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Estimation of total phenolics and flavonoids content of banana pulp and peel

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Abstract

In this present work, the effect of variation of parts (pulp and peel) on photochemical compounds such as phenolics and flavonoids content of the banana flours were studied. The results exhibited that different varieties did exhibit significant differences on TPC as well as TFC which means that different sample yielded different values of TPC and TFC. The TPC was determined in ethanolic extracts of banana peel and pulp flour. The TPC was found to be about 0.40 mg/ml in banana peel and about 0.33 mg/ml in banana pulp. Thus, it is clear that the TPC was higher in the peel than in the pulp, while the total flavonoids content was determined in methanolic extracts of banana peel and pulp flour. The results showed that TFC was higher in banana peel (0.37 mg/ml) than in banana pulp (0.20 mg/ml).

Key words: banana, catechol , quercetin, total flavonoids, total phenolics.

الملخص:

يتضمن البحث تأثير محتوى أجزاء فاكهة "الموز"(اللب والقشر) من كمية المركبات الكيميائية الفعالة مثل: الفينولات والفلافونيدات. وقد تبين من نتائج العينات المختلفة أنها تحتوي على كميات مختلفة منها. حيث تم تقدير المحتوى الكلي من الفينولات TPC في المستخلص الايثانولي لمسحوق كل من قشور ولب فاكهة الموز؛ فوجد أن المحتوى الفينولي في اللب(0.40 mg\ml)، بينما كانت كمية الفينولات في القشور (0.33mg\ml) مما يبين أن كمية الفينولات عالية في القشور مقارنة بمحتواها في اللب. وقدر المحتوى الكلي من الفلافونيدات TFC في المستخلص الميثانولي لمسحوق كل من قشور ولب فاكهة الموز ، فأظهرت النتائج أن قيمته في القشور(0.37 mg\ml)، بينما في اللب (0.20 mg\ml) مما يبين أن قيمته في القشور عالية مقارنة بمحتواه في اللب.

Introduction:

Natural products have been the basis for cure and treatment for thousands of years and an impressive number of modern drugs have been taken from natural sources which were used previously in traditional medicine. This is due to increased awareness of the limited ability of synthetic pharmaceutical products to control major diseases and the need to discover new molecular structures from the natural sources. Plants have become the basic source of knowledge of modern medicine. The basic molecular and active structures for synthetic fields are provided by rich natural sources.**(Preethi *et al.*, 2010).**

Fruits and vegetables are rich sources of various health beneficial phytochemicals such as flavonoids, phenols, vitamins, minerals, carbohydrates etc. Extensive research by various groups has revealed the role played by these phytochemicals in the reduction of incidence of certain degenerative diseases such as cardiovascular diseases, cancers, arthritis **(Kumar *et al.*, 2012, Babu *et al.*, 2012)**.

The consumption of fruits and vegetables is thought to be associated with a reduced risk of many diseases including cancer, atherosclerosis and neurodegenerative diseases, which are related to elevated levels of oxidative stress. Antioxidant compounds can decrease oxidative stress and minimize the incidence of these diseases **(Darsini *et al.*, 2012, Lim and Rabeta., 2013).**

Banana is one of the most widely distributed and consumed fruit in the tropical and subtropical countries. Considering the nutritional aspects, it is one of the world's leading food crops with a great source of minerals, vitamins, carbohydrates, flavonoids, phenolic compounds etc. It is both economical and easily accessible to people of all sections of the society, thus addressing food insecurity problems in many countries **(Mohammad and *Saleha.*, 2011**, **Guyle *et al.*, 2009)**. Banana peel represents about 30% of total weight of the fresh fruit **(Anhwange *et al* ., 2008)**.

The total amount of phenolic compounds in banana peel has been reported from 0.90 to 3.0 g/100g dry weight (**Someya *et al.*, 2002**, **Nguyen *et al.*, 2003**). Other phytochemicals such as anthocyanin, delphinidin, cyanidin and catecholamines have been identified in ripe banana pulp and peel (**Kanazawa and Sakakibara ., 2000**). Recent studies demonstrated that banana peel generally include higher phenolic

compounds than that of banana pulps (**Kondo *et al.*, 2005**, **Kondo *et al.*, 2005, Natakkakath *et al*., 2022, Subhanki *et al.*, 2022**, **Ligia *et al.*, 2014, Fatemeh *et al* ., 2012, Sulaiman *et al.*, 2011 and Sultana., 2008)**. Therefore, the objective of this study was to compare total phenolic content (TPC) and total flavonoids content (TFC) of banana flour (pulp and peel).

Material and Methods

Sample collection and extraction

Bananas were obtained from the local market in Allahabad and washed with distilled water. The fruit was then separated into pulps and peels and sliced into 2 mm thickness. The sliced bananas were air-dried under shade for several days at approximately 35°C. Afterward, the samples were oven-dried at 45°C until a constant weight was achieved. The dried plant materials were powdered using a grinder to obtain banana powder from both the pulp and peel.

For extraction**,** 10g of the dried and ground sample was individually mixed with 100 ml of solvents (methanol, ethyl acetate, and ethanol) and shaken overnight at 37°C in an orbital shaker. The solution was then filtered, and the filtrate was dried to obtain the extract for further analysis. The extraction process was conducted at room temperature.

In the case, 100g of the plant material was soaked in 80% ethanol (1000 mL) for 48 hours with intermittent shaking. The extracts were filtered through Whatman filter paper No.1. To increase the extract yield, the procedure was repeated three times. The combined filtrates were then concentrated under vacuum using a rotary evaporator (Eyela, Japan). All fractions obtained from the solvent extractions were evaporated to dryness and stored at 4ºC for future use.

Determination of total phenols

Total phenols estimation was carried out with Folin-ciocalteu reagent (FCR) elucidated by **(McDonald *et al.*, 2001)**.Phenols react with an oxidizing agent phosphomolybdate in Folin-ciocalteu reagent under alkaline conditions and result in the formation of a blue colored complex, the molybdenum blue which is measured at 650 nm. Ethanolic extract of each sample (banana pulp and peel flour) were prepared, 3.0 ml Folin-ciocalteu reagent (FCR) were dissolved in 3.0 ml distilled water**.** 100 mg catechol in 100 ml water was diluted 10 times for a working standard.

Typical procedure

Dissolved the extract of each sample 0.004 g in 1 ml distilled water, made up the volume to 3.0 ml with water in a test tube then 0.5 ml of FCR reagent was added, after 3.0 min. 2 ml of 20% Na_2CO_3 solution added to each tube, mixed thoroughly and then placed the tubes in boiling water bath for exactly one minute. Cooled and measured the absorbance at 650 nm against a reagent blank. Then, a standard curve using (0.2, 0.4, 0.6, 0.8 and 1.0 mg/ml) concentration of catechol was prepared.

Determination of total flavonoids.

Flavonoid content was estimated according to the method given by

(**Chang *et al.*, 2002**).

Different reagents Methanolic extract, Methanol, Aluminiumchloride (1.2%), Potassium acetate (120mM) and 0.2 mg/ml Quercetin. **(McDonald *et al.*, 2001)**

Typical Procedure:

The reaction mixture consisted 0.5 ml potassium acetate, 1.0 ml methanol, 0.5 ml of (1.2%) aluminium chloride and 1 ml of sample (1 mg/ml), incubated at room temperature for 30 min. The absorbance of all the samples was measured at 415 nm. The calibration curve was prepared by using 0, 0.2, 0.4, 0.6 and 0.8 mg/ml concentrations of quercetin. Flavonoids content was expressed in terms of Quercetin equivalent (mg/ml of extracted compound).

Results and discussion

Total phenol of banana pulp and peel extract

Total phenols estimation was carried out with Folin-ciocalteu reagent (FCR). The total phenolic content in the banana pulp and peel of ethanolic fruit extract was measured by Folin-ciocalteu technique in terms of catechol equivalent. Absorbance for total phenolic content of peel at 650 nm was 0.558. The standard curve was obtained at different concentration (0, 0.2, 0.4, 0.6, 0.8 and 1.0 mg/ml) of catechol. The absorbance obtained were (0, 0.310, 0.558, 0.902, 1.288 and 1.483) respectively. From the fig. 1 and table 1, it can be seen that the total phenolic content in the peel was about 0.4mg/ml.

Table 1 Absorbance of catechol standard and sample of peel

S. No	Concentration of catechol std. (mg/ml)	Absorbance (650 nm)
1	0	0
2	0.2	0.31
3	0.4	0.558
4	0.6	0.902
5	0.8	1.288
6	1.0	1.483
7	Sample	0.558

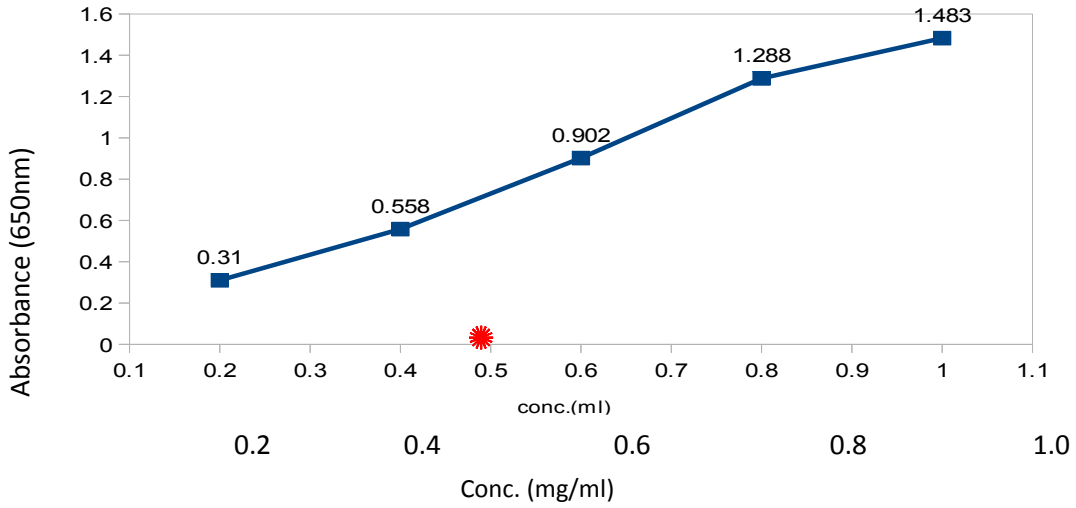

Fig 1. Analysis of the total Phenol content of banana peel of ethanolic extract.

The same procedure was followed for extract of banana pulp .Absorbance for total phenolic content of pulp at 650 nm was 0.441. The standard curve was obtained at different concentration (0, 0.2, 0.4, 0.6, 0.8 and 1.0 mg/ml) of catechol. The absorbance obtained were (0, 0.310, 0.558, 0.902, 1.288and 1.483) respectively. From the fig. 2 and table 2, it can be seen that total phenolic content of pulp was about 0.33 mg/ml**.**

Table 2. Absorbance of catechol standard and sample of pulp.

S. NO	Concentration of catechol std.(mg/ml)	Absorbance (650 nm)
1	0	0
2	0.2	0.310
3	0.4	0.558
4	0.6	0.902
5	0.8	1.288
6	1.0	1.483
7	Sample	0.441

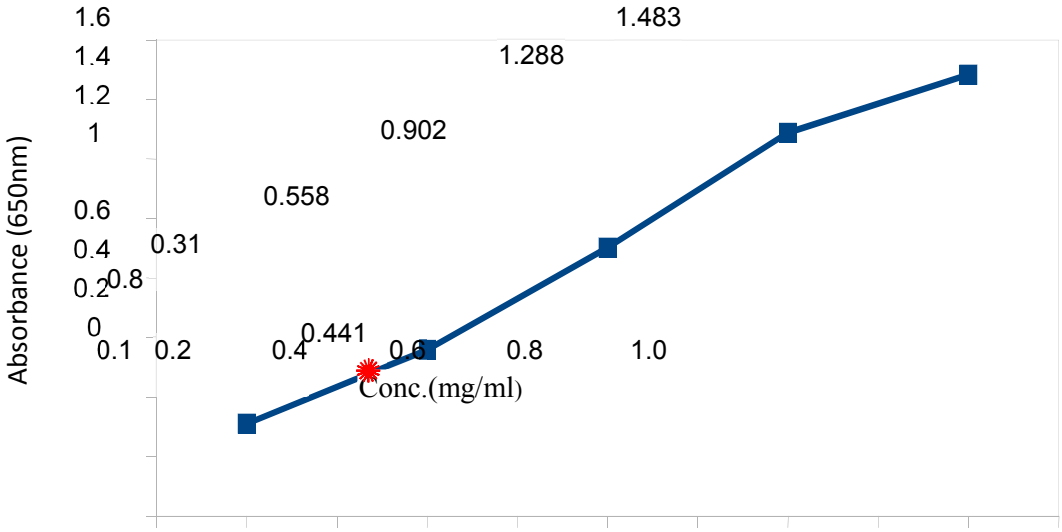

Fig 2. Analysis of the total Phenol content of banana pulp of ethanolic extract.

The TPC in present work was found to be higher in banana peel than in banana pulp. This result was relatively same with the previous study done by **(Fatemeh *et al.*, 2012)**, which demonstrated phenolic contents in banana peel flour extract is higher than phenolic contents in banana pulp flour extract.

Total flavonoid content of banana peel and pulp extract

Flavonoid content was estimated according to the method given by **(Chang *et al.*, 2002).** The absorbance for total flavonoid content of extract of banana of peel at 415 nm was 0.357 and the standard curve was obtained at 5 different concentration (0, 0.2, 0.4, 0.6, 0.8, and 1mg/ml). The absorbance obtained were (0, 0.183, 0.363, 0.586, 0.653, and 0.866) respectively. From the fig. 3 and table 4.3 it can be seen that total flavonoid in the peel was about 0.37 mg/ml.

Table 3. Absorbance of Quercetin standards and sample of peel.

S. NO.	Concentration of Quercetin std. (mg/ml)	Absorbance (415 nm)
1	0	0.00
2	0.2	0.183
3	0.4	0.363
4	0.6	0.586
5	0.8	0.653
6	1.0	0.866
7	Sample	0.357

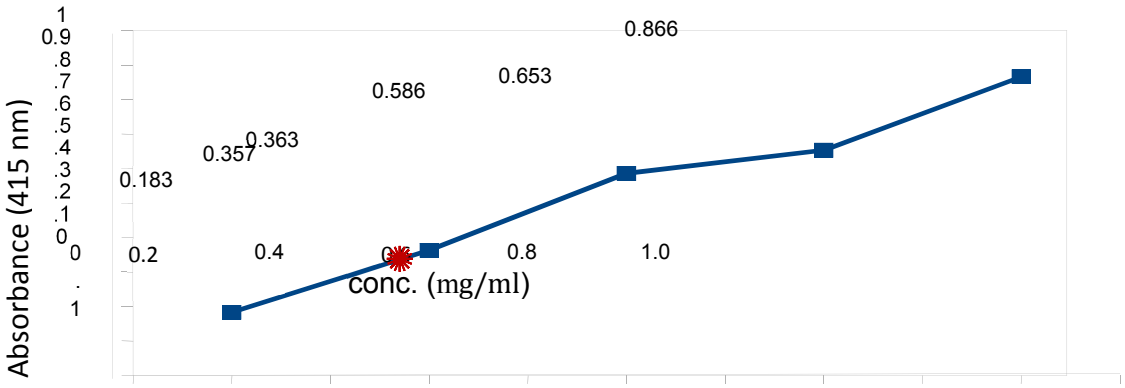

Fig 3. Analysis of the total flavonoids content of banana peel of methanolic extract.

The same procedure was followed for extract of banana pulp .Absorbance for total flavonoid content of pulp at 765nm was 0.189. The standard curve was obtained at different concentration (0, 0.2, 0.4, 0.6, 0.8 and 1.0 mg/ml) of methanolic extract. The absorbance obtained were (0, 0.183, 0.363, 0.586, 0.653, and 0.688) respectively. From the (fig. 4) and (table 4), it can be seen that total flavonoid content of pulp was about 0.2mg/ml**.**

Table 4. Absorbance of catechol standard and sample of pulp.

S. NO.	Concentration of catechol std. (mg/ml)	Absorbance (415 nm)
1	0	0.00
2	0.2	0.183
3	0.4	0.363
4	0.6	0.586
5	0.8	0.653
6	1.0	0.866
7	Sample	0.189

In present study, the TFC was higher in banana peel as compared to banana pulp, which demonstrated in all types and stage of ripeness of banana. Therefore, it is evident that the peel always presented higher TFC than the pulp.

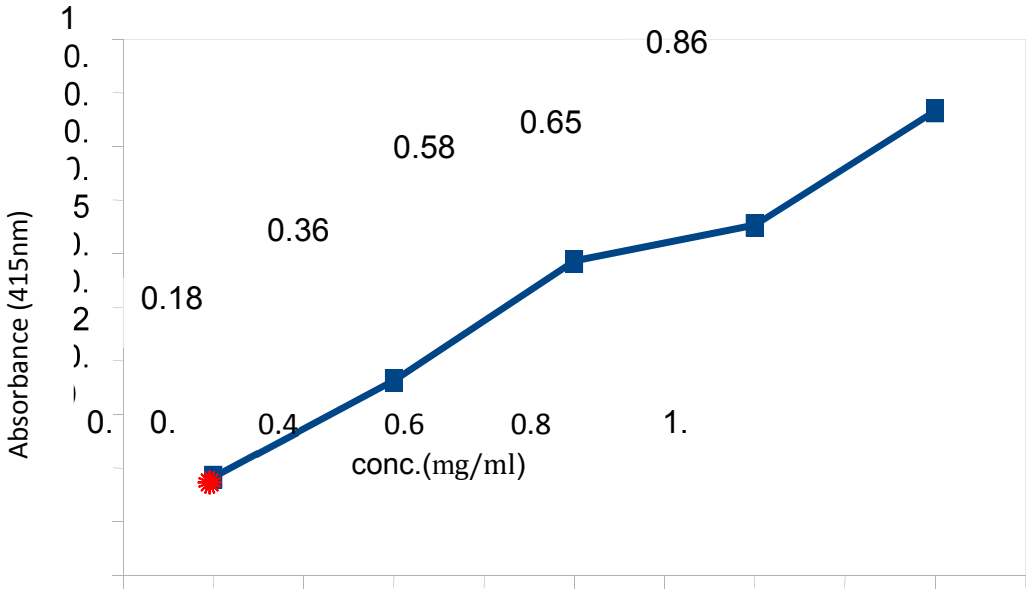

Fig4.Analysis of the total flavonoids content of banana pulp of methanolic extract.

CONCLUSION

Banana is one of the most popular fruits and several studies have indicated that both banana pulp and peel contain photochemicals compounds. The effect of variation of banana parts (pulp and peel) on TPC and TFC of the banana flours was studied. The results revealed that different varieties did show significant differences on TPC as well as TFC, which means that different samples produced different values of TPC and TFC compounds.

The TPC was determined in ethanolic extracts of banana peel and pulp flour. The TPC was found to be about 0.40mg/ml in banana peel and about 0.33 mg/ml in banana pulp. Thus, it is clear that the TPC was higher in the peel than in the pulp. Furthermore, the TFC was determined in methanolic extracts of banana peel and pulp flour. The TFC also was higher in banana peel than in banana pulp. It was found that the TFC in banana peel is about 0.37 mg/g and about0.20 mg/g in banana pulp.

References

1. **Anhwange, B.A., Ugye, T.J. and Nyiaatagher, T. D. (2008).** Chemical composition of musa sapientum (banana) peels. Electronic Journal of Environmental Agricultural and Food Chemistry 8 (6): 437-442.

2. **Babu, M. A., Suriyakala M. A., and Gothandam K. M., (2012)**Varietal Impact on Phytochemical Contents and Antioxidant Properties of *Musa acuminata*(Banana)*Journal Pharmacology Science & Research,* **10:**1950-55.
3. **Chia-Chi Chang1, Ming-Hua Yang2*, Hwei-Mei Wen1 and Jiing-Chuan Chern. (2002)** Estimation of Total Flavonoid Content in Propolis by Two Complementary Colorimetric Methods, Journal of Food and Drug Analysis, Vol. 10, No. 3, Pages 178-182.
4. **Darsini, D T P., Maheshu V., Vishnupriya M and Sasikumar J M., (2012).** *In vitro* antioxidant activity of banana (*Musa* spp. ABB *cv*. Pisang Awak). *Indian Journal of Biochemistry and Biophysics* **49:** 124-129.
5. **Fatemeh, S. R., Saifullah, R., Abbas, F. M. A. and Azhar, M. E.(2012**). Total phenolics, flavonoids and antioxidant activity of banana pulp and peel flours: influence of variety and stage of ripeness. International Food Research Journal 19 (3): 1041-1046.
6. **Guyle`ne Aurorea, Berthe, P., and Louis, F. (2009).** Bananas, raw materials for making processed food products. Trends in Food Science & Technology, 20, 78-91
7. **Kanazawa, K. and Sakakibara, H. (2000)** High content of dopamine, a strong antioxidant, in Cavendish banana. Journal of Agricultural and Food Chemistry 48(3) : 844–848.
8. **Kondo, S., Kittikorn, M. and Kanlayanarat, S. 2005**. Preharvest antioxidant activities of tropical fruit and the effect of low temperature storage on antioxidants and jasmonates. Postharvest Biology and Technology 36: 309–318.
9. **Kumar K P S., Bhowmik D., Duraivel S., and Duraivei M., (2012)** Traditional and Medicinal Uses of Banana. *Journal of Pharmacognosy and Phytochemistry* **1(3):** 51-63.
10. **Ligia Portugal Gomes Rebello, Afonso Mota Ramos, Paula Becker Pertuzatti, Milene Teixeira Barciad, Noelia Castillo-Muñoze,, Isidro Hermosín-Gutiérre. (2014)**. Flour of banana (Musa AAA) peel as a source of antioxidant phenolic compounds. FoodResearch International 55. 397–403.

11. **Lim A S L., and Rabeta M S., (2013)** Proximate analysis, mineral content and antioxidant capacity of milk apple, malay apple and water apple. *International Food Research Journal* **20(2):** 673-679
12. **McDonald S, Prenzler PD, Autolovich M, Robards K. (2001)** Phenolic content and antioxidant activity of olive extracts. *Food Chem.* 2001;73:73–84.
13. **Mohammad, Z.I., and Saleha, A. (2011).** Musa paradisiaca L. and Musa sapientum L.: A Phytochemical and Pharmacological Review. Journal of Applied Pharmaceutical Science, 01, 14-20.
14. **Natakkakath Kaliyathan Raveena , Nagaraja Ingaladal , M.V. Reshma , Ravi S. Lankalapalli. (2022).** Phytochemical investigation of unripe banana (Musa AAB) cv. Nendran and its novel 'Banana Grits'. Food Chemistry Advances Volume 1, 10006
15. **Nguyen, T.B.T., Ketsa, S. and Van Doorn, W.G. (2003)**. Relationship between browning and the activities of polyphenol oxidase and phenylalanine ammonia lyase in banana peel during low temperature storage. Postharvest Biology and Technology 30(2): 187–193.
16. **Preethi R., Vimal V., Devanathan and Loganathan M.,(2010)**. ntimicrobial and Antioxidant Efficacy of Some Medicinal Plants against Food Borne Pathogens. *Advances in Biological Research*, **2:** 122-125.
17. **Someya, S., Yoshiki, Y. and Okubo, K. (2002).** Antioxidant compounds from banana (Musa Cavendish). Food Chemistry 79: 351-354.
18. **Subhanki Padhi, Madhuresh Dwived. (2022)**. Physico-chemical, structural, functional and powder flow properties of unripe green banana flour after the application of Refractance window drying. Future Foods Volume 5, 100101.
19. **Sulaiman S F, Yusoff N A M, Eldeen I M, Seow E M, Sajak A A B, Supriatno O K L (2011)**. Correlation between total phenolic and mineral contents with antioxidant activity of eight Malaysian bananas (Musa sp.). *J. Food Comp. Ana.*, **24:** 1-10.
20. **Sultana B., and Anwar F., (2008)** Flavonols (kaempferol, quercetin ,myricetin) contents of selected fruits, vegetables and medicinal plants. *Food Chem*. **108:**879-884.