Analysis Of Phytochemical Composition In Sprouted Watermelon Seeds And Their Potential Health Benefits

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ABSTRACT
Watermelon seeds, often discarded along with the rind and skin, are nutrient-rich and offer various health benefits. This study aimed to analyze the phytochemical content of sprouted watermelon seeds. Fresh seeds were dried in the shade and subjected to qualitative and quantitative analyses, with all tests performed in triplicate for accuracy. Qualitative analysis revealed the presence of flavonoids, flavanols, phenolic compounds, and alkaloids in various solvent extracts. Notably, the aqueous extract contained significant amounts of phenolic compounds (175 mg/g) and polyphenols (121 mg/g). The chloroform extract showed high levels of alkaloids (75.3 mg/g), while the ethyl acetate extract contained diverse phytochemicals, including 107.6 mg/g of alkaloids and various flavonoids. These findings highlight the substantial phytochemical potential of sprouted watermelon seeds, suggesting their value as a nutritious food source.

Keywords: Sprouted Water Melon Seeds, Phytochemical Analysis, Polyphenols, nutritious

Introduction

Watermelon (Citrullus lanatus) is a widely consumed fruit known for its refreshing taste and high water content. While the sweet red pulp is enjoyed for its flavor and hydration properties, the seeds, rind, and skin are often discarded, despite their rich nutrient profile. Recent studies have highlighted the potential health benefits of watermelon seeds, which are rich in various bioactive compounds and phytochemicals. Phytochemicals are naturally occurring compounds found in plants that exhibit antioxidant, anti-inflammatory, and antimicrobial properties. They play a crucial role in human health by contributing to the prevention of chronic diseases, including cardiovascular diseases, diabetes, and certain cancers (Brahmi et al., 2023; Asgary et al., 2023). The seeds of watermelon, often overlooked, contain a variety of these beneficial compounds, including flavonoids, phenolic acids, and unsaturated fatty acids, which may enhance their nutritional value (Tamer et al., 2022).

Recent research has shown that sprouting can enhance the bioavailability and concentration of these phytochemicals. Sprouting activates enzymes that increase nutrient absorption and reduce antinutritional factors (Sharma et al., 2023). This process has been documented to improve the antioxidant capacity of seeds, making them a potentially valuable addition to the diet (Huang et al., 2023). Given the increasing interest in plant-based diets and functional foods, exploring the phytochemical composition of sprouted watermelon seeds is timely. Understanding the specific phytochemicals present and their potential health benefits could support the utilization of these seeds in functional food products, thus promoting sustainable practices by reducing food waste (Ghosh et al., 2022). This study aims to analyze the phytochemical composition of sprouted watermelon seeds and evaluate their potential health benefits. By shedding light on the nutritional value of these often-discarded parts of the watermelon, we hope to contribute to the broader discourse on food sustainability and health optimization.

2. METHODS AND MATERIALS

2.1 Materials

2.1.1 Plant Materials

Watermelon seeds were selected for the analysis of Phytochemicals qualitatively and quantitatively. Fresh watermelons were purchased from nearby fruits stall in Nagercoil, Kanniyakumari District, India.

2.2 Methods

2.2.1 Sample Preparation

The seeds were handpicked and cleaned in running tap water and the seed were kept in shadow drying for two days. Then seeds were soaked overnight and on the next day it was removed from the soaked water and washed in normal tap water. Finally, the soaked seeds were wrapped in damp white cotton cloth for 2 days. Once in every 12 hours the seeds were checked for sprouting. After the required amount of sprout was obtained, it was taken for the analysis.

2.2.2 Extraction of Sample

The extract of the seeds was prepared using various extracts such as aqueous, chloroform, ethyl acetate, hexane and petroleum ether as solvents. Take approximately 100 to 150 gm of the sample in to 1000ml round bottom flask. Add 500ml of the required solvant in to the flask. Keep it on heating mantle, and reflux it at 70°c to 80°c for 2-3 hrs using reflux condensor. After the extraction over, keep it for cooling at room temperature. Filter the extract using funnel with filter paper. Wash the residue with the solvant for complete recovery. Combine the extract and keep it in the hot plate to evaporate the solvant and dry it in hot air oven at 60°c to 70°c till completely evoporate the solvant. After evaporate the solvant, keep the residue for the required testing.

2.2.3 Tests for Flavonoids

Alkaline Reagent Test. 2 ml of 2.0% NaOH mixture was mixed with sample; concentrated yellow color was produced, which became colorless when we added 2 drops of diluted acid to mixture. This result showed the presence of flavonoids.

2.2.4 Presence of flavanols/flavones/Flavanones & Iso-flavanones

The reaction mixture consists of 1 mg of sample and 4 ml of distilled water was taken in a 10 ml volumetric flask. To the flask, 0.30 ml of 5 % sodium nitrite was treated and after 5 minutes, 0.3 ml of 10 % aluminium chloride was mixed. After 5 minutes, 2 ml of 1M Sodium hydroxide was treated and diluted to 10 ml with distilled water.

A set of reference standard solutions of Kaempherol/ Apigenin/ hesperitin/ daidzens were prepared separately in the same manner as described earlier. The absorbance for test and standard solutions were determined against the reagent blank at 510 nm with an UV/Visible spectrophotometer. The above compounds were compared separately for each standard.

2.2.5 Test for Terpenoids

2.0 ml of chloroform was added with the sample and evaporated on the water path and then boiled with 3 ml of H_2SO_4 concentrated. A grey color formed which showed the entity of terpenoids.

2.2.6 Test for Alkaloids

The sample is dissolved in dilute Hydrochloric acid and filtered.

Mayer's Test: Filtrates were treated with Mayer's reagent (Potassium Mercuric Iodide). Formation of a yellow coloured precipitate indicates the presence of alkaloids.

2.2.7 Test for Phenolic Compounds

2 ml of distilled water followed by few drops of 10% ferric chloride was added to sample. Formation of blue or green color indicates presence of Phenolic compounds.

2.2.8 Anthocyanin/Anthocyanidins

Preparation of Extract

1. The extract of the given sample was obtained from 5 g of the ground material with 50 mL of solvent.
2. Two solvents were used: 70% ethanol solution with 1.5 mol·L^{-1} HCl (85:15, v/v) and 70% ethanol.
3. The suspension was allowed to stand in the absence of light and under refrigeration (7 ± 1 °C) for 24 hours.
4. After 24 hours, the samples were filtered on Whatman Nº. 1 paper under vacuum in a Buchner funnel and the volume was completed to 50 mL.

Anthocyanins in the above extracts was done using a UV-Vis spectrophotometer according to the method proposed by Lees & Francis, 1972. The extracts were subjected to a reading in a spectrophotometer at 535 nm. The absorbance value showed the presence of anthocyanin/anthocyanidins.

2.2.9 Test for Polyphenols

Test for phenols A small amount of the extract was taken with 1 mL of water in a test tube and 1 to 2 drops of Iron III chloride (FeCl3) was added. A blue, green, red or purple color is a positive test.

2.2.10 Test for Tocopherols

Add 1 ml of phenanthroline solution to the samples, stopper the flasks and mix the solutions well. Carry out the next two stages of the determination by covering the flasks with aluminium foil and working in subdued light. Add 1 ml of iron (II1) chloride solution and mix thoroughly. Exactly 2 minutes later, add 1 ml of phosphoric acid solution and mix again. The flasks can now be brought into the light. phenanthroline gives a somewhat deeper colour if Tocopherols present.

2.2.11 Test for Phytosteroids

Sample was mixed with 20 ml of ethanol; the component was extracted for 2 hours. To the ethanolic extract of each sample extract was added 2 ml acetic anhydride followed with 2 ml of concentrated sulphuric acid. A violet to blue or green colour change in sample(s) indicates the presence of steroids.

2.2.12 Test for Lignans

In extract, 2 ml of distilled water followed by few drops of 10% ferric chloride was added. Formation of blue or green color indicates presence of Lignans.

2.2.13 Phytoestrogens

A colorimetric procedure, based on the formation of an azo dye by condensation of diazotized 5-chloro-2,4-dinitroaniline with ethinyl estradiol, was developed. An alkaline solution of ethinyl estradiol is reacted with the reagent, and the resulting color is measured at 450 nm. If the Phytoestrogens are detected based on the OD value compare to standard.

2.2.14 Determination of Flavonoid Content

Flavonoid content was measured by the aluminium chloride colorimetric assay. The reaction mixture consists of 1 mg of sample and 4 ml of distilled water was taken in a 10 ml volumetric flask. To the flask, 0.30 ml of 5 % sodium nitrite was treated and after 5 minutes, 0.3 ml of 10 % aluminium chloride was mixed. After 5 minutes, 2 ml of 1M Sodium hydroxide was treated and diluted to 10 ml with distilled water. A set of reference standard solutions of quercetin (20, 40, 60, 80 and 100 µg/ml) were prepared separately in the same manner as described earlier. The absorbance for test and standard solutions were determined against the reagent blank at 510 nm with an UV/Visible spectrophotometer. The flavonoid content was calculated from the calibration graph of the standard.

2.2.15 Determination of flavanols

The reaction mixture consists of 1 mg of sample and 4 ml of distilled water was taken in a 10 ml volumetric flask. To the flask, 0.30 ml of 5 % sodium nitrite was treated and after 5 minutes, 0.3 ml of 10 % aluminium chloride was mixed. After 5 minutes, 2 ml of 1M Sodium hydroxide was treated and diluted to 10 ml with distilled water.

A set of reference standard solutions of Kaempherol were prepared separately in the same manner as described earlier. The absorbance for test and standard solutions were determined against the reagent blank at 510 nm with an UV/Visible spectrophotometer. The above compounds were compared separately for each standard.

2.2.16 Determination of flavones

The reaction mixture consists of 1 mg of sample and 4 ml of distilled water was taken in a 10 ml volumetric flask. To the flask, 0.30 ml of 5 % sodium nitrite was treated and after 5 minutes, 0.3 ml of 10 % aluminium chloride was mixed. After 5 minutes, 2 ml of 1M Sodium hydroxide was treated and diluted to 10 ml with distilled water.

A set of reference standard solutions of Apigenin were prepared separately in the same manner as described earlier. The absorbance for test and standard solutions were determined against the reagent blank at 510 nm with an UV/Visible spectrophotometer. The above compounds were compared separately for each standard.

2.2.17 Determination of Flavanones

The reaction mixture consists of 1 mg of sample and 4 ml of distilled water was taken in a 10 ml volumetric flask. To the flask, 0.30 ml of 5 % sodium nitrite was treated and after 5 minutes, 0.3 ml of 10 % aluminium chloride was mixed. After 5 minutes, 2 ml of 1M Sodium hydroxide was treated and diluted to 10 ml with distilled water.

A set of reference standard solutions of hesperitin were prepared separately in the same manner as described earlier. The absorbance for test and standard solutions were determined against the reagent blank at 510 nm with an UV/Visible spectrophotometer. The above compounds were compared separately for each standard.

2.2.18 Determination of Iso-flavanones

The reaction mixture consists of 1 mg of sample and 4 ml of distilled water was taken in a 10 ml volumetric flask. To the flask, 0.30 ml of 5 % sodium nitrite was treated and after 5 minutes, 0.3 ml of 10 % aluminium chloride was mixed. After 5 minutes, 2 ml of 1M Sodium hydroxide was treated and diluted to 10 ml with distilled water.

A set of reference standard solutions of daidzens were prepared separately in the same manner as described earlier. The absorbance for test and standard solutions were determined against the reagent blank at 510 nm with an UV/Visible spectrophotometer. The above compounds were compared separately for each standard.

2.2.19 Determination of Terpenoid

Preparation of the reference solution: Linalool reference substance (10mg) was accurately weight, added in a 10ml volumetric flask, diluted with ethyl acetate to the marked line to afford a concentration of 1.0mg/ml standard solution.

Preparation of the test solution: The sample was precisely measured and placed in a 10ml volumetric flask, diluted with ethyl acetate to the marked line.

Chromogenic method: The color developing agent applied on this experiment was prepared by the procedure as follows, 5% vanillin-acetic acid solution plus 2mL of perchloric acid were heated at 65℃ for 20min, then cooled in ice water and warmed up to room temperature after being shaken. Vanillin (500mg) was dissolved in acetic acid (10ml) to prepare the vanillin solution.

The standard curve 0.0,0.2,0.4,0.8,1.2,1.6,2.0 ml Linalool standard solution were precisely measured, placed in a 10 ml flask with ethyl acetate to volume marked line, The sample solution and standard mixture was then shaken, coloured according to the chromogenic method. The absorbance (A) of each solution was measured at 210nm wavelength, a blank solution as the control reference. The total terpenoids content was expressed as mg of Linalool/g.

2.2.20 Determination of Alkaloid

The sample was dissolved in dimethyl sulphoxide (DMSO), added 1ml of 2 N HCl and filtered. This solution was

transferred to a separating funnel, 5 ml of bromocresol green solution and 5 ml of phosphate buffer were added. The mixture was shaken with 1, 2, 3 and 4 ml chloroform by vigorous shaking and collected in a 10-ml volumetric flask and diluted to the volume with chloroform. A set of reference standard solutions of atropine (20, 40, 60, 80 and 100 µg/ml) were prepared in the same manner as described earlier. The absorbance for test and standard solutions were determined against the reagent blank at 470 nm with an UV/Visible spectrophotometer. The total alkaloid content was expressed as mg of AE/g.

2.2.21 Determination of Total Phenolic Compounds

The concentration of phenolics in the sample was determined using spectrophotometric method. Folin-Ciocalteu assay method was used for the determination of the total phenol content. The reaction mixture consists of 0.5-1g of sample and 9 ml of distilled water was taken in a volumetric flask (25 ml). One millilitre of Folin-Ciocalteu phenol reagent was treated to the mixture and shaken well. After 5 minutes, 10 ml of 7 % Sodium carbonate (Na2CO3) solution was treated to the mixture. The volume was made up to 25 ml. A set of standard solutions of gallic acid (20, 40, 40, 60, 80 and 100 µg/ml) were prepared in the same manner as described earlier. Incubated for 90 min at room temperature and the absorbance for test and standard solutions were determined against the reagent blank at 550 nm with an Ultraviolet (UV) /Visible spectrophotometer. Total phenol content was expressed as mg of GAE/g.

2.2.22 Determination of Anthocyanin and Anthocyanidins

The extract of the given sample was obtained from 5 g of the ground material with 50 mL of solvent. Two solvents were used: 70% ethanol solution with 1.5 mol·L $^{-1}$ HCl (85:15, v/v) and 70% ethanol. The suspension was allowed to stand in the absence of light and under refrigeration (7 ± 1 °C) for 24 hours. After 24 hours, the samples were filtered on Whatman Nº. 1 paper under vacuum in a Buchner funnel and the volume was completed to 50 mL. Anthocyanins in the above extracts were done using a UV-Vis spectrophotometer according to the method proposed by Lees & Francis, 1972. The extracts were subjected to a reading in a spectrophotometer at 535 nm. The anthocyanin and anthocyanidins content was calculated from the calibration the graph.

2.2.23 Determination of Polyphenol Content

The concentration of phenolics in plant extracts was determined using spectrophotometric method. Folin-Ciocalteu assay method was used for the determination of the total phenol content. The reaction mixture consists of 1 ml of extract and 9 ml of distilled water was taken in a volumetric flask (25 ml). One millilitre of Folin-Ciocalteu phenol reagent was treated to the mixture and shaken well. After 5 minutes, 10 ml of 7 % Sodium carbonate (Na2CO3) solution was treated to the mixture. The volume was made up to 25 ml. A set of standard solutions of gallic acid (20, 40, 40, 60, 80 and 100 µg/ml) were prepared in the same manner as described earlier. Incubated for 90 min at room temperature and the absorbance for test and standard solutions were determined against the reagent blank at 550 nm with an Ultraviolet (UV) /Visible spectrophotometer. Total phenol content was expressed as mg of GAE/g.

2.2.24 Determination of Tocopherols by UV-VIS spectrophotometer

Measure 0.5 g of the analysed sample into the test-tube I (centrifugal) with a tight stopper, add 0.5 ml of anhydrous ethanol and shake vigorously the plugged test tube for 1 minute. Add 3 ml xylene, plug the test tube and shake vigorously for another 1 minute. Centrifuge the tube to separate the extract (1500×g, 10 minutes); simultaneously measure 0.25 ml solution of batophenanthroline into a usual test-tube II

Collect 1.5 ml of the extract (upper layer), transfer to the test-tube II and mix the content. Add 0.25 ml of FeCl3 solution to the test tube II, mix, add 0.25 ml of H3PO4 solution and mix again. This way a test sample is obtained for spectrophotometric measurements. Prepare the standard sample (0.5 ml of the standard solution instead of the analyzed sample): using Trolox.

Prepare as the test sample, using α-tocopherol

Add 0.5 ml of DI water instead of anhydrous ethanol at the beginning of the analysis; do not centrifuge this sample. Measure absorbance of the test sample and of the standard sample at 539 nm against the blank test (preparation – as the test sample but using water instead of the analysed liquid). Calculate concentration of tocopherols in the analysed sample, using the calibration curve of the standard.

2.2.25 Estimation of Lignans

Standard compounds, sesamol and sesamin (0.01 g) were dissolved separately in 100 ml of hexane + chloroform mixture (7:3, v/v) and 10 ml of the solution was further diluted to 100 ml to give a 0.001 % solution, the uv-spectra were recorded. The absorbance of standard sesamol and sesamin at 288 nm was also read in a 1cm cell. Specific extinction (E1% 1cm) values of 231.1 for sesamin and 230.1 for sesamol were determined using this approach. The sample (0.01 g), in triplicate, were dissolved in 10 ml of hexane + chloroform mixture (7:3, v/v) and the absorbance at 288 nm was determined.

The lignans content was calculated by using the formula:

% Lignans (as sesamol) = [(A/W) x (100/230.1)] (1)

% Lignans (as sesamin) = [(A/W) x (100/231.1)] (2)

Where,

A Absorbance of the Sample,

W Weight of the Sample in gram / 100 ml,

230.1 $E^{1\%}_{1cm}$ for Sesamol
231.1 $E^{1\%}_{1cm}$ for Sesamin

2.2.26 Estimation of PhytoSteroids

1mg of sample extract and different concentration of Prednisone standard steroid solution was transferred into 10 ml volumetric flasks.

2ml of 4N Sulphuric acid was added and 2ml of 0.5% of iron (III) chloride was added followed by 0.5ml of 0.5% potassium hexacyanoferrate (III) solution.

The mixture was heated in a water-bath maintained at 70±20 C for 30 minutes with occasional shaking and diluted to the mark with distilled water. The absorbance was measured at 780 nm against the reagent blank. Total PhytoSteroid content was expressed as mg of Prednisone/gm of extract.

2.2.27 Estimation of Phytoestrogens

A colorimetric procedure, based on the formation of an azo dye by condensation of diazotized 5-chloro-2,4-dinitroaniline with ethinyl estradiol, was developed. An alkaline solution of ethinyl estradiol is reacted with the reagent, and the resulting color is measured at 450 nm. Phytoestrogens was calculated from the standard graph.

2.3 Statistical Analysis

The data obtained were analyzed using Microsoft Excel and the results were expressed as mean ± standard deviation.

3. RESULTS

3.1 Phytochemical Analysis

3.1.1 Qualitative Analysis

The aqueous extract of the sprouted water melon seeds showed the presence of flavonoids, flavanols, anthocyanidins, anthocyanins, phenolic compounds, polyphenols, lignins, tocopherols and phytoestrogens whereas flavones, flavanones, isoflavones, alkaloids, terpinoids and phytosteroids were absent. The chloroform extract of the sprouted water melon seeds showed the presence of alkaloids, terpinoids, lignins, tocopherols, phytoestrogens and phytosteroids whereas flavonoids, flavanols, flavones, flavanones, isoflavones, anthocyanidins, anthocyanins, phenolic compounds and polyphenols were absent. The ethyl acetate extract of the sprouted water melon seeds showed the presence of flavonoids, flavanols, flavones, flavanones, isoflavones, alkaloids, terpinoids, lignins, tocopherols phytoestrogens and phytosteroids whereas anthocyanidins, anthocyanins, phenolic compounds, polyphenols were absent. The hexane extract of the sprouted water melon seeds showed the presence of terpinoids, lignins, tocopherols, phytoestrogens and phytosteroids whereas flavonoids, flavanols, flavones, flavanones, isoflavones, anthocyanidins, anthocyanins, alkaloids, phenolic compounds and polyphenols were absent. The petroleum ether extract of the sprouted water melon seeds showed the presence of terpinoids, phenolic compounds, lignins, tocopherols, phytoestrogens and phytosteroids whereas flavonoids, flavanols, flavones, flavanones, isoflavones, anthocyanidins, anthocyanins, alkaloids and polyphenols were absent. Table 1 shows the qualitative analysis of watermelon seeds.

Table 1 . Qualitative Phytochemical Analysis of Sprouted Water Melon Seeds

Si. No.	Parameters	Result				
		Aqueous	Chloroform	Ethyl Acetate	Hexane	Petroleum Ether
1	Flavonoids	+	-	+	-	-
2	Flavanols	+	-	+	-	-
3	Flavones	-	-	+	-	-
4	Flavanones	-	-	+	-	-
5	Isoflavones	-	-	+	-	-
6	Anthocyanidins	+	-	-	-	-
7	Anthocyanins	+	-	-	-	-
8	Alkaloids	-	+	+	-	-
9	Terpenoids	-	+	+	+	+
10	Phenolic Compounds	+	-	-	-	-
11	Polyphenols	+	-	-	-	-
12	Lignins	+	+	+	+	+
13	Tocopherols	+	+	+	+	+
14	Phytoestrogens	+	+	+	+	+
15	Phytosteroids	-	+	+	+	+

(+) shows the presence (-) shows the absence

Table 2. Quantitative Phytochemical Analysis of Sprouted Water Melon Seeds

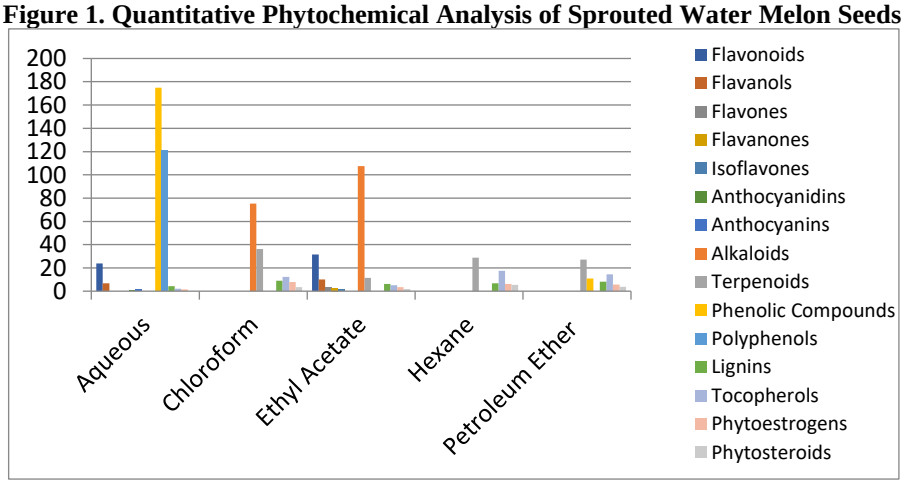
Si. No.	Parameters	Mean ± SD				
		Aqueous (mg/g)	Chloroform (mg/g)	Ethyl Acetate (mg/g)	Hexane (mg/g)	Petroleum Ether (mg/g)
1	Flavonoids	23.7 ± 0.05	-	31.6 ± 0.1	-	-
2	Flavanols	6.7 ± 0.15	-	10.1 ± 0.15	-	-
3	Flavones	-	-	3.2 ± 0.1	-	-
4	Flavanones	-	-	2.5 ± 0.1	-	-
5	Isoflavones	-	-	1.6 ± 0.1	-	-
6	Anthocyanidins	0.8 ± 0.1	-	-	-	-
7	Anthocyanins	1.2 ± 0.1	-	-	-	-
8	Alkaloids	-	75.3 ± 0.1	107.6 ± 0.1	-	-
9	Terpenoids	-	36.1 ± 0.1	11.4 ± 0.1	28.8 ± 0.08	27.1 ± 0.15
10	Phenolic Compounds	175 ± 1	-	-	-	11 ± 0.81
11	Polyphenols	121 ± 1	-	-	-	
12	Lignins	4.3 ± 0.15	9.1 ± 0.1	6.1 ± 0.1	6.7 ± 0.12	8.1 ± 0.1
13	Tocopherols	2.06 ± 0.05	12.2 ± 0.1	5.1 ± 0.1	17.5 ± 0.04	14.4 ± 0.1
14	Phytoestrogens	1.6 ± 0.1	7.8 ± 0.1	3.4 ± 0.1	6.2 ± 0.08	5.7 ± 0.1
15	Phytosteroids	-	3.4 ± 0.1	1.8 ± 0.1	5.3 ± 0.08	3.8 ± 0.1

Results are expressed in Mean ± Standard Deviation

3.1.2 Quantitative Analysis

The aqueous sample of the sprouted water melon seeds has 23.7 mg/g flavonoids, 6.7 mg/g flavanols, 0.8 mg/g anthocyanidins, 1.2 mg/g anthocyanins, 175 mg/g phenolic compounds, 121 mg/g polyphenols, 4.3 mg/g lignins, 2.06 mg/g tocopherols and 1.6 mg/g phytoestrogens respectively. The chloroform sample of the sprouted water melon seeds has 75.3 mg/g alkaloids, 36.1 mg/g terpinoids, 9.1 mg/g lignins, 12.2 mg/g tocopherols, 7.8 mg/g phytoestrogens and 3.4 phytosteroids respectively. The ethyl acetate sample of the sprouted water melon seeds has 31.6 mg/g flavonoids, 10.1 mg/g flavanols, 3.2 mg/g flavones, 2.5 mg/g flavanones, 1.6 mg/g isoflavones, 107.6 mg/g alkaloids, 11.4 mg/g terpinoids, 6.1 mg/g lignins, 5.1 mg/g tocopherols, 3.4 mg/g phytoestrogens and 1.8 mg/g phytosteroids respectively. The hexane sample of the sprouted water melon seeds showed has 28.8 mg/g terpinoids, 6.7 mg/g lignins, 17.5 mg/g tocopherols, 6.2 mg/g phytoestrogens and 5.3 mg/g phytosteroids respectively. The petroleum ether sample of the sprouted water melon seeds has 27.1 mg/g terpinoids, 11 mg/g phenolic compounds, 8.1 mg/g lignins, 14.4 mg/g tocopherols, 5.7 mg/g phytoestrogens and 3.8 mg/g phytosteroids respectively. Table 2 shows the quantitative analysis of sprouted watermelon seeds. Results of the quantitative analysis of sprouted watermelon seeds is represented in figure 1.

Figure 1. Quantitative Phytochemical Analysis of Sprouted Water Melon Seeds



4. DISCUSSION

In this research study, we have evaluated the phytochemicals present in the freshly sprouted seeds of Citrullus lanatus (watermelon). The phytochemicals were evaluated qualitatively and quantitatively with five different extracts. The proximate qualitative phytochemicals composition of sprouted watermelon seeds is shown in Table 1. The aqueous showed the presence of flavonoids, flavanols, anthocyanidins, anthocyanins, phenolic compounds, polyphenols, lignins, tocopherols and phytoestrogens and ethyl acetate sample of the sprouted water melon seeds showed the presence of flavonoids, flavanols, flavones, flavanones, isoflavones, alkaloids, terpinoids, lignins, tocopherols phytoestrogens and phytosteroids. Ethyl acetate showed more phytochemicals components compared to other 4 extracts. Hexane and Petroleum ether showed the least phytochemicals components.

Table 2 shows the quantitative analysis of phytochemicals of the sprouted watermelon seeds. In aqueous sample, phenolic compounds are the highest phytochemicals (175 ± 1 mg/g), polyphenols are the second highest phytochemicals (121 ± 1 mg/g) and flavonoids are the third highest phytochemicals (23.7 ± 0.05 mg/g). In chloroform sample, alkaloids are the highest phytochemicals (75.3 ± 0.1 mg/g), terpinoids are the second highest phytochemicals (36.1 ± 0.1 mg/g) and tocopherols are the third highest phytochemicals (12.2 ± 0.1 mg/g). In ethyl acetate sample, alkaloids are the highest phytochemicals (107.6 ± 0.1 mg/g), flavonoids are the second highest phytochemicals (31.6 ± 0.1 mg/g) and terpinoids are the third highest phytochemicals (11.4 ± 0.1 mg/g). In hexane sample, terpinoids are the highest phytochemicals (28.8 ± 0.08 mg/g), and tocopherols are the second highest phytochemicals (17.5 ± 0.04 mg/g). In petroleum ether sample, terpinoids are the highest phytochemicals (27.1 ± 0.15 mg/g), and tocopherols are the second highest phytochemicals (14.4 ± 0.1 mg/g). The quantitative analyses of phytochemicals were compared with Titilayo et al.

Phenolic compounds are high in aqueous sample and visible in petroleum ether but absent in the other three extracts. Some studies have reported the benefits of phenolic compounds which include anti-inflammatory activity, anti-aging activity, antioxidant activity and anti-proliferative activity (Moo-Huchin et al.,2015; Shukitt-Hale et al.,2008. Phenolic compounds can also prevent the development of long-term diabetes complications, including cardiovascular disease, retinopathy, neuropathy and nephropathy (Iwai et al., 2006; Iwai., 2008).

Lignins, tocopherols and phytoestrogens are visible in all extracts. Lignins are involved in many different biological activities such as reducing the serum cholesterol by binding to the bile acids in the intestine (Banard et al., 1973), and preventing tumor development in rats exposed to an intestinal carcinogen 3,2-dimethyl-4-ami-nobiphenyl and fed a lignin diet (Reddy et al., 1983). Tocopherols are the most important lipid-soluble antioxidants in food and in the human and animal tissues. Tocopherols are found in lipid-rich regions of cells such as mitochondrial membranes, fat depots, and lipoproteins such as low-density lipoprotein cholesterol. Phytoestrogens are naturally occurring compounds in plants. Fruits, vegetables, legumes and some other grains contain phytoestrogens. Phytoestrogens may respond as similar to the estrogens which is present in our bodies.

5. CONCLUSION

In this study, the phytochemicals compositions of fresh sprouted Citrullus lanatus seeds were analyzed qualitatively and quantitatively. Consumption of sprouted watermelon seeds can provide immense health benefits. The enhancement of these phytochemicals through the sprouting process suggests that sprouted watermelon seeds could serve as a valuable functional food, offering both nutritional benefits and culinary versatility. By promoting the utilization of watermelon seeds, often discarded as waste, we can support sustainable food practices while enhancing dietary diversity.

6. ACKNOWLEDGEMENT

Conflicts of Interest

The authors have no conflict of interest.

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