ISSN No: 0976-5921
Published online at https://ijam.co.in

International Journal of Ayurvedic Medicine, Supplement of International Conference on Ayurveda-Yoga-Nathpanth - 2025

Evaluating the Impact of Little Millets on Glycaemic Control and Metabolic Health in Individuals with Diabetes: An Analytical Study

Research Article

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Abstract

Diabetes mellitus is a metabolic disease that carries serious health hazards. Diabetics can attain sufficient glycemic control with the aid of weight loss, exercise, oral glucose-lowering medications, and a healthy diet. The numerous antioxidant components found in millets, such as phenolic flavonoids, are crucial for regulating the body's glucose levels. Antioxidant elements found in millet include phenolic flavonoids, which are crucial in preventing and treating lifestyle diseases such as cancer, diabetes, heart disease, and gastrointestinal disorders. Using conventional analytical techniques, the chemical composition of the little millet grain was ascertained through observation and analysis. The analytical study reveals that the little millet is slightly yellow colour with a smooth texture and slightly bitter taste, the moisture content of Little millet is 11.24%, the mean time taken by the sample to dry up to the successive loss of <0.01 is 27.67min, the total ash value of Little Millet is 56.77%, the mean acid insoluble ash of Little millet is 27.89, the mean water-soluble ash of little millet is 41.22, Alcohol soluble extract of little millet is 0.45 %, Water soluble extract of little millet is found to be 9.938% and the pH of little millet is 6. FTIR study confirms the presence of compounds with functional groups such as Carboxylic acid, Alkenes, Aliphatic amine, Aromatics, and Alkyl halides.

Keywords: Millets, Little millets, Diabetes mellitus, Carboxylic acid, Alkenes, Aliphatic amine, Aromatics, Alkyl halides

Introduction

The risk of climate change and growing global awareness of the value of leading a healthy lifestyle to prevent non-communicable diseases opened the door for millets to gain significant attention once again. Millets are a powerful source of minerals, fiber, and vitamins, including the B complex. Additionally, abundant in phytochemicals that serve as immune modulators, detoxifiers, antioxidants, and polyphenols, including lignans, phytoestrogens, phytocyanins, and phytosterols. and so guard against age-related degenerative diseases, and non-communicable diseases like diabetes, heart disease, cancer, etc (1). The utilization of millet in our diet has become ingrained due to its health benefits and nutritional richness, necessitating a change in dietary habits (2). Little millets are also known as "cool food" because they have a cooling effect on the body when consumed in the summer (3).

Nutritious facts abound in it, including gamma-aminobutyric acid, phenolics, resistant starch, phytates, and lignans (4). Studies have shown that phylate retention acts as an antioxidant by facilitating the development of antidiabetic and anticancer properties (5). A high fiber content helps to heal stomach ailments more quickly and prevents constipation. Also makes it possible for the body to accumulate less fat (6). Little millets are rich in phenolic compounds, which are the source of antioxidants among the phytoconstituents found in the kingdom of plants. Bioactive components including caffeic acid, vanillic acid, p-hydroxybenzoic acid, gallic acid, ferulic acid, and chlorogenic acid are abundant in little millets (7). Little millets reported th huge number of secondary metabolites that help in curing diabetes's (8) The analytical study of little millets reveals the abundance of micronutrient and macronutrients (9).

Little millets prevent spikes in blood glucose levels and helps control diabetes. It also prevents heart disease (10). Millets are good sources of magnesium and phosphorus. Magnesium has the ability to help reduce the effects of migraine and heart attacks, while, phosphorus is an essential component of adenosine triphosphate (ATP) a precursor to energy in the body (11)

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Method

Collection and authentication of little millets

The raw material of little millet for the physio-chemical analysis was collected from the Eco ventures, 3-196, Industrial Estate, Kummara vandal Palli, Kadiri,

Anantapur, Karnataka. The same Little Millets is later authenticated in the Department of Dravyaguna (related to Ayurvedic Pharmacognosy) and Accession No - DG/ 22-23/562.

Physico-chemical analysis of little millets

Organoleptic analysis

The organoleptic test was by visualization and taste study done by an expert.

Loss of Drying

An evaporating dish was used to precisely weigh the test substance while drying it at 105° C, with precision i.e. successive difference of <0.01. The percentage of moisture content in little millet was recorded in triplicate (12, 13, 14).

Acid insoluble Ash determination

For six minutes, 25 millilitres of diluted hydrochloric acid will be heated with the ash that results from the total ash test. After that, the insoluble material is gathered in the crucible, cleaned with hot water, and ignited to a consistent weight. The weight of the air-dried ash will be used to compute the percentage of acid-insoluble ash (12, 13, 14).

Water soluble Ash determination

The ash from the total ash test will be boiled in 25 millilitres of water for five minutes. After collecting the insoluble material in the crucible, it will be cleaned with hot water and burned for 15 minutes at a temperature that doesn't go above 450ºC. The water-soluble ash is represented by the difference in weight, which is calculated by subtracting the weight of the insoluble matter from the total importance of the ash. Determine the water-soluble ash percentage of the little millet that has been air-dried (12, 13, 14).

Alcohol Soluble Extractive determination

The test sample was macerated for twenty-four hours in a closed flask with 100 ml of alcohol, shaking constantly for six hours and letting it stand for eighteen hours. In a shallow dish with a tared bottom and a flat bottom, quickly filter the filtrate while taking care to prevent solvent loss. Evaporate 25 ml of the filtrate to dryness and dry at 105° C until the weight remains constant. Determine the alcohol-soluble extractive percentage of the medication that has been air-dried (12, 13, 14).

Water Soluble Extractive determination

The test sample was macerated in a closed flask containing 100 ml of chloroform water for twenty-four hours, with frequent shaking for six hours and no standing time for eighteen hours. In a tared shallow dish with a flat bottom, quickly filter the filtrate while taking care to prevent solvent loss. Evaporate 25 ml of the filtrate to dryness and dry at 105 °C until the weight remains constant (12, 13, 14).

Determination of Total Ash

The test substance was precisely weighed in a silica dish and burned at 400°C in the furnace until it was burned and turned white, signifying the absence of carbon. Regarding the weight of the little millets that had been air-dried, the percentage of total ash was computed (12, 13, 14).

pH test of little millets

pH of 1% Solution. An accurately weighed 1 g of drug was dissolved in accurately measured 100 mL of water and filtered and the pH of filtrate was checked with a standardized filter paper (15).

FTIR analysis of little millets

The Fourier transform infrared spectrophotometer (FTIR) is arguably one of the most effective instruments for classifying the different kinds of chemical bonds, or functional groups, that various substances have. For FTIR analysis, dried millet solvent extract powder was utilized. To create the translucent sample disc, 100 mg of KBr pellet was encapsulated with 10 mg of the dried extract powder. The powdered material was placed into an FTIR Spectroscope (Shimadzu, IR Affinity1, Japan) with a resolution of 4 cm-1 and a scan range of 400 to 4000 cm-1 (16).

Result

Physico-chemical analysis of little millets was done. The organoleptic test shows colour is slightly yellow with a smooth texture and slightly bitter taste (Table 1). The mean moisture content of Little millet is found to be 11.24% and the mean time taken by the sample to dry up to successive loss of <0.01 is 27.67min (Table 2). The mean total ash value of Little Millet is found to be 56.77% (Table 3). The mean acid insoluble ash of Little millet is found to be 27.89 (Table 4). The mean water-soluble ash of little millet is found to be 41.22 (Table 5). Alcohol soluble extract of little millet is found to be 0.45 % (Table 6). Water soluble extract of little millet is found to be 9.938% (Table 7). The pH of little millets is 6. FTIR confirms the presence of compounds with functional groups such as Carboxylic acid, Alkenes, Aliphatic amine, Aromatics, and Alkyl halides (Table 8, Figure 1.)

Table 1: Result showing organoleptic analysis of little millet

S.no	Characteristic	Result
1	Taste	Slightly bitter
2	Colour	Golden yellow
3	Smell	N/A
4	Sound	N/A
5	Touch	Smooth

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Published online at https://ijam.co.in
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Table 2: Loss of Drying

Sample	Initial weight (Wi)	Final weight (Wf)	Moisture content(%) = Wi-Wf/Wi *100	Time (min)
A	2.003 gm	1.800 gm	10.13%	27
B	2.016 gm	1.777 gm	11.86%	29
C	2.023 gm	1.786 gm	11.72%	27
Mean moisture content			11.24%	27.67

Table 3: Determination of Total Ash

Sample	Wt of the crucible	Wt of the drug	Wt of the crucible with	After burning the final weight of the crucible	Ash obtained (Ao) = Wf - Wc	Ash value concerning air-dried drug (%) = Ao/
A	31 gm	3 gm	34.1 gm	32.6 gm	1.6 gm	53.33
B	27.49 gm	3 gm	30.4 gm	29.3 gm	1.81 gm	60.33
C	19.2 gm	3 gm	22.2 gm	20.9 gm	1.7 gm	56.66
Mean Total ash						56.77

Table 4: Acid insoluble Ash determination

Sample	Wt of the crucible	Wt of the drug	Wt of the crucible	Acid insoluble ash value with Wt of	Acid insoluble Ash obtained (Ao) = Wf	Acid insoluble Ash value concerning air-dried drug (%)
A	31 gm	3 gm	34.1 gm	31.8 gm	0.8 gm	26.67
B	27.49 gm	3 gm	30.4 gm	28.2 gm	0.71 gm	23.67
C	19.2 gm	3 gm	22.2 gm	20.2 gm	1.0 gm	33.33
Mean acid insoluble ash						27.89

Table 5: Water soluble Ash determination

Sample	Wt of the crucible	Wt of the drug	Wt of the crucible	Water soluble ash value with Wt of	Water soluble Ash obtained (Ao) = Wf	Water soluble Ash value concerning air-dried drug (%)
A	31 gm	3 gm	34.1 gm	32.2 gm	1.2 gm	40.00
B	27.49 gm	3 gm	30.4 gm	28.5 gm	1.01 gm	33.67
C	19.2 gm	3 gm	22.2 gm	20.7 gm	1.5 gm	50.00
Mean water soluble ash						41.22

Table 6: Alcohol Soluble Extractive determination

Sample	Weight of raw millet (wm)	Weight of crucible (Ea)	Weight of extract obtained with Wt of the crucible (Eb)	Eb- Ea)	Alcohol soluble Extract of Eb+Ea/wm
A	5 gm	56.924 gm	56.9403 gm	0.0163 gm	0.326%
B	5 gm	28.648 gm	28.671 gm	0.031	0.62%
C	5 gm	45.12 gm	45.141 gm	0.021	0.42%
Mean					0.45%

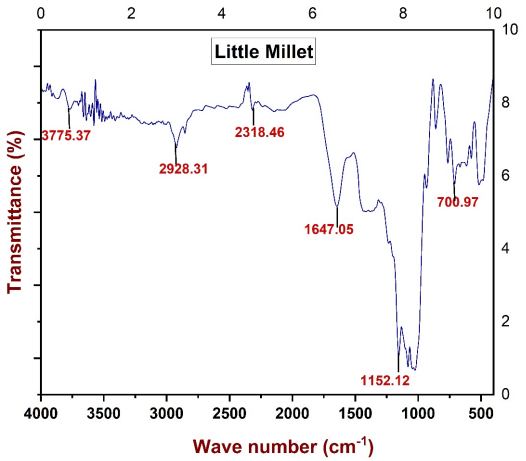
Table 7: Water Soluble Extractive determination

Sample	Weight of raw millet (wm)	Weight of crucible (Ea)	Weight of extract obtained with Wt of the crucible (Eb)	(Eb- Ea)	Alcohol soluble Extract of Eb+Ea/wm
A	5 gm	59.4168 gm	59.9225 gm	0.5057	10.114%
B	5 gm	28.64 gm	29.105 gm	0.465	9.3%
C	5 gm	45.12 gm	45.640 gm	0.52	10.40%
Mean					9.938%

Table 8: FTIR study of little millets

Wavelength	Bond	Functional group
3775.37	-	-
2928.31	O-H	Carboxylic acid
2318.46	-	-
1647.05	–C=C–	Alkenes
1152.12	C–N	Aliphatic amines
700.97	C–H “oop”	Aromatics
700.97	C–Cl stretch	Alkyl halides

Figure 1: The peaks of detected compounds through FTIR



Discussion

The analytical study provides a comprehensive profile of little millet, highlighting its distinctive attributes and compositional details. The millet exhibits a slightly yellow colour and smooth texture, coupled with a mildly bitter taste. The moisture content stands at 11.24%, and it takes an average of 27.67 minutes for the sample to dry up to a successive loss of less than 0.01%. The total ash value is recorded at 56.77%, with 27.89% being acid-insoluble ash and 41.22% water-soluble ash. Additionally, the alcohol-soluble extract is 0.45%, while the water-soluble extract is 9.938%. The pH of the little millet is measured at 6.

The role of compounds found in FTIR in managing Diabetes mellitus type 2**.** Carboxylic acids, particularly omega-3 fatty acids, play a significant role in managing type 2 diabetes. Omega-3 fatty acids, found in fish oil and some plant oils, have been shown to improve insulin sensitivity, reduce inflammation, and enhance lipid profiles (17). Clinical studies have demonstrated that omega-3 supplementation can significantly decrease fasting blood glucose levels and triglycerides while increasing HDL cholesterol levels, thus aiding in better glycemic control and reducing cardiovascular risks associated with diabetes.

While alkenes themselves are not directly used in diabetes treatment, certain bioactive compounds containing alkene groups, such as curcumin from turmeric, have shown promise due to their anti-inflammatory and antioxidant properties. These properties may enhance insulin sensitivity and potentially lower blood glucose levels, though more research and clinical trials are required to confirm their effectiveness in diabetes management.

In contrast, aliphatic amines play a well-established role in diabetes treatment. For example, metformin, an aliphatic amine, is a cornerstone in the management of type 2 diabetes. It works by reducing hepatic glucose production and improving insulin sensitivity, thereby helping to control blood glucose levels. Other aliphatic amines are also being explored for their potential in developing diabetes medications that address various metabolic pathways.

Aromatic compounds, particularly polyphenols, have been studied for their benefits in managing diabetes. Found in foods like berries, tea, and dark chocolate, polyphenols possess antioxidant and anti-inflammatory properties that can enhance insulin sensitivity and lower blood glucose levels. Regular consumption of polyphenol-rich foods may contribute to better management of type 2 diabetes and reduction in associated complications.

On the other hand, alkyl halides do not have a significant direct role in diabetes treatment. While some halide-containing compounds are being investigated in drug development for their effects on metabolic pathways, the role of alkyl halides in diabetes management remains minimal and not a primary focus in current treatments.

Conclusion

The presence of various functional groups shows that little millets are suitable for diabetes mellitus effects and that consumption of little millets is good for health

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