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Strengthening Rural Livelihoods through Accelerating the Utilization of Inner Layer of Thin (Thin-u) (*Schumannianthus dichotomus* (Roxb.) Gagnep. Synonym Clinogyne dichotoma (Roxb.) Salisb.) Treatment with Hydrogen Peroxide

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စာတမ်းအကျဉ်း

ရာစုနှစ်ပေါင်း များစွာကတည်းမှ စ၍ သစ်တောများကို အမှီသဟဲပြု၍ နေထိုင်ကြသော လူသား သန်းပေါင်းများစွာတို့သည် မိမိတို့၏ စားဝတ်နေရေးအတွက် သဘာဝတောထွက် ပစ္စည်းများပေါ်တွင် မှီတင်းကြရပေသည်။ သဘာဝမှရရှိသော အပင်အမျှင်များသည်လည်း လူသားတို့၏ စားဝတ်နေရေးကို တစ်ဖက်တစ်လမ်းမှ အထောက်အကူပြုပေးနေပါသည်။ ယခုအခါ မြန်မာ နိုင်ငံတွင် ထုတ်လုပ်ကုန်ကျစရိတ် မြင့်မားခြင်း၊ အချိန်ကုန်ခြင်းနှင့် ဈေးနှုန်း မြင့်မားခြင်းတို့ကြောင့် သဘာဝ အပင်အမျှင် သင်ပင်မှ ပြုလုပ်သည့် သင်ဖြူးဖျာ၏ ဈေးကွက် နေရာတွင် အခြား ဓာတုနည်းဖြင့် ပြုလုပ်ထားသော ဖျာများ၏ ဈေးကွက်က နေရာယူနေပြီ ဖြစ်ပါသည်။ နောက်ဆက်တွဲ အနေဖြင့် သင်နှင့် စပ်ဆက်၍ လုပ်ကိုင်နေသော အသေးစား စီးပွားရေး လုပ်ငန်းရှင်များနှင့် ဖျာယက်ခြင်း လုပ်ငန်းတွင် ပါဝင်လုပ်ဆောင်နေသော ကျေးလက်နေ ပြည်သူတို့၏ စီးပွားရေး အခြေအနေကို ထိခိုက်လျက်ရှိပါသည်။ ထို့ကြောင့်လူအသုံးနည်းလာပြီဖြစ်သော စက်ရုံထုတ်အမျှင်မဟုတ်သည့် သဘာဝသင်၏ အရည်အသွေးကို တန်ဖိုးမြှင့်တင်ခြင်းအားဖြင့် ကျေးလက်နေ ပြည်သူတို့၏ စီးပွားရေးအခြေအနေကို တစ်ဖက်တစ်လမ်းမှ အထောက်အကူပြုနိုင်မည် ဖြစ်ပါသည်။ ဤသုတေသန၏ အဓိက ရည်ရွယ်ချက်မှာ သင်၏အရည်အသွေးနဲ့ အသုံးချမှုကို မြှင့်တင်၍ ဈေးကွက်မဝင်သော သင်အူကို ဈေးကွက်ဝင်စေရန် တန်ဖိုးမြှင့်တင်ခြင်းဖြစ်ပါသည်။ ယခု သုတေသနလုပ်ငန်းသည် (က) သင်ပင်တစ်ပင်တွင် ပါဝင်သော အပေါ်ကြော၊ အလယ်ကြော၊ သင်အူနှင့် သင်အူတိုင်တို့၏ ပါဝင်မှု ရာခိုင်နှုန်းကို လေ့လာခြင်းအားဖြင့် သင်ပင် တစ်ပင်၏ အသုံးချနိုင်မှု ရာခိုင်နှုန်းကို ဖော်ပြရန်နှင့် (ခ) ဟိုက်ဒရိုက်ျင် ပါအောက်ဆိုဒ် အသုံးပြုခြင်းဖြင့် အပေါ်ကြော၊ အလယ်ကြောနှင့် သင်အူတို့၏ အရောင်တောက်ပြောင်မှု၊ ကြာရှည်ခံနိုင်မှုတို့ကို စမ်းသပ်ဖော်ပြရန် လုပ်ဆောင်ခဲ့ခြင်း ဖြစ်ပါသည်။ သုတေသနလုပ်ငန်း လုပ်ဆောင်ရန် သင်ပင်စိုက်ပျိုးပြီး သင်ဖြူးဖျာ ယက်လုပ်ရောင်းချလျက်ရှိသော ဇရာဝတီတိုင်း ဒေသကြီးရှိ မြို့နယ် ၃ မြို့နယ်မှ သင်ပင်များကို စုဆောင်း၍ လေ့လာမှု ပြုလုပ်ခဲ့ပါသည်။ လက်ရှိ သင်လုပ်ငန်းတွင် သင်ပင်၏ အပေါ်ကြောနှင့် အလယ်ကြော ၂၆% ကိုသာ အသုံးပြုနိုင်ပြီး ယခုသုတေသနတွင် ဟိုက်ဒရိုက်ျင် ပါအောက်ဆိုဒ် အသုံးပြုမှုကြောင့် သင်အူအပါအဝင် သင်ပင်၏ ၅၁% ကို အသုံးပြုနိုင်ကြောင်း စမ်းသပ် တွေ့ရှိရပါသည်။ သင်အပေါ်ကြောအတွက် အရောင်တောက်ပမှုနှင့် ကြာရှည်ခံနိုင်မှု အကောင်းဆုံး အခြေအနေကို ဟိုက်ဒရိုက်ျင် ပါအောက်ဆိုဒ် ၅% တွင် ၁၂ မိနစ်မှ ၁၅ မိနစ်ကြာ၊ သင်အလယ်ကြောအတွက် ဟိုက်ဒရိုက်ျင် ပါအောက်ဆိုဒ် ၆% တွင် ၁၅ မိနစ်မှ ၁၈ မိနစ် ကြာနှင့် သင်အူအတွက် ဟိုက်ဒရိုက်ျင် ပါအောက်ဆိုဒ် ၆% တွင် ၁၈ မိနစ်မှ ၂၁ မိနစ်ကြာ စိမ်ထား ခြင်းဖြင့် ရရှိနိုင်ကြောင်း စမ်းသပ်တွေ့ရှိရပါသည်။ သင်၏ အသုံးဝင်မှုကို ဟိုက်ဒရိုက်ျင်ပါ အောက်ဆိုဒ် အသုံးပြု၍ လက်မှုပစ္စည်း အသုံးအဆောင်များ ထုတ်လုပ်ခြင်းအားဖြင့် မြှင့်တင်နိုင်ရုံ သာမက ဈေးကွက်မဝင်သည့် သင်အူကိုလည်း ပစ္စည်းငယ်များ ပြုလုပ်၍ ဈေးကွက်ဝင်ရန် ပြင်ဆင်လျက်ရှိပါသည်။ ကျေးလက်နေ ပြည်သူတို့၏ စည်းပွားရေးအခြေအနေကို အထောက်အကူ ပြုနိုင်ရုံ သာမက သဘာဝ အရင်းအမြစ်များကို ပိုမိုထိရောက်စွာ အသုံးချနိုင်ပြီး တန်ဖိုးမြှင့်တင် ပေးနိုင်သော နည်းပညာများကို ဖြန့်ဖြူးပေးခြင်းသည် အရေးကြီးသော သုတေသနလုပ်ငန်း တစ်ရပ် ဖြစ်ပါသည်။

Accelerating the Utilization of Inner Layer of Thin (Thin-u) (*Schumannianthus dichotomus* (Roxb.) Gagnep. Synonym Clinogyne dichotoma (Roxb.) Salisb.) to enhance Rural Livelihoods

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Abstract

Since decades ago, millions of people with different cultures and livelihoods systems living in or adjacent to the forests have been dependent on the natural products for their basic needs such as food, shelter and clothes. Natural plant fibers are one of them. Nowadays, with the increasing cost of production, time consuming and high price, the market for natural fiber mats made of Thin is substituting by the cheaper synthetic mats in Myanmar. This has negative effects on rural livelihoods who are mainly working on this business and who are depending on the value addition process of Thin mats for their income. The development of lesser-used or non-industrial natural fiber "Thin" should be encouraged for value addition along with socio-economic development in rural areas by supporting new technologies for higher benefits. The overall objective of this study is to upgrade the quality and additional usefulness of *Clinogyne dichotoma* (Roxb.) Salisb. , local name (Thin) and its inner layer (Thin-u) which is poorly marketable in the current situation. The specific objectives are: (1) to observe the percentage composition of four layers of Thin plant and (2) to experiment on three layers of Thin treatment with hydrogen peroxide (H_2O_2). Three standards of Thin plants from three townships in Ayeyarwaddy Division were collected as samples, tested for their layers percentage composition and treatment with 3%, 4%, 5%, 6% and 7% solution of H_2O_2 for different time durations. The results showed that average 39.69% of the whole plant composition can be utilized for making handicrafts after treatment with H_2O_2 while the usable amount was only 20.7% in the control. The favorable duration for the best quality on bleaching, brightening and strength are immersing in 5% solution of H_2O_2 for 12-15 minutes for the upper layer of Thin, 6% solution of H_2O_2 for 15-18 minutes for the middle layer of Thin, 6% solution of H_2O_2 for 18-21 minutes for the inner layer of Thin (Thin-u) respectively. From this research, the utilization of Thin can be accelerated treatment with H_2O_2 by creating traditional handicrafts made of the upper and middle layers and household utensils made of the inner layer of Thin. This value addition technology will help not only in strengthening rural livelihoods but also in the effective utilization of natural resources.

Keywords: *Clinogyne dichotoma* (Roxb.) Salisb., Hydrogen peroxide, value addition, handicrafts

Accelerating the Utilization of Inner Layer of Thin (Thin-u) (*Schumannianthus dichotomus* (Roxb.) Gagnep. Synonym Clinogyne dichotoma (Roxb.) Salisb.) to enhance Rural Livelihoods

1. Introduction

Since decades ago, millions of people with different cultures and livelihoods systems living in or adjacent to the forests are dependent on the natural products for their basic needs such as food, shelter and clothes. Natural fibers are one of them.

Natural fibers are the substances produced by the plants and animals that can be spun into filaments, thread or rope. They become fabrics after woven, knitted, matted or bonded that serve as basic materials to our society. They are the renewable sources and special supplements for polymer based materials. With the increasing awareness of environmental conservation, the development of natural fiber composite materials or environmentally friendly composites has been increasing interest to supplement the synthetic materials not only because they are renewable but also they can be used for energy conservation (Sanjay et.al, 2016). Natural fibers has been utilized by human since dawn of the civilization and their application is growing in many sectors such as furniture, construction, packing, decoration, medicines, food for both human and animals, textiles, and also for other biopolymers and fine chemicals (Reddy & Yang, 2005).

Natural fibers are produced in almost all over the world and used to manufacture a wide range of traditional and novel products from textiles, ropes and nets, brushes, carpets and mats to paper and board materials. Some fibers are used by transforming to threads or yarns that are used to join or attach and to form bonds and weaves (Dam, 2008). Some industrial fibers such as cotton need intensive labors for the value addition while other fibers such as *Clinogyne dichotoma* are value added by small scale enterprises with local labors especially rural people who make handicrafts to get their side income.

By the introduction of cheaper synthetic substitutes and the increasing cost of production, the trade markets and export of most of the natural fibers such as Jute, Sisal and Flax have been declining in the past decades (Dam, 2008). This has negative effect on the economy not only from national to local small scale enterprise but also to household level who are depending on this value addition process for their income.

Approximately 2.2 billion people which is 67% of world total rural population live in rural areas of Asia where historically poverty has been concentrated (Chen & Ravallion, 2007, FAOSTAT, 2017). In Myanmar, 2/3 of population live in rural areas mainly depending on agricultural production, extraction of forest products and other farm related activities. Even though agriculture for food production is the major contribution to the rural livelihoods, it is important to establish other rural development programs such as diversification of economic activities of farm households not only for the economic sustainability but also for employment opportunities in rural areas. Moreover, these rural development programs should support resource efficiency as a base of rural economy in long-term perspective.

Due to the growing demand caused by the economic and the demographic rise of population, utilization of the Earth's resources has been continuously increasing, yet understanding and the implementing the policies for resource efficiency by public and private

decision makers and the civil society is weak (UNEP, 2017). Resource efficiency is maximizing the supply of money, materials and other assets by efficiently converting them into finished products or services with minimum wasted natural resource expenses, which means using the Earth's limited resources in a sustainable manner (Wikipedia, EU commission, 2017). Increasing resource efficiency not only brings economic opportunities but also stimulate new technologies and boost employment. Improving management of resource stocks and optimizing production processes are one of the steps in value chain to be upgraded (EU commission, 2017).

Myanmar is a tropical country rich in biodiversity with diverse ecosystems providing several ecosystem services. Among them, provisioning services such as food, fibers, and fuels are directly contributing to the livelihoods of people. While several utensils have been made from industrial fibers such as cotton, Jute (Shaw) and Shaw-phyu (local name) which are widely grown in Myanmar (Khin Maung Lwin, 1995), traditional handicrafts such as mats, ropes, bags, baskets, hats, and some religious utensils are also made from plant fibers such as Lotus, Water Hyacinths and Thin.

'Thin' plant, *Clinogyne dichotoma* (Roxb.) Salisb., is the source of raw material for hand-making traditional mats (Thinbyu). Nowadays, especially rural people use traditional mats woven by Thin while urban people use synthetic mats because they are cheaper and easy to carry. This is revealing the increasing substitution of synthetic products in the place of natural handicrafts. Moreover, as only the upper 2 layers of the whole plant can be used to make the mats and because of high cost of production, the price of the final product mat is high. Yet no other handicrafts are made from Thin apart from the mats although the inner part (Thin-u) is used as the rope just to tie the farm products and the pith is completely useless. Therefore, the development of lesser-used or non-industrial natural fiber Thin should be encouraged for resource efficiency along with socio-economic development in rural areas by supporting new technologies or value addition to receive higher benefit.

1.1 Objectives

The overall objective of this study is to upgrade the quality and accelerate additional usefulness of *Clinogyne dichotoma* (Roxb.) Salisb. , local name (Thin) and also its inner layer (Thin-u) which is poorly marketable in the current situation.

The specific objectives are:

1. To observe the percentage composition of four layers of Thin plant,
2. To experiment on three layers of Thin treatment with hydrogen peroxide (H_2O_2) for their quality on bleaching, brightening and strength

2. Literature Review

2.1 Thin "*Clinogyne dichotoma* (Roxb.) Salisb"

Schumannianthus dichotomus (Roxb.) Gagnep. Synonym *Clinogyne dichotoma* (Roxb.) Salisb., also known as 'cool mat', is the plant belongs to the family Marantaceae (WCSP).

Scientific classification:

Kingdom	Plantae
Phylum	Tracheophyta
Class	Liliopsida
Order	Zingiberales
Family	Marantaceae
Genus	Schumannianthus
Specific Epithet	Dichotoma
Higher Classification	Marantaceae
Scientific Name	Clinogyne dichotoma (Roxb.) Salisb.

Clinogyne dichotoma (Roxb.) Salisb., *Maranta dichotoma* (Roxb.) D.Dietr., *Maranta dichotoma* (Roxb.) Wall., *Phrynium dichotomum* Roxb., *Thalia dichotoma* (Roxb.) Roxb., *Thalia dichotoma* (Roxb.) Roxb. ex Link. are synonyms of *Schumannianthus dichotomus* (Roxb.) Gagnep. The species widely found in Myanmar is cited as *Clinogyne dichotoma* (Roxb.) Salisb. Geographically *S. dichotomus* is distributed in northeast Bangladesh, West Bengal, Assam, Burma, Thailand, Cambodia, Vietnam, Peninsular Malaysia, Borneo and the Philippines. It has several names as Pati Doi in Assamese, Murta, Mostak and Patipata in Bengali, and Lum nuoc in Vietnamese (WCSP, Wikipedia).

It is a small perennial dichotomously branched shrub that grow generally on low land and swamps. The plant is about 90-180 cam height with beautiful highly polished green color (Figure 1-b). The average diameter of the plant at top portion is about 2.8cm, middle 3.0cm, and bottom portion is 3.6cm (Bor, 1953; Royle, 1983).

In Myanmar, *C. dichotoma* is distributed in Ayeyarwady, Bago, Kachin, Shan, Taninthayi, and Yangon with common names as Thin, Thin-byu, Thin-phyu. It is tropical herbaceous perennial plant and well grown in muddy riparian areas (Kress et.al, 2003).

Harvesting of Thin is done manually using a sharp knife every 3 years of plantation and the price depends on the length of the plants. Mostly, the pricing is decided on the visual perceptions on the standing plants of the plantation area. Harvested Thin is bundled and brought into the place where the sticks are manually split into two and the pith is removed (Figure 4). The split sticks are sun dried for 2 to 3 days and then soaked in water for one night. On the next day, the soaked sticks are layered as upper layer, middle layer, and the inner layer (Thin-u) and sun dried again. The dried layers are sent to the market directly or can be kept until 2 years. Only the upper and middle layer are used to make the mats and sold at the market while the inner layer (Thin-u) is not marketable and used as the ropes.

The common use of fibers is separating the fibers from the rest of vegetable matters and it can be done by striping the bark from the plant or subsequently washing. This is usual method and the fiber is loosened and easily separated by maceration or boiling (Royle, 1983).

In the chemical process of refining the fiber, it includes boiling the fiber in a chemical solution where the amount of chemical used and the duration depends on the quality and chemical composition of the fiber and the bark (Mishra, 2000). Treatment of fibers with the chemicals appeared to be a promising degumming method, however, the process conditions had to be carefully optimized for the best results (Doraiswamy, 1991).

Bleaching is the important process for cellulosic grey goods (Tzanon et.al., 2001: Geeta and Sunanda, 1997) and it results uniform absorbency, whiteness and high degree of dye ability (Gursoy and Hall, 2001). The aim of bleaching is to produce white fabrics by destroying coloring matters with the help of bleaching agents (Shenai, 1991).

Hydrogen peroxide is shown to be the safest bleacher whose superiority than other chemicals is that it produces superior whiteness and higher absorbency. However, the concentration of hydrogen peroxide should be used wisely for the bleaching to prevent degradation of material (Pandey et.al., 1995; Chattopadhyay and Sharana, 2000; Pan et.al., 2001) as the concentration depends on the variety of the fiber. The fineness of fibers obtained after bleaching with H_2O_2 bleaches were the best for Ramie *Boehmeria nivea* (Kalita, 2004).

3 Materials and Method

3.1 Study area and sample plants selections

Ayeyarwaddy Region is the place where Thin plant is widely grown in its swampy fields. The quality and grade of Thin plant is characterized as three: First grade if the length of the plant is above 7.6 feet, Second grade for the length below 7.6 feet and Third grade for below 4.6 feet length (Figure 2-b). 10 plants for each 3 grades of Thin plants from three villages in Pantanaw township, Wakema township and Ma-ubin township in Ayeyarwaddy Region were collected as samples. Pantanaw township is the highest Thin plantation place with 4000 acres because of plenty of riparian areas and it is the main market of Thin plants for other Thin mats-making business, while there are only 100 acres of plantation in Wakema township and 20 acres in Ma-ubin township. The main buyers of Pantanaw Thin plants are from Danubyu township, Hinthada township, Zalun township and Ingapu township for its best quality and higher percentage of upper and middle layers of Thin plant due to better management of the plantation.

3.2 Laboratory experiments

3.2.1 Preparing the samples

The collected plant materials from the study areas were transported to the Wood Base Panel Section in Forest Research Institute Yezin and the experiments were conducted.

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3.2.2 Experiment

There are three steps to do this experiment**:**

1) Measuring the composition of the plant layers
2) Hydrogen peroxide boiling method
3) Treatment with Hydrogen peroxide, H_2O_2

1) Measuring the composition of the plant layers

Total 30 Thin plants for each 3 grades were measured in feet corrected to the second decimal place. Measurement was taken with the help of measuring tape, from the top after the shoot to the ground level. The total weight of the plants were measured as green weight and then split as 4 layers and allowed to air-dry under the shelter at temperature ranging from 20-30°C and the composition of layers percentage were measured.

2) Hydrogen peroxide boiling method

For the treatment with H2O2, the mixture solution has to be made first. Mix 50% concentration of Hydrogen peroxide (H2O2) solution with water using a proportion of 3% to 6% H2O2 (e.g. 30ml to 60ml H2O2 for every 1 liter of water).

3) Treatment with Hydrogen peroxide, H_2O_2

The bleaching of extracted fibers was carried out with different concentrations of Hydrogen peroxide (H2O2) for different periods of time. Three layers of Thin plants were boiled respectively in 3%, 4%, 5%, 6% and 7% concentration of H2O2 solution at 100°C with the cover, checked for every 3 minutes and tested till 30 minutes (Table 3). The bleached and dried fibers were evaluated for their physical properties such as whiteness, and strength.

4. Results and Discussion

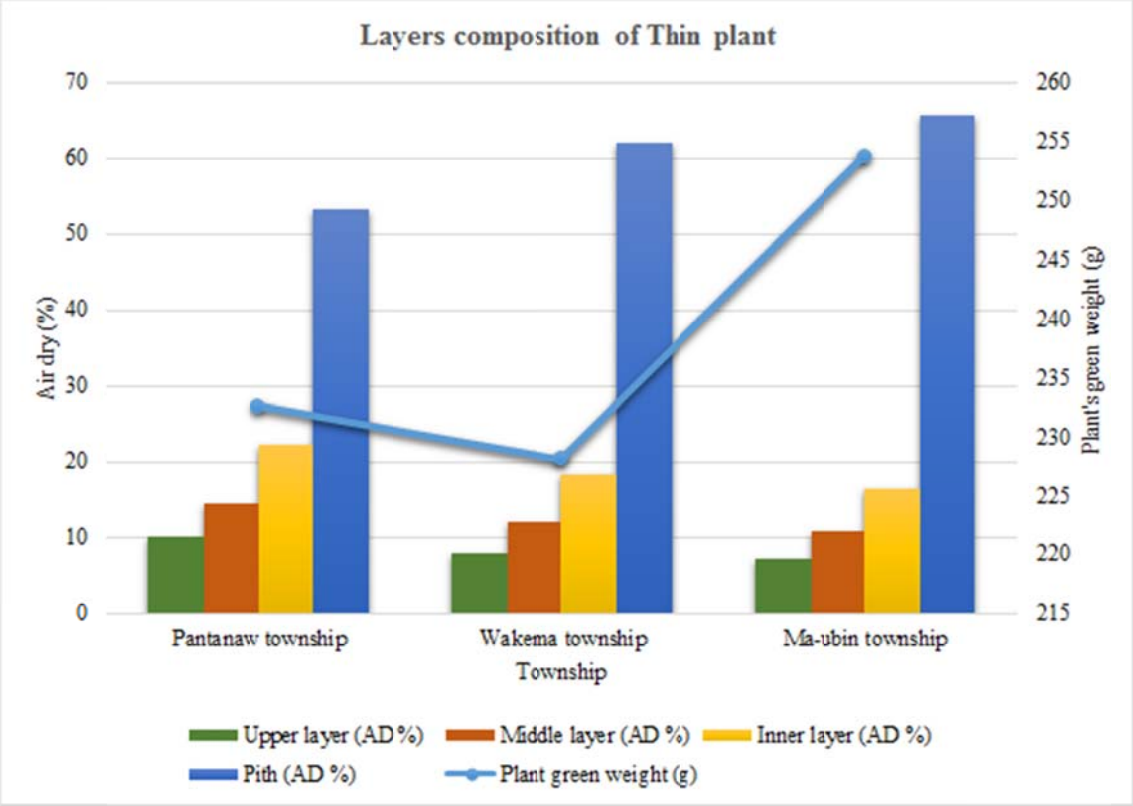
According to the measuring results for the grades, surprisingly Third-grade Thin plants with the length of below 4.6 feet were the one with highest composition of upper and middle layers (Table 1). The First and Second-grade Thin plants have lower composition of upper and middle layers and higher composition of the pith than Third-grade. The interesting point here is why they are denoted as High-grade Thin plants. This is because plantation owners and business owners judge the grade of Thin plant according to its length as the price of the final product Thin-phyu mat increases with its length.

Table 1: Composition of the layers of Thin plants according to their length

Composition of Thin plant's layers	Length below 4.6 feet			Length below 7.6 feet			Length above 7.6 feet		
	PTNaw tsp	WKMa tsp	MUBin tsp	PTNwtsp	WKatsp	MUBntsp	PTNaw tsp	WKMatsp	MUBin tsp
Average weight (g)	83.20	78.20	80.50	203.00	198.00	230. 00	411.40	408. 00	450.50
Upper layer (Air-dry %)	14.60	12.14	9.70	8.47	6.06	7.04	6.93	5.50	4.46
Middle layer (Air-dry %)	18.33	14.71	14.16	13.05	10.10	11. 00	12.23	10.98	6.97
Inner layer (Air-dry %)	28.49	24.04	20.87	19.90	15.76	14.44	18.67	15.12	13.59
Pith(Air-dry%)	38.58	49.11	55.27	58.57	68.08	67.52	62.17	68.40	73.98

After measuring the composition of the layers, the Thin plants from three townships were compared. Among them, the composition of upper and middle layer in the plants from Pantanaw township have the highest percentage composition while the plants from Wakema township as second highest and Ma-ubin township as third highest (Figure.1)

Figure 1: Average composition of the layers of Thin plants in three townships



The results from the treatment with hydrogen peroxide showed that average 39.69% of the whole plant composition can be utilized for making handicrafts after treatment with H_2O_2 while the usable amount was only 20.7% in the control. Moreover, the suitable duration and concentration of H2O2 to test the bleaching, brightening and strength for each layer were experimented. All layers of Thin plant are treated with 3-7 % concentration of H_2O_2 in different duration (3-30) minutes to fine their best quality. The favorable duration for the best quality on bleaching, brightening and strength are immersing in 5% solution of H_2O_2 for 12-15 minutes for the upper layer of Thin, 6% solution of H_2O_2 for 15-18 minutes for the middle layer of Thin, 6% solution of H_2O_2 for 18-21 minutes for the inner layer of Thin (Thin-u) respectively (Table 2).

Table 2: Experiment for the suitable duration and concentration of Hydrogen peroxide treatment to Thin Plant

Thin plant's layer	**Suitable concentration of H_2O_2**	**Treatment duration (minutes)**
		Boiling water and cover with the lid
Inner layer	6 %	18-21
Middle layer	6 %	15-18
Upper layer	5%	12-15

5. Conclusion and Recommendation

Clinogyne dichotoma (Roxb.) Salisb. is lesser-used and non-industrial fiber plant in Myanmar. With its habitat on riparian and swampy areas in Asia, its main use is for making the mat manually in the cottage industry. With the limited literature on this plant, there is no research information about the value addition of Thin fiber for the purpose of efficient utilization. This research experimented on the value addition of Thin fiber treatment with Hydrogen peroxide for its efficient use with the aim to encourage creating more diversity of handicrafts along with socio-economic development in the rural areas.

The measurement for the layer composition of Thin plant reveals that currently *Clinogyne dichotoma* (Roxb.) Salisb is a plant with less efficient use for its layers. The usable layers are the upper and middle layers which accounts for only 20.7% of the whole plant while the usable amount is 39.69% after treatment with H2O2. The solution of H2O2 value added to make use of the inner layer and this is why the usable amount of layer was increased twice than the one without treatment.

From this research, the utilization of Thin can be accelerated treatment with H_2O_2 by creating traditional handicrafts made of the upper and middle layers and household utensils made of the inner layer of Thin. This value addition technology will help not only in strengthening rural livelihoods but also in the effective utilization of natural resources. For the rural development, the government could help to empower rural communities by creating more employment opportunities or disseminating new technologies or diversifying economic activities for the long-term perspective.

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WCSP: World Checklist of Selected Plant Families

Appendices

(a) (b)

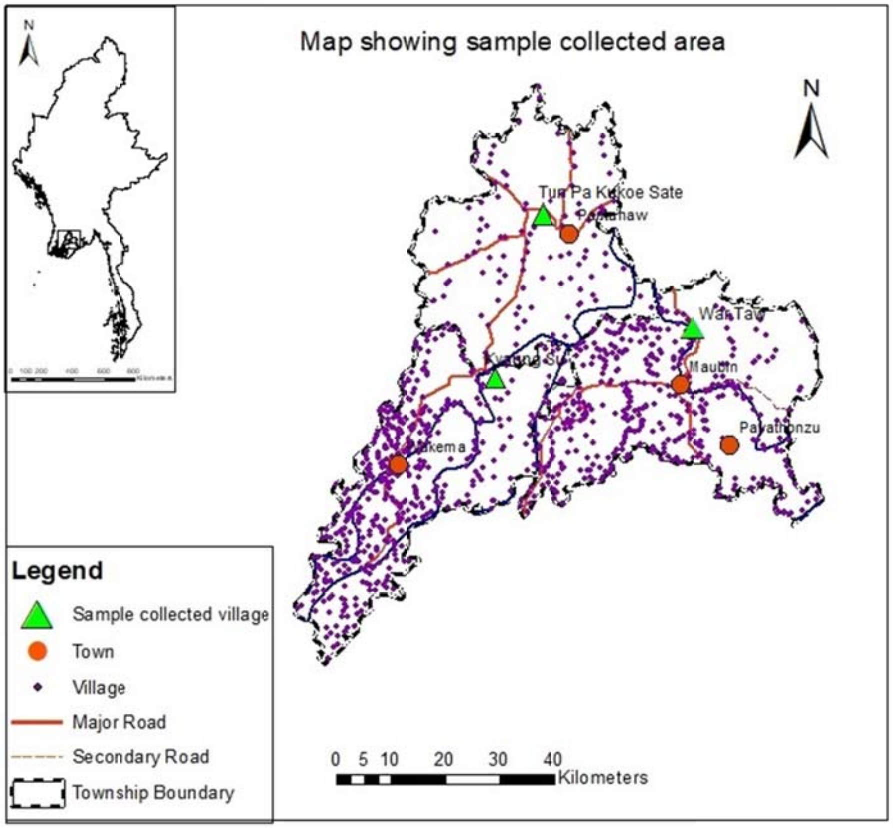
Figure 2: (a) Plantation of Thin *Clinogyne dichotoma* (Roxb.) Salisb (b) Polish green color Thin plant

(a) (b)

Figure 3: (a) Author collecting Thin plants (b) 3rd, 2nd and 1st Grade Thin plants


Figure 4: Author weighing Thin plants in the field


Figure 5: Layering Thin plant by the villagers


Map showing sample collected area
N
Tun Pa Kukoe Sate
Maubin
Legend
Sample collected village
Town
Village
Major Road
Secondary Road
Township Boundary
0 5 10 20 30 40
Kilometers