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REVIEW ON EXTRACTION OF PHENOL FROM BANANA PEELS AND ITS COMPARISON

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Abstract:

Background: The banana peels is a household and industrial food waste discarded in large scale; it represents about 35% of the total fresh mass of ripe fruit. India is the first world producer of banana over a 14.2 million tons is products annually. The extract of banana peels exhibits a high total phenolic content around 29mg/g, as GAE. This peel waste should be considered as potential source of bioactive compound that are important for both food and pharmaceutical industries because of its antioxidant capacity, low cost and easy availability.

Objective: The objective of this study is to compare Total Phenolic Content (TPC) in various variant of banana (100 gram of material) using parameters such as temperature, time, methods of extraction and solvents.

Conclusion: Extraction of TPC out by different methods and Innovative techniques avoid shortcomings of content optional technique friendly to environmental to avoid chemical risk, extraction time, consumption the solvents and obtain yield quality of phenol.

Index Terms **-Banana Peels, TPC, Solvent.**

1. INTRODUCTION

Banana is second-largest producer after citrus fruit account for under around 16% of worldwide world product. India is contributing 27% of the world for banana production. From an environmental perspective, it's vital that plant by-products produced by the agro-food industry be reused. Peels of a range of fruits and plants are gaining attention as a natural source of polyphenols and bioactive compounds, which possesses various beneficial effects on human health. Banana peel contains high content of micronutrient compared to fruit pulp (Shanthy Sundaram et al.,2011). It attracts great attention due to their nutritional and antioxidant properties. Due to the importance of those compounds, it's necessary to grasp its initial production and losses during fruit development, ripening, and maturation. Medicinal plants are currently in considerable significance view because of their special attributes as an outsized source of therapeutic phytochemicals which will result in the development of novel drugs. Most of the phytochemicals from plant sources like phenolic and flavonoids are reported to own positive impact on health and cancer prevention.

1.1 Solvent extraction:

Solvent extraction is a process in which compounds are separated by using their relative solubility. This method involves a solvent and a fluid that has the ability to dissolve another substance. Then the produced received is cooled and filtered through a standard screen mesh or filter paper. The filtrate is then collected for further uses.

1.2 Ultrasound-Assisted Extraction (UAE):

UAE uses acoustic waves within the kilohertz range that travel through the solvent producing cavitation bubbles. When the cavitation bubbles burst at the surface of the banana sample matrix, a shockwave-induced damage to banana cell membrane enhances the mass transfer of phenolic compounds across cellular membranes into solution. However, ultrasonic waves are reported to lead to the degradation of some phenolic acids and also the creation of highly reactive hydroxyl radicals within the gas bubbles. UAE is an affordable and easy alternative to Soxhlet extraction. In UAE, the sample and solvent (typically 50% ethanol in water and a solvent

(mL) to biomass (g) ratio of 20:1) are contained in a volumetric flask that's placed in a very temperature-controlled ultrasonic bath then sonicated at 40 kHz for a period of 10–60 min at temperatures below 100°C (typically 60°C). Filtration is employed after extraction to separate the extract from the plant residue. The UAE extraction protocol is often optimized with respect to solvent, temperature and solvent to biomass ratio for the plant sample under investigation**.**

1.3 Microwave Assisted Extraction (MAE):

Microwave assisted extraction may be a conventional technique for the extraction of active components from medicinal plants, using microwave energy to heat solvents containing samples, thereby partitioning analytes from a sample matrix into the solvent. The important advantage of Microwave assisted extraction is its ability to rapidly heat the sample solvent mixture, leading to its wide applicability for the rapid extraction of analytes, including thermally unstable substances. The efficiency of Microwave assisted extraction depends on several factors, including solvent properties, sample material, and also the components being extracted, specifically their dielectric constants. In developing methods to extract plant-derived medicines, several Microwave assisted extraction parameters should be optimized, including the polarity and volume of extracting solvent, sample size, extraction temperature and time, and microwave power. The extraction efficiency is significantly improved by increasing microwave power and time. However, cooling time during irradiation didn't affect the extraction efficiency. Optimal conditions were identified at ratio of 2:100 g/mL, 6 min irradiation, and microwave power of 960 W. Under these optimal conditions, approximately 50.55 mg phenolics may perhaps be recovered from 1 g dried peel. These conditions are recommended for recovery of phenolic compounds from peel for further utilization.

1.4 Homogenizer Assisted Extraction (HAE):

The Homogenizer assisted extraction is used for the extraction of total phenolic compounds from the banana peel powder. The extraction conditions are pre-determined according to the experimental design. For the extraction, the banana peel powder is mixed with hydroethanolic solutions with the aid of Ultra-Turrax Homogenizer at 11,000 rpm for 30 s. Once the extraction was completed, the supernatant is separated from the insoluble solids by centrifugation at 3,801 g for 11 min at 58C is done. The supernatant is used for the analysis of total phenolic compounds and antioxidant activity.

1.5 Reflux extraction:

Reflux extraction method is a solid–liquid extraction process at a constant temperature with solvent evaporation and condensation for a selected period of time without the loss of solvent. The system is widely employed in herbal industry because it is simple to use economic e. In these 100 grams of powdered sample is used for extraction by reflux using various solvents.

1.6 Soaking method:

In Soaking method, the Sample is soaked into solvent separately for a particular period of time inside a conical flask. The resulting extracts are filtered and then distilled. The obtained extracts are obtained and sealed with aluminum foils and stored in the refrigerator until required.

1.7 Soxhlet Extraction:

Firstly, banana peels are washed so it is kept for shaded drying for 2-3 days After drying powder is formed of that dry peels using jaw crusher. After Crushing separate the fine particle by screening. Wash all the apparatus and arrange equipped up. Place the filter paper inside the thimble to avoid fall of powder within the extractor also avoid blockage in reflux tube. After adding solvent start heating. The solvent is heated to reflux the solvent vapors travels to a distillation arm and floods into the chamber housing the thimble of solid the condenser makes sure that any solvent vapor cool and drips back off into the chamber housing the solid material. The chamber containing the solid material slowly fills with warm solvent a number of the required compound will then dissolve within the warm solvent when the Soxhlet chamber is nearly full the chamber is automatically emptied by a Siphon, with the solvent running all the way down to distillation flask. This cycle could also be allowed to repeat repeatedly. After particular period of time remove the extract from the round bottom flask filter it using a watt man after filtration give this solution for test.

2. COMPARISON OF TOTAL PENOLIC CONTENT (TPC)

The following tables compare the total Phenolic content in banana peels (100g of banana peel powder) based on six parameters

1.Type of banana
2.Solvent used for extraction
3.Methods used for extraction
4.Temperature
5.Time

2.1 SOLVENT: METHANOL

Table 1. Yield of TPC in g GAE/100g DW using Methanol as solvent

CULTIVAR (TYPE OF BANANA)	METHOD	TEMPERATURE (DEGREE CELCIUS)	TIME(MIN)	TOTAL PHENOLIC CONTENT(g GAE/100g DW)
MUSACEAE	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	25	_	0.1789
GRANDE NAINE	SOLVENT EXTRACTION	25	1	1.4
GRANDE NAINE	SOLVENT EXTRACTION	25	120	1.8
GRANDE NAINE	SOLVENT EXTRACTION	55	1	1.4
GRANDE NAINE	SOLVENT EXTRACTION	55	120	1.8
GRUESA	SOLVENT EXTRACTION	25	1	1.4
GRUESA	SOLVENT EXTRACTION	25	120	1.9
GRUESA	SOLVENT EXTRACTION	55	1	1.2
GRUESA	SOLVENT EXTRACTION	55	120	1.6

Table 2. Yield of TPC in 100 GRAM OF SAMPLE mu/ml using Methanol as solvent

CULTIVAR (TYPE OF BANANA)	METHOD	TEMPERATURE (DEGREE CELCIUS)	TIME(MIN)	TOTAL PHENOLIC CONTENT (100GRAM OF SAMPLE mu/ml)
Pisang Abul (matured)	FOLIN- CIOCALTEU	-	240	5.91
Pisang Abul (matured)	FOLIN- CIOCALTEU	-	480	7.20
Pisang Berangal (unmatured)	FOLIN- CIOCALTEU	-	33.00	12.0
Pisang Berangal (unmatured)	FOLIN- CIOCALTEU	-	60	12.56

2.2 SOLVENT ETHANOL

Table 3. Yield of TPC in g GAE/100g DW using Ethanol as solvent

CULTIVAR (TYPE OF BANANA)5	METHOD	TEMPERATURE (DEGREE CELCIUS)	TIME(MIN)	TOTAL PHENOLIC CONTENT (g GAE/100g DW)
MUSACEAE	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	25	_	0.1544
TANDUK	BY REFLUX	_	_	1.09
NANGKA	BY REFLUX	_	_	0.82
NENDRAN	BY REFLUX	_	_	0.82
MUSA SP.	HOMOGENIZER ASSISTED EXTRACTION	TILL BP	0.5	2.44
GRANDE NAINE	SOLVENT EXTRACTION	25	1	0.31
GRANDE NAINE	SOLVENT EXTRACTION	25	120	0.23
GRANDE NAINE	SOLVENT EXTRACTION	55	1	0.33
GRANDE NAINE	SOLVENT EXTRACTION	55	120	0.53
GRUESA	SOLVENT EXTRACTION	25	1	0.29
GRUESA	SOLVENT EXTRACTION	25	120	0.30
GRUESA	SOLVENT EXTRACTION	55	1	0.27
GRUESA	SOLVENT EXTRACTION	55	120	0.68

Table 4. Yield of TPC in 100 GRAM OF SAMPLE mu/ml using Ethanol as solvent

CULTIVAR (TYPE OF BANANA)5	METHOD	TEMPERATURE (DEGREE CELCIUS)	TIME(MIN)	TOTAL PHENOLIC CONTENT (100g OF SAMPLE mu g/ml)
Pisang Berangal (matured)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	_	120	7.41
Pisang Berangal (matured)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	_	60	7.17
Pisang mas(matured)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	_	120	12.68
Pisang mas(unmatured)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	_	120	19.09
Pisang mas(matured)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	_	120	12.81
Pisang masun (matured)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	_	120	20.26

2.3 SOLVENT DISTILLED WATER

TABLE 5. Yield of TPC in g GAE/100g DW using Distilled water as solvent

CULTIVAR (TYPE OF BANANA)	METHOD	TEMPERATURE (DEGREE CELCIUS)	POWER IN WATTS	TIME(MIN)	TOTAL PHENOLIC CONTENT (g GAE/100g DW)
MUSACEAE	SOLVENT EXTRACTION (FOLIN- CIOCALTEU)	25	_	_	0.0989
GRANDE NAINE	SOLVENT EXTRACTION	25	_	1	0.18
GRANDE NAINE	SOLVENT EXTRACTION	25	_	120	0.09
GRANDE NAINE	SOLVENT EXTRACTION	55	_	1	0.20
GRANDE NAINE	SOLVENT EXTRACTION	55	_	120	0.031
GRUESA	SOLVENT EXTRACTION	25	_	1	0.29
GRUESA	SOLVENT EXTRACTION	25	_	120	0.19
GRUESA	SOLVENT EXTRACTION	55	_	1	0.32
GRUESA	SOLVENT EXTRACTION	55	_	120	0.13
MUSA CAVWNDISH	MICROWAVE ASSISTED	_	1200	2	0.3787
MUSA CAVWNDISH	MICROWAVE ASSISTED	_	960	4	0.4895
MUSA CAVWNDISH	MICROWAVE ASSISTED	_	720	6	0.5327

Table 6. Yield of TPC in g GAE/100g DW using Distilled water as solvent

CULTIVAR (TYPE OF BANANA)	METHOD	TEMPERATURE (DEGREE CELCIUS)	TIME(MIN)	TOTAL PHENOLIC CONTENT (g GAE/100g DW)
MUSA PARADISICA (UNMATURED)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	25	5	0.071
MUSA PARADISICA (MATURED)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	25	5	0.371
MUSA PARADISICA(LEAKY)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	25	5	0.155

2.4 SOLVENT ACETONE

Table 7. Yield of TPC in g GAE/100g DW using Acetone as solvent

CULTIVAR (TYPE OF BANANA)5	METHOD	TEMPERATURE (DEGREE CELCIUS)	TIME(MIN)	TOTAL PHENOLIC CONTENT (g GAE/100g DW)
GRANDE NAINE	SOLVENT EXTRACTION	25	1	0.11
GRANDE NAINE	SOLVENT EXTRACTION	25	120	0.16
GRANDE NAINE	SOLVENT EXTRACTION	55	1	0.12
GRANDE NAINE	SOLVENT EXTRACTION	55	120	0.88
GRUESA	SOLVENT EXTRACTION	25	1	0.10
GRUESA	SOLVENT EXTRACTION	25	120	0.013
GRUESA	SOLVENT EXTRACTION	55	1	0.10
GRUESA	SOLVENT EXTRACTION	55	120	0.24
MUSA PARADISICA (UNMATURED)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	25	5	1.743
MUSA PARADISICA (MATURED)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	25	5	1.091
MUSA PARADISICA(LEAKY)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	25	5	8.44

Table 8. Yield of TPC in 100 GRAM OF SAMPLE mu/ml using Acetone as solvent

CULTIVAR (TYPE OF BANANA)	METHOD	CONCENTRATION OF SOLUTION	TEMPERATURE (DEGREE CELCIUS)	TIME(HOUR)	TOTAL PHENOLIC CONTENT (100 GRAM OF SAMPLE mu g/ml)
MUSA ACUMINATA	SOAKING (COLD EXTRACTION)	200	_	48	23.815
MUSA ACUMINATA	SOAKING (COLD EXTRACTION)	400	_	48	43.018
MUSA ACUMINATA	SOAKING (COLD EXTRACTION)	600	_	48	49.67
MUSA ACUMINATA	SOAKING (COLD EXTRACTION)	800	_	48	59.918
MUSA ACUMINATA	SOXHLET (HOT EXTRACTION)	200	TILL BP	40	25.30
MUSA ACUMINATA	SOXHLET (HOT EXTRACTION)	400	TILL BP	40	49.381
MUSA ACUMINATA	SOXHLET (HOT EXTRACTION)	600	TILL BP	40	56.745
MUSA ACUMINATA	SOXHLET (HOT EXTRACTION)	800	TILL BP	40	66.209

2.5 SOVENT HEXANE

Table 9. Yield of TPC in g GAE/100g DW using Hexane as solvent

CULTIVAR (TYPE OF BANANA)5	METHOD	TEMPERATURE (DEGREE CELCIUS)	TIME(MIN)	TOTAL PHENOLIC CONTENT (g GAE/100g DW)
TANDUK	REFLUX EXTRACTION	_	_	0.49863
NANGKA	REFLUX EXTRACTION	_	_	0.49766
NENDRAN	REFLUX EXTRACTION	_	_	0.506866
MUSA PARADISICA (UNMATURED)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	25	5	0.0087
MUSA PARADISICA (MATURED)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	25	5	0.068
MUSA PARADISICA(LEAKY)	SOLVENT EXTRACTION (FOLIN-CIOCALTEU)	25	5	0.071

3.CONCLUSION

Banana peel includes wide range of phenolic compounds with different polarities. The study concludes that Acetone acts as best solvent for extraction of phenol from banana peels. Observations let to suggest that the extracts can be as potential source of pharmaceutical ingredient. The TPC obtained in the Cold extraction method (soaking) is lower that the activity obtained in the hot extraction method (Soxhlet).Polarity of solvents indirectly played a significant role in extraction process since it'd increase the solubility of antioxidant compounds .Increase in acetone concentration led to a rise in TPC yield .The increase in the concentration of organic solvent resulted in increased TPC extraction. In UAE increase of TPC along with the increase of temperature from 30 to 40 C, and then decreased. In HAE in optimum conditions was able to extract a high TPC content (2.44 g GAE/ 100 g DW) from banana peel with just 30 s of extraction using ethanol as solvent. The impact of extraction time or temperature should be studied in greater depth (Rafaela González-Montelongo et al.,2010). Overall, the use of peel as a potential cheap and rich source of phenolic compounds relies on two definitive future research directions: (a) the cost-effective and efficient methods of recovering phenolic compounds; and (b) the potentiality of utilizing phenolic compounds as functional agents in food or in pharmaceutical products.

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