International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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A comparative analysis of phytochemical and biochemical activities of two varieties of mango seed kernels

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International Journal of Science and Research Archive, 2023, 10(02), 240–248

Publication history: Received on 30 August 2023; revised on 15 October 2023; accepted on 18 October 2023

Article DOI: https://doi.org/10.30574/ijsra.2023.10.2.0814

Abstract

The present research work embraces the study of moisture content, yield percentage, organoleptic properties, and phytochemical and biochemical estimation of two varieties of mango seed kernel using different solvents with various polarity such as n-hexane, chloroform, ethyl acetate, acetone, methanol, and aqueous. Moisture content and percentage of yield were also calculated which were more in Banganpalle variety. The qualitative phytochemical and biochemical screening indicated the presence and amount of phenol, flavonoid, tannin, quinone, oxalate, saponin, sterol, triterpene, carbohydrate, protein, and lipid. The quantitative analysis result showed that phytochemicals like phenol, flavonoids, and tannin were present in higher content in the seed kernel of Neelam as compared to Banganpalle. The results from biochemical tests showed a high content of carbohydrates, proteins, and lipids in Neelam. The present study therefore conclusively points out that the mango seed kernel is a good source of various pharmacologically active substances that make a potential antioxidant, anti-inflammatory, and other therapeutic uses.

Keywords: Mango seed kernel (MSK); Biochemicals; Phytochemicals; Antioxidant; Anti-inflammatory; Therapeutic uses

1. Introduction

The Mango (*Mangifera indica* L., from the family Anacardiaceae) is the tastiest and most lauded of all tropical fruits. From ancient times onward, it has been regarded and appreciated as a sacred plant in its native India, and today it can be found flourishing in most tropical regions. Of the total mangoes grown worldwide, India is responsible for 44.14 percent [1]. Mango products are loved all over the world, but the industrial processing of mango results in a lot of waste that might be difficult to dispose of. The northern provinces of India are known for their usage of flour made from mango seed kernels in the preparation of traditional flatbreads known as chapattis. In addition, it is a nutritionally promising seed, and estimating its proximate composition would help to discover the potential value of the kernel, filling the scarcity and competitiveness problem of feed for livestock and industrial applications [2].

The majority of the mango production process is unneeded, and its byproducts contribute to pollution [3]. Mango seeds, if used correctly as a raw material or food additive, could create economic gains for businesses while also helping to reduce nutritional deficiencies, improving health, and lessening the toll on the environment.

Therefore, this piece of experiment aimed to analyze the biochemical and phytochemical properties as well as the antibacterial activity of the natural metabolites associated with seed kernels of two mango cultivars.

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2. Material and methods

2.1. Collection of mango seeds, removal, and processing of kernel

The mango kernel was collected locally from Jagatpur in the Cuttack district of Odisha is located between latitude 20.4958^{0}N and 85.9208^{0}E. The seeds were washed and air-dried. The kernels and sheaths were removed manually from the seeds. To eliminate moisture, fresh kernel seeds were broken into small pieces and dried in a dehydrator at 50 ^{0}C for 2-3 days. The dried kernel was milled into a fine powder.

2.2. Percentage of moisture content in the mango seed kernel

The MSK were dried and weighed at regular intervals over the course of several hours to determine their moisture content. Moisture was expressed as a percentage, and the amount of moisture was determined in mg per gram of dry substance [4, 5].

$$\%\ of\ moisture\ content = \frac{Initial\ weight\ (g) - Final\ weight\ (g)}{Initial\ weight\ (g)} \times 100$$

2.3. Extraction of plant material

In a Soxhlet system, powdered plant materials were extracted using n-hexane, chloroform, ethyl acetate, acetone, methanol, and distilled water. Then, a rotating evaporator removes surplus solvent. The residual solvents were vaporized by heating the extracts in an oven until they became semisolid.

2.4. Yield percentage

The yield percentage was calculated by following formulae:

$$Yield\ percentage = \frac{Weight\ of\ the\ dried\ extract}{Weight\ of\ the\ dried\ plant\ material} \times 100$$

2.5. Evaluation of organoleptic properties

The organoleptic properties of crude extract were assessed by their color, texture and odour, physical appearance, and surface [6,7]

2.6. Qualitative analysis for biochemicals

Biochemical analysis of MSK was referred to test the presence of total carbohydrates, protein, and lipids in the sample to determine its nutritional value. Tests for carbohydrates, protein, and lipids were done by the Fehling test, Millon test, and Sudan red test respectively.

2.7. Quantitative analysis for biochemicals

The total amount of carbohydrates [8], Protein [9], and Lipid [10] present in the plant sample was estimated using standard laboratory procedure.

2.8. Qualitative analysis of phytochemicals

The presence of several phytochemicals was initially screened qualitatively using the methods described by Sheel *et al*. [11], Nanna *et al.* [12], Mishra *et al.* [13], and Sharma *et al.* [14].

2.9. Quantitative analysis of phytochemicals

2.9.1. Estimation of total phenolic content

Based on the work of Ebrahimzadeh *et al.* [15], the total phenolic content of MSK's various solvent fractions was calculated. At 760 nm, the absorbance was measured. The total phenolic content was determined in triplicate for each extract and reported as mg of gallic acid equivalents per gram of plant extract (mg GAE/g).

2.9.2. Estimation of total flavonoid content:

The aluminum chloride colorimetric method as published by Uddin *et al*. [16], was used to calculate the total flavonoid content. Quercetin was used as standard. At 415 nm, absorbance was measured with a blank as a reference. The extract's total flavonoid content was determined and represented as mg of quercetin equivalents per g of extract.

2.9.3. Estimation of total tannin content:

Following the method of Makker *et al*. [17], the total tannin content of each MSK solvent fraction was calculated. At 510 nm, the absorbance was measured against a blank. The amount of tannin was determined to be the equivalent of mg of tannic acid per g of solvent extract.

3. Results and discussion

3.1. Percentage of moisture content in the mango seed kernel

The percentage of moisture content in the Neelam and Banganpalle varieties is depicted in the following pie chart:

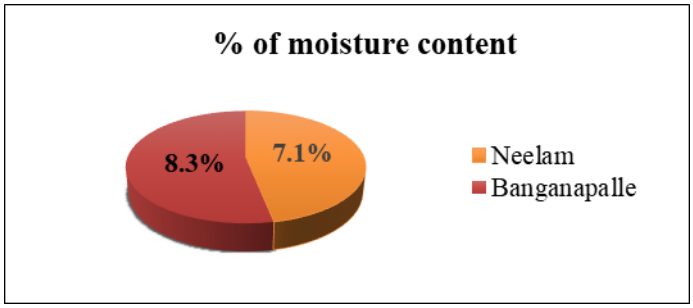

Figure 1 Percentage of moisture content in the MSK of two varieties

From Figure 1, it has been observed that the MSK of the Banganpalle variety has more moisture content as compared to the Neelam variety.

3.2. Yield percentage

Table 1 shows the yield percentage of two MSK varieties in different solvent extracts.

Table 1 Yield percentage of *Mangifera indica* seed kernel

Solvents used	Neelam	Banganpalle
n-hexane	16.583±0.334	14.253±0.834
Chloroform	9.083±0.301	7.803±0.931
Ethyl acetate	11.026±0.110	11.026±0.110
Acetone	11.863±0.075	12.64±0.940
Methanol	20.99±0.261	15.70±0.513
Aqueous	13.43±0.278	23.24±0.268

Results are in mean ± SD of triplicate determination

From Table 1, it has been observed that the yield percentage of Neelam is highest in methanol extract and lowest in chloroform extract. Similarly, in Banganpalle, the yield percentage is maximum in aqueous extract and minimum in chloroform extract.

3.3. Evaluation of Organoleptic Properties of *Mangifera indica* Seed Kernel

Table 2 Organoleptic properties of *Mangifera indica* seed kernel

Parameters	Characters
Colour	White creamy (Fresh), Brown (Dry)
Odour	Sweet
Taste	Sweet

Table 3 Organoleptic properties of crude extract of *Mangifera indica* seed kernel

Parameters	n-Hexane	Chloroform	Ethyl acetate	Acetone	Methanol	Aqueous
Colour	Yellowish-white	Yellowish-white	Brownish	Brownish	Brownish	Brownish
Texture	Oily	Oily	Oily	Sticky	Sticky	Sticky
Odour	Sweet	Sweet	Sweet	Sweet	Sweet	Pungent

3.4. Qualitative analysis for biochemicals

From Table 4, it has been observed that carbohydrates, protein, and lipid are present in the MSK sample of two varieties

Table 4 Qualitative analysis of mango seed kernel of two varieties

Variety name	Carbohydrate	Protein	Lipid
Neelam	+	+	+
Banganpalle	+	+	+

+: Present

3.5. Quantitative analysis for biochemicals

Table 5 represents the amount of carbohydrate, protein and lipid present in the dried biomass of MSK of two varieties. The carbohydrate content is higher in two varieties than the protein and lipid.

Table 5 Quantitative analysis of mango seed kernel of two varieties

Variety name	Carbohydrate (mg/g)	Protein (mg/g)	Lipid (mg/g)
Neelam	42.28	15.67	10.7
Banganpalle	41.15	14.75	9.98

3.6. Qualitative analysis of phytochemicals

Table 6 represents the phytochemicals present in the two MSK varieties of different solvent extracts.

The qualitative analysis of phytochemicals showed that phenol, flavonoid, tannin, and sterol, are present in all the extract of both the varieties. Saponin is present in three solvent extracts such as acetone, methanol, and aqueous of both varieties. Quinone and oxalate are absent in all the solvent extracts.

Table 6 Qualitative analysis of phytochemicals of Neelam and Banganpalle

Phytochemicals	Nature of the solvent											
	n-hexane		Chloroform		Ethyl acetate		Acetone		Methanol		Aqueous	
	N	B	N	B	N	B	N	B	N	B	N	B
Phenol	+	+	+	+	+	+	+	+	+	+	+	+
Flavonoid	+	+	+	+	+	+	+	+	+	+	+	+
Tannin	+	+	+	+	+	+	+	+	+	+	+	+
Quinone	_	_	_	_	_	_	_	_	_	_	_	_
Oxalate	_	_	_	_	_	_	_	_	_	_	_	_
Saponin	_	_	_	_	_	_	+	+	+	+	+	+
Sterol	+	+	+	+	+	+	+	+	+	+	+	+
Triterpene	_	_	_	_	+	+	+	+	+	+	+	+

N: Neelam variety, B: Banganpalle variety, +: Present, -: Absent

3.7. Quantitative analysis of phytochemicals

3.7.1. Estimation of total phenolic content

Figure 2 and Table 7 represents the total phenol content in two MSK varieties in different solvent extractions.

Table 7 Total phenol content of mango seed kernels in two varieties

Sample	Total Phenol content						
	n-Hexane	Chloroform	Ethyl Acetate	Acetone	Methanol	Aqueous	Control
Neelam	9.999± 0.043	5.263± 0.017	157.854± 0.086	55.903± 0.081	36.947± 0.060	9.983± 0.018	171.571± 0.030
Banganpalle	9.502± 0.027	4.241± 0.028	137.377± 0.025	49.358± 0.021	49.082± 0.038	7.49± 0.073	171.571± 0.030

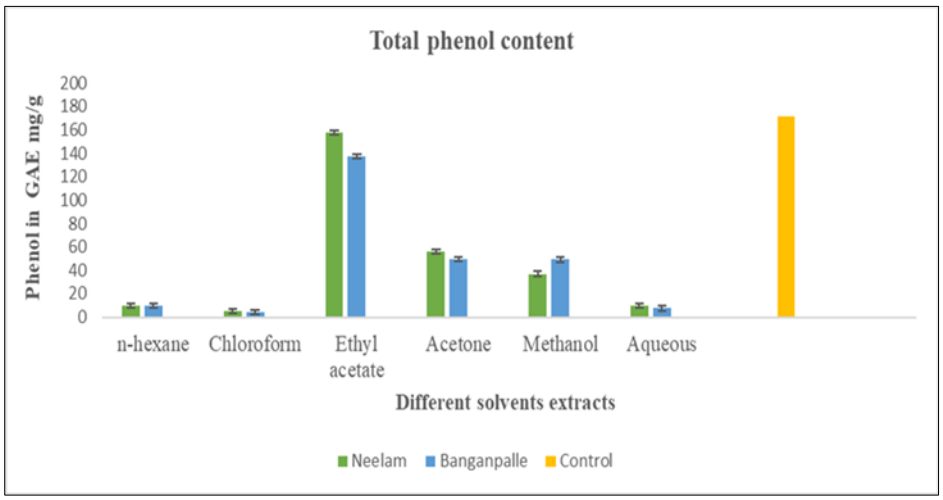

Figure 2 Total phenol content in MSK of two mango varieties in different solvent extracts

The concentration of total phenol was highest in the ethyl acetate extract of the Neelam variety (157.854±0.086 GAE mg/g) followed by 137.377±0.025 GAE mg/g in the Banganpalle variety. The phenol content was reported 171.571±0.035 GAE mg/g in the control sample.

3.7.2. Estimation of total flavonoid content:

Table 8 and Figure 3 represent the total flavonoid content in two MSK varieties in different solvent extractions.

Table 8 Total Flavonoid content in mango seed kernel of two varieties

Sample	Total Flavonoid content						
	n-Hexane	Chloroform	Ethyl Acetate	Acetone	Methanol	Aqueous	Control
Neelam	18.52± 0.063	19.253± 0.066	34.086± 0.088	27.323± 0.014	86.146± 0.088	25.543± 0.014	109.346± 0.092
Banganpalle	16.063± 0.072	18.92± 0.057	38.52± 0.088	33.42± 0.057	98.796± 0.062	25.356± 0.020	109.346± 0.092

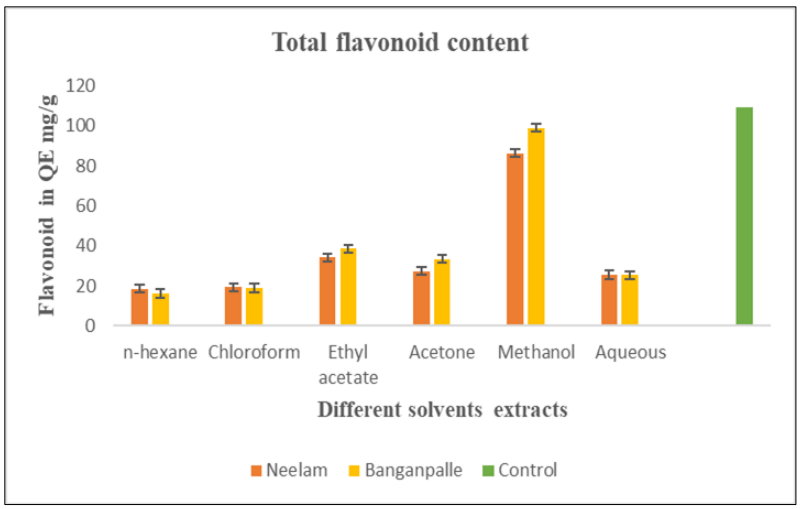

Figure 3 Total flavonoid content in MSK of two mango varieties in different solvent extracts

The amount of total flavonoid was highest in the methanol extract of Neelam and Banganpalle i.e., 86.146±0.088 and 98.796±.0.062 QE mg/g respectively. Similarly, the lowest flavonoid content was found in the n-hexane extract of the Banganpalle variety 18.52±0.063 QE mg/g followed by the Neelam variety 18.520±0.063 QE mg/g.

3.7.3. Estimation of total tannin content

Table 9 Total Tannin content in mango seed kernel of two varieties

Sample	Total Tannin content						
	n-Hexane	Chloro-form	Ethyl Acetate	Acetone	Methanol	Aqueous	Control
Neelam	7.753± 0.014	5.85± 0.011	157.833± 0.012	78.056± 0.049	204.23± 0.051	11.666± 0.029	212.96± 0.023
Banganpalle	9.873± 0.032	5.879± 0.021	134.246± 0.020	86.37± 0.011	159.51± 0.030	9.72± 0.029	212.96± 0.023

Table 9 and Figure 4 represent the total tannin content in two mango seed kernel varieties in different solvent extractions.

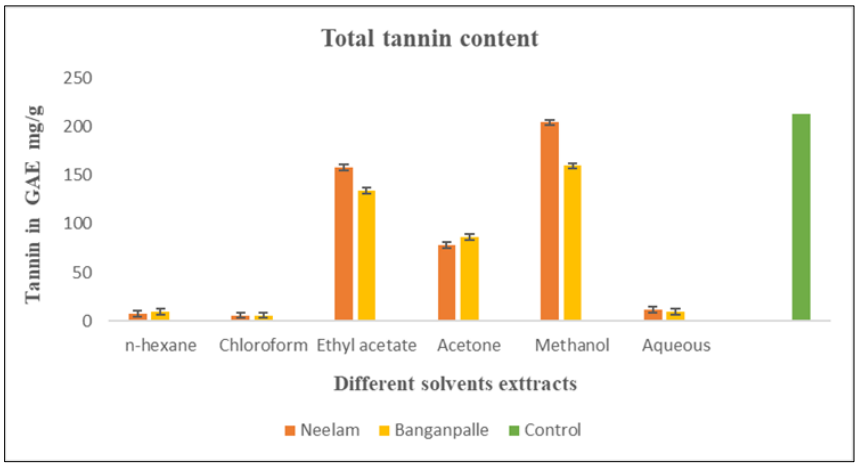

Figure 4 Total tannin content in MSK of two mango varieties in different solvent extracts

Total tannin content was highest in methanol extract of both the varieties i.e., 157.833±0.012 GAE mg/g in Neelam and 134.246±0.020 GAE mg/g in Banganpalle respectively. Similarly, the lowest tannin content was found in chloroform extract of both the varieties i.e., 5.85±0.011 GAE mg/g in Neelam and 5.879±0.021GAE mg/g in Banganpalle respectively. The control sample contains 212.96±0.023 GAE mg/g.

Organoleptic characters were determined by using the senses of sight (eyes), touch(skin) and smell (nose), which provide the simplest as well as quickest means to establish the identity and purity to ensure the quality of a particular drug. This is again necessary because once the plant is dried and made into powder, it loses its morphological identity and is easily prone to adulteration [18]. The moisture content of drugs could be at a minimum level to discourage the growth of bacteria, yeast, or fungi during storage [19]. Low moisture content is always advantageous for the higher stability of drugs [20]. In 2017 Jane et al.,[21] reported that mango seed kernel contains 5.58 -7.94% moisture in four different varieties of mango seed kernels such as kent, sabine, apple, and ngowe. The moisture content was 5.90% in mango seed kernel powder [22]. The percentage of loss drying of mango seed kernel was 3.30% [23]. Sahu et al., 2013[24] investigated different solvent extracts of mango seed kernel and found that the hexane and acetone extracts showed high yield percentages such as 11.21 and 7.15 %, and the lowest in distilled water and ethanol ratio (3:1) was 2.64%. The yield percentage was 15.33 and 11.65 % in two different varieties of mango seed kernel of methanol extract [25]. Mango seed kernel extracts showed the presence of alkaloids, phenol, tannin, and saponin [26]. Ethanolic flower extract of *Mangifera indica* showed the presence of alkaloids, phenol, and flavonoids and the absence of saponins [27].

Luka and Mohammed, 2012 [28] reported that ethanolic extract of mango leaves exists in the presence of alkaloids, phytosterols, and flavonoids. Kuganesan et al., in 2017 [29] reported total phenolic content (TPC), and total flavonoid content (TFC) was evaluated. The higher TPC was observed in the peels (52.67-275.61 mg GAE/ g of extract) and the seed kernels (132.95-270.56 mg GAE/ g of extract) than that of the pulp while the highest TFC was present in the pulps (120.20-479.80 mg QE/g of extract). Villanueva et al., 2020 [30] observed the total phenol content and flavonoid content in four mango seed kernel flour of ethanolic extracts. The phenolic content varied from 103±8.3b -125±2.1a mg GAE/g of dry weight and flavonoid was 0.72±0.07 to 0.8±0.04 mg QE/g dry weight.

4. Conclusion

The present research shows that MSK has a wide variety of phytochemicals and biomolecules. Isolating the pure molecule has been the focus of recent research due to its potential as a medicinal agent and functional food market player. Furthermore, the present study showed that the extract from seed kernels of mango have potential phytochemical source for the functional food market and pharmaceutical need.

Compliance with ethical standards

Acknowledgments

The authors would like to express their earnest gratitude to the Department of Botany, Ravenshaw University, Odisha for giving the properly maintained laboratory space and other instrumental facilities to carry out this investigation.

Authors would also like to extend their sincere thanks to their supervisor, Prof. (Dr.) Sanhita Padhi, for her invaluable support and timely guidance.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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Author's short Biography

As an academician and researcher of plant science, **Dr. Sanhita Padhi** holds the position of a Professor in Botany in Ravenshaw University, Cuttack, Odisha. her research has spanned across different areas of Biophysics and Biochemistry, Phytochemistry and Abiotic stress and Microbial Biochemistry and the areas of Acoustic research such as effects of sound waves in the form of Indian Classical Instrumental Music and its effects on Plant Processes, Planetary Radiations-converted into sonic frequency range, and their effects on Plant Metabolism and Sound energy as bio-pesticides etc. In addition, her research also covers other fields like Magnetism and its effects on plant processes for an increase in crop productivity to address the world-hunger. She has completed 35 years in Teaching and 27 years in research in plant Science and 18 years of administrative responsibilities.

She has published and presented 146 research papers in referred journals, Book chapters, Books and conferences Proceedings / symposia, Popular Science Articles of both national and international repute. She has also served as a Reviewer, Editor, Member of the Editorial Board and holds Eminent Fellow Membership of several national and international journals. She is a Visiting Professor of International Leadership Institute, South Asia. She has completed 8 National & International Projects and Collaborations and has supervised 12 Ph.D. Scholars, 13 M.Phil. Scholars and 25 M.Sc. Projects. She works as a subject Expert both for Odisha and Rajasthan Public Service Commission and remains active in various Women Empowerment Programs.