ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 14, Issue, 04, pp. 65442-65447, April, 2024
https://doi.org/10.37118/ijdr.27845.04.2024

RESEARCH ARTICLE OPEN ACCESS

FROM WASTE TO RESOURCE: TRANSFORMING RICE HUSK AND BANANA PEEL INTO ECO-FRIENDLY PAPER PLATE

Armamento Mycaela D., Barairo Francheska Vera P., Canales Jasper Matthew Y., Iranzo Patrick James C., Magmanlac Gad Truman H., Rosento Alliah Ashly A., Saldua Paul Ranni J., Tuzon Troy P. and Bagui Joyce C.

LPU-Laguna, Philippines

ARTICLE INFO

Article History:

Received 17th January, 2024
Received in revised form
20th February, 2024
Accepted 23rd March, 2024
Published online 30th April, 2024

Key Words:

Waste transformation, Eco-friendly paper plates, resource efficiency, Sustainable practices, and Organic waste.

****Corresponding author:***
Armamento Mycaela D

ABSTRACT

The study addressed the imperative challenge of waste reduction and environmental impact by proposing a novel approach to create eco-friendly paper plates from transformed rice husks and banana peels. The objective was to explore the viability of these agricultural and organic waste materials as alternative resources for paper plate production, mitigating environmental harm and fostering resource efficiency. This experimental study evaluated the resulting eco-friendly paper plates' physical properties and consumer perceptions, considering tensile strength, thickness, water absorbency, and burst strength. The research contributed to sustainable practices by introducing an innovative paper plate base material and assessing its potential for broader adoption. The methodology involved combining rice husk and banana peels, assessing physical attributes, and gauging consumer preferences through surveys. Detailed examinations were presented in the tables that covered physical properties, consumer options, and practical attributes of these innovative plates. The findings implied that despite variations and limitations, eco-friendly paper plates held promise in terms of both physical properties and consumer perceptions, aligning with the sustainability trend and enhanced product qualities. Additionally, the study explored various materials to create an environmentally friendly paper plate. The researchers advised adjusting the rice husk to banana peel ratio for customized results and suggested adhering to industry and government standards for quality and uniformity, ensuring consumer and business acceptance. This innovation aligned with the growing demand for environmentally conscious products and showcased the viability of utilizing agricultural waste for creating functional and environmentally beneficial consumer goods.

Citation*: *Armamento Mycaela D., Barairo Francheska Vera P., Canales Jasper Matthew Y., Iranzo Patrick James C., Magmanlac Gad Truman H., Rosento Alliah Ashly A., Saldua Paul Ranni J., Tuzon Troy P. and Bagui Joyce C. 2024. *"*From Waste to Resource: Transforming Rice Husk and Banana Peel into Eco-Friendly Paper Plate*". International Journal of Development Research*, 14, (04), 65442-65447.

INTRODUCTION

Paper plates were widely used for serving food due to their convenience. Despite being compostable and biodegradable, their production contributed to deforestation, causing the loss of around 4 billion trees annually. To address this issue, making paper plates from rice husk and banana peel offered a solution. Conventional paper plate production relied on wood pulp, leading to forest depletion and biodiversity loss. Utilizing agricultural waste like rice husk and banana peel as alternatives can decrease the demand for wood-based materials, reducing deforestation and promoting sustainable land practices. Banana peels were quickly grown and harvested but were often underutilized, primarily used as natural fertilizer and animal feed. The significant environmental concern posed by banana peel waste arose from its substantial percentage (30% to 40%) of the total banana weight (Ewing-Chow, 2022).

This resulted in a yearly global waste of about3.5 million tons of banana peel, containing carbon-rich organic compounds that can take years to break down, releasing odorous gases and greenhouse emissions contributing to climate change.The Philippines, a major banana producer, had a challenge in mitigating this wastage, particularly in the CALABARZON region, with tens of thousands of tons of discarded banana peel, according to a study conducted by the Department of Agriculture in the Philippines. The high cellulose content of banana peel also offered potential for paper production. To address these issues, optimizing banana peel utilization could lead to more sustainable practices and products (Agustina, 2018). The Philippines, a significant global rice producer, needed help with substantial waste from rice husks. Despite being the seventh-largest rice producer, only 5% of the 1.8 million metric tons of rice husks produced annually were used productively for energy generation and soil enhancement. At the same time, the majority were discarded through incineration or decay, contributing to environmental

degradation. The growing waste issue was evident from the estimated 3.96 million metric tons of rice husk waste in 2021, a consequence of increasing rice consumption (Barra et al., 2022). Efforts were being madeto repurpose agricultural waste like rice husks and banana peels. Research has shown that rice husk fibers, rich in cellulose, were ideal for paper production due to their strength and durability. Moreover, lignin found in rice husks could be utilized to create sustainable polymers. Investigations had explored rice husk-filled polymeric composites, studying their impact on various materials. The versatility of rice husks extended to uses like insulation and animal feed, making them a valuable resource (Prasanniya, 2023). This highlighted the potential to transform waste into valuable products and promote sustainable practices in various industries. Sourcing rice husks from local farmers in Calauan, Laguna, could bring about substantial benefits for these stakeholders. For local farmers, using rice husk and banana peel can create an additional stream of income that taps into resources that would otherwise go to waste. Additionally, this approach could lead to a more positive public image for market vendors, showcasing their commitment to sustainable practices. By creating a symbiotic relationship between local farmers and market vendors, sourcing rice husk and banana peel can foster economic growth, reduce waste, and promote sustainable practices in Laguna. This collaborative effort aligned with global trends in sustainable agriculture and positioned the local community for long-term prosperity while fostering environmental stewardship. In support of sustainable practices, this study emphasized the importance of embracing resource efficiency and sustainable practices by transforming rice husk, banana peel, and recycled paper into eco-friendly paper plates. Through repurposing waste as a valuable resource, it did not only address environmental concerns but also offered a practical and eco-conscious alternative for the sustainable production of eco-friendly paper plates.

evaluating the physical properties of the paper plates. Consumer perceptions were assessed through surveys targeting eco-friendly consumers, street vendors, households, and event attendees. The study involved a sample size of 120 participants with a set alpha error threshold of 0.10 and a 90% power level, striving for enhanced precision in identifying actual effects, represented by a Cohen's d effect size of 0.30. The materials selection process was crucial, aiming to identify sustainable materials meeting the functional requirements of eco-friendly paper plates while minimizing environmental impact. The study delved into various material options, from recycled paper to biodegradable plastics and plant-based substrates, exploring alternatives to traditional disposable dining products.

The treatment solution code 256 pertains to the sodium hydroxide to water and rice husk solution wherein the sodium hydroxide will be responsible for breaking down the molecular structure of the rice husk, almost turning it into a slimy texture which is desirable for the grinding and mixing procedure towards the end. The treatment solution code 256 was observed to have a 1 hour and 30 minutes cooking time because it was found during the trial and error that any less than the time determined would result in the rice husk to be still quite tough, almost not changing its molecular structure. Meanwhile, the treatment solution code 367 pertained to the sodium hydroxide to water and banana peel solution wherein again the sodium hydroxide took care of the breaking down of the molecular structure of the banana peel, making it soft, which is desirable for the grinding and mixing procedure at the end. The treatment solution code 367 underwent 10 minutes of cooking time as it was discovered during trial and period sessions that the optimal time of cooking for banana peels should be around the time frame; lower time would result in the material being unbothered while higher time would result in the

Table 1. Materials

Materials	Specification	Source	Quantity
Rice Husk Solution:			
Rice Husk		Rice Mill Plant (Calauan)	250 grams
Water	Tap water		2000 ml
Sodium Hydroxide (NaOh)	Food Grade (caustic soda)	Online Shop (Lazada)	80 grams
Banana Peel Solution:			
Banana Peels	Ripe: could be green with a trace of yellow to yellow with a trace of green Picked up with room temp storage	Vendors' waste (Calamba City Public Market)	750 grams
Water	Tap water		4000 ml
Sodium Hydroxide (NaOh)	Food Grade (caustic soda)	Online Shop (Lazada)	180 grams
Recycled Paper Solution:			
Recycled Paper	White paper: bond paper, Oslo paper, and typewriting paper	Junkshops, Printshops, and offices (Calamba)	100 grams
Water	Tap Water		500ml
Materials:			
Water	Tap Water		7 liters
Stainless steel Deep Basin	35cm (22" x 16")		1 unit
Plastic Pail	20 L		1 unit
Measuring Cups			1 unit
Weighing Scale	Electronic kitchen scale (sf-400 digital scale max. 5kg)		1 unit
Mold and Deckle	14'' x 16''		1 unit
Blender	1000 watts		1 unit
Pelon Cloth	20'' x 20''		20 yards
Dishwashing Sponge			2 units
Stock Pot	11 quarts use stainless steel		2 units
Wooden Boards	10'' x 50''		2 units
Plate Molder	9-inch dia.		2 units
Vinyl Gloves		Online Shop (Lazada)	1 box of 100

METHODOLOGY

The researchers employed an experimental design to test the combination of rice husk, banana peels, and recycled paper for creating eco-friendly paper plates. Two treatment solutions for rice husk and banana peels were developed and tested for thickness, burst index, tensile strength, and water absorbency. The FPRDI Pulp and Paper Testing Laboratory in UPLB served as the source for

material being too mushy and would eventually mix in with the water due to overcooking and over breakdown. The treatment solution code 489 was combined and gradually soaked the recycled paper in water enough for the soaked material to be easily ground towards the final mixing. The treatment solution code 489 did not require cooking time as soaking the material in water gradually could change its molecular structure. The eco-friendly paper plates underwent lab testing to determine their physical properties, with experiments set for further refinement. The questionnaire was validated by an expert and then

used in a survey to gauge consumer acceptability. The study involved experiments and surveys to gather and analyze numerical data, ensuring accuracy. Statistical analysis, using weighted mean and frequency percentage distribution, assessed variable values, including the ratios of banana peel mixtures and rice husk used. Collected raw data was organized into tables, depicting product components, manufacturing processes, and quality assessment through various experiments. Tensile strength, water absorbency, burst strength, and thickness were measured and compiled into detailed tables. Survey data, evaluated through a 9-point scale, aimed to measure variability and analyze quality and consumer perception variables. The questionnaire was validated by an expert, and the results were presented in tables with thorough explanations and interpretations.

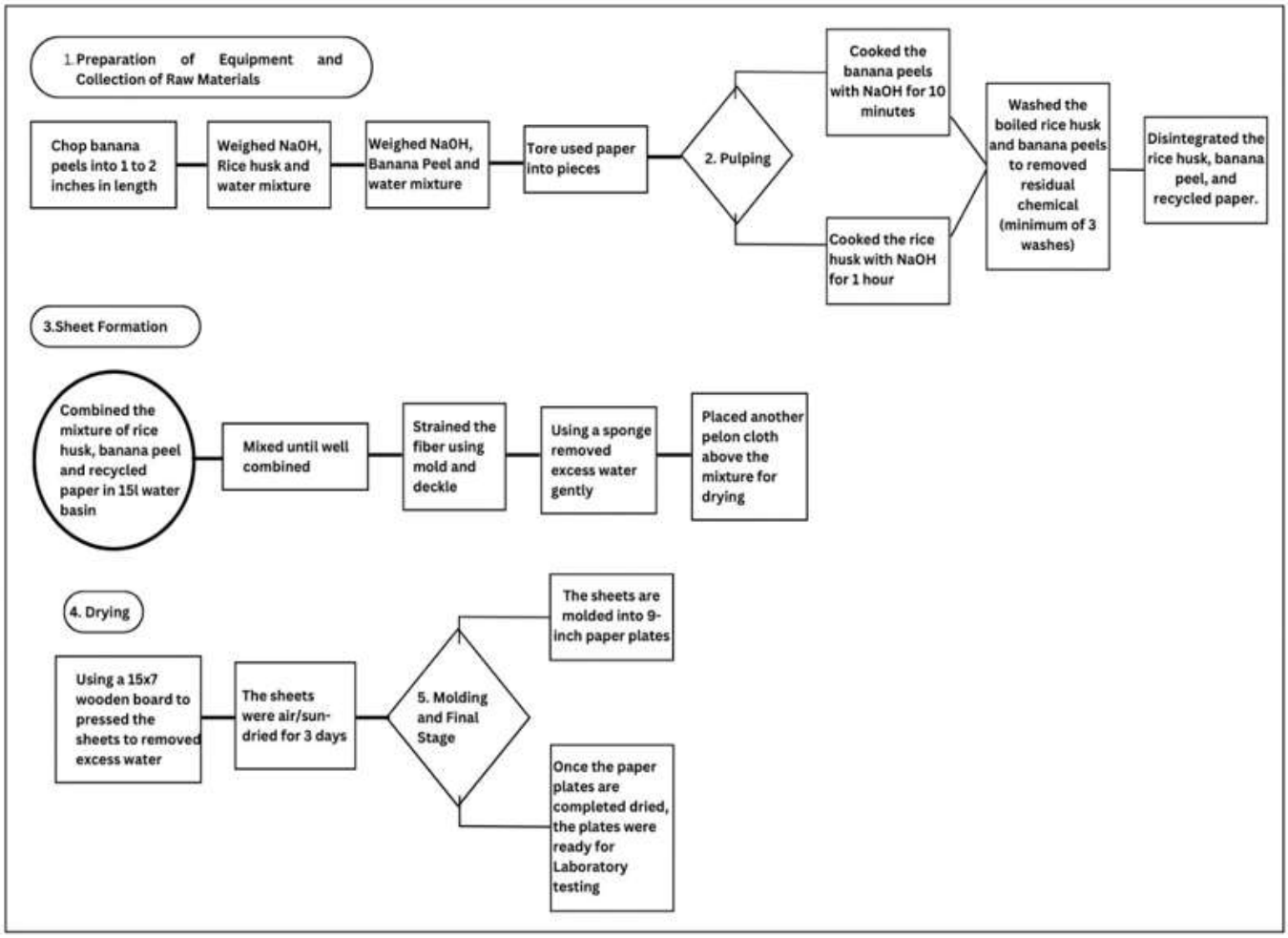

Figure 1. Process Flow Diagram of the Study

Table 2. Rice Husk Treatment Solution (Code 256)

Components	Measurements
Rice Husk	250 grams
Water	2000 ml
Sodium Hydroxide	80 grams

Table 3. Banana Peel Treatment Solution (Code 367)

Components	Measurements
Banana Peel	750 grams
Water	4000 ml
Sodium Hydroxide	180 grams

RESULTS AND DISCUSSIONS

The section meticulously examined consumer perceptions of eco-friendly paper plates made from rice husk and banana peels. Insights from participants provided valuable understanding of the product's market acceptance and its alignment with sustainable consumption trends. Rigorous testing in the Pulp and Paper Testing Laboratory generated detailed results, analyzing the paper plates' burst strength, tensile strength, water absorbency, and thickness. These analyses provided a comprehensive understanding of the product's physical properties and its potential for versatile applications, contributing significantly to the discourse on sustainable material innovation. Based on the comparison from other studies and presented test values of the laboratory test results, it could be concluded that the thickness of the eco-friendly paper plate made from rice husk and banana peel is thinner compared to the pineapplepulp paper; this was also supported due to the inconsistency and lightness of the paper which tends to be more fragile and brittle as a prototype. The comparison between the eco-friendly paper plate made from rice husk and banana peel and the pıneapple pulp paper presented ın Lewkıttayakorn et al. (2020) indicated that the absence of hot-pressing and chemical coatings resulted in lower burst index and water absorbency values for the rice husk and banana peel prototype. Specifically, the absence of these elements contributed to the relatively lower burst index and nearly similar water absorbency levels compared to the pineapple pulp paper. For the tensile index, the rice husk and banana peel-based

prototype showcased stronger tensile strength compared to the pineapple pulp paper, suggesting a favorable choice for using this combination of materials in paper-making processes. Therefore, implementing hot-pressing and coatings could potentially strengthen the burst index and enhance water absorbency for eco-friendly paper plates.

The plates' appearance, texture, shape, size, and color collectively influence customers' perceptions, impacting their dining experiences and overall impression of the food. These findings suggest the importance of such attributes in shaping consumer perception and the overall dining experience.

Table 4. Recycled paper Treatment Solution (Code 489)

Components	Measurements
Recycled Paper	100 grams
Water	500 ml

Table 5. Physical Properties (Thickness)

Item No.	Sample Description	Physical Property	Test Value (Average)	Test Method	Test Details (10 Replicates)
1	Eco-Friendly Paper plate made from rice husk and banana peel	Thickness, um	3,975.800	ISO 534	Highest Value: 4,200.00 Lowest Value: 3,290.00 Std. Dev.: 387.150
		mm	0.795		Highest Value: 0.840 Lowest Value: 0.658 Std. Dev.: 0.077

Table 6. Physical Properties (Burst index, Tensile index, water absorptiveness)

Item No.	Sample Description	Physical Property	Test Values (Average)	Test Method	Test Details (10 Replicates)
1	Eco-Friendly Paper plate made from rice husk and banana peel	Burst Index, $kPa.m^2/g$	0.484	ISO 2758	Highest Value: 0.806 Lowest Value: 0.322 Std. Dev.: 0.148
		Tensile Index, N.m/g	7.613	ISO 1924	Highest Value: 10.037 Lowest Value: 5.544 Std. Dev.: 1.751
		Water Absorptiveness sec	9.579	ISO 535	Highest Value: 12.420 Lowest Value: 7.110 Std. Dev.: 1.964

Table 7. The Appearance of the Eco-friendly paper plate

The Appearance of the Eco-friendly paper plate		
Variable	Weighted Mean	Interpretation
Visual Appeal Rating of the Eco-Friendly Paper Plate Design	7.18	Moderately appealing
Rating of Eco-Friendly Paper Plate's Overall Color Scheme	7.23	Moderately appealing
Effectiveness of Eco-Friendly Paper Plate in Mimicking Conventional Plate Appearance	7.36	Like moderately
Rating of Size and Shape Convenience and Usability for Eco-Friendly Paper Plates	7.35	Like moderately

Table 8. The Texture of the Eco-friendly paper plate

The Texture of the Eco-friendly paper plate		
Variable	Weighted Mean	Interpretation
Surface Texture Smoothness Rating of Eco-Friendly Paper Plate	5.28	Neither harsh nor smooth
Noticeability of Natural Fibers in Eco-Friendly Paper Plate Texture	6.69	Moderately noticeable
Durability Comparison of Eco-Friendly Paper Plate Texture to Traditional Disposable Plates	7.18	Like moderately
Food Presentation Enhancement by Eco-Friendly Paper Plate Texture	7.26	Like moderately

The research focuses on the evaluation of an eco-friendly paper plate's attributes, revealing that while it possesses a reasonably balanced and moderately appealing visual design, improvements are needed to enhance its resemblance to conventional plates for higher visual attractiveness. Respondents rated the plate's visual appeal, color scheme, effectiveness in mimicking conventional plates, and functionality. The results show a moderate rating across these attributes, indicating room for advancement to achieve higher visual appeal and similarity to conventional plates, despite the plate's reasonable functionality and user satisfaction. The surface texture and durability of eco-friendly paper plates play pivotal roles in the users' dining experience. A moderately positive perception was noted regarding the texture's comfort level and the discernibility of natural fibers in the plate, contributing to the eco-friendly aspect. The observed durability of the plates, even when soaked in liquid, was positively received, indicating their potential for long-lasting use. The texture of the plates was seen to enhance food presentation, influencing the overall visual appeal and contributing to consumers' dining experiences.

REFERENCES

Agustina, E., & Susanti, V. H. E. (2018). *Natural wrapping paper from banana (Musa paradisiaca Linn) peel waste with additive essential oils.* Journal of Physics, 1022, 012032. https://doi.org/10.1088/1742-6596/1022/1/012032

Alex, J., Dhanalakshmi, J., Ambedkar, B. Experimental investigation on rice husk ash as cement replacement on concrete production. (2016, October 7). Experimental Investigation on Rice Husk Ash as Cement Replacement on Concrete Production - ScienceDirect. https://doi.org/10.1016/j.conbuildmat.2016.09.150

Bajsic, E. G., Persic, A., Jemric, T., Buhin, J., Grgic, D. K., Zdraveva, E., Zizek, K., &Grguric, T. H. (2021, November 10). Preparation and Characterization of Polyethylene Biocomposites Reinforced by Rice Husk: Application as Potential Packaging Material. MDPI. https://doi.org/10.3390/chemistry3040096

Barra, Estrada, Ngo, So, Beltran (2022). Paper Review on Application of Rice Hull Ash as Cement Additive: A Systematic Mapping Approach.

Bediako, Sarkar, Lin, Zhao, Song, Choi, Cho, Yun. (2019) ScienceDirect. Characterization of the residual biochemical components of sequentially extracted banana peel biomasses and their environmental remediation applications. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0956053X19302223

Bo, J. H. (2018). The effect of tableware color in university canteen on dining mood. Diet Science, 47(8), 265.

Castillo-Israel, K. A. T., Baguio, S. F., Diasanta, M. D. B., Lizardo, R. C. M., Dizon, E. I., &Mejico, M. I. F. (2015). Extraction and characterization of pectin from Saba banana [Musa'saba'(Musa acuminata x Musa balbisiana)] peel wastes: A preliminary study. *International Food Research Journal*, *22*(1).

Cherian, J., & Jacob, J. (2012, September 1). Green Marketing: A Study of Consumers’ Attitude towards Environment Friendly Products. Green Marketing: A Study of Consumers&Rsquo; Attitude Towards Environment Friendly Products. https://dspace.adu.ac.ae/handle/1/2872

Department of Agriculture (2019). Philippine Banana Industry Roadmap 2019-2022.

Detective, G. L. Danielle Vick (2022, October 5). *How green is it. . . to use aluminum foil? - Green Living Detective*. Green Living Detective. https://www.greenlivingdetective.com/how-green-is-it-to-use-aluminum-foil/

Du P, MacDonald EF (2015) Products' shared visual features do not cancel in consumer decisions. J Mech Des 137:071409. https://doi.org/10.1115/1.4030162

Dungani, R., Karina, M., Subyakto, Sulaeman, A., Hermawan, D., Hadiyane, A. (2016) Agricultural waste fibers towards sustainability and advanced utilization https://www.cabdirect.org/cabdirect/abstract/20163329672

Ewing-Chow D. (2022). Banana Peel Cuisine Is The Latest Plant Based Trend

Gueco, L. S., Posada, I. B., Corpuz, F. V., Yanos, L. A., Damasco, O. P., Descalsota, M. L. V., & Molina Jr, A. B. (2020). Characterization and Agronomic Evaluation of Naturally Occurring Short-statured Saba Banana in the Philippines. *Philippine Journal of Science*, *149*.

Gupta, G., & Anjali, K. (2023). Environmentally Friendly Beeswax: Properties, Composition, Adulteration, and its Therapeutic Benefits. *IOP Conference Series*, *1110*(1), 012041. https://doi.org/10.1088/1755-1315/1110/1/012041

Hughes (2022, February) How paper recycling benefits the environment retrieved July 5, 2023 from https://www.forgerecycling.co.uk/blog/how-paper-recycling-benefits-environment/#:~:text=Paper%20is%20one%20of%20the,footprint%20of%20the%20manufacturing%20process.

Iewkittayakorn, J., Khunthongkaew, P., Wongnoipla, Y., Kaewtatip, K., Suybangdum, P., &Sopajarn, A. (2020). Biodegradable plates made of pineapple leaf pulp with biocoatings to improve water resistance. Journal of Materials Research and Technology, 9(3), 5056-5066. Is Resin Environmentally Friendly? | Sustainability Nook. (2021, March 23). Sustainability Nook. https://sustainabilitynook.com/is-resin-eco-friendly/

Jain, P. (2022, May 18). Importance of Eco-Friendly Products. Green Feels. Retrieved March 3, 2023, from https://greenfeels.in/blogs/sustainability-basics/importance-of-eco-friendly-products

K. (2019, October 7). *The Importance Of Food Presentation For Restaurant Business | Kopin*. Kopin | Tableware Company Indonesia. https://kopintableware.com/article/importance-food-presentation-restaurant-business/

Kaur, M. (2017) Green Marketing: A Study of Consumer Perception on using Eco-Friendly Products https://www.indianjournals.com/ijor.aspx?target=ijor:ajrbem&volume=7&issue=8&article=023

Kumar, A., Sengupta, B., Dasgupta, D., Mandal, T., & Datta, S. (2015, November 19). Recovery of value-added products from rice husk ash to explore an economic way for recycling and reuse of agricultural waste - Reviews in Environmental Science and Bio/Technology. SpringerLink. https://doi.org/10.1007/s11157-015-9388-0

Kumar, G. (2021, April 17). *Everything you need to know about tableware*. Exclusive Lane. https://exclusivelane.com/blogs/handmade/everything-you-need-to-know-about-tableware

Lacoma (2017, September) Process of Manufacturing Paper Plates Retrieved July 5, 2023 from

Ma, J., He, J., Kong, X. (2022) From agricultural cellulosic waste to food delivery packaging: A mini review. From Agricultural Cellulosic Waste to Food Delivery Packaging: A Mini-review - ScienceDirect. https://doi.org/10.1016/j.cclet.2022.04.005

Martins (2023, February 22) Your Customers Prefer Sustainable Products - businessnewsdaily.com. Business News Daily. Retrieved March 3, 2023 from: https://www.businessnewsdaily.com/15087-consumers-want-sustainable-products.html

Maya, C. (2022, September 21). *What is the thickness of a sheet of paper? – - La Cultura de los Mayas*. La Cultura De Los Mayas. https://culturalmaya.com/what-is-the-thickness-of-a-sheet-of-paper/

Obi, F., Ugwuishiwu, B., &Nwakaire, J. (2016, October 11). Agricultural waste concept, generation, utilization and management | Nigerian Journal of Technology. Agricultural Waste Concept, Generation, Utilization and Management | Nigerian Journal of Technology. https://doi.org/10.4314/njt.v35i4.

Otutu. (2023, March 21). *What is a Tensile Strength? - Definition from Corrosionpedia*. Corrosionpedia. Retrieved June 18, 2023, from http://www.corrosionpedia.com/definition/1072/tensile-strength

Palmer, S. E., Schloss, K. B., & Sammartino, J. (2013). Visual aesthetics and human preference. *Annual review of psychology*, *64*, 77-107.

Prasanniya. (2023, June 21). 12 *Surprising Uses For Rice Hulls You Never Knew About - Hydroponic Way. Hydroponic Way.* https://hydroponicway.com/12-surprising-uses-for-rice-hulls-you-never-knew-about/

R., & R. (2023, July 11). *How Long Does It Take to Eat at a Restaurant?* Rochaksafar.com. https://rochaksafar.com/how-long-does-it-take-to-eat-at-a restaurant

Reginio, F. C., Qin, W., Ketnawa, S., & Ogawa, Y. (2020, April 21). *Bio-properties of Saba banana (Musa 'saba', ABB Group): Influence of maturity and changes during simulated in vitro gastrointestinal digestion - Scientific Reports*. Nature. https://doi.org/10.1038/s41598-020-63501-x

Rinkesh (2023) Is it Better for the Environment to Use Paper Plates or Wash Dishes?. Conserve Energy Future. https://www.conserve-energy-future.com/use-paper-plates-or-wash-dishes.php

Romero P. (2020, September 7) Philippines Facing Garbage Crisis; 16.6 Million Metric Tons of Waste This Year Can Fill 99 Philippine Arenas. The Star Philippines. 2020. Available from: https://www.onenews.ph/phl-facing-garbage-crisis-16-6-million-metric-tons-of-waste-this-year-can-fill-99-philippine-arenas.

Rosen (2022). 3 benefits of using biodegradable cups and plates. Rosen with Many Kinds of Paper Plates and Cups. https://rosenpack.com/uncategorized/3-benefits-of-using-biodegradable-cups-and-plates/#author

Rullifank, K. F., Roefinal, M. E., Kostanti, M., &Sartika, L. (2020, May). Pulp and paper industry: An overview on pulping technologies, factors, and challenges. In IOP Conference Series: Materials Science and Engineering (Vol. 845, No. 1, p. 012005). IOP Publishing.

Sánchez-Safont, E., Aldureid, A., Lagarón, J., Gámez-Pérez, J., Cabedo, L. (2018) Biocomposites of different lignocellulosic wastes for sustainable food packaging applications. Biocomposites of Different Lignocellulosic Wastes for Sustainable Food Packaging Applications - ScienceDirect. https://doi.org/10.1016/j.compositesb.2018.03.037

Satbaev, B., Yefremova, S., Zharmenov, A., Kablanbekov, A., Yermishin, S., Shalabaev, N., Satbaev, A., & Khen, V. (2021, July 23). Rice Husk Research: From Environmental Pollutant to a Promising Source of Organo-Mineral Raw Materials. MDPI. https://doi.org/10.3390/ma14154119

Sekifuji, R., &Tateda, M. (2019, April 18). Study of the feasibility of a rice husk recycling scheme in Japan to produce silica fertilizer for rice plants - Sustainable Environment Research. BioMed Central. https://doi.org/10.1186/s42834-019-0011-x

Singh (2018). Rice Husk Ash. Science Direct. https://www.sciencedirect.com/topics/engineering/rice-husk-ash

Singh, A. Managing the uncertainty problems of municipal solid waste disposal. (2019, April 2). Managing the Uncertainty Problems of Municipal Solid Waste Disposal - ScienceDirect. https://doi.org/10.1016/j.jenvman.2019.03.025

Starforth (2022, September) What are the different raw materials for paper? Retrieved July 5, 2023 from https://www.waynear thurgallery.com/what-is-paper-plate-craf

United Nations (n.d) Sustainable Development Goal 2: Zero Hunger. https://www.un.org/sustainabledevelopment/hunger/

W, P. (2015, December 4). *Why Food Presentation Is So Important*. Spoon University. https://spoonuniversity.com/lifestyle/ importance-of-plating-your.

****