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Evaluation of phytochemical contents and antioxidant activities of crude seed extracts of *Musa balbisiana* Colla accessions of northeast India

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Abstract

Northeast Indian region is known for presence of diverse and unique banana (*Musa* spp.) accessions and its seeded wild relatives including the seeded *M. balbisiana* (BB genome). These bananas are used for various purposes such as food, medicinal, handicrafts, fabrics, etc. In the present study carried out with 6 different *M. balbisiana* seed extracts collected from different states of northeast India, phytochemical contents such as total phenol, total tannin and total flavonoid were evaluated along with DPPH radical scavenging activity and Ferric reducing antioxidant power for evaluating the antioxidant potential. Variable contents of total phenol, total tannin and total flavonoid long with antioxidant potential were observed. Overall, the findings indicated possible application of the huge banana resources including the wild seeded accessions for various economic and useful value-added food, nutraceutical and herbal products.

Keywords antioxidant potential, DPPH, FRAP, *Musa balbisiana*, phytochemical, northeast India

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Introduction

Bananas (*Musa* spp.) are grown across the tropical and sub-tropical Asian, African, Latin American, the Caribbean and the Pacific regions [1]. It is the fourth most important crop after rice, wheat and maize [2]. Banana domestication started in Southeast Asia 7,000 years ago then further spread to other regions by trans-migrants and travelers [3]. The seeded wild relatives of banana are heavily seeded and are unpopular for dessert or cooking items. The commercial non-seeded edible bananas originated from the inter and intra-specific hybridization of *M. acuminata* (AA) and *M. balbisiana* (BB), leading to the origin of bananas with different genomic groups and also ploidy levels such as AB, ABB, AAA, AAB, AAAA and ABBB [4-5]. While the seeded *M. acuminata* (AA) has been extensively studied, limited information on *M. balbisiana* (BB) are available [6].

Natives of the northeastern (NE) Indian region used *M. balbisiana* for various purposes as a source of fibre, food, roofing, handicrafts source and ethnomedicines. It is also a special delicacy for the Meitei community in the NE region for various ingenious vegetable preparations of the inflorescence and the pseudostems.

The rich dietary phytochemical and bioactive contents such as the phenolics present in the plants are known to scavenge free radicals which

are generated due to different metabolic processes [7]. The advantages of dietary-antioxidants over the synthetic ones mainly due to its lesser, open up avenues for the exploration of numerous plants as an alternative food preservative [8].

Thus, a study was designed for the evaluation of phytochemical contents and antioxidant potential of the wild seeded *M. balbisiana* accessions of NE India.

Methodology

Matured seed samples from six different fruiting *M. balbisiana* accessions collected from the NE region of India and maintained in the banana field gene bank of the Department of Biotechnology, Mizoram University (Table 1).

Table 1. Details of different *M. balbisiana* accessions of northeast region of India used in the present study

S.N.	Local Name	Genome Group	State
1	Bhimkal	BB	Arunachal Pradesh
2	Athiakal	BB	Assam
3	Changbi	BB	Manipur
4	Changthir	BB	Mizoram
5	Junglekola	BB	Nagaland
6	Aittakola	BB	Tripura

The seeds were extracted from the fruits by slicing and thoroughly washing in running tap water followed by double distilled water separately for each sample. The samples were then air dried under shade for 3 days and then in an oven maintained at 40 °C followed by powdering using an electric blender. Sample to solvent 1:10 (weight: volume) ratio of the powdered samples were dissolved in 60% acetone chosen according to our previous study (data not shown) for 24 h in a shaker incubator maintained at 120 rpm and 37 °C using the protocols of Alothman et al., [9]. The crude seed extracts were extracted by centrifuging at 5000 rpm for 5 min at 17 °C and the supernatants were collected gently and stored at 4 °C for further analysis. The total phenol content (TPC) of the extracts were estimated based on the Folin–Ciocalteu method of Singleton and Rossi [10]. For the determination of total flavonoid content (TFC), the Aluminium chloride method of Dewanto et al., [11] was followed with qurcetin as the standard and the total tannin content (TTC) was estimated using the protocol of Makkar et al., [12]. Each of the experiment was carried out with three triplicates. Statistical analysis of the data was carried out with SPSS version 16.0 software for analysis of variance and comparison of significance.

Results and Discussion

Total phenol content

The total phenol contents (TPC) of the *M. balbisiana* seeds collected from different states of NE India evaluated with extraction with 60% acetone ranged from 10.37 to 13.17 mg GAE/1g dried sample in the order of 13.17 mg GAE/1g in Nagaland sample, 12.91 mg GAE/1g in Assam sample, 12.82 mg GAE/1g in Mizoram sample, 12.28 mg GAE/1g in Arunachal Pradesh sample, 10.99 mg GAE/1g in Manipur sample and 10.37 mg GAE/1g in Tripura sample respectively (Table 2). Phenolics are common plant secondary metabolites present in the plants, which acts as natural antioxidants having characteristic colors and odour [13]. Similar findings of variable TPC contents were also reported in green and ripe Cavendish and Dream bananas [14]. Sultana et al., [15] reported the presence of high TPC in the banana peels. The important roles of phenols in plants as the secondary metabolites playing various important roles in the reproduction, growth and defense mechanism as well its usefulness in human diet were well documented [16].

Total flavonoid content

Total flavonoid contents (TFC) of the different crude seed extracts dissolved in 60% acetone of the different M. balbisiana accessions studied and expressed in terms of quercetin equivalents (QE) are given in Table 2. Highest flavonoid content was observed with the accession from Arunachal Pradesh with 2.17 mg QE/1g dried sample and the sample from Manipur with 0.29 mg QE/1g dried sample showed the lowest content. The TFC in all the samples ranges between 0.29 to 2.17 mg QE/1g dried sample. Similarly, Fatemeh et al., [14], had also observed varied TFC in different varieties of bananas). Flavonoids are possesses various properties including antioxidative activity in food lipid systems due to the presence of natural benzo-γ-pyrane derivatives [17-19].

Table 2. Details on the presence of total phenol content (TPC), total tannin content (TTC), total flavonoid content (TFC), DPPH scavenging value and ferric reducing value of the seeds extracts of different *M. balbisiana* of northeast India

Origin of the sample (State)	Total Phenol (mg GAE/1g dried sample)	Total Tannin (mg GAE/1g dried sample)	Total Flavonoid (mg QE/1g dried sample)	IC_{50} of DPPH (mg/ml)	FRAP (mg Fe(II)E /1g dried sample)
Arunachal Pradesh	12.28 ± 0.09^{a}	6.55 ± 0.04a	2.17 ± 0.08a	1.24 ± 0.07^{a}	4.81 ± 0.06^{a}
Assam	12.91 ± 0.05^{ab}	7.10 ± 0.05^{b}	1.84 ± 0.02^{b}	1.08 ± 0.30^{ab}	5.33 ± 0.03^{b}
Manipur	10.99 ± 0.08^{c}	5.47 ± 0.05^{c}	0.29 ± 0.03^{c}	1.42 ± 0.10^{c}	3.79 ± 0.07^{c}
Mizoram	12.82 ± 0.04^{ab}	5.93 ± 0.05^{d}	0.91 ± 0.03^{d}	1.41 ± 0.06^{c}	4.06 ± 0.04^{c}
Nagaland	13.17 ± 0.09^{b}	7.82 ± 0.05^{e}	1.68 ± 0.09^{b}	0.89 ± 0.02^{b}	5.48 ± 0.60^{b}
Tripura	10.37 ± 0.05^{c}	4.70 ± 0.11^{f}	0.52 ± 0.04^{e}	1.43 ± 0.03^{c}	3.74 ± 0.06^{c}

All values are means ± SD; Means in the same column having superscripted different letters denotes significantly different at P ≤ 0.05

Total tannin content

The total tannin contents (TTC) of the different seed extracts also showed variable quantities ranging from 4.70 to 7.82 mg GAE/1g dried sample (Table 2). The Nagaland sample was found to have highest total tannin content with 7.82 mg GAE/1g dried sample while the minimum content was found in extract sample of Tripura having 4.70 mg GAE/1g dried sample. Tannins are also reported to be present in variable amounts in Nendran banana varieties [20]. The antioxidant properties of phenolics such as tannins renders the astringency taste in unripe fruits that decreases with ripening [21-22]. Tannins provides the characteristic tart flavor and color in fruits and fruit juices which also determines the feeding habits of the animals [23]. Tannins help in reducing blood pressure, accelerate blood clotting, decrease the serum lipid level and modulate immune responses [24].

DPPH radical scavenging activity

The DPPH radical scavenging activity for the different accessions of *M. balbisiana* seed extracts collected from different states of NE India are given Table 2. The seed extract from Nagaland showed the highest antioxidant potential with the DPPH scavenging activity value of IC50 of 0.89 mg/ml followed by Assam and Arunachal Pradesh with a value of 1.08 and 1.27 mg/ml respectively. DPPH radical scavenging activity with IC50 values of ethyl acetate fraction (0.64 mg/ml) and ethanol fractions (0.31 mg/ml) reported in *Musa ensete* seeds are similar to the present finding [25].

Ferric reducing antioxidant power

The ferric reducing antioxidant power (FRAP) values which indicates the antioxidant activities expressed as ferric reducing ability equivalent to that of mg/ml $FeSO_4$ of the samples are given in Table 2. Highest FRAP value with 5.48 was observed in the sample from Nagaland then the sample from Assam with a value of 5.33 and then Arunachal Pradesh, with a value of 4.81.

In the present study, it is also observed that in vitro antioxidant activity of the different accessions of *M. balbisiana* seed extracts collected from different states of NE India showed variable

DPPH radical scavenging activity and FRAP assay. Schmidt et al., [26], reported that the highest antioxidant activity was observed with the samples with the highest flavonoids and phenolic concentrations. The variability in the observation of antioxidant activity is related to the different composition and availability of extractable compounds which are due to the environmental factors such as physico-chemical properties of the soil and climatic condition [27]. The findings will be useful for the application of the huge banana resources including the wild seeded accessions for various economic and useful value-added food, nutraceutical and herbal products.

Conclusion

The findings of the present study revealed the details of the phytochemical contents such as total phenol, total tannin, total flavonoid and the antioxidant potentials of the 6 seeded wild seeded banana (*M. balbisiana*) accessions collected from different parts of northeast India. Scientific data and understandings generated from the banana genetic resources from the northeast Indian region, considered as one the centers of origin with diverse accessions, will find its usefulness in the application for various economic and production of value-added food, nutraceutical and herbal products.

References

[1] OECD **(2009)**. Consensus document on the biology of bananas and plantains (*Musa* spp.). Series on Harmonisation of Regulatory Oversight in Biotechnology No. 48. Environment, Health and Safety Publications, Paris, France.
[2] S. Uma and S. Sathiamoorthy **(2002)**. Names and synonyms of bananas and plantains of India. National Research Centre for Banana, ICAR, Tiruchirapalli, India, pp62.
[3] J. S. Heslop-Harrison and T. Schwarzacher **(2007)**. Domestication, genomics and the future for banana. Ann. Bot., **100:** 1073-1084.
[4] N. W. Simmonds **(1962)**. The evolution of the bananas. Longman Group Ltd., London, UK.
[5] K. Shepherd **(1999)**. Cytogenetics of the genus Musa. International Network for the Improvement of Banana and Plantain, Montpellier, France, pp154.
[6] X. L. Wang, T. Y. Chiang, N. Roux, G. Hao and X. J. Ge **(2007)**. Genetic diversity of wild banana (*Musa balbisiana* Colla) in China as revealed by AFLP markers. Genet. Resour. Crop Evol., **54:** 1125-1132.
[7] J. V. Buren **(1970)**. Fruit phenolics. *In*: A. C. Hulme (ed) The biochemistry of fruits and their products. vol 1. Academic Press, London, pp269-304
[8] P. Yingming, L. Ying, W. Hengshan and L. Min **(2004)**. Antioxidant activities of several Chinese medicinal herbs. Food Chem., **88:** 347-350.
[9] M. Alothman, R. Bhatt and A. A. Karim **(2009)**. Antioxidant capacity and phenolic content of selected tropical fruits from Malaysia, extracted with different solvents. Food Chem., **115:** 785-788.
[10] V. L. Singleton and J. A. J. Rossi **(1965)**. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. Am. J. Enol. Vitic., **16:** 144-158.
[11] V. Dewanto, X. Wu, K. K. Adom and R. H. Liu **(2002)**. Thermal processing enhances the nutritional value of tomatoes by increasing total antioxidant activity. J. Agric. Food Chem., **50:** 3010-3014.
[12] H. P. Makkar, M. Bluemmel, N. K. Borowy and K. Becker **(1993)**. Gravimetric determination of tannins and their correlations with chemical and protein precipitation methods. J. Sci. Food Agric., **61:** 161-165.
[13] C. Vasco, J. Ruales and A. Kamal-Eldin **(2008)**. Total phenolic compounds and antioxidant capacities of major fruits from Ecuador. Food Chem., **111:** 816-823.
[14] S. R. Fatemeh, R. Saifullah, F. M.A. Abbas and M. E. Azhar **(2012)**. Total phenolics, flavonoids and antioxidant activity of banana pulp and peel flours: influence of variety and stage of ripeness. Int. Food Res. J., **19:** 1041–1046.

[15] B. Sultana, F. Anwar, M. R. Asi and S. A. S. Chatha **(2008)**. Antioxidant potential of extracts from different agro wastes: stabilization of corn oil. Grasas Aceites, **59:** 205-217.
[16] R. H. Liu **(2013)**. Health-promoting components of fruits and vegetables in the diet. Adv. Nutr., **4:** 384S-392S.
[17] S. S. Pekkarinen, H. Stöckmann, K. Schwarz, M. Heinonen and A. I. Hopia **(1999)**. Antioxidant activity and partitioning of phenolic acids in bulk and emulsified methyl linoleate. J. Agric. Food Chem., **47:** 3036-3043.
[18] S. Nieto, A. Garrido, J. Sanhueza, L. Loyola, G. Morales, F. Leighton and A. Valenzuela **(1993)**. Flavonoids as stabilizers of fish oil: an alternative to synthetic antioxidants. J. Am. Oil Chem. Soc., **70:** 773-778.
[19] B. J. F. Hudson and J. I. Lewis **(1983)**. Polyhydroxy flavonoid antioxidant for edible oils. phospholipids as synergists. Food Chem., **10:** 111-120.
[20] S. Siji and P. V. Nandini **(2016)**. Phytochemical analysis of selected banana varieties. Int. J. Adv. Eng. Manag. Sci., **2:** 964-968.
[21] M. Parimala and F. G. Shoba **(2013)**. Phytochemical analysis and in vitro antioxidant activity of hydro alcoholic seed extract of *Nymphaea nouchali* Burm. Asian Pac. J. Trop. Biomed., **3:** 887-895.
[22] P. Khawas, A. J. Das, N. Sit, L. S. Badwaik and S. C. Deka **(2014)**. Nutritional composition of culinary Musa AAB at different stages of development. Am. J. Food Sci. Technol., **2:** 80-87.
[23] M. Jackson **(2003)**. Potential mechanisms of action of bioactive substances found in foods. *In*: G. Goldberg (ed.), Plants: Diet and health. Blackwell Publishing, Oxford, UK, pp65-75.
[24] J. L. Donovan, C. Manach, R. M. Faulks and P. A. Kroon **(2006)**. Absorption and metabolism of dietary plant secondary metabolites. *In*: A. Crozier, M.N. Clifford and H. Ashihara (eds.), Plant secondary metabolites: occurrence, structure and role in the human diet. Blackwell Publishing, Oxford, UK, pp303-351.
[25] M. Afolayan, S. Abubakar, A. Adedayo, I. Doyinsola and F. Adebisi **(2014)**. In vitro antioxidant, antimicrobial and phytochemical properties of wild banana [*Ensete gilletii* (E.A.J. DE Wildman)] seeds extract. Int. J. Adv. Chem., 2: 59-61.
[26] M. M. Schmidt, R. C. Prestes, E. H. Kubota, G. Scapin and M. A. Mazutti **(2015)**. Evaluation of antioxidant activity of extracts of banana inflorescences (*Musa cavendishii*). CyTA. J. Food, **13:** 498-505.
[27] B. Hsu, I. M. Coupar and K. Ng **(2006)**. Antioxidant activity of hot water extract from the fruit of the Doum palm, *Hyphaene thebaica*. Food Chem., **98:** 317-328.