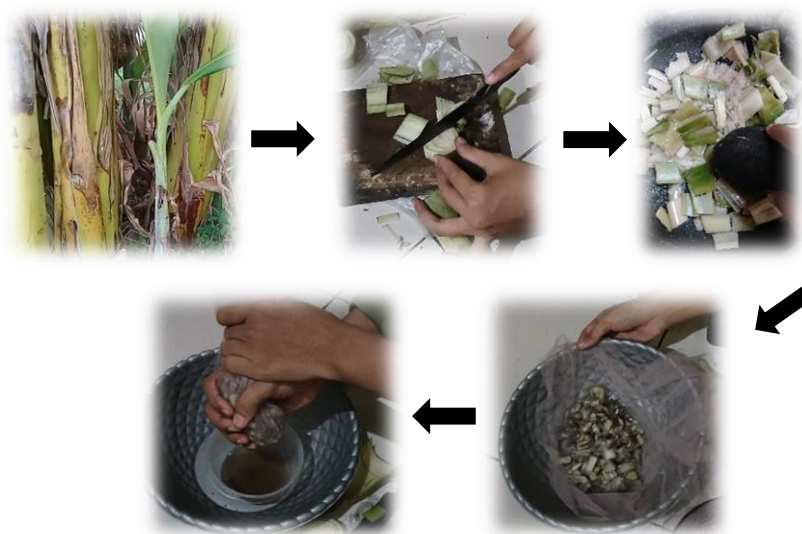


Fig. 3. Extraction Banana Steam Sap Kepok and Milk

3.2.2. Banana Tree Extraction Process

Color is the main element that attracts attention and is an important factor in the acceptance of products such as textiles, cosmetics, food, and others (Rymbai et al, 2011). Dyes are important for enhancing artistic value and providing variety to products (Jos B et al, 2011). Natural dyes can be obtained through extraction from various plant parts using aqueous solvents at high or low temperatures, depending on the type of source (Purnomo, 2004:57). This process aims to obtain pigments from natural dyes. The part used to obtain the dye is sap and extraction from parts of the banana tree. Banana tree sap contains tannin, which is a brown natural coloring pigment. The sap is taken from various parts of the banana tree such as the

leaf stalk, fruit stalk, and tree trunk. Natural dyes are usually used in the form of liquid extracts or powders. In this study, researchers processed banana tree sap into natural dyes in the form of extracts and powders, making it more practical to use and store. At this stage, extraction was carried out with the solvents mineral water and banana tree sap. Extraction is the process of separating components from a material consisting of two or more components by dissolving one of the components using a suitable solvent. Extraction time is an important factor that must be considered because it can affect the quality of the extraction results. The longer the extraction time, the higher the resulting absorbance.

- **Process Stages Of Banana Leaf Extraction:** The steps taken by researchers in this process are; (1) the process of taking young banana leaves, (2) Banana leaves that have been taken, separated from the leaf midrib, then cut into small pieces of 4 leaves, (3) Slices of kepok and milk banana leaves are then pounded until smooth, do it separately, (4) Take the leaves that have been pounded, then put them into a container to be mixed with 200 ml of hot water, (5) The next process is filtering with a filter cloth to separate the banana leaf extraction and leaf pulp. The extraction process of kepok banana leaves and milk banana leaves is done separately.

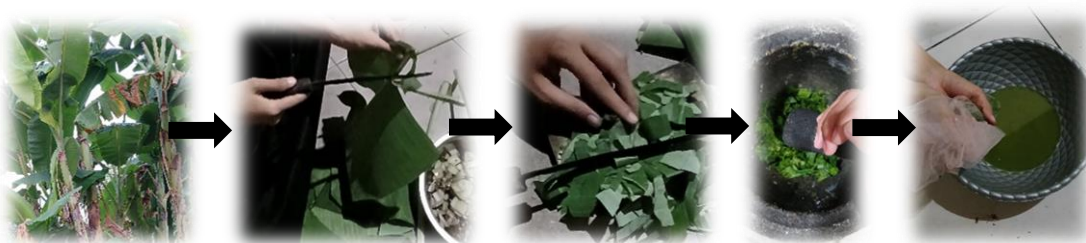


Fig. 4. Banana Leaf Extraction Process

- **Process Stages of Extraction Banana Stem Sap Kepok and Milk:** The effect of settling time on the color of the sap on the fabric shows that the longer the settling time, the better the color produced. In this experiment, the researcher conducted the deposition for several days to evaluate the color results. The stages of the extraction process carried out by the researcher are as follows: (1) Take 5 banana stems that have just appeared small buds, (2) Cutting the banana stems into small pieces, (3) Pounding the banana stems so that the sap can be squeezed, (4) Preparing a filter cloth and a container to squeeze the sap, (5) Filtering the sap from the banana stems to separate it from the pulp.

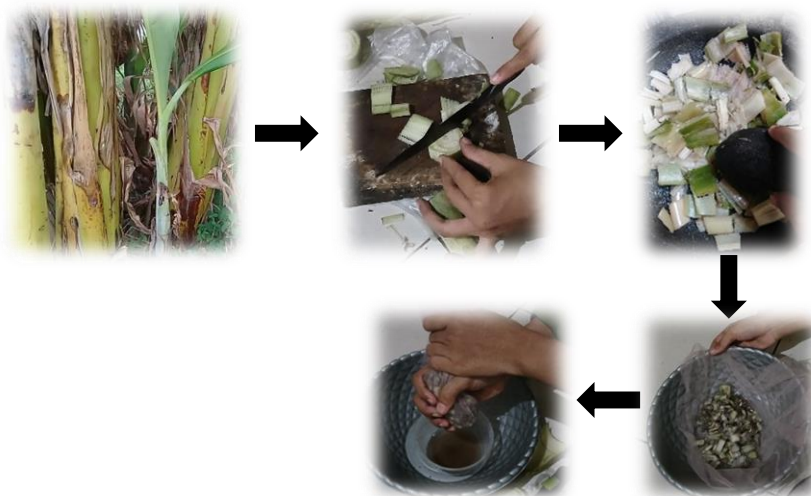


Fig. 5. Extraction Banana Steam Sap Kepok and Milk

3.2.3. High Print Technique Process

In general, graphic art techniques can be categorized into four main methods: flat printing, relief printing, screen printing (serigraphy), and intaglio printing (Scheder, 1994:160). Graphic arts is a branch of art that offers many opportunities for exploration for artists to achieve a certain aesthetic and create a unique character. The maturity of a graphic art work can be measured by the quality of the techniques used and the ideas conveyed by the artist. The graphic arts branch implements creative skills and imagination to produce aesthetic objects (Supriyanto, 2005:4). High print technique is a print technique that uses a raised surface as a print reference. This raised surface is obtained by removing parts that are not needed to pass the dye. The creation of works through *linocut* with the dimensions of medium-scale works. The coloring process is done with banana tree sap strokes and banana leaf extraction. Making works using the linocut technique on a medium scale involves a coloring process using banana tree trunk sap and banana leaf extraction. The stages carried out by researchers in this process include; (1) the process of making designs in the procreate application, (2) The next step, transferring the design on tracing paper or can be sketched directly on *linocut*, (3) The next process is to transfer the design from tracing paper to lino by rubbing it with a coin, (4) The transferred image can be carved according to its shape, (5) Trim the carving, with the edges removed so that it can be printed, (6) In the next step, the lino brush that has been carved is colored by brush. 7) Next attach it to the cloth that has been spread out, repeat the print 3 times. For coloring, the author uses natural dyes of sap from kepok banana stems and milk.



Fig. 6. High Print Graphic Process

3.2.4. Fabric Marbling Process

The marbling technique is a paper decoration method originating from Persia, where the main principle is to create motifs by processing dyes that float on the surface of a liquid or gel. The gel serves as a key ingredient in this technique as a medium for motif formation. The process carried out by the researcher is; 1) the gel that has been made is poured and leveled into a large tray. 2) The next step drips the banana leaf dye extraction or sap over the gel. 3) Droplets of dye are formed according to taste, using skewers. 4) The fabric is spread out and placed on the gel, after which lift and clean the powdery gel with a ruler. 5) The next step is to run the fabric with water to remove the remaining gel. 6) The fabric is aerated, and then the fixation process.

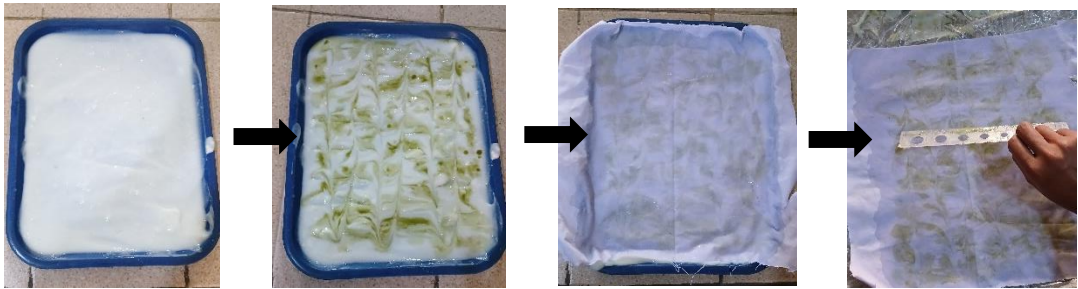
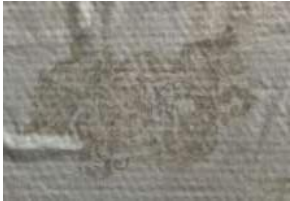


Fig. 7. Marbling Process

3.2.5. Exsperimental Process

The experimental research method can be understood as an approach that aims to evaluate the impact of a treatment on other treatments under controlled conditions (Sugiyono, 2018:107). According to Sugiyono, a true experiment allows researchers to control all external variables that can affect the experimental process (Sugiyono, 2012:112). In a true experimental design, the samples used as experimental and control groups are randomly drawn from a specific population, with a control group and random sample selection. The experimental process aims to determine the most effective and appropriate procedure. In this context, the researcher applied the described dye experiment formula for dye making, and conducted graphic and marbling experiments with different parts of the banana tree and different extraction deposits, in order to evaluate the results.

Table 1. High Print Graphic Experiment

Results	Methods	Analysis
	Initial mordant: rice washing water, alum, glycerin, salt. Coloring agent: banana stem sap. High print graphic technique. Final mordant of arbor and salt	The resulting color is deep yellowish brown. The shape of the graphic mold is clearly visible. Sap deposition process for 3 days. The fixation process is done twice.
	Initial mordant: rice washing water, alum, glycerin, salt. Coloring agent: sap of kepok banana stem High print graphic technique. Mordan akhir tawas dan garam	The resulting color is deep light brown. The shape of the graphic mold is clearly visible. Sap deposition process for 3 days. The fixation process is done twice.
	Initial mordant: rice washing water, alum, glycerin, salt. Coloring agent: sap of kepok banana stem and kepok banana leaf. High print graphic technique. Final mordant alum and salt.	The resulting color is brownish green. The graphic shape is softer. Sap deposition process for 2 days. The fixation process is done twice.
	Initial mordant: rice washing water, alum, glycerin, salt. Colorant: banana leaf extraction. High print graphic technique. Final mordant of arbor and salt	The resulting color is light green. Graphic shape looks soft. Deposition process of leaf extraction for 2 days. The fixation process is done 2x.

Results	Methods	Analysis
	Initial mordant: rice washing water, alum, glycerin, salt. Coloring agent: milk banana stem sap extraction. High print graphic technique. Final mordant alum and salt.	The resulting color is a deep yellowish brown. The graphic. Form looks quasi-transparent. Gum deposition process for 1 day. fixation process.
	Initial mordant: rice washing water, alum, glycerin, salt. Coloring agent: milk banana stem sap extraction. High print graphic technique. Final mordant alum, arbor, and salt.	The resulting color is a deep yellowish brown. The graphic shape is clear and transparent. Sap deposition process for 2 - 3 days. Graphic results vary. The fixation process is done twice.

Table 2. Marbling Experiment

Results	Methods	Analysis
	Initial mordant: rice washing water, alum, glycerin, salt. Final mordant water, alum, salt. Gel: Maizena Colorant: Banana Kepok leaf extraction. Marbling technique	The shape of the motif looks abstract. The resulting color is faded greenish. The ratio of water and coloring material is 1: 2 so that the results are as desired. Fixation is done 2x.
	Initial mordant: rice washing water, alum, glycerin, salt. Final mordant water, alum, salt. Gel: Maizena Colorants: extraction of kepok banana leaf and stem sap. Marbling technique	The shape of the motif looks abstract. The resulting color is light green. Extraction of stem sap mixed with kapok banana leaves. Fixation is done 2x.
	Initial mordant: rice washing water, alum, glycerin, salt. Final mordant water, alum, salt. Gel: Maizena. Colorant: banana stem sap extraction. Marbling Technique	The shape of the motif looks abstract. The resulting color is pseudo-brownish. Pure banana sap extraction. Fixation is done 2x.

Results	Methods	Analysis
	Initial mordant: rice washing water, alum, glycerin, salt. Final mordant of water, arbor, and salt. Gel: Maizena Colorant: milk banana leaf extraction. Marbling technique	The shape of the motif looks abstract. The resulting color is yellow. The ratio of water solvent and coloring material is 1:2 so that the results are as desired. Fixation is done 2x.
	Initial mordant: rice washing water, alum, glycerin, salt. Final mordant of water, arbor, and salt. Gel: Maizena Colorant: kepok banana leaf extraction. Marbling technique	The shape of the motif looks abstract. The resulting color is a combination of light green The ratio of water and coloring material is 1: 2 so that the results are as desired. Fixation is done 2x.

3.3. Post Experimental

3.3.1. Final Mordan Process (Fixation)

The final step in the fabric dyeing process is fixation, which aims to lock the color on the yarn using fixators such as lime, alum, and arbor. The purpose of this fixation is to prevent the color of the yarn from fading and avoid mixing other colors. Natural dyes are obtained by extracting various plants with aqueous solvents at high and low temperatures, depending on the raw material. Variations in color yield are influenced by the type of metal fixator used. In this study, alum and arbor were used as fixing agents, as they produce little chemical waste compared to other natural fixators. The fixation process was carried out by dipping and drying each sample 2 to 3 times. The researcher dissolved 3 spoons of alum and 1 spoon of salt with 1 ½ liters of hot and ½ liter of cold water in a bucket. The next process is soaking the fabric for 30 minutes so that the color is concentrated and resistant to fading, repeat soaking 2 to 3 times. The next process is to aerate the fabric to dry.



Fig. 8. Final Mordan Process

3.3.2. Fashion Design

Fashion trends are influenced by socio-cultural phenomena that emerge through social media, particularly TikTok and Instagram. These two platforms have had a significant impact on fashion trends among teenagers, one of which is the scene style of dressing, which is now a major trend among young people. The main characteristic of the scene style is the freedom of expression it offers, where the young people involved are not afraid to be different and unique. Scene performers combine fashion elements from different subcultures and historical eras, resulting in interesting and eye-catching outfit combinations. This trend shows how fashion is constantly adapting and changing according to the individual. Based on this trend, the

researcher chose to design fashion with a scene style. After the graphic creation and marbling process, the next step was the creation of the fashion design. This process involves drawing the anatomy of the general fashion design with a scale of 1:10 based on the body anatomy guide and designing the fashion with embellishment details. This design was created using the Coreldraw application.

- Alternative Design



Fig. 9. Alternative Artwear Fashion Design

- Selected Design: The designs include cape, asymmetric obi, skirt, and skirt. The materials chosen for making this outfit are oxford, primisima cotton, and toyobo. The decoration used high print and marbling techniques, with natural coloring from banana trees. In addition, the sleeves are decorated with ruffles. The visual produced from the graphic technique shows a combination of bird shapes and Javanese carvings, while marbling gives a more abstract look.



Fig. 10. Women's Artwear Fashion Design

3.3.3. Fashion Visualization

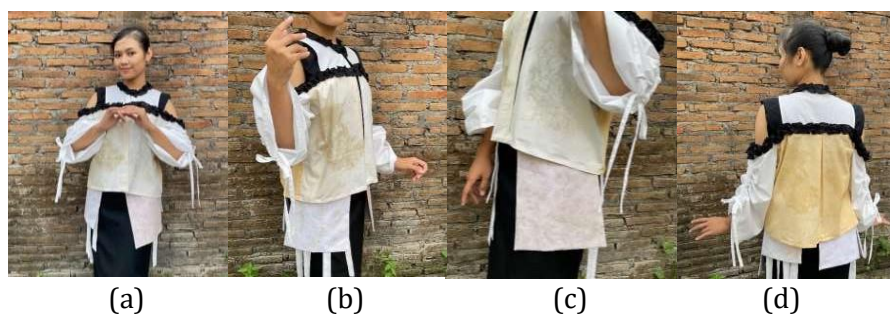


Fig. 11. Finished Results Of Women's Artwear, (a) Front View (b) Right Side View (c) Left Side View (d) Rear View

4. Conclusion

Chemical waste from synthetic dyes is a significant problem that impacts the environment and public health. One solution to reduce the negative impact of chemical waste is to utilize plants as an alternative to natural dyes. The aim of this study is to contribute to the development of alternative natural textile dyes that are more environmentally friendly and sustainable. One of the natural dye alternatives is banana tree parts, which are utilized for extraction and sap. The techniques used in the experimental works are high print and marbling techniques on artwear. In the extraction process, the dosage must be precise to produce the appropriate dye composition. The experimentation process is carried out sequentially for maximum results. The final product of this research is artwear fashion with an environmentally friendly scene style. Hopefully, this research can encourage the fashion industry to gradually switch to the use of natural dyes in products. The existence of these values is expected through this research, to encourage the fashion industry to gradually switch to using natural dyes in the products they produce and contribute to increasing public awareness of environmental pollution.

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