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Kampus Tapah

FACULTY OF APPLIED SCIENCES

SCIENTIFIC PROJECT COLLOQUIUM

2024



Final Year Project Colloquium 2024
Faculty of Applied Sciences,
Universiti Teknologi MARA,
Perak Branch Tapah Campus,
35400 Tapah Road, Perak, Malaysia.

Colloquium date 12 July 2024

Publication date 30 October 2024

Proceedings of Extended Abstracts

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e-I.S.B.N: 978-629-97630-4-8

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Preface

The Scientific Project Colloquium offers a platform for publishing Diploma Science final year projects (FYP). The objective is to effectively distribute research findings throughout all scientific disciplines. The primary objective of including final year projects into the course curriculum is to encourage students to put their theoretical knowledge into practical applications.

We would like to express our gratitude to our primary establishment, the Faculty of Applied Sciences and Universiti Teknologi MARA, Perak Branch, for their invaluable assistance.

Lastly, we would like to express our gratitude to all of the authors for the tremendous help in preparing the articles, without which this undertaking would not have been completed.

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October 2024

PAPERMAKING WITH TURMERIC AND LEMONGRASS LEAVES

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Abstract: This study explores the use of turmeric and lemongrass leaves in papermaking. The objectives are to determine the best ratio for producing high-quality paper. In this study, 7 samples with different ratios were tested. The process of papermaking involved cutting, boiling, blending and then straining and drying the leaf mixture. The samples have the same amount of volume to ensure the samples have the same thickness and size. The samples were analyzed for their quality based on air flow, solid filtration and tensile strength. Among the samples, the sample with a ratio of 1:2 (turmeric to lemongrass) has the best quality of paper due to its tensile strength and overall quality.

Keywords: *papermaking, turmeric, lemongrass, solid filtration, tensile strength*

INTRODUCTION

Paper is an essential material that can be used in daily life, whether it is used in office, school and various personal purposes. Paper is also a biodegradable material that can replace plastic in the production of packaging and bags (Balea et al., 2020). In addition, the pulp and paper industry is the world's fourth-largest in terms of energy consumption, accounting for 6% of overall industrial energy consumption and 2% of direct CO₂ emissions (Corcelli et al., 2018). The shortage of wood supply has increased concern about sustainable resources that drive non-wood sources for pulp and papermaking (Mohamad & Jai, 2022). The alternative to pulp in this study is by using turmeric leaves and lemongrass leaves, which do not involve the use of wood. Besides the acute water shortage in certain countries and environmental pollution caused by retting methods, there is a demand for new techniques and materials for papermaking (Jahan et al., 2016). Furthermore, the search for alternative petroleum-based products has increased the need for innovative solutions for replacing material from trees to produce more eco-friendly paper production (Ang et al., 2021).

Turmeric has gained global popularity due to its increased cultivation and productivity, especially its curcuminoid content, which is crucial for both domestic and international demand (Visakh et al., 2023). Turmeric is also known for its medicinal properties and culinary uses, thus it is a great choice for papermaking material. In recent reports, the discarded parts of turmeric, such as leaves and stems, have their own functionality due to their curcumin and bioactive compounds. According to recent reports, the wasted parts of turmeric, such as the leaves and stems, also have their own functionality from their curcumin and other bioactive components (Yan & Asmah, 2010). Lemongrass, on the other hand, has a different texture and aromatic quality of paper. The fibers of lemongrass leaves significantly reinforce the mechanical properties of the composites, as shown in an analysis study (Kurien et al., 2022). Lemongrass leaves also have a strong fibrous structure as well as a refreshing scent that can be retained in the paper production. Lemongrass (*Cymbopogon citratus*) leaves contain phytochemical constituents that provide health benefits and can be extracted using water, ethanol, or hexane; all these extracts have antibacterial properties against undesirable bacteria (Alzobaay, 2019). This makes both turmeric and lemongrass perfect materials for the papermaking process.

METHODOLOGY

The turmeric leaves and lemongrass were cut into small pieces and boiled separately. Boiling the leaves helps to remove lignin and softens the fibers to make it easier to blend into a pulp. The leaves were then transferred to a blender to produce a finer texture. Seven (7) different ratios were prepared to determine the best ratios for producing high-quality paper. The ratios are shown in Table 1 below:

Table 1. Sample ratios of Turmeric and Lemongrass Leaves

Sample Number	Tumeric to Lemongrass Ratio	Percentage tumeric leaves	Percentage lemongrass leaves
1	1:1	50%	50%
2	0:1	0%	100%
3	1:0	100%	0%
4	2:1	67%	33%
5	1:2	33%	67%
6	3:1	75%	25%
7	1:3	25%	75%

The pulp is then poured into individual mold and spread evenly to form a sheets of paper. To ensure uniform thickness each sample has the same volume of 100ml and was subjected to compression to remove excess water. The sampels were left to dry thoroughly for testing.



Figure 1: Papermaking process

The first testing is call air flow test, that use to determine the sample air's absorption. Each sample were placed in front of mini electric fan to allow air to flow through it. The palm of hand was placed to feel any air that passed through the paper. This test is used to assessing the porosity and breathability of each sample. Beside that to evaluated the paper's ability to filter or retain solid particles. A pinch of flour was sprinkle on the top of the paper to observe

any flour spilled or pass through the sample. The final testing is the tensile strength of each sample to measure the paper's durability and strength. The sample was measured using a spring balance and maximum force is applied until the paper tore up.

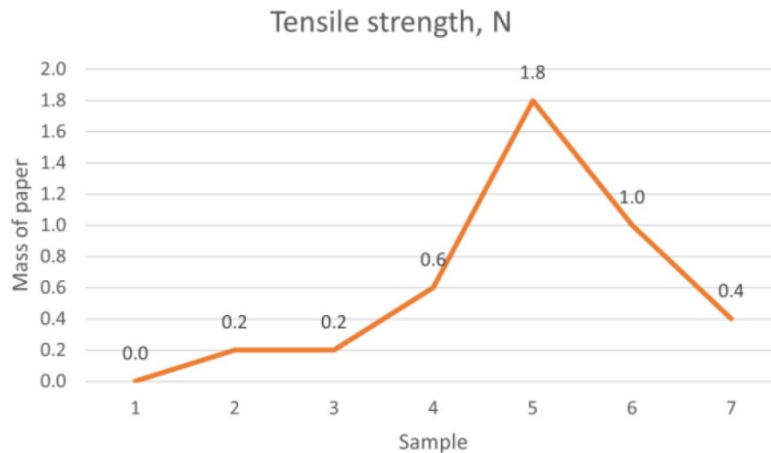


Figure 2: Testing the air flow, solid filtration and tensile strength.

FINDINGS

Table 2 Summarizes the results of the various tests conducted on the samples.

Sample	Air Flow	Flour Filtration	Tensile Strength, N
1	Yes	Yes	0.0
2	Yes	No	0.2
3	No	Yes	0.2
4	Yes	No	0.6
5	No	Yes	1.8
6	No	Yes	1.0
7	No	No	0.4



Graph 1: Graph of tensile strength for all the sample

The table 2 above shows sample 1,2 and 4 allowed air to flow through the sample. This indicate the sample has better breathability. Higher lemongrass content tends to decrease air flow due to increased paper density and able to reduce porosity. As for solid filtration test, shows that sample 2,4 and 7 effectively prevent solids from passing through. These sample with higher percentage of lemongrass has ability to filter out solid particle. As for the tensile strength varied significantly. Sample 5 with ratio of 1:2 (turmeric to lemongrass) exhibited the higher tensile strength which is 1.8 N that making it the most durable. The tensile strength refer to the maximum force that the material can sustain before it fracture or break(Parsai et al., 2024). While sample 1 and 3 had the lowest durability due to sample 3 has 100% of tumeric leaves, tumeric leaves have a shorter and less robust compare to lemongrass. This result a less uniform fiber distribution and weaker bonding.

CONCLUSIONS

The study shows that different ratio sample of turmeric and lemongrass leaves influences the quality of paper sample. Higher lemongrass content will decrease the air to flow in the sample and also higher solid filtration test. Higher percentage of lemongrass also provide higher tensile strength the makes the sample more durable. Compare to tumeric leaves opposite with lemongrass due to its porous structure and lower durability. Thus, the optimal sample should be selected based on the ratio leaves with higher percentage of lemongrass. Sample 5 based on the finding appears the most optimal option among other ratio sample. For further research, using a different types of leaves or material to produce paper and to explore more types of testing to get more quality and effective results. Beside that, the shift towards paper-based packaging instead of using plastic will cause environmental issues in future(Nurul Syahida et al., 2021).

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Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023

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Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

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Saya yang menjalankan amanah,

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Setuju.

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