COLOR AND COLOR ACCEPTABILTIY OF NATURAL DYES FROM DIFFERENT WEEDS APPLIED TO PIÑA CLOTH

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by

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APPROVAL SHEET

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"Color and Color Acceptability of Natural Dyes from Different Weeds Applied to Piña Cloth"

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ABSTRACT

Natural dyes are used to color various materials such as textiles, paper, and cosmetics. Some of the colors produced by these dyes are orange, maroon, brown, gray, blue, purple, black, yellow, pink, violet, beige, peach and also with different shades. Researches show that natural dyes can be extracted from different plants including weeds. Among all weeds, only cogon (*Imperata exaltata* Brongn.) has been proven as a source of dye.

The first objective of the study aimed to identify the colors produced by the dyes extracted from the weeds: *Amaranthus spinosus* (Kolitis), *Ageratum conyzoides L.* (Bulak-manok), *Euphorbia hirta* (Gatas-gatas), *Cyperus iria* (Payong-payong) and *Mimosa pudica* (Makahiya). Using the peak wavelength of absorption measured by the UV-mini Spectrophotometer 1240, the weeds produced red color for *Cyperus iria* (Payong-payong) and *Mimosa pudica* (Makahiya) while the weeds *Amaranthus spinosus* (Kolitis), *Ageratum conyzoides L.* (Bulak-manok), and *Euphorbia hirta* (Gatas-gatas) produced colors in the green-yellow range.

The second objective of the study aimed to determine which concentration of natural dye is most acceptable in terms of color and appearance on piña cloth. Nine panelists were invited to rate the dyed piña cloth. Using the Kruskal-Wallis Test, it was determine that the concentration of the dye extracted from the weeds did not affect the color acceptability of the dye.

Based on major findings, it is recommended that future studies may be conducted exploring different mordant from alum, and utilizing different types of cloth. Also, factors such as colorfastness and light fastness may be considered as another variable.

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Chapter 1

INTRODUCTION

A. Background of the Study

For decades in our history, Filipinos have naturally dyed fabrics. Overtime, however, the use of natural dyes for coloring textiles were nearly abandoned due to a very use of labor, time consuming and irreproducible processes, and were to a large extent, replaced by the synthetic dyes which are easier to prepare and apply, and generally cheaper . Habal and de Guzman (2003) pointed out that as a result of heightened ecological awareness and growing global concern for the environment such as global warming, interest in projects and studies to address the various environmental issues has intensified. They further stressed that the textile industry, which is known to be one of the major pollutants of the environment, became conscious to undertake environmentally- sound, culturally sensitive and economically beneficial programs for the farmers, weavers, dryers and plant harvesters. Various government agencies and concerned private sectors launched projects focusing on minimizing the negative effects to the natural ecosystem.

The Philippine Textile Research Institute (PTRI) is one of the government agencies that are searching for other sources of natural dyes. So far, around 26 new sources of natural dyes, namely: acacia, albutra, alig, lalake. Alder, alugbati, ansoan dilaw, bakawan lalake, bakawan babae, guava, bitaog, bunga de china, cashew, castor plant, flame, gemelina, golden shower, kasubha, katmon, lanzones, neem tree, pagatpat, pili, red skinned onion, rhoeo discolor, siling labuyo and sineguelas were known to be dye yielding and can be good alternative in dyeing textiles (www.ptri.org.ph).

Weeds, defined as unwanted plants imposing problems to most farmers' different crops, and are very abundant in the locality but have the least number of uses. Since cogon (*Imperata exaltata* Brongn.) has been proven as a source of dyes as studied by the PTRI (Habal and de Guzman,2003), the researchers would like to explore the possibility of *Amaranthus spinosus* (Kolitis), *Ageratum conyzoides L.* (Bulak-manok), *Euphorbia hirta* (Gatas-gatas), *Cyperus iria* (Payong-payong) and *Mimosa pudica* (Makahiya) as dye yielding weeds.

B. Statement of the Problem

The possibility of producing dye from *Amaranthus spinosus* (Kolitis), *Ageratum conyzoides L.* (Bulak-manok), *Euphorbia hirta* (Gatas-gatas), *Cyperus iria* (Payong-payong) and *Mimosa pudica* (Makahiya) which is acceptable when applied to piña cloth based on its color appearance.

C. Objectives

This study specifically aimed:

1. To identify the colors produced by the dyes extracted from the weeds: *Amaranthus spinosus* (Kolitis), *Ageratum conyzoides L.* (Bulak-manok), *Euphorbia hirta* (Gatas-gatas), *Cyperus iria* (Payong-payong) and *Mimosa pudica* (Makahiya)
2. To determine which concentration of natural dye is most acceptable in terms of color and appearance on piña cloth.

D. Significance of the Study

Natural dyes are environment-friendly. Unlike chemical dyes, it is not carcinogenic, it is biodegradable and safe to use. (Katutubong Kulay, 1998) Disposal of wastes is not a problem because it decomposes naturally not like wastes from synthetic dyes, which contain high amount of aniline that is harmful in the ecosystem being not biodegradable (Katutubong Kulay, 1998). Wastes formed after dye extraction is a very good source of organic fertilizer for plant use. Also, vegetative dyes can be used as coloring matters for edible products since they are not poisonous.

The textile industries will also benefit in this study because their knowledge in natural dyes will help them determine what the consumers want: color and health. In terms of color, natural dyes produce brilliant colors as synthetic dyes (www.chem.divched.org/HS/Journal/Issues/1999/Dec/clicSubscriber/V76N12/p1688A.pdf).

On the other hand, natural dyes are safer to use compared with synthetic dyes. Synthetic dyes may irritate the skin and cause allergies preventing the consumers from buying their products.

The common people will also benefit in the study because of its economic value. This study will provide information on the extraction process of natural dyes from the different species of weeds. This is advantageous to the rural areas because weeds grow abundant in these places. In this manner, the people will gain valuable knowledge and ideas and become creative in utilizing local materials, which are abundant in their locality.

Moreover, the findings of this study will be useful to the PTRI specialists in their tasks of continuous search for dye-yielding plants in the country side and reviving the interest of people in natural dyeing.

E. Scope and Delimitation of the Study

This research was delimited to the use of *Amaranthus spinosus* (Kolitis), *Ageratum conyzoides L.* (Bulak-manok), *Euphorbia hirta* (Gatas-gatas), *Cyperus iria* (Payong-payong) and *Mimosa pudica* (Makahiya) as dye sources.

The dye that was obtained from the different species of weeds was applied to piña cloth that was purchased at Aklan Heritage, Arts and Crafts in Kalibo, Aklan.

Likewise, the dye was set for color evaluation by using student-respondents. The students came from the different year levels of Philippine Science High School- Western Visayas.

The mordant used was provided by Aklan State University- Main Campus located at Banga, Aklan.

The color acceptability was measured by using eight experts. These experts were chosen according to their knowledge about dyes. Chosen artists, textile instructors, fashion designers and dye experts were requested to evaluate the dye samples.

F. Definition of Terms

1. Acceptability – the state or quality of being worth accepting (New Webster Dictionary, 1992)

   It refers to the degree of acceptance of the panelist on the color produced from different dye-yielding weeds when applied to piña cloth. It is categorized as most acceptable (5), more acceptable (4), moderately acceptable (3), acceptable (2), and least acceptable (1).

2. Boiling- the state or process of ebullition (Webster Comprehensive Dictionary, 1987)

3. Color- physical phenomenon of light or visual perception associated with the various wavelengths in the visible portion of the electromagnetic spectrum. As a sensation experienced by humans and some animals, perception of color specification is a complex neurophysiological process. The methods used for color specification today belong to a technique known as colorimetry and consist of accurate scientific measurements based on the wavelengths of three primary colors (Microsoft Encarta, 2007).

   Color in this study refers to the color of the natural dye obtained form the different of the nipa palm as fixed to piña cloth.

4. Dyeing- refers to the fixing of color to the fabric by soaking it in a liquid coloring material known as dye (Encarta Dictionary, 2006).

   In this study, dyeing is the process of fixing the natural dye extracted from the different parts of the nipa palm on the piña cloth.

5. Dyes- natural or synthetic substances that can be used to color something, e.g. a textile or hair, and is most applied as a liquid.

   In this study, dye refers to the natural dye extracted from the different species of weeds.

6. Spectrophotometer- photometer used to measure intensity as a function of the color, or more specifically, the wavelength of light (www.wikipedia.org).

   In this study, it refers to the instrument used to measure the intensity of color of natural dyes extracted from the different species of weeds.

7. Weeds- plants growing where they are not wanted (A Handbook for Weed Control in Rice, 1991).

Chapter 2

REVIEW OF THE RELATED LITERATURE

This chapter consists of the following topics: natural dye, weeds, colors from natural dye, uses of natural dye, synthetic dyes, factors affecting colors, factors affecting color preference.

A. Natural Dye

Dyes are materials that give color to substances such as yarn, food, paper, cosmetics and cloth. Since time immemorial, man has been attracted and fascinated in the use of colored clothing and accessories. The ancient people considered color important as their food. All cloths, yarns, wallpapers, paints and household products were colored using natural dyes (Habal and de Guzman, 2003). Natural dyes can be derived from plants, minerals, insects and some shellfish. Most natural dye colors are found in the rots, barks, leaves, flowers, fruit skin and nutshell of plants. Some plants may have more than one color or source of color among the variants proportions of their anatomy. The hue or shade of color that a plant produces is dependent on the soil and weather conditions, the time of year the plant is harvested and the age at which it is taken.

Furthermore, minerals and other foreign substances in the water used in dye vat can also alter the color. Very few natural dyes are substantive, that is, yielding a color, which is fast without the addition of a chemical called mordant. A mordant is a metallic substance that creates a chemical affinity between the substance and the dyestuffs and fixes the coloring matter on the materials permanently. Mordants such as copper sulfate, alum and potassium dichromate are commonly added to produce different color and improve the colorfastness of the dyed material.

In 1998, a Coca Cola Foundation, Philippines Incorporation (CCFPI) published a book known as "Katutubong Kulay", mentioned that a country is endowed with an abundance of natural dye-yielding plants that can easily cultivated and propagated. These plants offer a myriad of colors in various shades and tones.

Evidences showed that in the southern and northern parts of the Philippines during the Spanish era, the most widespread vegetable dye was from the species of indigo plants. These indigo plants were extensively cultivated for the commercial production of dark blue yielding indigo dye. To the Bagobo tribes and other Mindanao highlanders, a plant dye known as sikalig (*Morinda bracteates Rox*) gave a deep red color. Another plant which produced a dark brown dye was katuray (*Sesbania grandiflora*). A good red was obtained from Makopa (*Syzgium malaceccense*) known as mountain apple. Sibucao (*Caessalpinia sappan*) wood when boiled produced the popular red dye. Yellow dye was obtained from the common yello ginger or luyang dilaw. Black and dark brown dyes were extracted from talisay leaves (*Terminalia catappa*) while achuete or annatto (*Bixa cerellana*) seeds were often used to produce orange dye.

B. Weeds

B.1. Bulak-manok (*Vernonia cinerea*)

The leaves are stalked, alternate, ovate, 4-11 cm long, and 1-5 cm wide, with the tip and base somewhat pointed, and with round toothed margins, hispidly hairy.

B.1.a Distribution

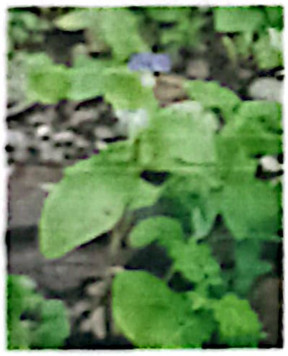
This weed is common, flowering year-round, from sea level to an altitude of 2,000 m. the seeds are light, easily dispersed and disseminated by wind.

B.1.b Uses

The whole plant has been used as a decoction for cough, colds, fever, skin disease, and high blood pressure. It is also applied for bleeding due to external wounds, furuncle, eczema, carbuncle, and poultices for headaches.

(http://www.stuartxchange.org/BulakManok.html)

B.2. Kulitis (*Amaranthus viridis*)



The leaves are alternate, ovate, long-petioled, 4-10 cm long, obtuse tip, usually notched, base truncate or decurrent.

B.2.a. Distribution

Kulitis is a common roadside weed on lowlands and low altitudes. The seeds or cuttings are used for propagation.

B.2.b. Uses

Kulitis is considered as a vegetable. The tops are rich in calcium and iron. The plant is a good source of vitamins B and C. the therapeutic properties and dosage are very nearly identical to *Amaranthus spinosus*. Poultice of leaves for inflammations, boils and abscesses. Infusion of plant has been used as a diuretic and galactagogue. It is also used for snakebites and scorpion stings. (http://www.stuartxchange.org/Kolitis.html)

B.3. Gatas-gatas (Euphorbia hirta)

Leaves are opposite, elliptic-oblong to oblong-lanceolate, distichous, 1-2.5 cm long, blotched with purple in the middle, toothed at the edge.

B.3.a. Distribution

Gatas-gatas are abundant in waste places and open grasslands.

B.3.b. Uses

Gatas-gatas is called as such because of the healing property of the milky juice. The juice is used for colics, and also as ophthalmic drops for conjunctivitis or ulceration of the cornea. Infusion or tea of the plant, 4 glasses daily, for bronchitis and labored breathing, asthma, chronic dysentery. Decoction of dry plant is used for skin disease. Decoction of fresh plant used as gargle for the treatment of thrush. Decoction of the root is used to allay vomiting, chronic diarrheas, and fevers. The root decoction is also beneficial for nursing mothers deficient in milk: 4-5 glasses of tea. The same root decoction is used as an enema for constipation. The root is used for snakebites. For superficial bleeding, crush the leaves and apply on the affected part, as local hemostatic.

(http://www.stuartxchange.org/GatasGatas.html)

B.4. Payong-payong (*Cyperus iria*)

The stems are triangular in cross-section, occurring in bunches. It is approximately 8-24 inches tall.

B.4.a Distribution

"It is mainly a weed of open, wet places" (Holm et al., 1977; p.240). In Fiji, "a naturalized adventives, often locally abundant on Viti Levu from sea level to 300 m, along roadsides and in swamps, cultivated areas, and in rice fields" (Smith, 1979; pp. 250-251).

B.4.b. Uses

The decoction of the ground tubers are used fro fevers. (http://www.stuartxchange.org/PayongPayong.html)

B.5. Makahiya (*Mimosa pudica*)

B.5.a. Distribution

Makahiya is a common weed that is widely distributed in the Philippines, in open moist areas, open grasslands and open thickets.

B.5.b. Uses

Decoction or infusion of leaves used in asthma; expectorant. Urinary complaints, hypertension. Glandular swelling, sore throat and horseness. Powdered seeds applied to wounds and sores. Decoction of roots used for bladder stones. Bruised leaves applied to bruises. Decoction of leaves used for diabetes. Powdered roots and leaves take with milk for piles and fistula. Juice applied externally to fistulous sores. Poultice of leaves for glandular swellings. (http://www.stuartxchange.org/Makahiya.html)

C. Colors From Natural Dyes

The PTRI (Philippines Textile Research Institute) published a book entitled "Gampol" which discovered new sources of dyes. Some of the color produced are orange, maroon, brown, gray, blue, purple, black, yellow, pink, violet, beige, peach and also with different shades.

These colors were extracted by fermentation and boiling. Some factors were changed like the pH level, liquor ratio, and the boiling time. (Habal and de Guzman, 2003)

The part of the plant that gives off the color of the dye is produced by the natural dye pigments. Some types of these pigments are carotenoids, p-benzoquinones, napthoquinones, anthraquinones, flavane derivatives, xanthones, and chlorophyll.

D. Uses of Natural Dyes

Natural dyes are used to color various materials such as textiles, paper, and cosmetics. (Katutubong Kulay, 1998)

Before the discovery of synthetic dyes in the mid-19th century, all dyes were obtained from natural sources. The oldest artifacts of dyeing in the Philippines date back to the country's Iron Age (circa 200 B .C.). Textile and mats of that era were colored with vegetable dyes. Also malong(tubular garment) saputangan (headgear) still retain their multi-dyed patterns, all displaying the now well-known batik technique. (Katutubong Kulay, 1998)

Today, as the natural dye industry immerges, export quality gowns and barong tagalogs are now dyed with brilliant colors from natural dyes. (Katutubong Kulay, 1998)

E. Synthetic Dyes

The first human-made (synthetic) organic dye, mauveine, was discovered by William Henry Perkin in 1856. Many thousands of synthetic dyes have since been prepared.

Synthetic dyes quickly replaced the traditional natural dyes. They cost less, they offered a vast range of new colors, and they imparted better properties upon the dyed materials.[1] Dyes are now classified according to how they are used in the dyeing process.

Acid dyes are water-soluble anionic dyes that are applied to fibers such as silk, wool, nylon and modified acrylic fibers using neutral to acid dyebaths. Attachment to the fiber is attributed, at least partly, to salt formation between anionic groups in the dyes and cationic groups in the fiber. Acid dyes are not substantive to cellulosic fibers.

Basic dyes are water-soluble cationic dyes that are mainly applied to acrylic fibers, but find some use for wool and silk. Usually acetic acid is added to the dyebath to help the uptake of the dye onto the fiber. Basic dyes are also used in the coloration of paper.

Direct or substantive dyeing is normally carried out in a neutral or slightly alkaline dyebath, at or near boiling point, with the addition of either sodium chloride ($NaCl$) or sodium sulfate (Na_2SO_4). Direct dyes are used on cotton, paper, leather, wool, silk and nylon. They are also used as pH indicators and as biological stains.

Mordant dyes require a mordant, which improves the fastness of the dye against water, light and perspiration. The choice of mordant is very important as different mordants can change the final color significantly. Most natural dyes are mordant dyes and there is therefore a large literature base describing dyeing techniques. The most important mordant dyes are the synthetic mordant dyes, or chrome dyes, used for wool; these comprise some 30% of dyes used for wool, and are especially useful for black and navy shades. The mordant, potassium dichromate, is applied as an after-treatment. It is important to note that many mordants, particularly those in the hard metal category, can be hazardous to health and extreme care must be taken in using them.

Vat dyes are essentially insoluble in water and incapable of dyeing fibres directly. However, reduction in alkaline liquor produces the water soluble alkali metal salt of the dye, which, in this leuco form, has an affinity for the textile fibre. Subsequent oxidation reforms the original insoluble dye. The indigo color of blue jeans is a vat dye.

Reactive dyes utilize a chromophore containing a substituent that is capable of directly reacting with the fibre substrate. The covalent bonds that attach reactive dye to natural fibers make it among the most permanent of dyes. "Cold" reactive dyes, such as Procion MX, Cibacron F, and Drimarene K, are very easy to use because the dye can be applied at room temperature. Reactive dyes are by far the best choice for dyeing cotton and other cellulose fibers at home or in the art studio.

Disperse dyes were originally developed for the dyeing of cellulose acetate, and are substantially water insoluble. The dyes are finely ground in the presence of a dispersing agent and then sold as a paste, or spray-dried and sold as a powder. They can also be used to dye nylon, cellulose triacetate, polyester and acrylic fibres. In some cases, a dyeing temperature of 130 °C is required, and a pressurised dyebath is used. The very fine particle size gives a large surface area that aids dissolution to allow uptake by the fibre. The dyeing rate can be significantly influenced by the choice of dispersing agent used during the grinding.

Azo dyeing is a technique in which an insoluble azoic dye is produced directly onto or within the fibre. This is achieved by treating a fibre with both diazoic and coupling components. With suitable adjustment of dyebath conditions the two components react to produce the required insoluble azo dye. This technique of dyeing is unique, in that the final color is controlled by the choice of the diazoic and coupling components.

Sulfur dyes are two parts "developed" dyes used to dye cotton with dark colors. The initial bath imparts a yellow or pale chartreuse color. This is oxidized in place to produce the dark black we are familiar with in socks. (www.wikipedia.org)

F. Factors Affecting Color

F.1. Type of Extraction

Some extraction processes can affect the color of the dye produced. An example of these is fermentation. The chemicals used in this kind of extraction can alter the color of dye when it reacts.

F.2. Mordant

Mordants are metallic or mineral salts which, when added to the natural bath either enhance, intensify, or change the color. They also play a large role in making the resulting shade faster to light and washing.

Generally all fibers are pre-mordanted with alum. This does not affect the color of the dyestuff; it helps to increase wash and light fastness. Other mordants will alter the color of the natural dye bath. Some dyers like to add mordants a pinch at a time until they see a color change. (www.dyeman.com/natural%20Dye%20recipe.htm)

F.3. Cloth

Wool is the easiest fiber to dye with natural dyes. Clean fleece or yarn is most easily dyed. Wool is most widely used for several reasons; it is relatively inexpensive, always available, disperse in use, easy to handle and takes the dye well. Resulting colors are fast to light and washing when used in conjunction with appropriate mordant.

Silk can also be dyed although the dyer must be very careful with the use of string alkalis as these can 'eat' silk. It is also important to note that silk cannot be dyed at high temperatures for long periods of time as this degrades the quality of the silk. Silk does not take well to strong natural dyes e.g. cochineal, and when pre-mordanted, colors become much deeper.

Cotton and linen do not have the same affinity for natural dyes. They do not seem to 'take up' the dye as well. This could be because they are cellulose fibers unlike protein fibers of wool and silk. However, they do take the stronger natural dyes. For first attempts, dyeing of these fibers is not recommended. Results are harder to achieve, often resulting in uneven dyeing. Wash and colorfastness tends not to be as good either.

There are no rules for dyeing of synthetic fibers. Most acrylic will take a natural dye, sometimes even brighter than its woolen counterpart. Nylons will dye though results was paler. Processing at high temperatures cannot harm most synthetics; therefore repeated dyeing for stronger colors is not of concern.

All fibers must be free of commercial sizing, oil or dirt. It is a good idea to wash all fibers in soap before dyeing.

Yarn is best dyed in skein, tied in several places to avoid knots. It is also possible to dye woollen garments, or lengths of fabric, but is generally avoided, as it is almost impossible to achieve even dyeing. (www.dyeman.com/natural%20Dye%20recipe.htm)

F.4. Temperature

Temperature may affect the color of the natural produced. When it is too hot in the environment of the weeds, the plants becomes dry having a less concentrated solution. (Habal and de Guzman,2003)

F.5. Natural Dye Pigments

A pigment is a material that changes the color of light it reflects as the result of selective color absorption. This physical process differs from fluorescence, phosphorescence, and other forms of luminescence, in which the material itself emits light. Many materials selectively absorb certain wavelengths of light. Materials that humans have chosen and developed for use as pigments usually have special properties that make them ideal for coloring other materials. A pigment must have a high tinting strength relative to the materials it colors. It must be stable in solid form at ambient temperatures.

Over 2000 different pigments are known to be secreted by plants. The coloring matters that occur in plants are chemically and functionally diverse. Plant pigments refer to all colored compounds isolated from plants, lichens and fungi. The different types of plant pigments are classified as, carotenoids, p-benzoquinones, napthoquinones, anthraquinones, flavane derivatives, xanthones and chlorophyll.

Carotenoids are pigments found in many plants and algae and also occur in the animal kingdom. They are fat-soluble substances, thus are sometimes known as lipochrome pigments. Carotenoids vary in vary color from yellow to red which is due to a long carbon chain consisting of alternate single and double linkages. The color passes through yellow to red as chain increases. Bixin, the red pigments from the seeds of Bixa orella is a natural carotenoid which is used as dyestuff and food color.

Chlorophylls are greenish pigments which contain a porphyrin ring. This is a stable ring-shaped molecule around which electrons are free to migrate. Because the electrons move freely, the ring has the potential to gain or lose electrons easily, and thus the potential to provide energized electrons to other molecules. This is the fundamental process by which chlorophyll "captures" the energy of sunlight.

Napthoquinone pigments are hydroxyl-derivatives of the 1-4 napthoquinone and in addition possess an alkyl side chain of varying degree of complexity. Most of the napthoquinone pigments possess mordant dyeing properties due to the presence of hydroxyl group adjacent to the carboxyl group either in the same or the other nucleus.

Majority of the naturally occurring yellow pigments are derived from flavan nucleus. Some of the common yellow pigments include luteolin found in hervaceous palnt Raseda luteola or dryer's weed which yielded the best fastness to light when used on alum mordanted silk. Quercetin from the bark of Quercitron is polydroxylated flavone. (Habal and de Guzman, 2003)

G. Factors Affecting Color Preferences

Of all the choices we make about things we own-from cars to clothes, draperies to slipcovers-color influences us the most. We often base our purchases not on the advantages of a particular model or style, but on whether we really like the color.

G.1. Color Vision

In our retina, photoreceptors can be found. Photoreceptors called rod cells (rods) are very sensitive to light and function in black and white vision at night; cone cells (cones) account for color vision during the day. Both rods and cones are modified neurons. Visual pigments are embedded in folded membranes comprising a stack of discs In the outer segment of each rod and cone.(Campbell, Mitchell, and Reece, 1999)

G.2. Age

There are different preferred colors depending on what age group you belong. Young children seem to gravitate towards bright colors-primarily warm colors, such as red and yellow. One study showed that children between the ages of five and eight rejected black, white, gray and dark brown. Instead, young children preferred red, orange, yellow and violet. Warm and bright color schemes seem to complement the active and energizing nature of children. However, white color brightness and intensity are useful in attracting attention but they may not be conducive to learning.

For pre-schools and elementary, mild, soothing colors-such as warm, soft shades of white and light creams-work well as the anchor color. Stronger, brighter colors are recommended as accents and focal points. In this age category, it should be remembered that children's artwork is frequently on display, so the color scheme selected shouldn't compete with the artwork, but, rather, should compliment or enhance the display.

Teenagers, on the other hand, view primary colors as immature. These children are often influenced by prevailing fashion. Young teens typically reject neutral colors in favor of blue, ultramarine and-their current favorite-orange. In selecting a color scheme for middle schools and high schools there may be more leeway, depending on the objective. Subtle colors work well, such as light sage greens and refreshing blues and greens, with brighter, trendy and more saturated hues used as accent colors. In addition, the use of school colors also works to promote school spirit.

The situation changes in technical or trade school environments because the learning activities are different from those in a traditional classroom. Where computers are used a lot, eyestrain and glare are common problems. Mild and mid-toned wall and floor colors help produce the contrast between workstations and surroundings. In an automotive trade classroom or workspace, try using metallic faux finishes to replicate colors found in automotive finishes or race-car colors for accents that enhance the learning environment.

College-level facilities must appeal to a broader range of ages-from late teens to adults of all ages. Variety of color is important in this category. Dark, highly saturated colors can be used strategically in a classroom to avoid distraction from equipment like televisions, video monitors and projectors. Another option, as in the case of middle and high schools, is the use of school colors to promote schools spirit.

G.3. Culture

Culture plays a role too, as does region of the country. Here are several examples: in the Sunbelt, where the sun shines most days, orange may be too stimulating a color choice. In the northern part of the United States where winters tend to be gray, taupe or gray in quantity is not a good choice. On the West Coast, where day-to-day life is less conservative, bright blues and lime greens are popular choices. On more conservative East Coast, traditional and muted toned-down colors, such as hunter green and burgundy or pastels, are preferred. In the Southwest, more saturated colors are favored, possibly of the area's stark landscape.

G.4. Emotional Issues and Traditions

We are influenced by colors we knew as children and how we felt then. We never, ever forget our color associations, although some negative experiences in which certain colors were present may be submerged without remembering why we despise those colors.

Our daily judgements also are based on the traditionally associated colors of seasons, holidays, religious experiences, patriotic holidays and events, and what we see in theaters, on television and in print.

Our preferences are based on how we respond to individual colors because of psychology of color-how the colors make the people feel, for example calm or exited, secure or imaginative.

G.5. Spectrophotometer

The spectrophotometer model UV mini-1240 Shimadzu at the South East Asian Fisheries and Development Center (SEAFDEC) was used in the study. Its wavelength range is from 190.0 ~ 1100.0 nm, has a scan speed of approximately 3800 nm/min wavelength change and can scan at approximately 24-1400 nm/min. It has a light source of 20W halogen lamp (long life - 2000 hrs), deuterium lamp (socket type), with auto adjustment for maximum sensitivity. The use of the power source depends on some instances. It may change it because of the wavelength. The UV-mini uses a single beam measurement and a silicon photodiode detector. The spectrum bandwidth is 5 nm and the wavelength accuracy is Â± 1.0 nm. The photometric range of the UV-mini is -0.3~3.0 Abs for absorbance and 0.0 ~ 200 % for transmittance.

The UV Mini comes standard with a Spectrum mode that allows for full spectral data acquisition over its wavelength range. Upon completion of the spectral scan, the peaks and valleys can be marked within a few seconds. The standard peak pick function allows for clear and accurate detection of the most sensitive wavelengths.

It could not only determine absorbance and transmittance but with its over 35 different types of attachments including multicell positioners, sippers, temperature control devices, the UV Mini can provide all the tools necessary to fit your specific application. The IC program cards quickly expand the functionality of the instrument. By simply inserting the appropriate IC card into the slot on the front panel, dedicated applications such as DNA/Protein analysis can now be performed.

Chapter 3

RESEARCH METHODOLOGY

This chapter was presented the materials to be used in the process of extracting the dye and as well as the methodologies for the said processes such as collection of dye materials, extraction of dye, pretreatment of piña cloth materials, mordanting, dyeing, identification of color and evaluation of color acceptability as applied to piña cloth. Likewise, data analysis was also discussed.

I. Materials

A. Materials used in dye extraction:

(Basis: 1 gram of piña cloth to be dyed; 30 ml crude extract)

3 grams of dye source

30mL water

Cheesecloth

1 unit LPG stove

1 stainless pot

1 piece stainless strainer

Chopping board

Bolo

B. Materials used in mordanting:

1 gram of pretreated piña materials

0.05 grams of mordant (copper sulfate)

30 ml water

1 unit LPG stove

1 pair of tongs/ stick for stirring

1 piece of small aluminum pot

1 piece plastic small basin

Materials was used for dyeing:

1 gram of the mordanted piña

30 mL liquid dye extract

2-tablespoon teepol detergent

200 mL water

1 unit LPG stove

1 pair of tongs for stirring

1 piece aluminum pot

1 piece plastic small basin

II. METHODOLOGY

Collection of dye materials

A. Weeds Collection.

Five species of weeds was collected in the rice field growing naturally in the vicinity of the experimental area at Aklan State University, Banga, Aklan.

One hundred grams (100 g) of dye source was obtained from each of the parts using a sharp knife. The weeds were gathered and placed in different plastic bags according to their species.

In the weeds: *Amaranthus spinosus (*Kolitis*)*, *Ageratum conyzoides L. (*Bulak-manok*).and Euphorbia hirta (*Gatas- gatas*)*, the leaves were collected and chopped into smaller pieces using a sharp knife. In *Amaranthus spinosus(*Kolitis*)*, *Ageratum conyzoides L. (*Bulak- manok*)*, two inches of leaves were gathered while on *Euphorbia hirta (*Gatas-gatas*)*, one inch leaves were gathered.

On the other hand, *Cyperus iria* (Payong- payong) and *Mimosa pudica* (Makahiya), stalks and roots were collected respectively. The stalks and roots of each part were chopped into smaller pieces and were readied for extraction. In gathering the stalks, the researchers measured 16 inches before gathering.

The dye parts used in this study were based on the preliminary results in which different parts of each plant were extracted with dye and the extract with the most intense color was chosen.

B. Extraction

To extract the dye, the fresh leaves of the weeds were chopped and placed in a stainless pot filled with 30 ml of water. They were then boiled for 30 minutes. (Habal and de Guzman, 2003). The volume of water was maintained by adding hot water to the dye extract to compensate the water loss. While still hot, the mixture was filtered using cheesecloth. Liquid dye extract was collected and set aside in a glass jar ready for use. The transparent jar was covered to avoid insects from going inside the jar. It was stored in room temperature.

C. Pretreatment of piña cloth materials.

The piña cloth was purchased at Uswag in Kalibo, Aklan.

The materials cloth was pre- wet with tap water before mordanting and dyeing application. This is done to remove dirt, grease, starch, and other resinous impurities. (Katutubong Kulay, 1998)

It was then weighed to determine how much water it needs.

D. Mordanting.

Habal and de Guzman (2003) of PTRI developed a standard method for the mordant application as follows:

First, the mordant solution was prepared by mixing 5% copper sulfate (based on the weight of the materials to be dyed) with water using a liquor ratio of 1:30 ratio at a stainless pot. Then, the pretreated piña cloth was immersed in the mordant solution and was heated for thirty minutes at 50°C while stirring frequently. Let the solution to cool and then the mordanted material was taken out and squeezed lightly. It was set it aside or air dried for dye application.

E. Dyeing

The established standard procedure of PTRI for cogon leaves and malunggay leaves was adopted in this study. (Habal and de Guzman, 2003)

The 30 ml liquid dye extract was put in a stainless container together with the mordanted material. It was then heated for 30 minutes at 50°C while stirring frequently. The heating time starts when the solution reaches 50°C. Then, the dyed materials was lightly squeezed and washed thoroughly with tap water. One (1) teaspoon of teepol detergent was prepared. This was mixed with water in a container. The dyed materials were soaped with teepol solution. It was then air-dried until the materials were dried completely.

F. Acceptability of Color on Piña Cloth

Samples of colored piña cloth dyed with different dye yielding weeds were presented to the panelist for evaluation. There were 5 panelists to be chosen according to their expertise; 2 panelists were artists, another 2 was fashion designers and one (1) panelist was the textile and garment instructor. Score cards were distributed to the panelists. They were made to evaluate the acceptability of the color of dyed piña cloth based on its appearance. The rating scheme for evaluation is as follows:

Scale	Description	Interpretation
5	Most acceptable	The panel strongly believes that the color produced when applied to piña cloth is extremely preferable.
4	More acceptable	The panel strongly believes that the color produced when applied to piña cloth is highly preferable.
3	Moderately acceptable	The panel strongly believes that the color produced when applied to piña cloth is somewhat preferable.
2	Acceptable	The panel strongly believes that the color produced when applied to piña cloth is fairly preferable.
1	Less acceptable	The panel strongly believes that the color produced when applied to piña cloth is negligibly preferable at all.

After the samples were evaluated, the samples were again presented to the panelist but in a different order. This procedure was repeated for two sets so as to measure the reliability of the panelist.

The nature of the jobs of the panelists includes a barong Tagalog designer, a natural dye expert, a chemist, a professor/ artist, a professor in clothing and textile, a professor in arts and handicrafts, a fashion designer, a draftsman, and a professor/ designer.

G. Acceptability of different Color Concentration on Piña Cloth

Each dye- yielding weed had different concentrations. The concentration varied in the amount of dye source added to water. Concentrations 500 grams, 300 grams, and 100 grams of dye- yielding weeds were made. The crude extracts of the varied concentrations was dyed to piña cloth. The samples were presented to the panelist by source. The panelists ranked the samples from the most acceptable to the least acceptable. Each panelist was the replicate.

H. Identification of Color

For the identification of color, the UV mini 1240 Shimadzu Spectrophotometer was used. The different dye samples were subjected to spectroscopy and the UV mini 1240 Shimadzu Spectrophotometer measure the peak wavelength of absorbance of light on the dye sample. The absorbance value was then interpreted as the complementary wavelength of the true color possessed by the dye. (acept.asu.edu)

III. Data Analysis

The researchers utilized both the qualitative and quantitative form of analysis.

For the color acceptability on piña cloth, the weighted mean was obtained to know where the most acceptable color is to the piña cloth.

For the color acceptability of the different concentrations, the Kruskal-Wallis Test was used for acceptance test. Kruskal-Wallis Test determined the ranking of the treatments in different dye sources.

All levels of significance were set at 0.05.

Chapter 4

RESULTS AND DISCUSSION

A. Results

A.1 Colors Produced by the Dye Extracted from Weeds Applied to Piña Cloth.

The first objective of the study aimed to identify the colors of the dye extracted from different weeds, namely: *Cyperus iria* (payong-payong), *Ageratum conyzoides* (Bulak-manok), *Amaranthus spinosus* (Kolitis), *Euphorbia hirta* (Gatas-gatas), and *Mimosa pudica* (Makahiya) with different concentration as applied to piña cloth.

The natural dyes were obtained by boiling separately different amounts of the plant sources (1gram, 2grams, and 3grams) in 30mL water for 30 minutes. The volume of water was maintained by adding hot water to the dye extract to compensate the water loss. After 30 minutes, the extracted dye was filtered by a cheese cloth and was placed in a labeled beaker.

Using the UV mini 1240 Shimadzu Spectrophotometer, the absorbance abscissa of the weeds: *Cyperus iria* (payong-payong), *Ageratum conyzoides* (Bulak-manok), *Amaranthus spinosus* (Kolitis), *Euphorbia hirta* (Gatas-gatas), and *Mimosa pudica* (Makahiya) are 513.5 nm, 416.0 nm, 385.0 nm, 410.0nm and 503nm respectively.

In the weeds: *Cyperus iria* (payong-payong) and *Mimosa pudica* (Makahiya), the color seen was in the range of red while on the weeds: *Ageratum conyzoides* (Bulak-manok), *Amaranthus spinosus* (Kolitis), *Euphorbia hirta* (Gatas-gatas), the green-yellow range was seen.

The aforementioned data is presented in Table 1.

Table 1. Colors produced by the dye extracted from weeds applied to piña cloth in different dye concentrations.

Kinds of Weeds	Part used	Absorbance Abscissa(nm)	Color Range
Cyperus iria (payong-payong)	stems	513.5	Red
Ageratum conyzoides (Bulak-manok)	leaves	416.0	Green-yellow
Amaranthus spinosus (Kolitis)	leaves	385.0	Green-yellow
Euphorbia hirta (Gatas-gatas)	leaves	410.0	Green-yellow
Mimosa pudica (Makahiya)	roots	503	Red

A.2 Color Acceptability of the Natural Dye at Different Concentration Applied on Piña Cloth.

The next objective of the study was to determine which concentration of natural dye is most acceptable when applied on piña cloth.

Piña cloth dyed with 300% *Cyperus iria* (payong-payong) and *Euphorbia hirta* (Gatas-gatas) got the highest scores from the panelists with a rating of 3.89 each, respectively. *Euphorbia hirta* (Gatas-gatas) with 500% concentration was least acceptable to the panelist with a mean score of 3.11.

However, Kruskal-Wallis Test revealed that there was no significant difference in the acceptability of the natural dye source with different concentration when applied to piña cloth.

The abovementioned findings were reflected in Tables 2 and 3.

Table 2. Ratings of the acceptability of natural dye source with different concentrations as applied on piña cloth.

Dye Source	Concentration	Mean	Description
Cyperus iria (payong-payong)	100%	3.33	Moderately acceptable
	300%	3.89	More acceptable
	500%	3.67	More acceptable
Ageratum conyzoides (Bulak-manok)	100%	3.44	Moderately acceptable
	300%	3.56	More acceptable
	500%	3.44	Moderately acceptable
Amaranthus spinosus (Kolitis)	100%	3.89	More acceptable
	300%	3.67	More acceptable
	500%	3.2	Moderately acceptable
Euphorbia hirta (Gatas-gatas)	100%	3.56	More acceptable
	300%	3.89	More acceptable
	500%	3.11	Moderately acceptable
Mimosa pudica (Makahiya)	100%	3.33	Moderately acceptable
	300%	3.78	More acceptable
	500%	3.78	More acceptable

Table 3. Kruskal-Wallis Test on the acceptability of the different concentrations of natural dyes as perceived by the panelists.

Dye Source	Chi-Square	Asymp. Sig.	Interpretation
Cyperus iria (Payong-payong)	1.815	.404	Not significant
Ageratum conyzoides (Bulak-manok)	.138	.933	Not significant
Amaranthus spinosus (Kolitis)	1.527	.466	Not Significant
Euphorbia hirta (Gatas-gatas)	2.007	.367	Not significant
Mimosa pudica (Makahiya)	.972	.615	Not significant

B. Discussion

B.1. Colors Produced from the Different Concentration of extracts from different weeds as Applied to Piña Cloth.

This study aimed to identify the colors produced by the different concentration of extracts from different weeds *Amaranthus spinosus* (Kolitis), *Ageratum conyzoides L.* (Bulak-manok), *Euphorbia hirta* (Gatas-gatas), *Cyperus iria* (Payong-payong) and *Mimosa pudica* (Makahiya) as applied to piña cloth.

So far, there is no established data regarding dye extracted from different weeds except for Cogon(Imperata exaltata Brongn) as reported by Habal and de Guzman (2003) of the Philippine Textile Research Institute(PTRI). They revealed that when the leaves of cogon were subjected to a 30-minute boiling with liquor ratio of 1:30, the colors produced were light yellow, beige and brown. The colors were determined by specialists comparing the color of the dye extracted from cogon to the existing dye colors in the industry.

Natural dye pigments are the parts of the plant that give off the color of the dyes. Over 2000 different pigments are known to be excreted by plants. Plant pigments refer to all colored compounds isolated from plants, lichens, and fungi. Some of the natural dye pigments are carotenoids, p-benzoquinones, napthoquinones, anthraquinones and flavane derivatives. (Habal and de Guzman ,2003)

As discussed in Chapter 2, the plant pigment, carotenoid, gives off the color of the dye red. On the otherhand, the pigments chlorophyll and flavane derivatives give off the colors green and yellow, respectively.

Early humans valued colored pigments, and used them for decorative purposes. Many of these were inorganic minerals, but several important organic dyes were also known. These included the crimson pigment, kermesic acid, the blue dye, indigo, and the yellow saffron pigment, crocetin. A rare dibromo-indigo derivative, punicin, was used to color the robes of the royal and wealthy. The deep orange hydrocarbon carotene is widely distributed in plants, but is not sufficiently stable to be used as permanent pigment, other than for food coloring.

Color is produced by the reflection of selected wavelengths of light by an object. Objects can be thought of as absorbing all colors except the colors of their appearance which are reflected. A red object illuminated by white light absorbs most of the wavelengths except those corresponding to red light. These red wavelengths are reflected by the object. The red wavelength enters the eye of the observer and it is the brain that interprets it (acept.asu.edu/PiN/rdg/color/color.shtml) .

In our retina, photoreceptors can be found. Photoreceptors called rod cells (rods) are very sensitive to light and function in black and white vision at night; cone cells (cones) account for color vision during the day. Both rods and cones are modified neurons. Visual pigments are embedded in folded membranes comprising a stack of discs In the outer segment of each rod and cone.(Campbell, Mitchell, and Reece, 1999)

Pigments are also found in cone cells. There are three types of cone cells, each of which contains a visual pigment. These pigments are called the red, blue or green visual pigment. The cone cells detect the primary colors, and the brain mixes these colors in seemingly infinitely variable proportions so that we can perceive a wide range of colors. (Szaflarski)

In this study, the UV-spectrophotometer measured wavelength absorbed by the dye extract. For instance in the weed *Cyperus iria* (payong-payong), the wavelength absorbed was 513.5nm. The value of the absorbed wavelength falls in range of 500-520 nm which is interpreted as red. In the light spectrum, the range of 500-520 nm is interpreted as green. As we all know, green and red are complementary colors which means they oppose each other in the color wheel.

Even though the spectrophotometer reads the data at ±0.03 accuracy, the concentration of the diluted dye extract may affect the reading of the machine. The accuracy of ratio of the dye extract to the distilled water may have varied in the five solutions.

Other instruments such as the colorimeter and the Munsell book of colors can be used to identify the color of the material or object.

In the colorimeter, the function, data and procedure of the machine is almost the same as the spectrophotometer. The only difference is that the spectrophotometer measure the wavelengths more accurately that the colorimeter.

In the the Munsell Book of Colors, the sample is compared to the color variaties found in the book. Although it seems to be easy to use but the data that will be accumulated from this instrument will only be a qualitative one making it not very accurate compared to the colorimeter and spectrophotometer.

B.2 Concentration of Natural Dye most acceptable in terms of color and appearance on Piña Cloth.

Acceptability of color in dyed piña cloth can be influenced by various determinants such as age, sex, skin color and even on the current fashion followed.

In this study, the group of panelist used was a combination of experts in fashion designing, arts and painting, natural dyeing, clothing, and garments. These panelists were chosen because of close exposure to color especially dyes that are applied to clothing due to their job.

There are different preferred colors depending on what age group one belongs. Young children seem to gravitate towards bright colors-primarily warm colors, such as red and yellow. Teenagers, on the other hand, view primary colors as immature. These children are often influenced by prevailing fashion. Young teens typically reject neutral colors in favor of blue, ultramarine and-their current favorite-orange. College-level facilities must appeal to a broader range of ages-from late teens to adults of all ages. Variety of color is important in this category. Dark, highly saturated colors can be used strategically in a classroom to avoid distraction from equipment like televisions, video monitors and projectors. Another option, as in the case of middle and high schools, is the use of school colors to promote schools spirit.

The acceptability of color also depends on the sex of the respondent. Women tend to have different perspective from males. Most women love the hues of bright colors like red and pink while males like hues of blues and greens.

Fashion and skin color also influence the acceptability of color especially if color is applied to clothing. The current fashion suggests that people should wear clothes that suit their skin color to stand out and look good.

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. Summary

This first objective of the study aimed to identify the colors produced by the dye extracted weeds namely: *Cyperus iria* (payong-payong), *Ageratum conyzoides* (Bulak-manok), *Amaranthus spinosus* (Kolitis), *Euphorbia hirta* (Gatas-gatas), and *Mimosa pudica* (Makahiya) at different level of concentration applied to piña cloth.

The next objective of the study aimed to determine which concentration of natural dye is most acceptable in terms of color and appearance on piña cloth.

Significant Results

Colors Produced by the Dye Extracted from Weeds Applied to Piña Cloth

1. The color of the natural dye produced by the weeds *Cyperus iria* (payong-payong) and *Mimosa pudica* (Makahiya) was in the range of the red color.
2. The color of the natural dye produced by the weeds Ageratum *conyzoides* (Bulak-manok), *Amaranthus spinosus* (Kolitis), *Euphorbia hirta* (Gatas-gatas) was in the range of the green-yellow.

Concentration of Natural Dye most acceptable in terms of Color and Appearance on Piña Cloth

Kruskal-Wallis Test revealed that there was no significant difference in the acceptability of the natural dye source with different concentration when applied to piña cloth. This means that the acceptability of the natural dyes from the weeds will not change no matter what concentration it will be.

B. Conclusions

The natural dyes extracted from the weeds: *Cyperus iria* (payong-payong) and *Mimosa pudica* (Makahiya), can produce a color in the range of red while on the weeds: Ageratum *conyzoides* (Bulak-manok), *Amaranthus spinosus* (Kolitis), *Euphorbia hirta* (Gatas-gatas), can produce a color in the green-yellow range.

The concentration of the natural dyes did affect the color acceptability of the dyed piña cloth.

C. Recommendations

Based on the results and observations, the following recommendations are presented:

1. Natural dyes extracted from other species of weeds aside from *Cyperus iria* (payong-payong), *Ageratum conyzoides* (Bulak-manok), *Amaranthus spinosus* (Kolitis), *Euphorbia hirta* (Gatas-gatas), and *Mimosa pudica* (Makahiya) may also be investigated.
2. Natural dyes extracted from other species of plants may also be investigated.
3. Different mordant side from alum may be used in future studies.
4. Different extraction process may be introduced to the natural dyes.
5. Different types of cloth may also be used in future studies.
6. Factors such as colorfastness and light fastness may also be studied in future researches.

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APPENDIX A

RAW DATA

Table 1. Color Acceptability Survey (Duplicate 1)

Concentration	Payong-payong				Total
	Acceptable	Moderately Acceptable	More Acceptable	Most Acceptable	
100% Concentration	3	2	2	2	9
300% Concntration	0	3	4	2	9
500% Concentration	1	2	2	4	9
Total	4	7	8	8	27

Concentration	Bulak-Manok					Total
	less Acceptable	Acceptable	Moderately Acceptable	More Acceptable	Most Acceptable	
100% Concentration	1	1	2	3	2	9
300% Concntration	1	1	1	4	2	9
500% Concentration	0	2	3	2	2	9
Total	2	4	6	9	6	27

Concentration	Kulitis				Total
	Acceptable	Moderately Acceptable	More Acceptable	Most Acceptable	
100% Concentration	1	2	3	3	9
300% Concntration	2	2	2	3	9
500% Concentration	3	3	1	2	9
Total	6	7	6	8	27

Concentration	Gatas-Gatas					Total
	less Acceptable	Acceptable	Moderately Acceptable	More Acceptable	Most Acceptable	
100% Concentration	1	1	2	2	3	9
300% Concntration	0	1	2	3	3	9
500% Concentration	0	3	4	0	2	9
Total	1	5	8	5	8	27

Concentration	Makahiya				Total
	Acceptable	Moderately Acceptable	More Acceptable	Most Acceptable	
100% Concentration	2	3	3	1	9
300% Concntration	1	3	2	3	9
500% Concentration	2	2	1	4	9
Total	5	8	6	8	27

Table 2. Color Acceptability Survey (Duplicate 2)

Concentration	Payong-payong					Total
	less Acceptable	Acceptable	moderately Acceptable	More Acceptable	Most Acceptable	
100% Concentration	0	1	5	1	2	9
300% Concntration	0	1	2	3	3	9
500% Concentration	1	1	1	3	3	9
Total	1	3	8	7	8	27

Concentration	Bulak-Manok					Total
	less Acceptable	Acceptable	moderately Acceptable	More Acceptable	Most Acceptable	
100% Concentration	1	1	2	2	3	9
300% Concntration	0	2	3	1	3	9
500% Concentration	0	1	2	4	2	9
Total	1	4	7	7	8	27

Concentration	Kulitis				Total
	Acceptable	moderately Acceptable	More Acceptable	Most Acceptable	
100% Concentration	1	1	4	3	9
300% Concntration	1	2	2	4	9
500% Concentration	3	4	0	2	9
Total	5	7	6	9	27

Concentration	Gatas-Gatas					Total
	less Acceptable	Acceptable	moderately Acceptable	More Acceptable	Most Acceptable	
100% Concentration	2	1	3	2	1	9
300% Concntration	0	3	2	1	3	9
500% Concentration	0	3	1	2	3	9
Total	2	7	6	5	7	27

	Makahiya				Total
Concentration	Acceptable	moderately Acceptable	More Acceptable	Most Acceptable	
100% Concentration	2	4	2	1	9
300% Concntration	0	2	5	2	9
500% Concentration	0	4	2	3	9
Total	2	10	9	6	27

APPENDIX B

PLATES

Plate 1. Weed collection

Plate 2. Dye Extraction

Plate 3. Pretreatment of Piña Cloth Materials

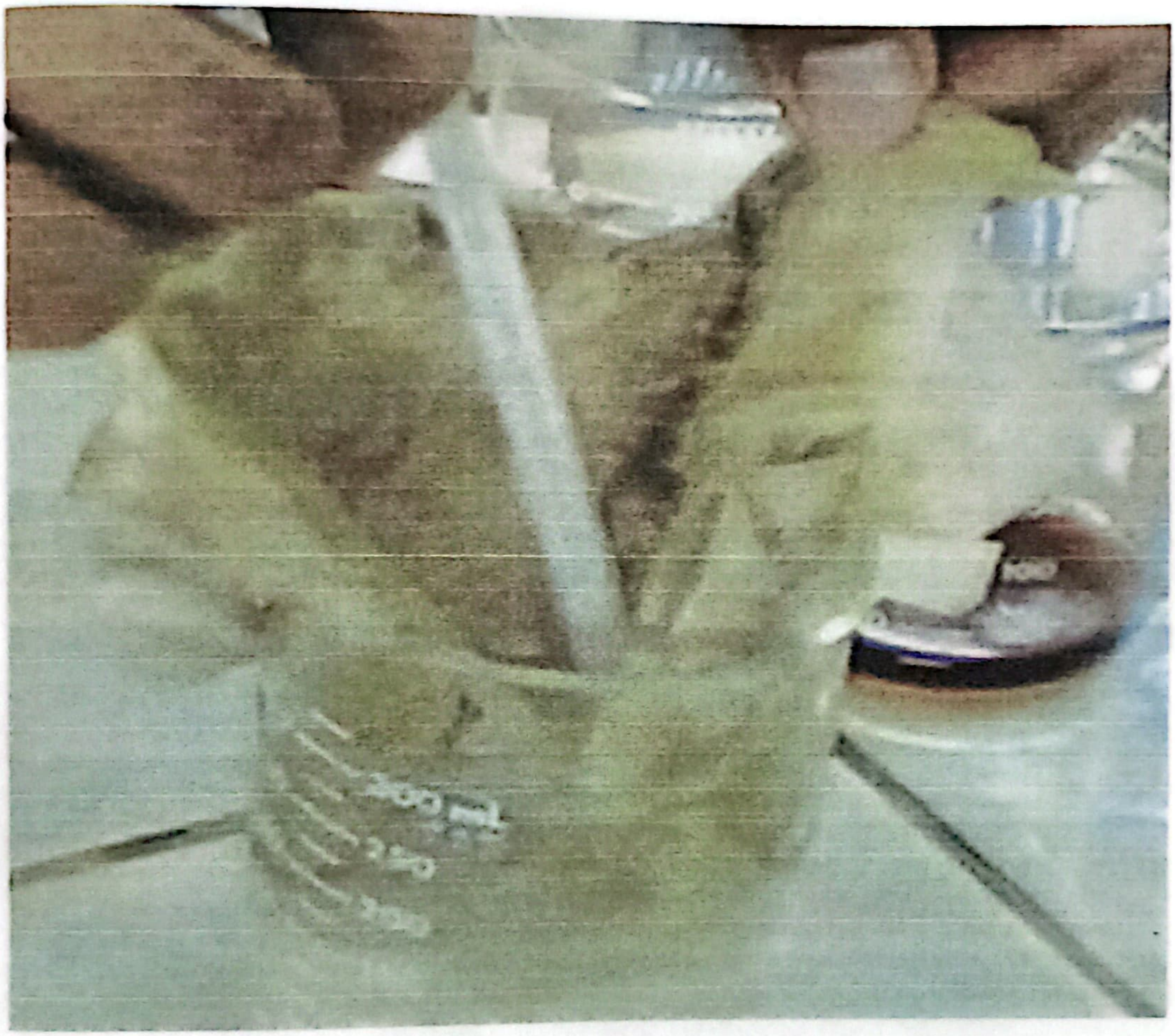

Plate 4. Mordanting

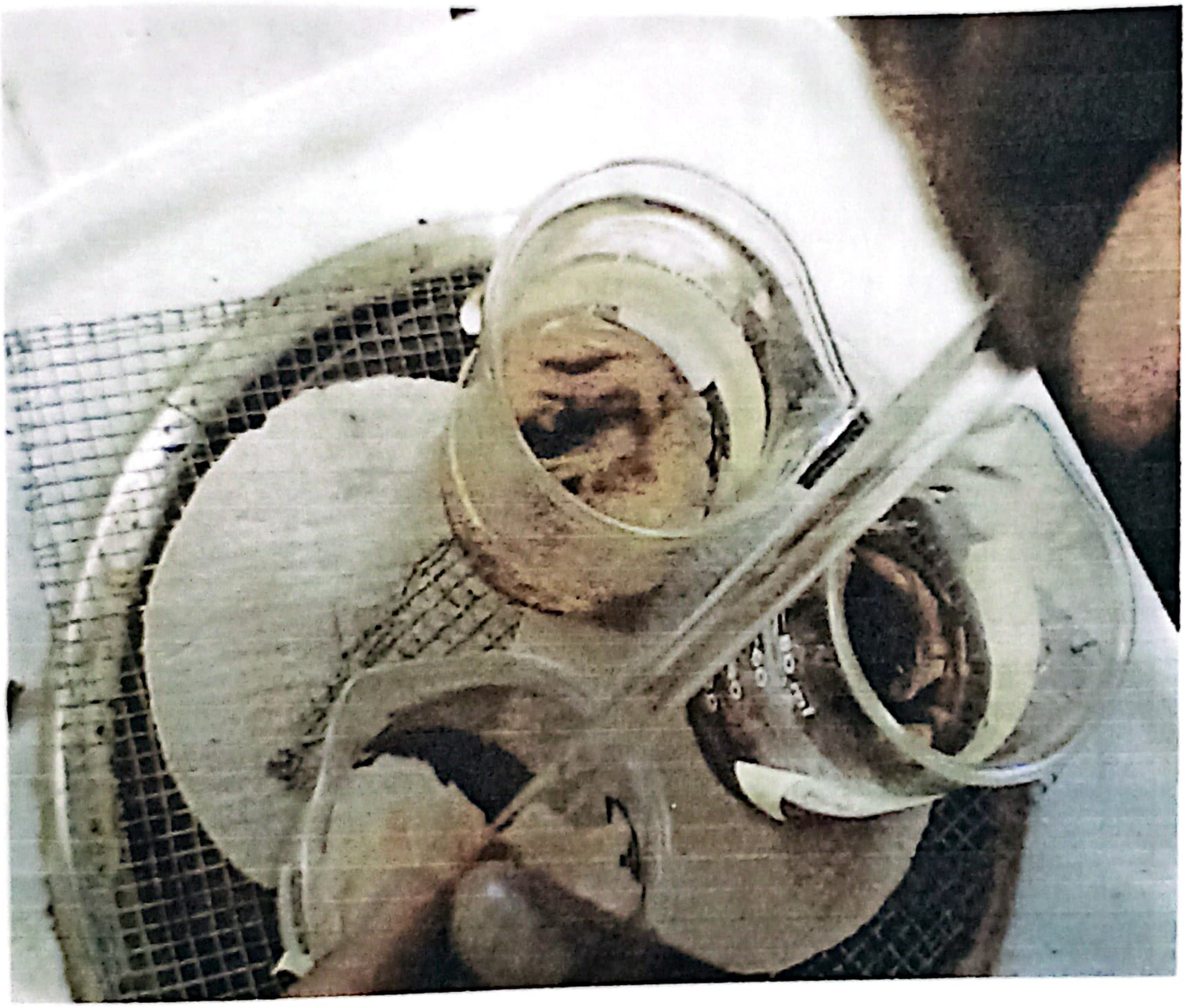

Plate 5. Dyeing of Piña Cloth

Plate 6. Drying of Dyed Piña Cloth MAterials

Plate 7. Color Acceptability Survey

Plate 8. Dye Extracts for Spectroscopy

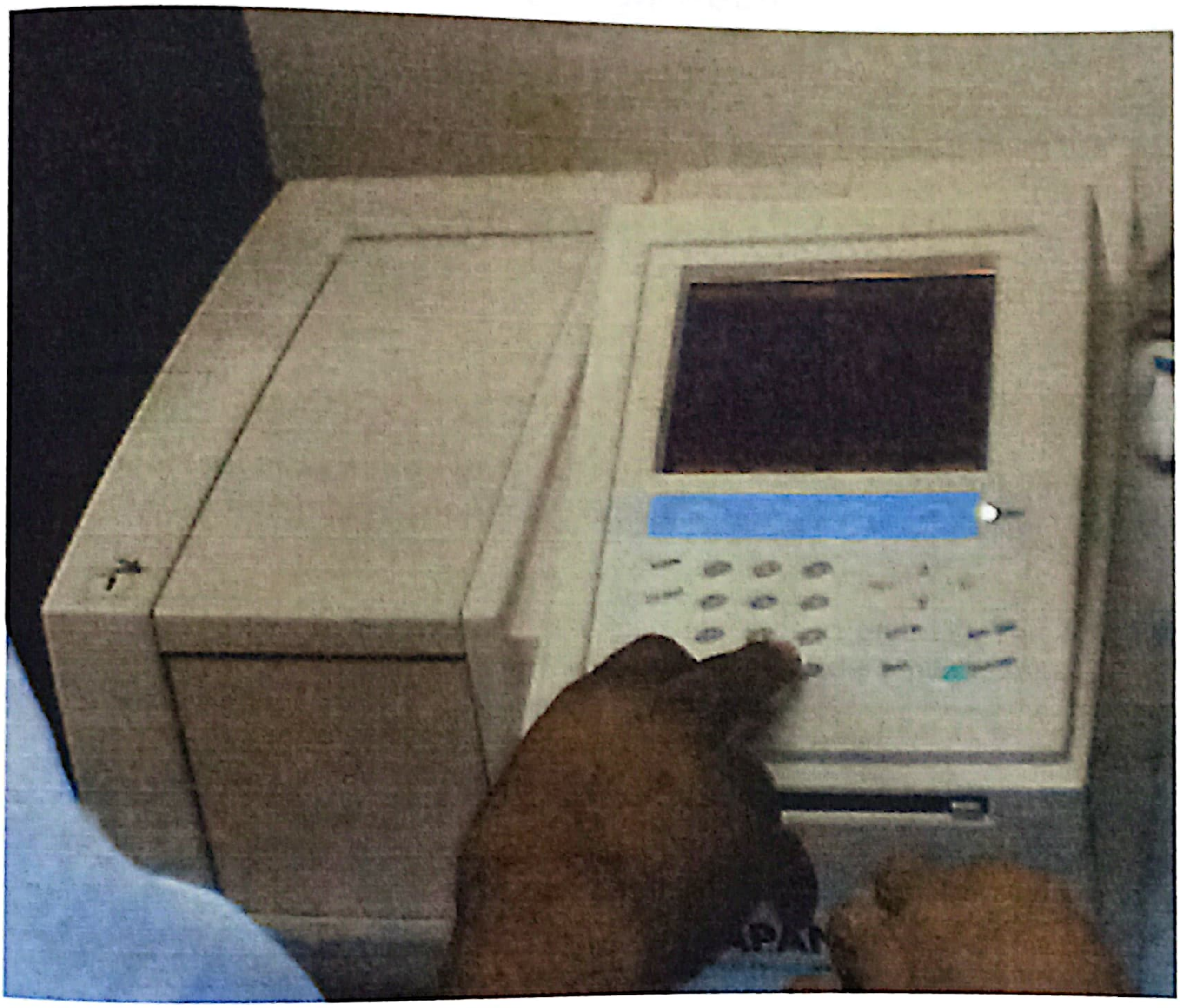

Plate 9. Spectroscopy

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bitoon, Jaro, Iloilo City

May 23, 2007

The Director
Philippine Science High School- Western Visayas
Bitoon, Jaro, Iloilo City

Madam:

Greetings!

This is in connection with our study entitled **"Color and Color Acceptability of Natural Dyes from Different Weeds Applied to Piña Cloth"** as a requirement for the subject Research 2.

In this regard, we would like to ask permission from your office that the Part 1 of our study (color acceptability of different concentrations of weeds) will be conducted at the Natural Dye Laboratory of Aklan State University, Banga, Aklan on May 29-31, 2007.

Anticipating your favorable approval for this request.

Thank you very much and God bless!

Very truly yours,

MARIELLE C. BANGHA-ON
AUBREY Y. FETALVERO
KRISTINE JOY Y. SUMANGA
Researchers

Recommending approval:

ROWENA LABRADOR
Research Adviser

Approved:

JOSETTE T. BIYO, PhD
Director III

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bitoon, Jaro, Iloilo City

May 23, 2007

DR. BENNY A. PALMA
President
Aklan State University
Banga, Aklan

Dear Dr. Palma,

Greetings!

This has reference to the research paper entitled **"Color and Color Acceptability of Natural Dyes from Different Weeds Applied to Piña Cloth"** of Ms. Kristine Joy Y. Sumanga, Marielle C. Bangha-on, and Aubrey Y. Fetalvero who are Fourth Year high school students of this institution.

In this regard, I have the honor to ask permission from your good office to allow them to use the **Natural Dye Laboratory and Facilities** located in your University on May 29-31, 2007.

Hoping that this request will merit your favorable action.

Thank you very much for your usual support.

Very truly yours,

JOSETTE T. BIYO, PhD
Director III

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bito-on, Jaro, Iloilo City

April 27, 2017

Dr. Marilyn E. Romaquin
Professor / Artist
ASU, Banga, Aklan

Sir/Madam:

Greetings!

This is in connection with our study entitled "**Color and Color Acceptability of Natural Dye from Different Weeds Applied to Piña Cloth**" as a requirement for the subject Research 1 at Philippine Science High School- Western Visayas.

In view of this, we would like to request you to be one of our panelists in determining the color acceptability of the dyed piña cloth.

Your support and favorable acceptance on this aforementioned request is highly appreciated.

Very truly yours,

KRISTINE JOY Y. SUMANGA
MARIELLE C. BANGHA-ON
AUBREY Y. FETALVERO
Student- Researchers

Noted:

ROWENA LABRADOR
Research Adviser

Approved:

MARILYN E. ROMAQUIN, PhD
Expert

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bito-on, Jaro, Iloilo City

April 27, 2007

Dr. Erlinda M. Jacinto
Professor / Fashion Designer
Kalibo, Aklan

Sir/Madam:

Greetings!

This is in connection with our study entitled "**Color and Color Acceptability of Natural Dye from Different Weeds Applied to Piña Cloth**" as a requirement for the subject Research 1 at Philippine Science High School- Western Visayas.

In view of this, we would like to request you to be one of our panelists in determining the color acceptability of the dyed piña cloth.

Your support and favorable acceptance on this aforementioned request is highly appreciated.

Very truly yours,

KRISTINE JOY Y. SUMANGA
MARIELLE C. BANGHA-ON
AUBREY Y. FETALVERO
Student- Researchers

Noted:

ROWENA LABRADOR
Research Adviser

Approved:

ERLINDA M. JACINTO, PhD
Expert

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bito-on, Jaro, Iloilo City

April 27, 2017

Mrs. Carolina I. Navarra
Professor, Clothing & Textile
ASCT, Banga, Aklan

Sir/Madam:

Greetings!

This is in connection with our study entitled "**Color and Color Acceptability of Natural Dye from Different Weeds Applied to Piña Cloth**" as a requirement for the subject Research 1 at Philippine Science High School- Western Visayas.

In view of this, we would like to request you to be one of our panelists in determining the color acceptability of the dyed piña cloth.

Your support and favorable acceptance on this aforementioned request is highly appreciated.

Very truly yours,

KRISTINE JOY Y. SUMANGA
MARIELLE C. BANGHA-ON
AUBREY Y. FETALVERO
Student- Researchers

Noted:

ROWENA LABRADOR
Research Adviser

Approved:

CAROLINA I. NAVARRA
Expert

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bito-on, Jaro, Iloilo City

April 27, 2007

Mrs. Pacencia R. Flores
Professor, Arts & Handicrafts
ASU, Banga, Aklan

Sir/Madam:

Greetings!

This is in connection with our study entitled **"Color and Color Acceptability of Natural Dye from Different Weeds Applied to Piña Cloth"** as a requirement for the subject Research 1 at Philippine Science High School- Western Visayas.

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Very truly yours,

KRISTINE JOY Y. SUMANGA
MARIELLE C. BANGHA-ON
AUBREY Y. FETALVERO
Student- Researchers

Noted:

ROWENA LABRADOR
Research Adviser

Approved:

PACENCIA R. FLORES
Expert

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bito-on, Jaro, Iloilo City

April 27, 2007

Mr. Leoncito Indelible
Barong Tagalog Designer
Banga, Aklan

Sir/Madam:

Greetings!

This is in connection with our study entitled "**Color and Color Acceptability of Natural Dye from Different Weeds Applied to Piña Cloth**" as a requirement for the subject Research 1 at Philippine Science High School- Western Visayas.

In view of this, we would like to request you to be one of our panelists in determining the color acceptability of the dyed piña cloth.

Your support and favorable acceptance on this aforementioned request is highly appreciated.

Very truly yours,

KRISTINE JOY Y. SUMANGA

MARIELLE C. BANGHA-ON

AUBREY Y. FETALVERO
Student- Researchers

Noted:

ROWENA LABRADOR
Research Adviser

Approved:

LEONCITO PINDELIBLE
Expert

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bito-on, Jaro, Iloilo City

April 27, 2017

Mr. Randy Albacino
Natural Dye Expert / Trainor on Natural Dye
Banga, Aklan

Sir/Madam:

Greetings!

This is in connection with our study entitled "**Color and Color Acceptability of Natural Dye from Different Weeds Applied to Piña Cloth**" as a requirement for the subject Research 1 at Philippine Science High School- Western Visayas.

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Your support and favorable acceptance on this aforementioned request is highly appreciated.

Very truly yours,

KRISTINE JOY Y. SUMANGA
MARIELLE C. BANGHA-ON
AUBREY Y. FETALVERO
Student- Researchers

Noted:

ROWENA LABRADOR
Research Adviser

Approved:

RANDY ALBACINO
Expert

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bito-on, Jaro, Iloilo City

April 27, 2007

Prof. Arlene B. Dela Cruz
Professor / Chemist / Trainor in Dyeing
ASU, Banga, Aklan

Sir/Madam:

Greetings!

This is in connection with our study entitled **"Color and Color Acceptability of Natural Dye from Different Weeds Applied to Piña Cloth"** as a requirement for the subject Research 1 at Philippine Science High School- Western Visayas.

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Your support and favorable acceptance on this aforementioned request is highly appreciated.

Very truly yours,

KRISTINE JOY Y. SUMANGA
MARIELLE C. BANGHA-ON
AUBREY Y. FETALVERO
Student- Researchers

Noted:

ROWENA LABRADOR
Research Adviser

Approved:

ARLENE B. DELA CRUZ
Expert

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bito-on, Jaro, Iloilo City

April 27, 2007

Mrs. Zarha P. Restar
Instructor/Fashion Designer
Banga, Aklan

Sir/Madam:

Greetings!

This is in connection with our study entitled "**Color and Color Acceptability of Natural Dye from Different Weeds Applied to Piña Cloth**" as a requirement for the subject Research 1 at Philippine Science High School- Western Visayas.

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Your support and favorable acceptance on this aforementioned request is highly appreciated.

Very truly yours,

KRISTINE JOY Y. SUMANGA
MARIELLE C. BANGHA-ON
AUBREY Y. FETALVERO
Student- Researchers

Noted:

ROWENA LABRADOR
Research Adviser

Approved:

ZARHA P RESTAR
Expert

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bito-on, Jaro, Iloilo City

April 27, 2007

Prof. Edilberto L. Solidum
Professor, Artist & Designer
Banga, Aklan

Sir/Madam:

Greetings!

This is in connection with our study entitled "**Color and Color Acceptability of Natural Dye from Different Weeds Applied to Piña Cloth**" as a requirement for the subject Research 1 at Philippine Science High School- Western Visayas.

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Your support and favorable acceptance on this aforementioned request is highly appreciated.

Very truly yours,

KRISTINE JOY Y. SUMANGA
MARIELLE C. BANGHA-ON
AUBREY Y. FETALVERO
Student- Researchers

Noted:

ROWENA LABRADOR
Research Adviser

Approved:

EDILBERTO L. SOLIDUM
Expert

Republic of the Philippines
Philippine Science High School- Western Visayas
Doña Lawaan H. Lopez Campus
Bito-on, Jaro, Iloilo City

May 4, 2007

Miss Frances Glee G. Legaspi
Banga, Aklan

Sir/Madam:

Greetings!

This is in connection with our study entitled "**Color and Color Acceptability of Natural Dye from Different Weeds Applied to Piña Cloth**" as a requirement for the subject Research 1 at Philippine Science High School- Western Visayas.

In view of this, we would like to request you to be one of our panelists in determining the color acceptability of the dyed piña cloth.

Your support and favorable acceptance on this aforementioned request is highly appreciated.

Very truly yours,

KRISTINE JOY O. SUMANGA
MARIELLE C. BANGHA-ON
AUBREY Y. FETALVERO
Student- Researchers

Noted:

ROWENA LABRADOR
Research Adviser

Approved:

____
Expert