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SHORT COMMUNICATION

Phytochemcial Analysis and Isolation, Identification of Bioactive Compounds Present in Root of *Borassus flabellifer* Linn. using GC/MS

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Abstract

Medicinal plants play a vital role in the health of humans and animals. Indians provide more importance and curiosity in cultivating medicinal plants. *Borassus flabellifer* Linn. is one among the plants that belong to the Araceae family, it is well known as the Palmyra palm is a native of tropical Africa but cultivated and naturalized throughout India. Traditionally different parts of this plant such as roots, leaves, fruit and seeds have been used for various human ailments, and the leaves of this tree are used to make mats, baskets, fans, toys, candy boxes and sulagu, etc. Aim: Most of the works have been studied from different parts of this tree like wood, stem, leaf, flower, fruits, pulp and petioles but the root has not been studied much yet, so this current research task is to focus on the isolation, identification and applications of bioactive compounds from the roots of *Borassus flabellifer* Linn. Standard methods were performed for preliminary phytochemical analysis. GC/MS was used to identify and isolate the bioactive components. Preliminary phytochemical analysis reveals that the roots of *Borassus flabellifer* Linn. comprise carbohydrates, terpenoids, flavonoids, coumarins, alkaloids, tannins, saponins, cardiac glycosides and proteins. GC/MS analysis reveals that ethanolic extracts from the roots of *Borassus flabellifer* Linn. are reported to have thirty-six bioactive compounds, and each compound has a unique significance. The result of this research work concludes and illustrates that the roots of *Borassus flabellifer* Linn. are rich in essential dietary nutrients, phytochemicals, and bioactive compounds that can be used for health-promoting benefits. Furthermore, a comprehensive and systematic approach is required to identify and understand the maximum potential for the benefit of mankind.

Keywords: Bioactive Compounds, *Borassus flabellifer*, D-Mannose, GC/MS, *n*-Hexadecanoic Acid, Octadecanoic Acid, Phenol, 2,4-bis(1,1-dimethylethyl), Roots, Traditional Uses

1. Introduction

Gas chromatography is a type of partition chromatography in which inert helium gas or nitrogen gas serves as a mobile phase. The glass or metal tubes act as a capillary column, which consists of a stable stationary phase (inert fine solid support) coated with a microscopic layer of non-volatile liquid. The samples are carried by a stream of inert gas, thereby separating the components from the unknown samples. Mass spectrometry can provide detailed structural information about most compounds that can be accurately identified[1]. Gas chromatography separates the different compounds present in the sample into pulses of pure chemicals based on their volatility when flowing along with the mobile phase that carries the

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sample through the stationary phase in the column[2]. As the sample leaves the end of the column, it is fragmented by the ionization process. Spectra or fragmentation patterns of the compounds are collected and sorted based on retention time. A mass analyzer identifies and quantifies the unique chemicals based on their mass to charge ratio (m/z). It is unique to different samples, often referred to as a molecular fingerprint. Therefore, it is convenient to define the characteristics of each and every compound. However, it requires a large amount of vacuum to operate in a predictable and efficient manner. These spectra can be stored on a computer and analyzed[2]. **A** combination of these two distinct analytical techniques (GC and MS) can be used to analyze complex organic and biochemical compounds present within the test samples[3]. *Borassus flabellifer* belongs to the family of Arecaceae, commonly known as Palmyra palm is a native of tropical Africa but cultivated and naturalized throughout India. Different parts of the *Borassus flabellifer* are being used for medicine[4]. The root extract of *Borassus flabellifer* embrace good antibacterial property and it can be used for the treatment of various infectious diseases, wound healing[5], anthelmintic, antidiuretic, antioxidant, antimalarial and immune modulatory activities[6], and is also used as medicine for diverse illnesses in traditional medicine[7]. Male flowers are used for anti-inflammatory activity, the juice from flowering stalks used for diabetes[8]. However, very little systematic evidence has been found for the biological activities of the roots of this plant. Hence, in this present research work, we mainly focus on the analysis of primary phytochemicals; identification, isolation, determination and significance of bioactive components from the root of *Borassus flabellifer* by GC-MS.

2. Materials and Methods

2.1 Chemicals and Reagents

All chemicals and reagents in this study were of laboratory grade and were processed without further purification.

2.2 Collection of Plant Materials

Fresh root products of *Borassus flabellifer* Linn. were collected from the Cuddalore district of Tamil Nadu, and authenticated based on organoleptic and macroscopic examination and certified by Professor P. Jayaraman, Department of Botany, Institute of Herbal Botany, (Authenticated no: PARC/2019/4092), Plant Anatomy Research Centre, Tambaram, Chennai, India.

2.3 Preparation of Ethanolic, Petroleum Ether and Aqueous Extract Separately

Extracts were prepared as described by the standard method[9]. Initially, the collected plant materials were allowed to dry in the sun so that the muddy portions were removed. The roots of *Borassus flabellifer* Linn. were chopped and cut into small bites. Dried, clean *Borassus flabellifer* L roots were coarsely powdered and weighed. Approximately 30gm of plant powder was weighed and soaked with ethanol, petroleum ether and distilled water separately. Three beakers were allowed to stand for overnight or for 72 hours with intermediate shaking. Soaked solutions were passed through filter paper. The filtrate was extracted using a Soxhlet apparatus. The extracts were concentrated to dryness by keeping them over the water bath. The final traces of solvent were removed by transferring them into a china dish and allowing them to heat through a sand bath at a normal temperature. In order to prevent charring or denature of the compound, care should be taken and avoid overheating[10,11]. The yield of the ethanolic (2.5gm), petroleum ether (2gm) and aqueous (2gm) extracts were noted for future reference. Dried crude extract is kept in sterile amber-colored storage vials in the refrigerator until used for further studies.

2.4 Preliminary Phytochemical Analysis

Dried plant crude extracts were then re-dissolved in dimethyl sulfoxide or diluted with appropriate solvents to get a solution concentration of 10mg/10ml, then each extract was allowed to test for phytochemical analysis as per standard methods[12-14].

2.5 Reagents and Chemicals Required for Quantitative Analysis of Carbohydrate

The stock β-D-Glucose solution was prepared by dissolving 50mg in 50ml of distilled water to make a known concentration of 1mg/ml. For the working standard, 5ml of stock solution was pipetted out into a dry, clean 50ml standard measuring flask and diluted by using distilled water at a concentration of 100µg/ml. 5% phenol reagents should be prepared and concentrated sulphuric acid is also required. 5mg of each extract from the root of *Borassus flabellifer* Linn. were weighed in a dry clean container separately and dilute with 5ml of appropriate solvents to make the known concentration of 1mg/ml.

2.6 Estimation of Carbohydrate by Phenol-Sulfuric Acid by Duboi's Method[15]

The phenol-sulfuric acid method is the easiest and most reliable colorimetric method among the quantitative assays for carbohydrate estimation; it was originally described as a non-specific quantitative test for carbohydrate (neutral sugar content in oligosaccharides, proteoglycan, glycoprotein and glycolipid)[15]. The basic principle of this method is that in a hot acetic medium, glucose undergoes dehydration to form hydroxyl-methyl-furfural (a yellowish-brown coloured product) with phenol, which has a maximum absorption at 490nm. The standard procedure for this method is as follows. Initially, 0.2 to 1ml of working standard glucose solution having a concentration of 20-100 µg was pipetted out into a series of test tubes, labelled as S_1 to S_5. 1ml of ethanolic and aqueous extract of *Borassus flabellifer* Linn. root was taken in two separate test tubes labeled as T_1 and T_2. The volume of the all-test tube was made up to 1ml by using water and 1ml of distilled water alone served as a blank. Add 1ml of 5% phenol reagents followed by 5ml of 96% sulfuric acid to all test tubes. The contents of all the test tubes were mixed well and kept in a water bath for 10 minutes. The yellowish brown colour developed was read at 490nm colorimetrically. The standard graph was plotted by taking the concentration of carbohydrate along the X-axis and the optical density along the Y-axis. The amount of carbohydrates present in the plant extract was calculated from the standard graph. The percentage of carbohydrates present in both the extracts from the *Borassus flabellifer* Linn. root can be calculated by the following method.

$$\% = \frac{\textit{Control OD or Standard OD} - \textit{Test OD or Extract OD}}{\textit{Control OD or Standard OD}} \times 100.$$

2.7 Reagents and Chemicals Required for Quantitative Analysis of Protein

The stock bovine serum albumin solution was prepared by dissolving 50mg in 50ml of 0.9% saline solution to make a known concentration of 1mg/ml. For the working standard, 5ml of stock solution was pipetted out into a dry, clean 50ml standard measuring flask and diluted by using distilled water at a concentration of 100µg/ml. 5% phenol reagents should be prepared and concentrated sulphuric acid is also required. Folin's phenol reagent was freshly prepared by using distilled water in the ratio of 1:2. Lowry's reagents: Solution A (2% sodium carbonate): 2gm of sodium carbonate was weighed and dissolved in 100ml of 0.1 M sodium chloride. Solution B (1% sodium potassium tartarate): Weighed 1gm of sodium potassium tartarate dissolved in 100ml of distilled water. Solution C (0.5% copper sulphate): 500mg of copper sulphate was weighed and dissolved in 100ml of distilled water. The solutions A, B and C were mixed in the ratio of 50:1:0.5. 5mg of each extract from the root of *Borassus flabellifer* Linn. were weighed in a dry clean container separately and dilute with 5ml of appropriate solvents to make the known concentration of 1mg/ml.

2.8 Estimation of Protein by Lowry's Method[16]

The Lowry's method is the most commonly used colorimetric method to find out the total proteins present in biological samples quantitatively. Protein reacts with Folin's phenol reagent in the presence of an alkaline copper solution to give an intense blue coloured complex, which is read at 680nm colorimetrically. The standard procedure for this method is as follows. Initially, 0.2 to 1ml of working standard bovine serum albumin solution having aconcentration of 20-100 µg was pipetted out into a series of test tubes, labelled as S_1 to S_5. 1ml of ethanolic and aqueous extract of *Borassus flabellifer* Linn. root was taken in two separate test tubes labelled as T_1 and T_2. The volume of all the test tubes was made up to 2ml using distilled water. 2ml of distilled water alone served as a blank. Add 5ml of Lowry's reagents (alkaline copper reagents) followed by 0.5ml of Folin's phenol reagent all-test tubes. The contents of each and all-test tubes were mixed well and kept at room temperature for 10 minutes. The intense blue coloured complex was developed. The intensity of the blue colour complex that developed was proportionate to the concentration of protein. A standard graph was drawn by using the concentration of protein along the X axis and optical density along the Y axis. From the standard graph, the total proteins present in the plant extract were measured. The percentage of proteins present in both the extracts from the root of the *Borassus flabellifer* Linn. can be calculated by the following method.

$$\% = \frac{\textit{Control OD or Standard OD} - \textit{Test OD or Extract OD}}{\textit{Control OD or Standard OD}} \times 100.$$

2.9 Analysis of Bioactive Components by GC/MS[3,17]

GC/MS are two different analytical techniques combined to analyze complex organic and biochemical mixtures. Perkin Elmer (GC) Claurus 500 systems interfaced to a Mass Spectrometer (MS) equipped with arElite-1 fused silica capillary column was performed to analyze the ethanolic extract from the root of *Borassus flabellifer* Linn. The samples were injected into a HP-5 column (30m X 0.25mm IDx1iMdf composed of 100% Dimethyl polysiloxane with 0.25µm film thickness), Agilent technologies 6890 N JEOL GC Mate II GC-MS model. The detector was performed to detect the ionization of an electron with a potential of 70eV, at a scan interval of 0.5 seconds. Fragment from 45 to 450Da, ion source and interface temperature of 250°C and mass range of 50-600 mass units. The total running time for GC is around 30 to 45 minutes. The relative percentage of each compound and its volume was calculated by comparing its retention time, average peak area, with the total area. Turbo Mass Ver 5.2.0 is software used to manipulate mass spectra and chromatogram.

3. Results and Discussion

3.1 Preliminary Biologically Active Compounds Analysis

Table 1. List of preliminary biologically active compounds from ethanolic, petroleum ether and aqueous extract from root of *Borassus flabellifer* Linn.

Compounds	Ethanol extract	Aqueous extract	Petroleum ether extract
Carbohydrates	Presence	Presence	Presence
Proteins	Absence	Presence	Presence
Terpenoid	Presence	Absence	Presence
Saponins	Presence	Absence	Absence
Coumarins	Presence	Presence	Absence
Alkaloids	Presence	Presence	Absence
Tannins	Presence	Absence	Absence
Flavonoids	Presence	Presence	Presence
Glycosides	Absence	Presence	Absence

The results of a preliminary phytochemical study of different extracts from *Borassus flabellifer* Linn. root were revealed in Table 1. The ethanolic extract consists of carbohydrates, terpenoids, saponins, coumarins, alkaloids, tannins and flavonoids. The aqueous extract consists of carbohydrates, proteins, coumarins, alkaloids, flavonoids, and cardiac glycosides. The petroleum ether extract consists of carbohydrates, proteins, terpenoids, flavonoids and cardiac glycosides. Earlier reports said that *Borassus flabellifer* Linn. mainly comprises gums, scleroprotein (albuminoid), fats, steroids (spirostane, borassosides and dioscin), steroidal glycosides. In addition, the fresh pulp of *Borassus flabellifer* is rich in vitamin A and C, and the fresh sap of *Borassus flabellifer* is a good source of B-complex vitamins[18]. Previous studies show that fruits and vegetables are rich in selected natural antioxidants, including polyphenols, ascorbic acids, and flavonoids. They are associated with lowering the risk of heart and chronic diseases and also some cancers[19]. From this preliminary phytochemical screening, it was found that root extracts of *Borassus flabellifer* Linn. consists of enriched amount of carbohydrates, terpenoid, flavonoids, coumarins, alkaloid, tannin, saponins, glycosides and proteins. This result reveals that *Borassus flabellifer* L comprises innumerable phytochemicals that impair the risk of heart and chronic diseases and also certain types of malignancy.

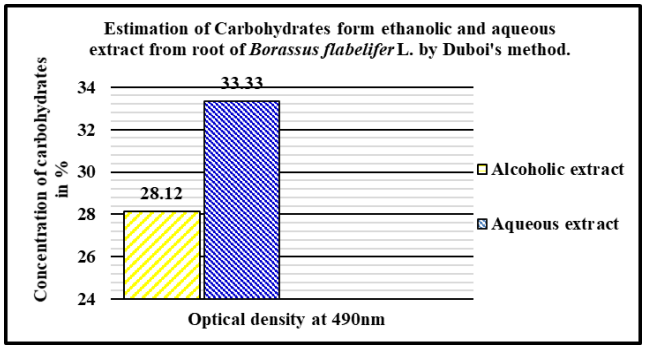


Figure 1. Estimation of Carbohydrate form ethanolic and aqueous extract from *Borassus flabellifer* using Duboi's method.

Figure 1 shows that the amount of carbohydrate content in both the extract from *Borassus flabellifer* root and it was calculated by taking the concentration (mg/100ml) of extract against the optical density at 490nm colorimetrically by standard Duboi's method quantitatively. The results of the present study show a significant increase in the carbohydrate content of 33.33% aqueous extract and 28.12% ethanolic extract.

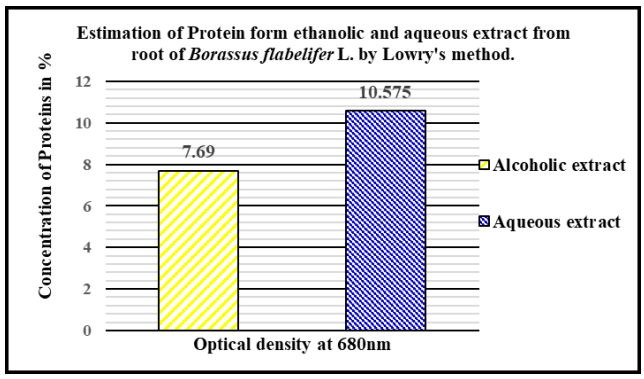
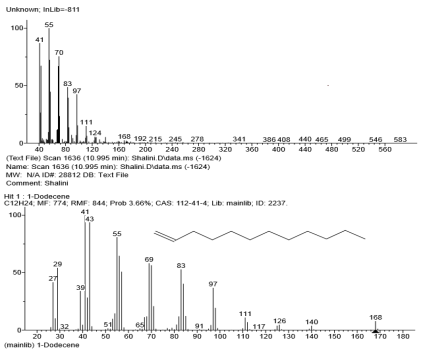
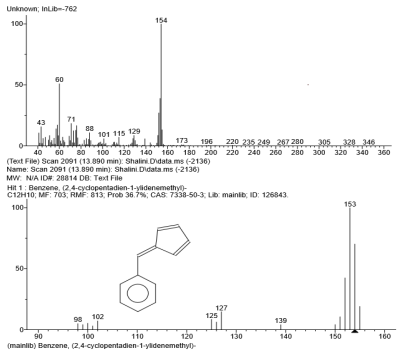
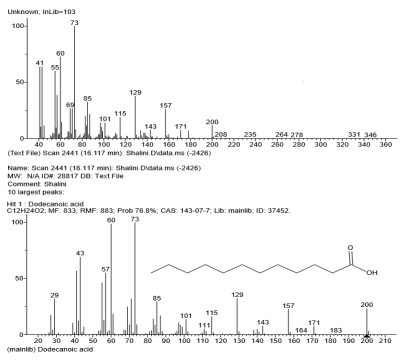
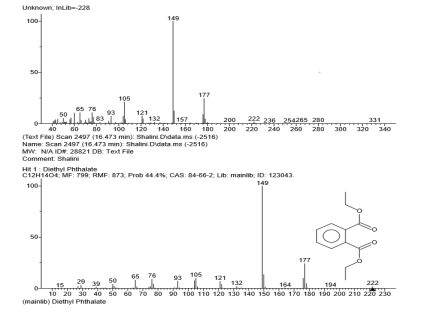
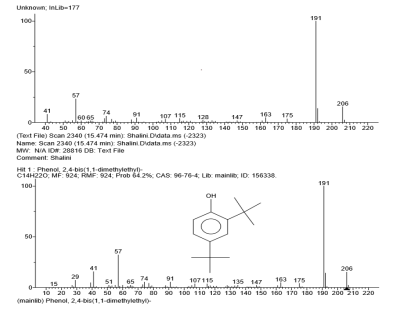
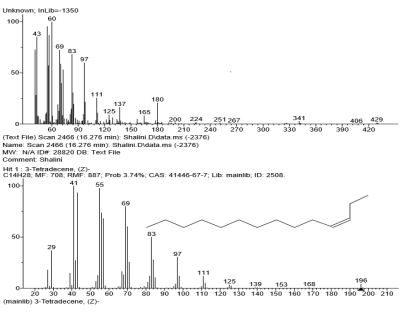


Figure 2. Estimation of Protein form ethanolic and aqueous extract from *Borassus flabellifer* using Lowry's method.

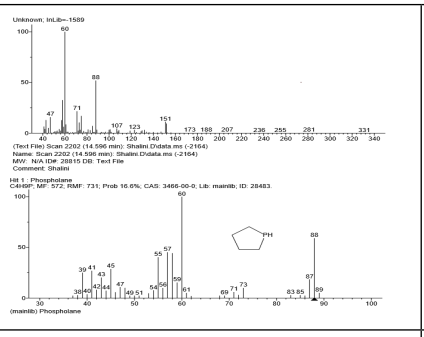
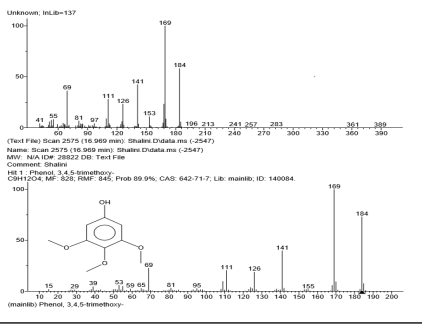
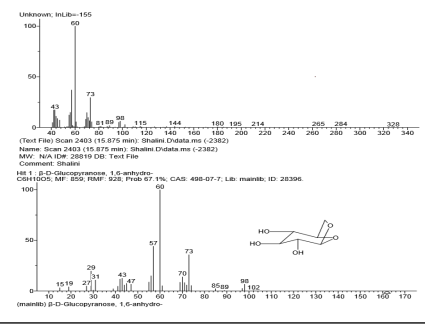
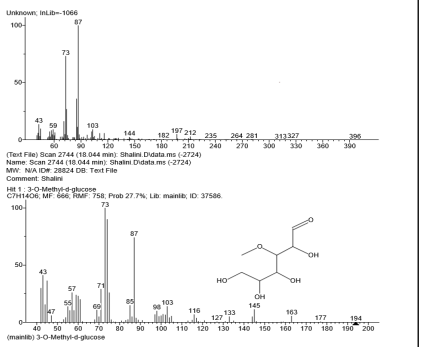
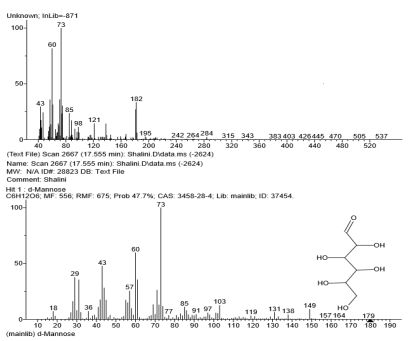
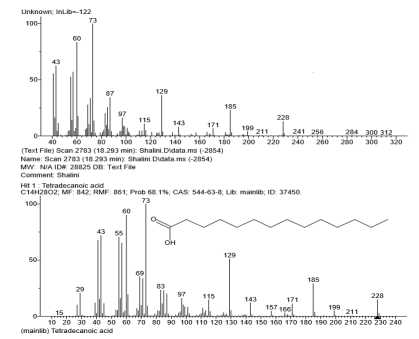
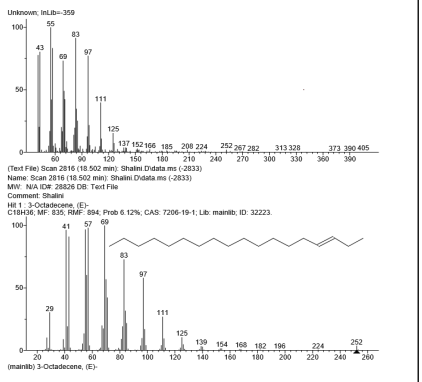
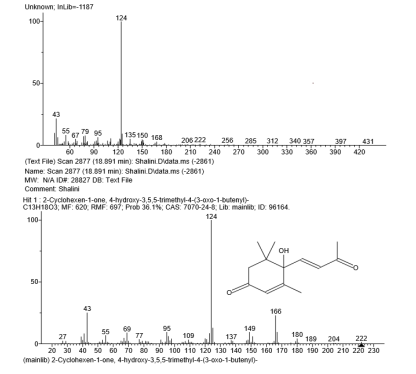
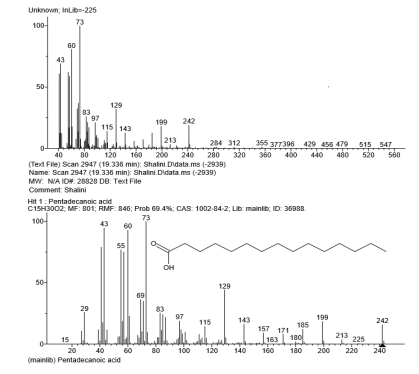
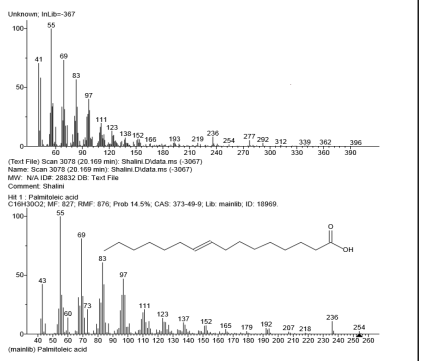
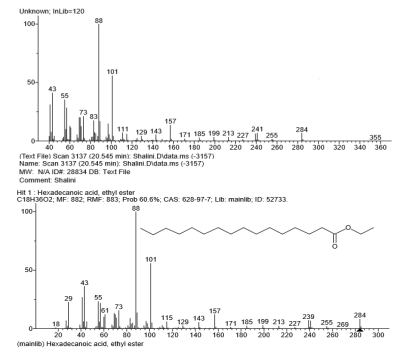
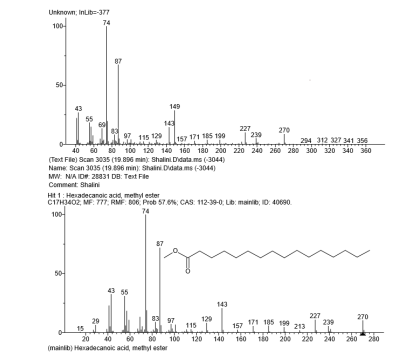
Figure 2 shows that the amount of protein content is present in both the extract from *Borassus flabellifer* root and it was calculated by taking the concentration (mg/100ml) of extract against the optical density at 680nm colorimetrically by standard Lowry's method quantitatively. The results of the present study show a significant increase in the protein content of 10.575% aqueous extract and 7.69% ethanolic extract. Earlier nutritional analysis of the root of *Borassus flabellifer* found that it contained 8.54% protein, 23.53% carbohydrate, 7.29% crude fibre and very little fat. Also, edible roots contain 1.33 ppm of iron and trace amounts of aluminium, arsenic, strontium, lead, manganese, copper and zinc[20]. Numerous literary studies over the past few years have shown that there is a close relationship between a highly nutritious diet, maintaining good health and reducing the risk of chronic diseases. Essential nutrients such as carbohydrates, protein and fibre rich in antioxidants can help to prevent the cell damage, cancer, inflammation, aging and atherosclerosis caused by free radicals throughout the body[21]. The result of this research work reveals that an aqueous extract of *Borassus flabellifer* root may be reported to comprise plenty of carbohydrates (33.33%) and proteins (10.575%). Hence, the result indicates that the root of *Borassus flabellifer* Linn. is an edible ingredient that can be used as a food additive and in health supplements. The root powder of *Borassus flabellifer* Linn., soaked in water and mixed with honey to make sarbeth (Soft drink) is considered a good remedy for various diseases in traditional medicine.

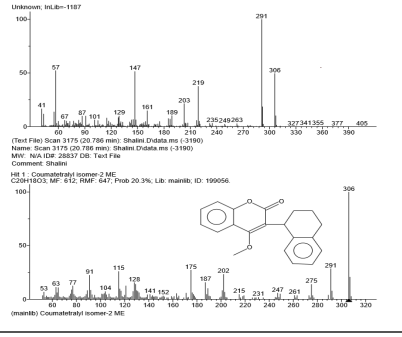
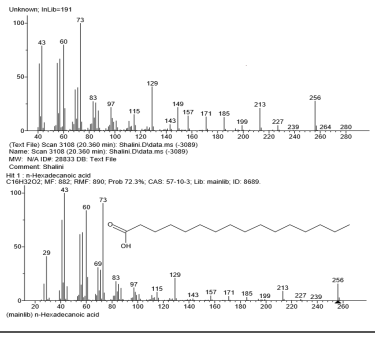
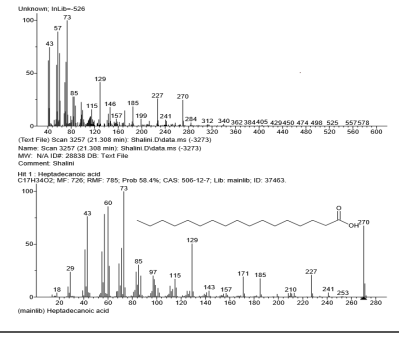
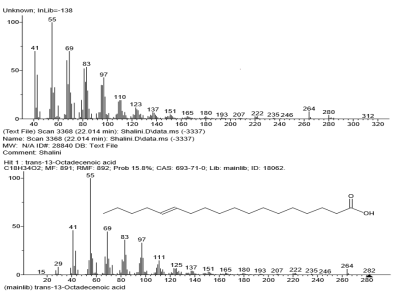
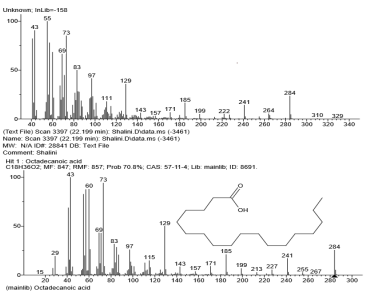
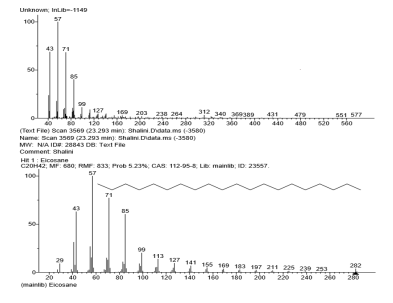
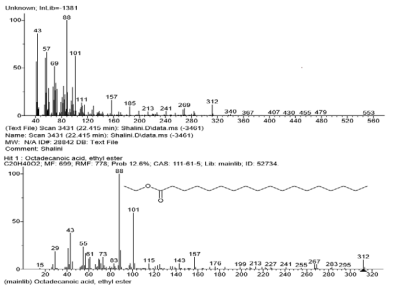
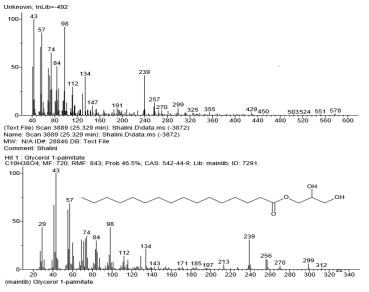
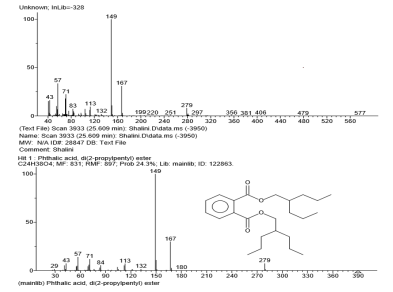
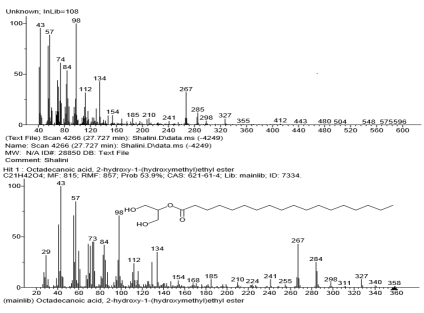
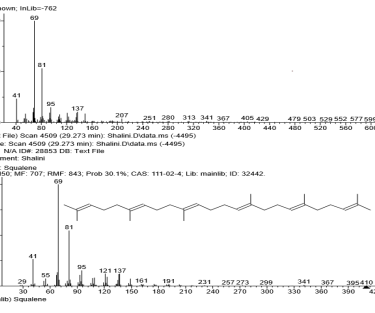
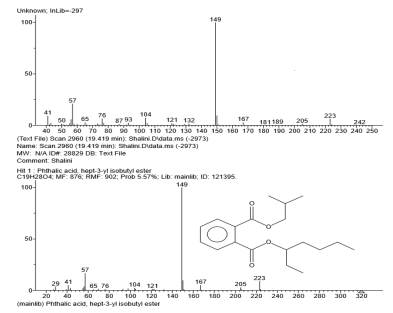
Table 2. Isolation and identification of bioactive components by GC/MS

		
(1) 1-Dodecene	(2) Benzene, (2,4cyclopentadien-1-ylidenemethyl)-	(3) *n*-Dodecanoic acid
		
(4) Diethyl Phthalate	(5) Phenol-2,4-bis (1,1 dimethylethyl) TMS or Antioxidant No. 33	(6) 3-Tetradecene, (Z)-

(*Continued*)

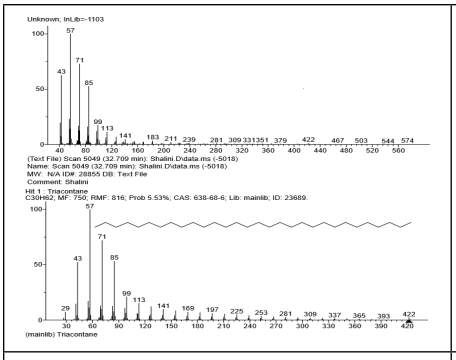
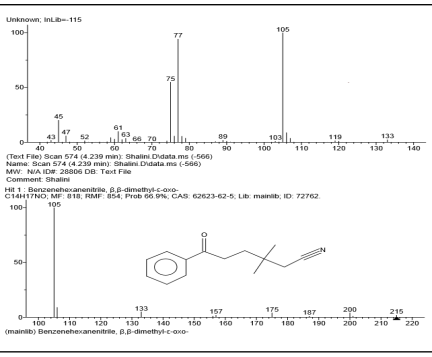
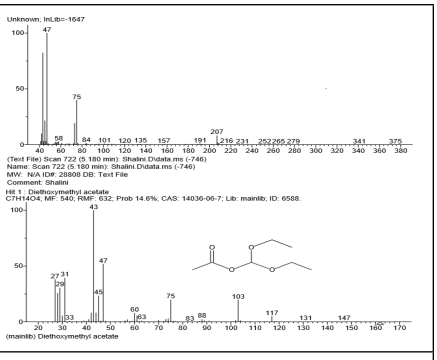
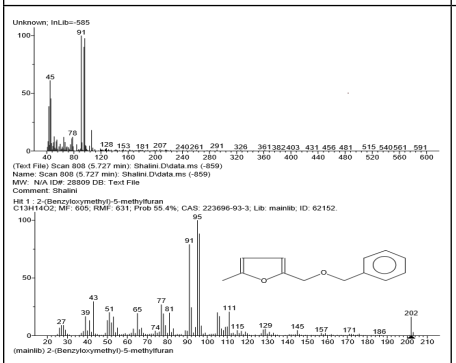
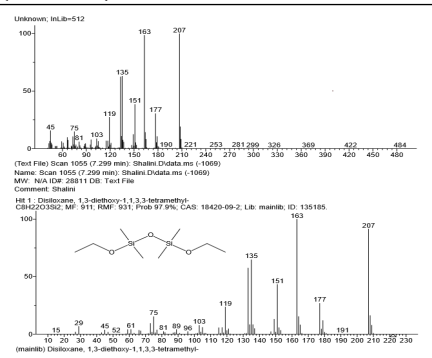
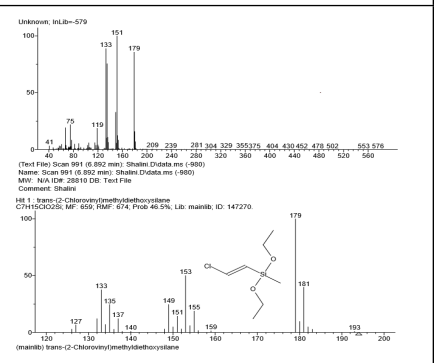
Table 2. (Continued)

		
(7) Phosphotane	(8) Phenol, 3,4,5-trimethoxy	(9) β-D-Glucopyranose, 1,6-anhydro
		
(10) 3-O-Methyl-d-glucose	(11) D-Mannose	(12) Tetradecanoic acid
		
(13) 3-Octadecene, (E)-	(14) 2-Cyclohexen-1-one,4-hydroxy-3,5,5-trimethyl-4-(3-oxo-1-butenyl)	(15) Pentadecanoic acid
		
(16) Palmitoleic acid	(17) Hexadecanoic acid ethyl ester or Ethyl palmitate	(18) Hexadecanoic acid methyl ester or Methyl palmitate

		
(19) Coumatetralyl isomer-2 ME	(20) *n*-Hexadecanoic acid	(21) Heptadecanoic acid
		
(22) trans-13-Octadecenoic acid	(23) Octadecanoic acid	(24) Eicosane
		
(25) Octadecanoic acid, ethyl ester	(26) Glycerol 1-palmitate	(27) Phthalic acid, di(2-propylpentyl) ester
		
(28) Octadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester or Stearin	(29) Squalene	(30) Phthalic-acid-hept-3-yl isobutyl ester

(*Continued*)

Table 2. (Continued)

		
(31) Triacontane	(32) Benzenehexanenitrile, β, β-dimethyl-ε-oxo	(33) Dithoxy methyl acetate
		
(34) 2-(Benzyloxymethyl)-5-methylfuran	(35) Disiloxane or 1,3-diethoxy-1,1,3,3-tetramethyl	(36) Trans-(2-Chlorovinyl) methyldiethoxysilane

In this present study Table 2 (1-36) and 3 shows that ethanolic extract from the root of *Borassus flabellifer* Linn. was used to analyze and identify the compounds by using this instrument. We identified and observed thirty-six bioactive compounds on the basis of retention time, peak area and molecular weight along with concentration in (%). They were listed as 1-Dodecene, Benzene, (2,4cyclopentadien-1-ylidenemethyl)-, *n*-Dodecanoic acid, Diethyl Phthalate, Phenol-2,4-bis (1,1 dimethylethyl) or Antioxidant No.33, 3-Tetradecene, (Z)-, Phosphotane, Phenol, 3,4,5-trimethoxy, βD-Glucopyranose-1-6-anhydro, 3-O-Methyl-d-glucose, d-Mannose, Tetradecanoic acid, 3-Octadecene, (E)-, 2-Cyclohexen-1-one-4-hydroxy-3,5,5-trimethyl-4-(3-oxo-1-butenyl), Pentadecanoic acid, Palmitoleic acid, Ethyl palmitate, Methyl palmitate, Coumatetralyl isomer-2 ME, *n*-Hexadecanoic acid, Heptadecanoic acid, trans-13-Octadecenoic acid, Octadecanoic acid, Eicosane, Octadecanoic acid, ethyl ester, Glycerol 1-palmitate, Phthalic acid, di(2-propylpentyl) ester or Di-n-2-propylpentylphthalate, Octadecanoic acid-2-hydroxy-1-(hydroxymethyl)-ethyl ester (Stearin), Squalene, Phthalic-acid-hept-3-yl-isobutyl-ester, Triacontane, Benzenehexanenitrile, β, β-dimethyl-ε-oxo, Dithoxy methyl acetate, 2-(Benzyloxymethyl)-5-methylfuran, Disiloxane or 1,3-diethoxy-1,1,3,3-tetramethyl, Trans-(2-Chlorovinyl) methyldiethoxysilane. Among which the most abundant were Phenol-2,4-bis (1,1 dimethylethyl) or Antioxidant No.33, *n*-Hexadecanoic acid, trans-13-Octadecenoic acid, Octadecanoic acid, Eicosane, Octadecanoic acid 2-hydroxy-1-(hydroxymethyl) ethyl ester and Triacontane at retention time 15.474, 20.341, 22.027, 22.199, 27.225; 30.470, 27.721 and 32.696 respectively with major peaks had been found. National Institute Standard and Technology (NIST) has over 62,000 patterns of database interpretation on mass spectrum for GC-MS. The unknown chemical compounds can be compared and identified from NIST-library. Each compound has a unique property and its uses and nature were collected from PUBCHEM and PUBMED[22].

Figure 3 shows the individual and total ionic chromatogram (GC/MS) of ethanolic extracts of *Borassus flabellifer* root obtained by using Elite-1 fused silica (stationary phase) in a capillary column and He carrier gas (mobile phase) at 70eV.

The applications of isolated and identified bioactive compounds through GCMS were listed as follows, *n*-Dodecanoic acid or *n*-Hexadecanoic acid is mainly used for the manufacture of soaps, cosmetics and popular ingredient in personal care products and is also used in skin make-up to hide marks (Table 3). Dietary intake of stearic acid (alternate of heptadecanoic acid) effectively stabilizes, thickens and softens, which helps to create a cooling sensation. Ingestion of odd-chain fatty acids (an alternate of heptadecanoic acid) associated with lower risks of heart disease, thus reducing mortality. Stearic acid (an alternate of heptadecanoic acid or octadecanoic acid) is used in the manufacture of emulsifiers, lubricants, ointments, lotions, emollients and etc. when applied as a moisturizer or ointment to the skin. Octadecanoic acid ethyl ester in the form of ethyl stearate is a flavoring ingredient. Ethyl ester of hexadecanoic acid is used as a hair and skin

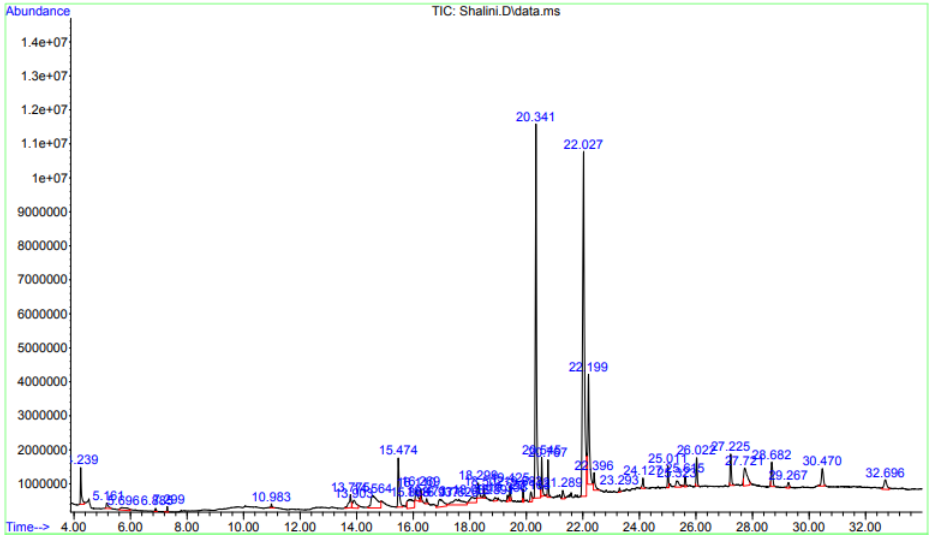


Figure 3. Isolated bioactive compounds from ethanolic extract of *Borassus flabellifer* root.

Table 3. Molecular formula, retention time and molecular weight for the GC/MS isolated bioactive components from ethanolic extraction of *Borassus flabellifer* root

S No	Isolated compounds	Formula	Retention time	Molecular weight
1	1-Dodecene	$C_{12}H_{24}$	10.983	168.32 g/mol
2	Benzene, (2,4cyclopentadien-1-ylidenemethyl)-	$C_{12}H_{10}$	13.903	154.21 g/mol
3	*n*-Dodecanoic acid	$C_{12}H_{24}O_2$	16.110	200.32 g/mol
4	Diethyl Phthalate	$C_{12}H_{14}O_4$	16.473	222.24 g/mol
5	Phenol-2,4-bis (1,1 dimethylethyl) or Antioxidant No.33	$C_{14}H_{22}O$	15.474	206.32 g/mol
6	3-Tetradecene, (Z)-	$C_{14}H_{28}$	16.269	196.37 g/mol
7	Phosphotane	C_4H_9P	14.564	88 g/mol
8	Phenol, 3,4,5-trimethoxy	$C_9H_{12}O_4$	16.937	184.19 g/mol
9	β-D-Glucopyranose, 1,6-anhydro	$C_6H_{10}O_5$	15.888	162.14 g/mol
10	3-O-Methyl-d-glucose	$C_7H_{14}O_6$	18.089	194.18 g/mol
11	D-Mannose	$C_6H_{12}O_6$	17.625	180.15 g/mol

(*Continued*)

Table 3. (Continued)

S No	Isolated compounds	Formula	Retention time	Molecular weight
12	Tetradecanoic acid	$C_{14}H_{28}O_2$	18.299	228.37 g/mol
13	3-Octadecene, (E)-	$C_{18}H_{36}$	18.502	252.5 g/mol
14	2-Cyclohexen-1-one-4-hydroxy-3,5,5-trimethyl-4-(3-oxo-1-butenyl)	$C_{13}H_{18}O_3$	18.891	222.28 g/mol
15	Pentadecanoic acid	$C_{15}H_{30}O_2$	19.336	242.40 g/mol
16	Palmitoleic acid	$C_{16}H_{30}O_2$	20.163	254.41 g/mol
17	Ethyl palmitate	$C_{18}H_{36}O_2$	20.545	284.48 g/mol
18	Methyl palmitate	$C_{17}H_{34}O_2$	19.883	270.45 g/mol
19	Coumatetralyl isomer-2 ME	$C_{20}H_{18}O_3$	20.767	306 g/mol
20	*n*-Hexadecanoic acid	$C_{16}H_{32}O_2$	20.341	256.42 g/mol
21	Heptadecanoic acid	$C_{17}H_{34}O_2$	21.289	270.45 g/mol
22	trans-13-Octadecenoic acid	$C_{18}H_{34}O_2$	22.027	282.46 g/mol
23	Octadecanoic acid	$C_{18}H_{36}O_2$	22.199	284.48 g/mol
24	Eicosane	$C_{20}H_{42}$	23.293, 24.127, 25.011, 26.022, 27.225, 28.682, 30.470	282.55 g/mol
25	Octadecanoic acid, ethyl ester	$C_{20}H_{40}O_2$	22.396	312.53 g/mol
26	Glycerol 1-palmitate	$C_{19}H_{38}O_4$	25.323	330.5 g/mol
27	Phthalic acid, di(2-propylpentyl) ester or Di-n-2-propylpentylphthalate	$C_{24}H_{38}O_4$	25.615	390.6 g/mol
28	Octadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester or Stearin	$C_{21}H_{42}O_4$	27.721	358.55 g/mol
29	Squalene	$C_{30}H_{50}$	29.267	410.72 g/mol
30	Phthalic-acid-hept-3-yl-isobutyl ester	$C_{19}H_{28}O_4$	19.425	320.4 g/mol
31	Triacontane	$C_{30}H_{62}$	32.696	422.8 g/mol
32	Benzenehexanenitrile, β, β-dimethyl-ε-oxo	$C_{14}H_{17}NO$	4.239	215.29 g/mol
33	Dithoxy methyl acetate	$C_7H_{14}O_4$	5.161	162.18 g/mol
34	2-(Benzyloxymethyl)-5-methylfuran	$C_{13}H_{14}O_2$	5.696	202.25 g/mol
35	Disiloxane or 1,3-diethoxy-1,1,3,3-tetramethyl	$C_8H_{22}O_3$-Si_2	7.299	222.43 g/mol
36	Trans-(2-Chlorovinyl) methyldiethoxysilane	$C_7H_{15}ClO_2Si$	6.885	194.73 g/mol

conditioner. Methyl ester of hexadecanoic acid is used for the manufacture of soaps, cosmetics and industrial printing agents. It is used to treat schizophrenia (a chronic brain disorder associated with disorganized speech, trouble with thinking and lack of motivation symptoms) PUBCHEM and PUBMED[22]. An early report states that hexadecenoic acid methyl ester is also known as methyl palmitate, which inhibits the growth and stimulates apoptosis of human gastric cancer cells[23]. Early reports say that GC/MS is mostly recommended for analysis of food, beverages, flavors and fragrances[24]. Eicosane is mostly used in the petrochemical industry. It can be used to store thermal energy and control temperature. Squalene is a very effective natural antioxidant used in the production of skin care products and in the medical field to treat wounds and skin problems. Diethyl phthalate is frequently used in cosmetics and perfumes. It is further used for the manufacture of plasticizers (materials added to plastics to increase their flexibility, transparency,

durability and longevity), soap bases and aerosol atomizer. Phthalic acid, di(2-propylpentyl) ester is primarily used to soften polyvinyl chloride, mainly as a plasticizer. Phthalic acid hept-3-yl isobutyl ester is used as a flavoring agent. In medicine, D-Mannose is used to prevent Urinary Tract Infections (UTIs) and to treat carbohydrate deficient glycoprotein syndromes. 3-O-Methyl-d-glucose is used as a marker to detect the mechanism of a glucose transporter present in various cell membranes of organs PUBCHEM and PUBMED[22]**.** According to an early report, GC/MS is mostly recommended in clinical toxicology studies[25], academic research purposes and industry (energy, fuel) applications[26-28].

It has been reported that Phenol-2,4-bis-1,1-dimethylethyl (Antioxidant No.33) has various functions that include medicine, food and agriculture. In medicine, it has antioxidant, anticancer, anti-fungal, anti-bacterial properties. It has protective functions against Tri-Methyl-Tin (TMT) induced cognitive impairment. 1-Dodecene and phenol 3,4,5-trimethoxy play an important role in the manufacture of cleaning washing products (laundry detergent). Glycerol 1-palmitate can be used in cosmetics in concentrations up to 12%. Coumatetralyl isomer-2 ME is commonly used to monitor food activity in a particular area in combination with rodent poison trace powder with grains and other cereals. 2-(Benzyloxymethyl)-5-methylfuran is added to the diet as a food additive, which includes spies, extracts or juice, colouring, flavours, etc., as well as sauces and seasonings for human consumption. Previous reports said that GC/MS analysis of *Borassus flabellifer* Linn. roots is well known for its medicinal properties and curative agents for many diseases[29], extracts of *Borassus flabellifer* using GC/MS stated that they contain fatty acids, alkanes, alkenes, ketones, aldehydes, diterpenes, phytols, and sterols, which can regulate blood pressure, coagulation and lipid levels. This may also influence an immune and inflammatory responses to any injury and infection[30]. Hence, from this research work, it was documented that the root of *Borassus flabellifer* L. was found to possess an enriched amount of nutritious ingredient, curative agents and drugs.

4. Conclusion

The result of this present research work concluded that the root of *Borassus flabellifer* Linn. contains plenty of phytochemical components, essential dietary nutrients and bioactive compounds. It is believed to possess medicinal values, frequently associated with impairing the risk of cardiovascular and chronic diseases and also certain types of malignancy. It is traditionally believed to be a potent antimicrobial, anti-inflammatory, analgesic and antipyretic drug. Therefore, it seems reasonable to consider the roots of *Borassus flabellifer* as a nutritious and valuable ingredient for food and soft drinks, which can improve and enhance our health. The reports from this research work and the potential of *Borassus flabellifer* Linn have been documented, which will provide scientific support for the development of novel drugs. Further work can be performed to isolate the same and study its biological activity in an *in vitro* system.

5. Acknowledgment

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