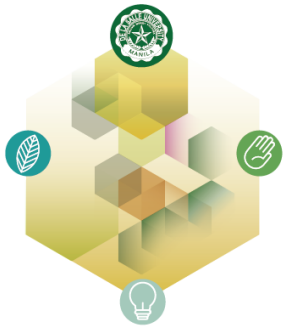
DLSU RESEARCH CONGRESS 2023
MANILA, PHILIPPINES
JULY 5-7, 2023
Fostering a Humane and Green Future:
Pathways to Inclusive Societies and Sustainable Development



Acceptability of Carbonized Mango (*Mangifera indica*) Peel as an Alternative Ink for Whiteboard Marker

Axel Gio Martirez[1], Charmaine Anne Del Pilar [1], Erin Rosabelle Joaquin[1], James Earviel Arcilla[1], and Zoe Britannia Fernandez[1]

[1] *Muntinlupa National High School*

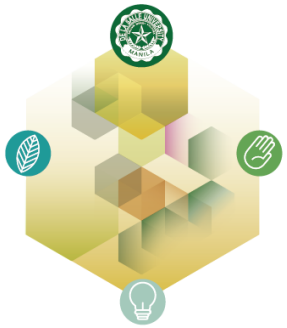
**Corresponding Author: princess.larosa@deped.gov.ph*

Abstract: *Mango, a tropical fruit, has been declared the national fruit of the Philippines. They have 2.5 million smallholder farmers and over 7 million mango trees. These produce a massive amount of waste that affects the environment. This research is intended to utilize mango peels as a raw material for whiteboard marker inks by increasing the concentration of the carbons to see how it affects the properties of the ink. In the process of making an ink, the Arabic gum and silicone oil served as resin, the carbon powder served as pigment, and lastly, the distilled water and 70% alcohol served as the solvent. The carbon powder was obtained by carbonizing the mango peels and sifting them through a 200-mesh sieve. The carbon concentration variations are 45g, 50g, and 55g. The powder will be dissolved in 74 ml, 82 ml, and 90 ml of water with respect to the carbon concentrations: 5 g of Arabic gum, 35 ml of 70% isopropyl alcohol, and 0.6g of silicone oil per 4g. Then the solution is stirred until the composition is uniform. The outcome demonstrated that the density, viscosity, pH, erasability, odor, drying time, and pigment of the ink are all affected by the addition of the mango peel carbon concentration. The carbonized mango peel ink's properties, which are quite similar to those of commercial ink, include 5 grams of mango peel carbon concentration, a viscosity of 3.55 seconds of time flow, pH of neutral to slightly basic (8), drying time of 9.70 seconds, density of 0.9125, erasability that is quite easy to erase, and ink pigment is dark enough to be able to read. It is to say that the null hypothesis was rejected since the carbonized mango peel was acceptable as alternative ink for whiteboard marker in terms of the said parameters.*

Key Words: *Mango peels; carbon concentration; solvent; white board marker;*

DLSU RESEARCH CONGRESS 2023
MANILA, PHILIPPINES
JULY 5-7, 2023

Fostering a Humane and Green Future:
Pathways to Inclusive Societies and Sustainable Development

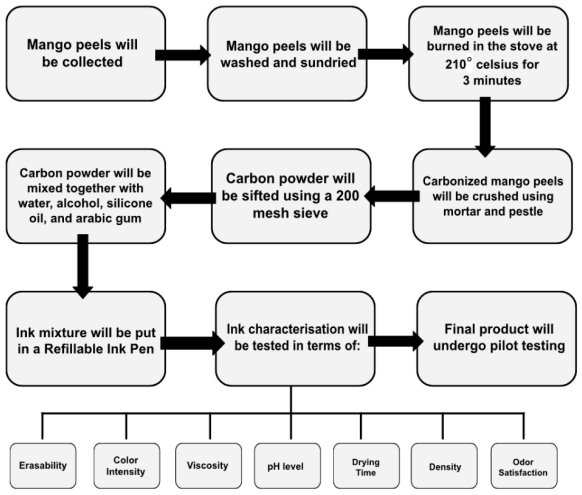


1. INTRODUCTION

Markers are widely used in Philippine Schools because of their clean appearance and ability to produce more vivid and opaque lines. They are also more user-friendly and popular in educational settings. Although markers are inexpensive, they also have a strong odor that can cause stomach upset and headaches. The researchers discovered that Mango (Mangifera indica) peel is an organic material that can be used as an alternative marker ink in this study. Mangoes, the Philippines' national fruit, are grown on more than 7 million trees by two million and five hundred thousand small - scale farmers. With this peel, waste is a significant problem. Making inks from natural materials has a number of benefits, including being less expensive and safer, as well as contributing to less environmental waste and pollution. This study aims to show that mango (*Mangifera indica)* peel-derived charcoal can be utilized as an alternative ink for whiteboard markers. Despite the fact that ink is freely available, the researchers think that having less expensive and more organic ink could have an impact on the environment. The researchers tested the effectiveness of their alternative whiteboard marker's color intensity, viscosity, pH level, and odor satisfaction.

2. METHODOLOGY

2.1 Carbonization Process



2.2 Production of Ink Solution

The mango Peel Ink was produced in the following setting:

Sample	Mass of Carbon (gram)	Volume of distilled water (mL)	Mass of Oily Silicone Polymer (0.5 grams per 4 grams)	Mass of Arabic Gum (gram)	Volume of Alcohol (mL)
A	45	74	4.56	5	35
B	50	82	4.09		
C	55	90	7.93		

The alternative ink was put in the ink tubes of used refillable whiteboard markers. Following the preparation of the marker, the ink was tested by the researchers to determine its characteristics.

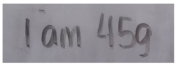
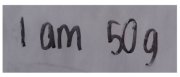
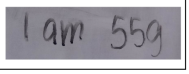
2.3 Descriptive equivalence of the acceptable rate proportion's range.

Point	Scale	Descriptive Equivalent
4	4.00 - 3.26	Very Acceptable
3	3.25 - 2.51	Quite Acceptable
2	2.50 - 1.76	Acceptable
1	1.75 - 1.00	Not Acceptable

Note. From "The Use of Charcoal and Isopropyl Alcohol as Innovative Alternative Ink for Whiteboard markers: A Comparative Analysis Between the Innovation and Commercialized Ink," by Barrameda, J., 2022. Permission not sought.

3. RESULTS AND DISCUSSION

Table 1. The color Intensity

No.	Mass of Carbon	Color Intensity
1	45 grams	
2	50 grams	
3	55 grams	

As shown in table 1, the carbon concentration of Mango peel and the color intensity of the ink are not directly proportional as we can see that 50g is much more pigmented than 55g.

Table 2. The Viscosity

No.	Mass of Carbon	Viscosity (time; seconds)
1	45 grams	3.41
2	50 grams	3.55
3	55 grams	4.56
4	Commercialized ink (Pilot Ink)	46.82

Table 2 showed that the ink made from mango peel flows faster than commercialized ink. The viscosity decreases as the amount of water increases.

Table 3. The pH Level

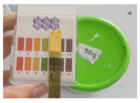
No.	Mass of Carbon	pH level of Ink
1	45 grams	
2	50 grams	
3	55 grams	

Table 3 showed that the pH of ink from the carbon of mango peel is almost neutral and is in the basic alkaline range. Thus shows that it is acceptable.

Table 4. The Drying Time

No.	Mass of Carbon	Drying Time (seconds)
1	45 grams	4.95
2	50 grams	9.70
3	55 grams	10.03

As shown in table 4., the standard ink dries in 2.21 seconds, which is a result of the ink's low viscosity. The drying takes around 4.95 seconds for 45g , 9.70 seconds for 50g, and 10.03 seconds for 40g, respectively.

Table 5. The Density

No.	Mass of Carbon	Density (g/cm³)
1	45 grams	0.9088
2	50 grams	0.9125
3	55 grams	1.084

According to the Indonesian National Standard (SNI) the ink has a density of 0.9-1.00 gram/cm^3. The carbon concentration of mango peel has a linear correlation with the mass of a substance. As shown in table 5, the density of a substance is the ratio of its mass to its volume; as the mass of a substance increases, so does its density.

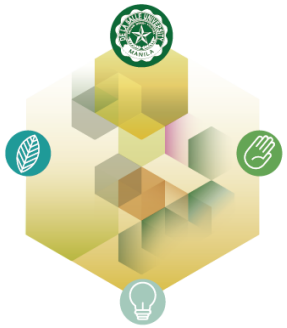
Table 6. The Erasability

No.	Mass of Carbon	Erasability (5 mins)	Erasability (10 mins)	Erasability (15 mins)
1	45 grams			
2	50 grams			
3	55 grams			

According to the findings, all three samples with increasing carbon concentrations were easily erased. However, findings also revealed that when the ink samples were left unerased for a longer duration of time, they became more difficult to erase.

Table 7. Odor of 50g Carbon

Indicators	M	Descriptive Equivalent
1. The odor of the carbonized mango peel ink is good	2.65	Acceptable
2. The odor of the carbonized mango peel ink is distinct from the smell of paint thinner	2.7	Acceptable
3. The odor of the carbonized mango peel ink does not bother the user in any way in terms of writing	3	Acceptable
4. The odor of the carbonized mango peel ink does not spread when being used	3.35	Very Acceptable
5. The odor of the carbonized mango peel ink is not too strong	3.1	Acceptable
Total Average:	2.96	Acceptable



In table 7, to determine the acceptability of the alternative ink's odor, the five (5) questions. The survey results revealed that the odor is tolerable, does not smell like a paint thinner, does not disturb the users in any way, does not spread when being used, and is not too strong. Overall, the respondents rated the odor of the alternative ink (50 g) as "Acceptable.

Table 8. Color Intensity of 50g Carbon

Indicators	M	Descriptive Equivalent
1. The whiteboard marker is acceptable to use for writing.	3.3	Very Acceptable
2. The color intensity of the carbonized mango peel ink satisfies my expectations in terms of its depth.	3.1	Acceptable
3. From a distance, the carbonized mango peel ink is visible.	3.4	Very Acceptable
4. The carbonized mango peep ink produces a deep black tone that is appealing to the eyes.	3.0	Acceptable
5. The carbonized mango peel ink maintains its intensity.	3.3	Acceptable
Total Average:	3.22	Acceptable

In table 8, to determine its color intensity of the organic ink is acceptable, the five (5) questions. Based on the observation, the organic ink has a good color intensity which passed the test. It satisfies the user which makes it acceptable to use for writing. It is also visible and it produces a dark color which can be seen easily. Overall, the respondents assess the color intensity of organic ink (50g) is Acceptable.

Table 9. Consistency of 50g Carbon

Indicators	M	Descriptive Equivalent
6. The pigment of the carbonized mango peel ink does not fade eventually.	3.4	Very Acceptable
7. The drying of the carbonized mango peel ink is fast.	3.25	Acceptable
8. The carbonized mango peel ink can be easily erased.	3.55	Very Acceptable
9. The carbonized mango peel ink does not appear blotchy when used for writing.	3.15	Acceptable
10. The carbonized mango peel ink's thickness has satisfied me.	3.25	Acceptable
Total Average:	3.32	Very Acceptable

In table 9, to determine if the consistency of the organic ink is acceptable, the five (5) questions. Based on the observations, the ink does not fade gradually when being written. The ink dries rather fast, the ink is easily erased, it does not appear blotchy, and its thickness has satisfied the respondents. Overall, the respondents assess the consistency of organic ink (50g) as "Very Acceptable".

4. CONCLUSIONS

Mango peels can be used as an alternative in making whiteboard marker inks. With the goal of developing more organic and cheaper alternative ink, and aiding in waste reduction, this study utilized carbonized mango peels as one of the main sources of the ink. The increasing carbon concentrations in the ink making creates a significant impact on the properties of the ink. The viscosity, density, and drying time of the ink are directly proportional to the carbon concentration; as the carbon content increases, the value of the ink properties also increase (viscosity, density, drying time). Thus, it was to say that the null hypothesis was rejected since the carbonized mango peel was acceptable as an alternative ink for whiteboard marker in terms of the said parameters.

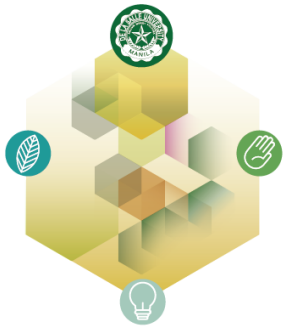
5. ACKNOWLEDGEMENTS

We, as researchers, gained so much support and guidance while making this research study. We would first like to thank the donors of our main variable (Mango peels) in our study, OMG store and Fruitas. We would also like to thank Mrs. Princes C. La Rosa, Our Research Adviser. Teacher in Muntinlupa National High School - Main. We also would like to acknowledge our Adviser and Homeroom teacher, Sir George B. Gatdula.

6. REFERENCES

Bernstein, L. (2019, February 14). *New Global Survey Offers Snapshot of Technology in the Classroom.* EdTech. https://edtechmagazine.com/k12/article/2019/02/new-global-survey-offers-snapshot-technology-classroom-2019?fbclid=IwAR2iwz9T3Kko8mLtOE2zJ6gIOD4waIXzWe1_xYRU12JSE14EOODSkqNSY5M

Dagde. K.K., Nwosa G. I., & Ukpaka, C. P. (2019) Formulation of White Board Marker Ink Using Locally Sourced Materials. *EJERS, European Journal of Engineering Research and Science, 4*(3), 107-114. https://doi.org/10.24018/ejeng.2019.4.3.1108



Dou, R., (2018, October 30). *Silicone Oil is Widely Used! Let's Learn Silicone Oil Production Technology*. LinkedIn. https://www.linkedin.com/pulse/silicone-oil-so-widely-used-lets-learn-production-technology-dou

Fatimah, S., Mustika, N., & Pratiwi, S. (2020). Carbon Ink Characterization from Banana and Cassava Peels by Carbonization Method. *JKPK (Jurnal Kimia dan Pendidikan Kimia), 5*(2), 159-166. https://jurnal.uns.ac.id/jkpk/article/view/33386

Lithium-Ion Energy Storage Devices. *Energy and Fuels,* 35 (13), 10878-10889. https://doi.org/10.1021/acs.energyfuels.1c01226

Lohner, S. (2018, November 15). *Make Your Drawing Float!* Scientific American. https://www.scientificamerican.com/article/make-your-drawings-float/#:~:text=In%20a%20dry%2Derase%20marker,as%20a%20whiteboard%20or%20glass.

Mohd Basri, M.S., Liew Min Ren, B., Talib, R. A., Zakaria, R., & Kamarudin, S.H. (2021). Novel Mangosteen-Leaves-Based Marker Ink: Color Lightness, Viscosity, Optimized Composition, and Microstructural Analysis. *Polymers, 2021, 13, 1581.* https://doi.org/10.3390/polym13101581

Speight, J. (2017). Industrial Organic Chemistry. In J. G. Speight & B. Heinemann (Eds.), *Environmental Organic Chemistry for Engineers* (pp. 87-151). Elsevier Science. https://doi.org/10.1016/B978-0-12-804492-6.00003-4.

What Are the Ingredients of Dry-Erase Markers? (2020, April). Reference. https://www.reference.com/science/ingredients-dry-erase-markers-bca76d260ce79048