CHARACTERIZATION OF THE PEEL OIL FROM TWO VARIETIES OF BANANA

Esha Rami[1], Swati Acharya[2*], Tirth Thaker[3], Ajit Gangawane[4]

Article History: Received: 23.02.2023 **Revised:** 08.04.2023 **Accepted:** 23.05.2023

Abstract

The Musa genus includes the enormous perennial plants known as banana trees. They originate in Southeast Asia. Bananas often have a limited shelf life and begin to degrade right after being picked. The fruit's meat is the portion of the banana that is utilized the most; the banana peel is solely used as organic fertilizer and animal feed. According to studies, the banana peel contains more phytochemical components than the pulp does. Banana peel's antifungal and antibacterial qualities can be beneficial. So, the goal of this study was to comprehend the physicochemical properties of the two banana kinds. In this investigation, the fatty oil content of two distinct types of banana peels—M. acuminate L. (Jahaji) and M. acuminate L. (Surya kadali). In Surya kadali and Jahaji peels, respectively, there were 7.5 and 10 percent fatty oil content. For both samples, it was also determined the amounts of unsaponifiable material, iodine value, free fatty acid content, and saponification value. Although the linoleate concentration of the Jahaji variety is somewhat greater than that of the Surya kadali type (2.41), the palmitate and stearate levels were found to be 12.55 and 13.86, respectively, in the two varieties. We wrap up by saying that both kinds include a sizable quantity of linoleate. Peel oil might readily be used as a supplement to the cattle's diet and feed. The individuals involved in the food sectors will find this information interesting.

Keywords: Oil, Saponification value, Iodine value, Banana, Peel

[1,2*]Department of Life science, Parul Institute of Applied Sciences, Parul University, Vadodara - 391760, Gujarat, India.
[3]Department of Chemistry, Parul Institute of Applied Sciences, Parul University, Vadodara-391760, Gujarat, India.
[4]Department of Biochemistry, Parul Institute of Applied Sciences, Parul University, Vadodara - 391760, Gujarat, India.

Corresponding author: [2*]Swati Acharya
Email: [2*]swativyas117@gmail.com, Contact no. 919727880253

DOI: 10.31838/ecb/2023.12.1.348

1. Introduction

One of the most significant fruits growing throughout the year in all of India is the banana (Padam et al. 2014). All facets of society use it since it is less expensive. Yet the peel is discarded as waste, either in thetrash or scattered all over the place. Polyphenols, carotenoids, and other antioxidants found in banana peels help the body combat cancer-causing free radicals. Depending on how ripe they are, banana peels may provide a variety of health advantages. Green, unripe bananas may be more useful for treating digestive problems, whereas ripe, blackened bananas have been proven to support the activity of white blood cells inthe body's defence against sickness and infection.

Increased quantities of antioxidant chemicals that lower the risk of cancer can be obtained by eating more banana peels, particularly green, unripe peels. Vitamin B6, Vitamin B12, magnesium, potassium, fiber, and protein are among the extra nutrients found in banana peels. It is estimated that 75 million tons of bananas are produced worldwide each year, including 19 million tons of peel (Vu et al. 2018). As with other fruits, it is typically referred to as waste during marketing and eating. However, this trash has a wide range of potential applications. Peels are sun-dried into chips in the Philippines and exported to Japan and Taiwan to be used as feed fillers in chemical processing (Sales et al. 2005).

Banana fruit peel fiber and office wastepaper are mixed in Costa Rica to create recycled paper, cardboard, notepads, envelopes, postcards, and notebooks (Ulloa et al. 2004). Banana peels are used in Uganda to make fuel briquettes and cow fodder (Kabenge et al. 2018). Phytoalexins and other substances present in the peels inhibit the germination and growth of certain fungus (Kabenge et al. 2018). Various varieties of bananas are produced throughout much of India, especially in Vadodara and the surrounding area (Parmar et al. 2018). It is also widely grown in the country's western region (Malhi et al. 2015). According to information obtained thus far from local sources, 5-6% of the entire production of bananas is peel. There are several types of bananas cultivated in India, but two are particularly well-liked and widely accessible toconsumers (Thomas et al. 1971).

The research of dietary parameters in this context will focus on Jahaji and Surya Kadali. The peel of a banana is typically just thrown away as trash in regions of the world where people consume bananas, while this practice does occur in other places. The disposal of banana peels results in unattractive pollution evenif they decompose. It was decided to look into the utility of the peel in order to extract and identify any potentially valuable compounds that may be present in it in light of this environmental issue and certain advantageous applications of bananas.

For now, we're interested in studying the physicochemical properties of the two types of fats and oils to find out if they include significant amounts of component fatty acids or any other unique components that might help us employ the peel fats for practical reasons.

2. Materials and Methods

Oil and fat extraction from peels Banana peels (2.0 Kg) were gathered, cleaned, diced into small pieces, and mixed with a little amount of distilled water. The peel paste was then baked and dried at a temperature below 50 °C. In order to get the greatest amount of particle exposure for oil extraction, dried peels were crushed into a fine powder. The Soxhlet extraction process was used on 500 g of powder. Analytical-grade n-Hexane was employed in this instance as the solvent. The solvent recovery process was used to get the brownish oil that had been extracted in the solvent. The oil was examined for acid content after physicochemical studies. Triplets of the study were run. In the case of physicochemical analysis, significant attributes relating to fats and oils, such as saponification value, unsaponifiable matter, and iodine levels, were established for each variety. The oils were esterified before being submitted to GC/MS analysis to determine the composition.

2.1 Methyl esterification of fatty acids

A pear-shaped flask containing 10 ml of methanolic sodium hydroxide received 200 mg of oil for each variation. The mixture was refluxed for ten minutes. 5 cc of BF_3 were added to the mixture following reflux. The produced compound was cooked on a water bath again for 10 minutes after being sonicated for

1 minute to remove any remaining solvents. N-hexane was then used to extract the combination. The n- Hexane extracted fraction underwent a GC/MS analysis after being filtered and dried. The GC-MS analysis was performed using a GC 7890A (Agilent Technologies) equipped with an injector (7683B) and a gas chromatograph interfaced to a mass spectrophotometer (5975C). 250°C was maintained as the injector temperature. The temperature of the oven was designed to start at 80°C and be held for 2 minutes before being raised to 120°C at a rate of 5°C minG1 and kept for 2 minutes before being raised to 240°C at a rate of 10°C minG1 and held for 6 minutes. Agilent Technologies' HP5MS capillary column was filled with one millilitre of the crude extract that had been dissolved in methanol (thickness 0.25 mm, id 0.320 mm). Helium was the carrier gas.

3. Results

In the case of the Jahaji variety, solvent extraction of the peel powder gives 10% oil, whereas in the case ofthe Surya kadali variety, it yields 7.50% oil. According to the study, Jahaji variety peels produce more oil than Surya kadali type peels. The oil yields of both kinds, while not important in terms of yield amount, would be more significant if they were regarded as waste and thrown away. According to the introductory chapter, discarded banana peel makes up between 5 and 6 percent of the entire banana crop. So, this knowledge is adequate for a businessperson to consider industrial oil extraction. Moreover, Table I includes physicochemical details on both kinds of oil.

The peel oil of the Jahaji cultivar has a little greater iodine content than the Surya kadali variety (103.16 vs. 100.04). Both of the types thus far considerably include linoleate. Jahaji variant has somewhat more (2.74 vs. 2.41), albeit not by much. An important fatty acid that may be quickly added to meals is linoleate (Cunnane 2003). It is possible to extract a sizeable quantity of linoleic acid from leftover peel (González- Montelongo et al. 2010). For those involved in the food sectors, this information is instructive. Peel oil might readily be used as a supplement to the cattle's diet and feed. Oleiate content was only discovered to be 1.48 percent in the Jahaji type, which is a favourable sign for those who make abrasives and ointments.

In the traditional process of making abrasive and ointment, they could include Jahaji peel oil. In the Jahajiand Surya kadali varieties, the amounts of palmitate and stearate were determined to be 12.55 and 13.86 and 2.62 and 4.57, respectively. The Surya kadali cultivar was found to have greater concentrations of both palmitate and stearate. The palmitate content, which appears to be more industrially practicable, outweighs the stearate content in both kinds in terms of significance for industrial application. Compared to Jahaji, which has a saponication value of 49.50, Surya kadali variety oil has a saponication value of 61.20. (Table I). Despite the variety's significant amount of saturated saponifiable fatty acids, the saponification value inthis case is not encouraging. Surya kadali has 13.86% palmitate whereas the Jahaji type has 12.55 percent.

Table I: Chemical characteristics of two varieties of banana peels

Sr.no	Parameters	Jahaji	SD	SE	Surya kadali	SD	SE
1	Fatty oil (%)	10	2.13	0.4	7.50	1.87	0.01
2	Un saponifiable matter (%)	48.81	12.47	0.7	40	3.51	0.37
3	Iodine value	103.16	19.32	1.2	100.04	14.9	2.47
4	Free fatty acid (%)(as oleic acid)	14.50	2.49	0.7	9.75	0.78	1.26
5	Saponification value	49.50	11.84	0.9	61.20	11.2	1.48

If the angle of waste is taken into account, the % acid saturated is not ignorable (Tables II and III). The palmitate content of both kinds may operate as a marker for those working in the soap sector who may readily incorporate peel oil into the production of soap, particularly palmitate soap. Both variants include negligible amounts of stearic acid (Mancini et al. 2015). While the amount of saturated fatty acids in any kind, notably in stearate and palmitate, is negligible, there is still room for industrial chemists to consider bulk separation of the oil from a waste source in order to launch various soap companies.

Jahaji variety has 48.0 percent unsponifiable matter content, whereas Surya kadali variety has 40.0 percent (Table I).

Table II: Analysis of methylated fatty oil of Jahaji peel M. acuminate L.

Sr.no	Compounds	Percentage	SD	SE
1	Methyl laurate	0.26	0.2	0.1
2	Methyl myristate	0.38	0.1	0.1
3	Methyl palmitoleate	0.41	0.3	0.1
4	Methyl palmitate	12.55	0.9	0.1
5	Methyl Linoleate	2.74	0.4	0.1
6	Methyl stearate	2.62	0.3	0.1
7	Methyl oleiate	1.48	0.1	0.1
8	Vitamin A aldehydes	1.04	0.1	0.1
9	5-Cholene, 3, 24-dihydroxy	50.82	12.4	0.4

Table III. Analysis of methylated fatty oil of Surya kadali peel M. acuminate L.

Sr.no	Compounds	Percentage	SD	SE
1	Methyl palmitate	13.86	0.4	0.1
2	Methyl Linoleate	2.41	0.1	0.1
3	Methyl petroselinate	5.79	0.1	0.1
4	Methyl isostearate	4.86	0.1	0.1
5	Methyl stearate	4.57	0.1	0.1
6	5-Cholene, 3, 24-dihydroxy	5.12	0.1	0.1
7	5-Dihydroergosterol	6.94	0.1	0.1
8	4,8,13-Duvatriene-1, 3-diol	11.50	0.2	0.1
9	Henicosyl formate	4.31	0.2.	0.1

Because the majority of the pigmented materials were incorporated into non-saponifiable portions, these results are consistent with the data in Tables II and III. The 3-24 dihydroxy 5-cholene (Tables II and III) in one of the unsaponifiable substances came to be over 50% in the Jahaji variety whereas it was only determined to be 5.12% in the Surya kadali variety. The fact that a single variety's high concentration of this chemical outperformed the other varieties should be considered. This discovery has now been set aside for future investigation into this chemical. About 1% of the vitamin A aldehydes in Jahaji peel oil were discovered in the scenarios (Table II). For someone who works in conventional medicine, this outcome is really instructive. If sufficient effort is made to isolate and concentrate vitamin A aldehyde industrially from the unsaponified portion of the oil, this would support the conventional pharmaceutical companies that deal with tonic and elixir manufacture.

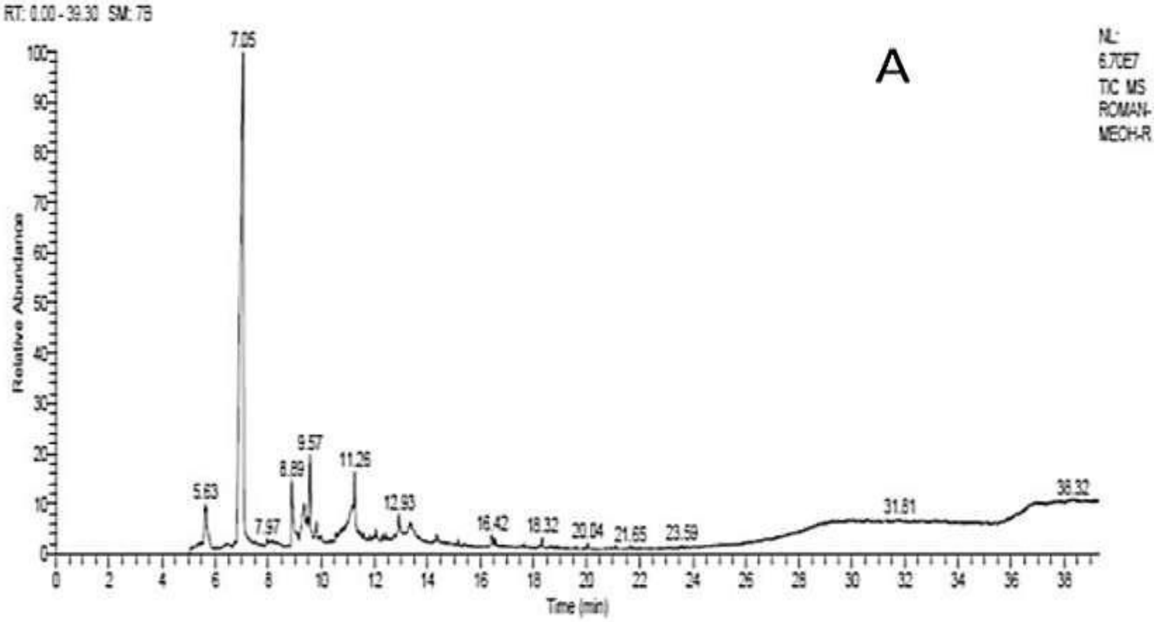

Fig. 1: GC of the components of the methanolic crude extract of Surya kadali

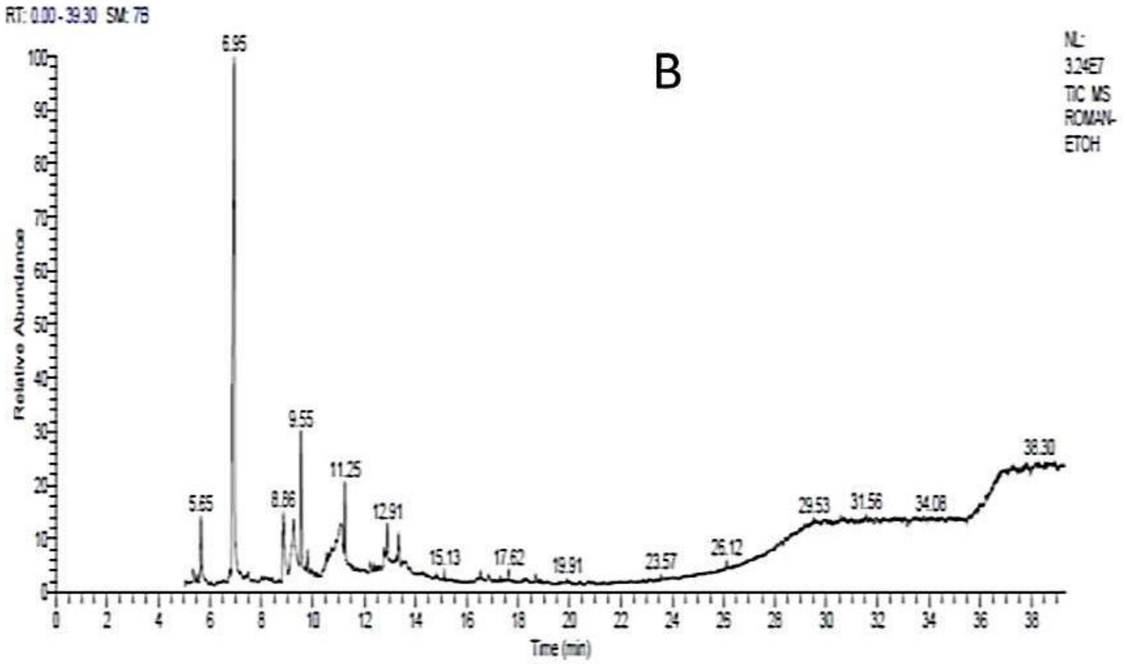

Fig. 2: GC of the components of the methanolic crude extract of Jahaji

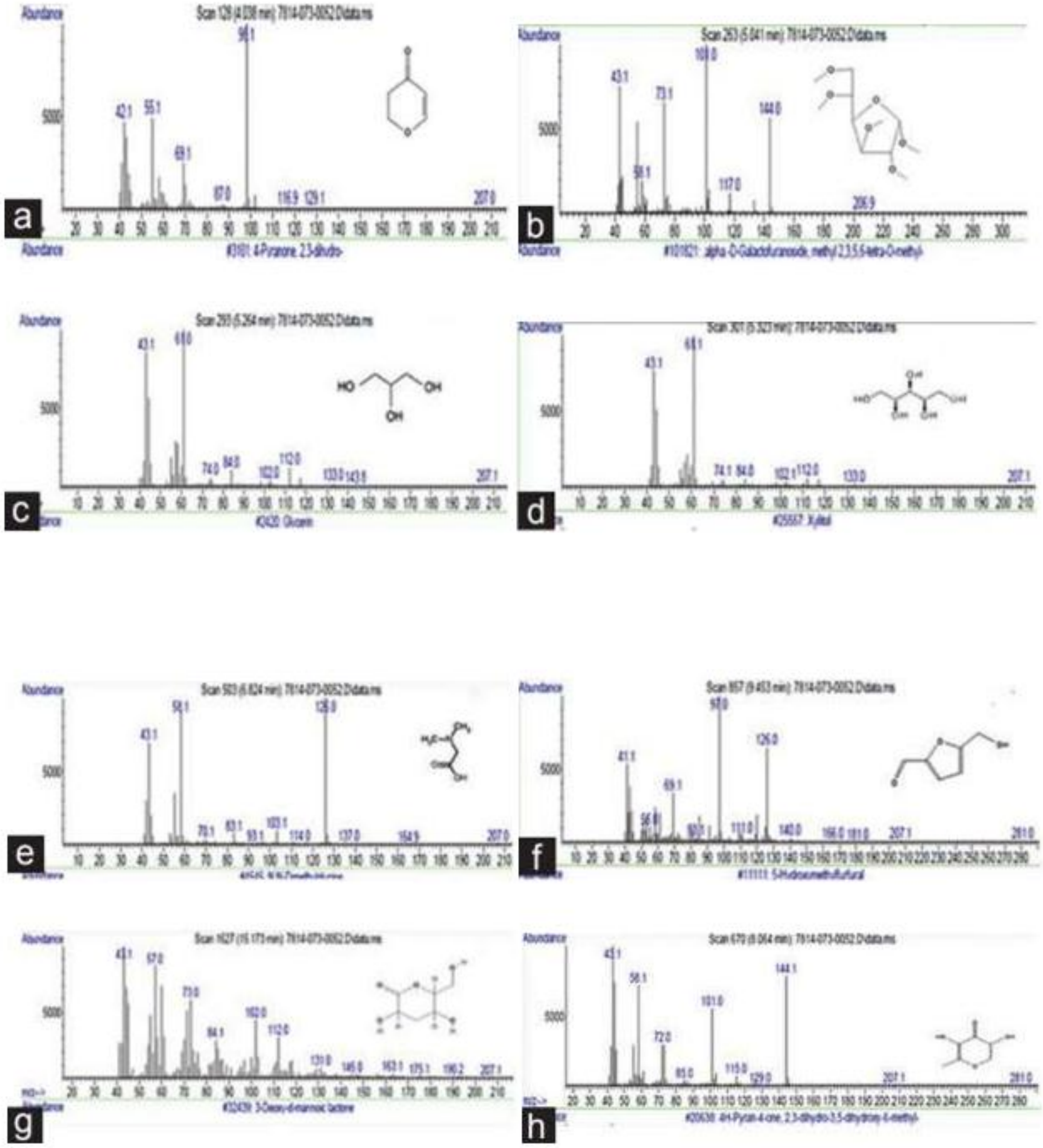

Fig.3: Mass Spectrometry Scan of the methanolic crude extract of Jahaji (a) 4-Pyranone,2,3-dihydro (b) alpha-d-Galactofuranoiside, methyl 2,3,5,6-tetra-O-methyl (c) Glycerin (d) Xylitol (e) N,N-Dimethylglycine (f)5-Hydroxymethylfurfural (g) 3-Deoxy-d-mannoic lactone 4H-Pyran-4- one,2,3-dihydro-3,5-dihydroxy-6- methyl

Figure 3 above shows the results of a mass spectrometry scan of the crude methanolic extract of Jahaji. The database of the National Institute of Standard and Technology (NIST), which contains more than 62,000 patterns, was used to interpret the mass spectrum of the mass spectrometry scan. The mass spectra of the unknown and recognised components were compared using the NIST library's mass spectra as a reference. The test materials' component names, molecular weights, and structural details were verified.

4. Discussion

Many authors have already reported the findings about banana peel extracts that were included in this study(LII et al. 1982; Emaga et al. 2007; Mordi et al. 2016). In Tables II and III, the fatty acid contents of the oil derived from two distinct species of fruit peels are listed. Notably, a standard was used to identify the methyl palmitate. Essential polyunsaturated fatty acids are abundant in fruit peel oil. From 0.26% to 50.82% of the total fatty acids in this research, saturated acids fluctuated. Five-Cholene, 3, 24-dihydroxy and 4, 8, 13-Duvatriene-1, 3-diol were the two most prevalent saturated acids among them. Blood pressure and serum cholesterol are decreased by methyl palmitate's positive impact on blood lipids. Linoleic acid's metabolic conversion into prostaglandins, which resemble hormones, occurs at the tissue level, giving it nutritional importance.

Methyl palmitate is used to promote health and prevent sickness, according to several researchers (LII et al. 1982; Emaga et al. 2007; Mordi et al. 2016). Gas chromatography-mass spectrometry (GC-MS) of the two species of banana was used in this work to identify fourteen and fifteen chemicals from the methanol extracts. There are some components that are present in both species of banana, however other chemicals are only found in Surya kadali while others are only found in Jahaji. Both species of banana included stearic, oleic, and linoleic acids as well as their methyl esters and the palmitic acid methyl ester, but only Jahaji had palmitic acid. It has been previously observed that these fatty acids and their esters are present in banana peels (Emaga et al. 2007; Mordi et al. 2016; Hassan et al. 2010).

It's also noteworthy to observe how drastically different these components are from those previously described by other writers (Nagarajaiah et al. 2011; Waghmare et al. 2014). The preparation of the peel before to extraction may account for the differences in content between these extracts. We employed fresh peel and extracted using methanol as opposed to the dried, powdered, and ethanol-based methods used in the prior article. The species of banana may also be responsible for the variation; even in our own research, we can observe that the components isolated from the two types under study differ.

5. Conclusion

For a trustworthy evaluation of the banana tree fruit peels, knowledge of the chemical contents' qualitative and quantitative distribution is crucial. The chemical makeup of these fruits' peels, however, has not previously been the subject of in-depth investigations. We conclude by saying that both kinds have significant concentrations of linoleate. Peel oil might readily be added to the cattle's meal and feed as a supplement. Anyone involved in the food sectors can learn from this information.

6. References

1. Cunnane, S. C. (2003). Problems with essential fatty acids: time for a new paradigm?. Progress in lipid research, 42(6), 544-568.
2. Emaga, T. H., Andrianaivo, R. H., Wathelet, B., Tchango, J. T., & Paquot, M. (2007). Effects of the stage of maturation and varieties on the chemical composition of banana and plantain peels. Food chemistry, 103(2), 590-600.
3. González-Montelongo, R., Lobo, M. G., & González, M. (2010). Antioxidant activity in banana peel extracts: Testing extraction conditions and related bioactive compounds. Food Chemistry, 119(3), 1030-1039.
4. Hassan, Z., Jahan, I. A., Saha, G. C., Begum, F., Nada, K., & Choudhury, J. (2010). Studies on thePeel Oil from Two Varieties of Banana. Bangladesh Journal of Scientific and Industrial Research,

45(4), 393-396.
5. Kabenge, I., Omulo, G., Banadda, N., Seay, J., Zziwa, A., & Kiggundu, N. (2018). Characterization of banana peels wastes as potential slow pyrolysis feedstock.
6. LII, C. Y., CHANG, S. M., & YOUNG, Y. L. (1982). Investigation of the physical and chemical properties of banana starches. Journal of food Science, 47(5), 1493-1497.
7. Malhi, R. K. M., & Kiran, S. (2015). Analysis of trends in area, production and yield of important crops of India. International Journal of Agronomy and Agricultural Research (IJAAR), 7(1), 86- 92.
8. Mancini, A., Imperlini, E., Nigro, E., Montagnese, C., Daniele, A., Orrù, S., & Buono, P. (2015).
9. Biological and nutritional properties of on health. Molecules, 20(9), 17339-17361.
10. Mordi, R. C., Fadiaro, A. E., Owoeye, T. F., Olanrewaju, I. O., Uzoamaka, G. C., & Olorunshola,
11. S. J. (2016). Identification by GC-MS of the components of oils of banana peels extract, phytochemical and antimicrobial analyses. Research Journal of Phytochemistry.
12. Nagarajaiah, S. B., & Prakash, J. (2011). Chemical composition and antioxidant potential of peels from three varieties of banana. Asian Journal of Food and Agro-Industry, 4(1), 31-46.
13. Padam, B. S., Tin, H. S., Chye, F. Y., & Abdullah, M. I. (2014). Banana by-products: an under- utilized renewable food biomass with great potential. Journal of food science and technology, 51, 3527-3545.
14. Parmar, H. C., & Mor, V. B. (2018). Quality of Banana Influenced By Different Varieties and Planting Materials. International Journal of Current Microbiology and Applied Sciences.
15. Sales, A. C., Azanza, P. V., & Yoshizawa, T. (2005). Microbiological and physicochemical factors affecting Aspergillus section Flavi incidence in Cavendish banana (Musa cavendishii) chipsproduction in Southern Philippines. Mycopathologia, 159, 41-51.
16. Thomas, P., Dharkar, S. D., & Sreenivasan, A. (1971). Effect of gamma irradiation on the postharvest physiology of five banana varieties grown in India. Journal of Food Science, 36(2), 243-247.
17. Ulloa, J. B., Van Weerd, J. H., Huisman, E. A., & Verreth, J. A. J. (2004). Tropical agricultural residues and their potential uses in fish feeds: the Costa Rican situation. Waste management, 24(1),87-97.
18. Vu, H. T., Scarlett, C. J., & Vuong, Q. V. (2018). Phenolic compounds within banana peel and their potential uses: A review. Journal of Functional Foods, 40, 238-248.
19. Waghmare, J. S., & Kurhade, A. H. (2014). GC-MS analysis of bioactive components from banana peel (Musa sapientum peel). European journal of experimental biology, 4(5), 10-15.

palm oil and palmitic acid: effects