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Full Length Research Paper

Enhancement of *Syzygium cumini* (Indian jamun) active constituents by ultra-violent (UV) irradiation method

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Syzgium cumini **(Indian jamun) is a fruit consumed by all sections of people in India. It is cheaply available and has certain medicinal properties too. The study was aimed at enchancement of its active constituents without altering its pharmacological properties. Ultra-violent (UV) irradiation is used as it provides the enhancement and sterilization at the same time. The test batch having been irradiated with UV showed higher proportion of active constituents than the control batch which was not irradiated. The control and test samples when subjected to gas chromatography-mass spectroscopy (GC-MS) analysis showed distinct variation in a number of characteristic peaks confirming the physical results that were obtained. Charateristic peaks obtained for the test sample, 11.31 and 95.43, demonstrate the demarcation required. The physical characteristics of the test sample were intact with organoleptic properties in line with the control sample. UV irradiation method proves to be an easy, inexpensive and beneficial way to enhance the active constituents of** ***Syzgium cumini*** **(Indian jamun). This method when implemented in large scale will largely benefit the farmer, trader and the consumer.**

Key words: Active constituents, irradiation, *Syzgium cumini*, ultra-violent (UV), gas chromatography-mass spectroscopy (GC-MS).

INTRODUCTION

The jambolan is native to India, Burma, Ceylon and the Andaman Islands. It was long ago introduced in these countries and it became naturalized in Malaya. In southern Asia, the tree is venerated by Buddhists, and is commonly planted near Hindu temples because it is considered sacred to Krishna. The leaves and fruits are employed in worshipping the elephant-headed god, Ganesha or Vinaijaka, the personification of "Pravana" or "Om", and the apex of Hindu religion and philosophy (Warrier et al., 1996). The tree is thought to be of prehistoric introduction into the Philippines where it is widely planted and naturalized, as it is in Java and elsewhere in the East Indies, and in Queensland and New South Wales. It is also found in the islands of Zanzibar, Pemba and Mombasa, and the adjacent coast of Kenya. In Ghana, it is found only in gardens. It was introduced into Israel perhaps in 1940, and it grows vigorously there but bears scantily. The fruit is considered valueless, but the tree is valued as an ornamental and for forestry in humid zones. However, it is grown to some extent in Algiers.

By 1870, it became established in Hawaii and because of seed dispersal by mynah birds, it occurs in a semiwild state on all Hawaiian islands in moist areas below 2,000 ft (600). There are vigorous efforts to exterminate it with herbicides because it shades out desirable forage plants. It is planted in most of the inhabited valleys in the Marquesas. It has been in cultivation in Bermuda, Cuba, Haiti, Jamaica, the French Islands of the Lesser Antilles and Trinidad in the early 20th Century. It was introduced into Puerto Rico in 1920; but still, it has remained little-known in the Caribbean region. At the Lancetilla Experimental Garden of Tela, Honduras, it grows and fruits well. It is seldom planted elsewhere in tropical America but is occasionally seen in Guatemala, Belize, Surinam, Venezuela and Brazil (Bhandary et al., 1995; Jia et al., 1999).

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The Bureau of Plant Industry of the United States Department of Agriculture received jambolan seeds from the Philippines in 1911, from Java in 1912, from Zanzibar and again from the Philippines in 1920. The tree flourishes in California, especially in the vicinity of Santa Barbara, though the climate is not congenial for production or ripening of fruit. In southern Florida, the tree was rather commonly planted in the past. Here, as in Hawaii, fruiting is heavy, but only a small amount of the crop has been utilized in home preservation. The jambolan has lost popularity, as it has in Malaya where it used to be frequently grown in gardens. Heavy crops litter the streets, sidewalks and lawns, attracting insects, rapidly fermenting and creating a foul atmosphere. Hence, people are eager to have the trees cut down. Where conditions favor spontaneous growth, the seedlings become a nuisance, as well (Rastogi and Mehrotra, 1990).

The evergreen jamun plant is originally from Indonesia and India. Indian mythology describes the Indian subcontinent as an island, 'situated in the centre of the world', called Jambudweep. Due to a majority of Jamun (black berry) trees, this island was named as Jambudweep. An evergreen tropical tree, 50 to 100 ft. tall, with oblong opposite leaves that are smooth and glossy, has a terpentine smell. Jamun has fragrant white flowers in branched clusters at stem tips and purplish-black oval edible berries. It is a fairly fast growing species that can reach heights of up to 30 m and can live more than 100 years. Its dense foliage provides shade and it is grown just for its ornamental value. The wood is strong and it is water resistant. The plant grows with lance-shaped leaves and greenish yellow flowers. The ripened fruit has a scent and taste of ripe apricots.

The common types of jambolan in India are: (1) Ra Jaman - with large, oblong fruits, dark-purple or bluish, with pink, sweet pulp and small seeds; and (2) Kaatha - with small, acid fruits. Among the named cultivars, the main cultivars are 'Early Wild', 'Late Wild' and 'Pharenda'; and the secondary ones are 'Small Jaman' and 'Dabka' ('Dubaka'). In Java, the small form is called Djoowet kreekil; although the seedless form is Djoowet booten. In southern Malaya, the trees are small-leaved with small flower clusters. Farther north, the variety called 'Krian Duat' has larger, thicker leaves and red inner bark. Fruits with purple flesh are more astringent than the white-fleshed types. The leaves are antibacterial, and are used for strengthning the teeth and gums. The fruit and seeds are sweet, acrid, sour, tonic and cooling, and are used in diabetes, diarrhoea and ringworm. The bark is astringent, sweet, sour, diuretic, digestive and anthelmintic. The fruit and seeds are used in the treatment of diabetes. Research has shown that it has significant hypoglycemic action in both urine and blood and, therefore, it is of value to diabetes (Benherlal and Arumughan, 2007).

A number of herbal medicines are proving to be helpful in this area, including the bilberry as well as jambul. Tests show that even the small amounts of jambul rapidly reduce blood and urine sugar levels. The presence of oxalic acids, tannic acids, gallic acid and certain alkaloids makes one to feel such an astringency taste. According to nutritionists, the fruit is rich in carbohydrates, minerals and vitamins. It comprises glucose and fructose as principal sugars. The fruit is also rich in minerals such as manganese, zinc, iron, calcium, sodium and potassium. Jamun is recommended for kapha and pitta doshas. The ripe jamun fruit is well recognized as a liver stimulant, digestive, carminative and coolant. Their hypoglycemic (lowering blood sugar) property is well recognized in Ayurveda and Siddha system of medicine in India (Paganga et al., 1999). The fresh seeds of jamun fruit has more varied uses than any other part of the tree. The seeds reduce blood sugar levels and glucosuria in diabetic patients. The seed is also used in various alternative healing methods in Unani. Howevr, the fruit juice is used in diarrhea and dysentery and its effectiveness is noted when the patient passes blood-mixed stool. The leaves provide the best remedy for ulcerative colitis. The leaves and bark are used for gingivitis and controlling blood pressure. The decoction of the Jamun bark is also used as tonic.

The seeds, which are marketed in 1/4 inch (7 mm) lengths, and the bark are much used in tropical medicine and are shipped from India, Malaya and Polynesia, and, to a small extent, from the West Indies, to pharmaceutical supply houses in Europe and England. Extracts of both, but especially the seeds, in liquid or powdered form, are freely given orally, 2 to 3 times a day, to patients with diabetes mellitus or glycosuiria. In many cases, the blood sugar level is reported to quickly reduced and there are no ill effects. However, in some quarters, the hypoglycemic value of jambolan extracts is disclaimed. Mercier, in 1940, found that the aqueous extract of the seeds, injected into dogs, lowered the blood sugar for long periods, but did not do so when given orally. Reduction of blood sugar was obtained in alloxan diabetes in rabbits. In experiments at the Central Drug Research Institute, Lucknow, the dried alcoholic extract of jambolan seeds, given orally, reduced blood sugar and glycosuria in patients.

The seeds are claimed by some to contain an alkaloid, jambosine, and a glycoside, jambolin or antimellin, which halts the diastatic conversion of starch into sugar. The seed extract lowered blood pressure by 34.6% and this action is attributed to the ellagic acid content. This and 34 other polyphenols in the seeds and bark have been isolated and identified by Bhatia and Bajaj. Other reported constituents of the seeds are: protein (6.3 to 8.5%), fat (1.18%), crude fiber (16.9%), ash (21.72%), calcium (0.41%), phosphorus (0.17%), fatty acids (palmitic, stearic, oleic and linoleic), starch (41%), dextrin (6.1%), a trace of phytosterol, and 6 to 19% tannin. The leaves, steeped in alcohol, are prescribed in diabetes. The leaf juice is effective in the treatment of dysentery, either alone or in combination with the juice of mango or emblic leaves. Jambolan leaves may be helpful as poultices on skin diseases (Machado et al., 2010). They yield 12 to 13% tannin (by dry weight).

The leaves, stems, flowerbuds, opened blossoms, and bark have some antibiotic activity. A decoction of the bark is taken internally for dyspepsia, dysentery, and diarrhea and also serves as an enema. The root bark is similarly employed. Bark decoctions are taken in cases of asthma and bronchitis and are gargled or used as mouthwash for the astringent effect on mouth ulcerations, spongy gums and stomatitis. Ashes of the bark, mixed with water, are spread over local inflammations, or blended with oil, and applied to bums. In modern therapy, tannin is no longer approved on burned tissue because it is absorbed and can cause cancer. Excessive oral intake of tannin-rich plant products can also be dangerous to health. The leaves served as fodder for livestock and as food for tassar silkworms in India. In Zanzibar and Pemba, the natives use young jambolan shoots for cleaning their teeth. Analyses of the leaves show: crude protein (9.1%), fat (4.3%), crude fiber (17.0%), ash (6.0%), calcium (1.3%), phosphorus (0.19%) (Giovannucci et al., 2002). They are rich in tannin and contain the enzymes esterase and galloyl carboxylase which are presumed to be active in the biosynthesis of the tannins. The essential oil distilled from the leaves is used to scent soap and is blended with other materials in making inexpensive perfume. Its chemical composition has been reported in Brazil. It consists mainly of mono- or sesqui-terpene hydrocarbons which are "very common in essential oils." Constituents of *Syzgium cumini* seeds are fatty oils (30 g/kg), including lauric (2.8%), myristic (31.7%), palmitic (4.7%), stearic (6.5%), oleic (32.2%), linoleic (16.1%), malvalic (1.2%), sterculic (1.8%) and vernolic acid (3%) and phytosterols such as β-sitosterol. Further constituents are tannins (6%), predominantly corilagin, ellagitannins, ellagic acid, galloyl-galactoside and gallic acid (Lock et al., 2009). Additionally, phenolic compounds like quercetin, ferulic acid, veratrole, guajacol and caffeic acid have been identified as constituents of *S. cumini.*

MATERIALS AND METHODS

Indian jamun or *Syzgium cumini* fruits were procured from local market (Guduvancherry, Tamilnadu, India). It was certain that there was no insect or any other type of infection present in the fruits. About 100 g of the fruit was cleaned, rinsed with distilled water and wiped with sterilized napkins. The fruits were then weighed using an electronic balance, before it was divided equally into the test and control sample. Each group had 50 g of fruit.

UV irradiation

The control sample was stored at room temperature in a maintained incubator, while the test sample was subjected to UV irradiation using a laminar air flow (Acmas, Vertical Laminar Air Flow - 42101- L). The test sample was kept inside the laminar air flow with UV switched on for 8 h in a continuous fashion. The process was continuous without giving it any break and the uniformity of the process was taken care of. After the UV irradiation was completed, the sample was carefully removed from the laminar air flow and analysed with GC-MS for the change in its active constituents. The control sample of the fruit was also analysed by GC-MS simultaneously.

GC-MS data analysis

GC-MS instrument used was in JEOL GC mate-II – Mass Spectrometer. It was tested in HP5 column using helium gas at a temperature range of 80 to 280°C. The rate of temperature was 10°C/min.

RESULTS AND DISCUSSION

The active constituents of the *S. cumini* fruits were analysed using GC-MS and the estimation was done after ensuring that the samples were defect free. In the gas chromatography graph analysis, the control sample had 7 characteristic peaks with the highest peak value of 10.73. The peak of 10.73 had a clear distinction in comparison with other peaks present in the graph (Figure 1). In the mass spectromtery graph analysis, it was found that there were 20 characteristic peaks with base of 23.6% and RT of 11.46. The distinct peaks were 85.0609, 169.5912, 206.3656 and 279.9776 (Figure 2). The test sample had 3 characteristic peaks with the highest peak value of 11.31. The peak of 11.31 had a clear distinction in comparison with other peaks present in the graph (Figure 3). In the mass spectromtery graph analysis, it was found that there were 12 characteristic peaks with a base of 100% and RT of 11.36. The distinct peaks were 81.6302, 95.4330, 109.3581 and 124.2571 (Figure 4).

The GC-MS results clearly indicated that UV irradiation of the fruit samples resulted in the enhancement of its active constituents in a considerable way. The method seems to be beneficial to the farmer or the producer where the dual process of fruit sterilization and active constituents enhancement were done at the same time. As far as the consumer is concerned, the enhancement of active constituents comes with no change in organoleptic properties which ensure that there is no room for dissatisfaction in that context. This method is cheap, easy to perform, relatively harmless to the personnel carrying out the process and increases the marketability of the product in the competitive world of fruit market in domestic areas. Also, this can be extended to shelf life extension which would make the process more viable.

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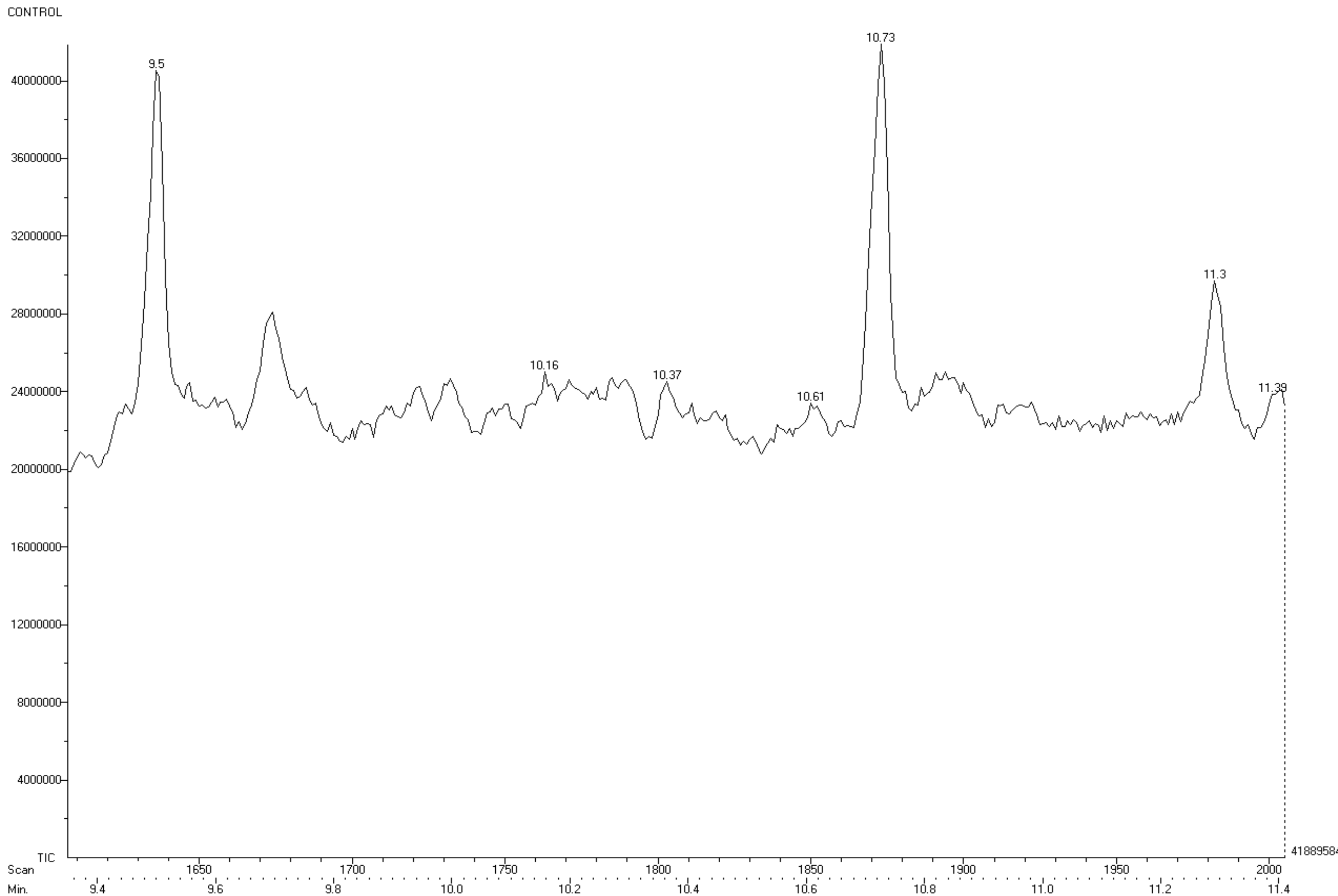

Figure 1. Gas chromatography (GC) graph of the control sample.

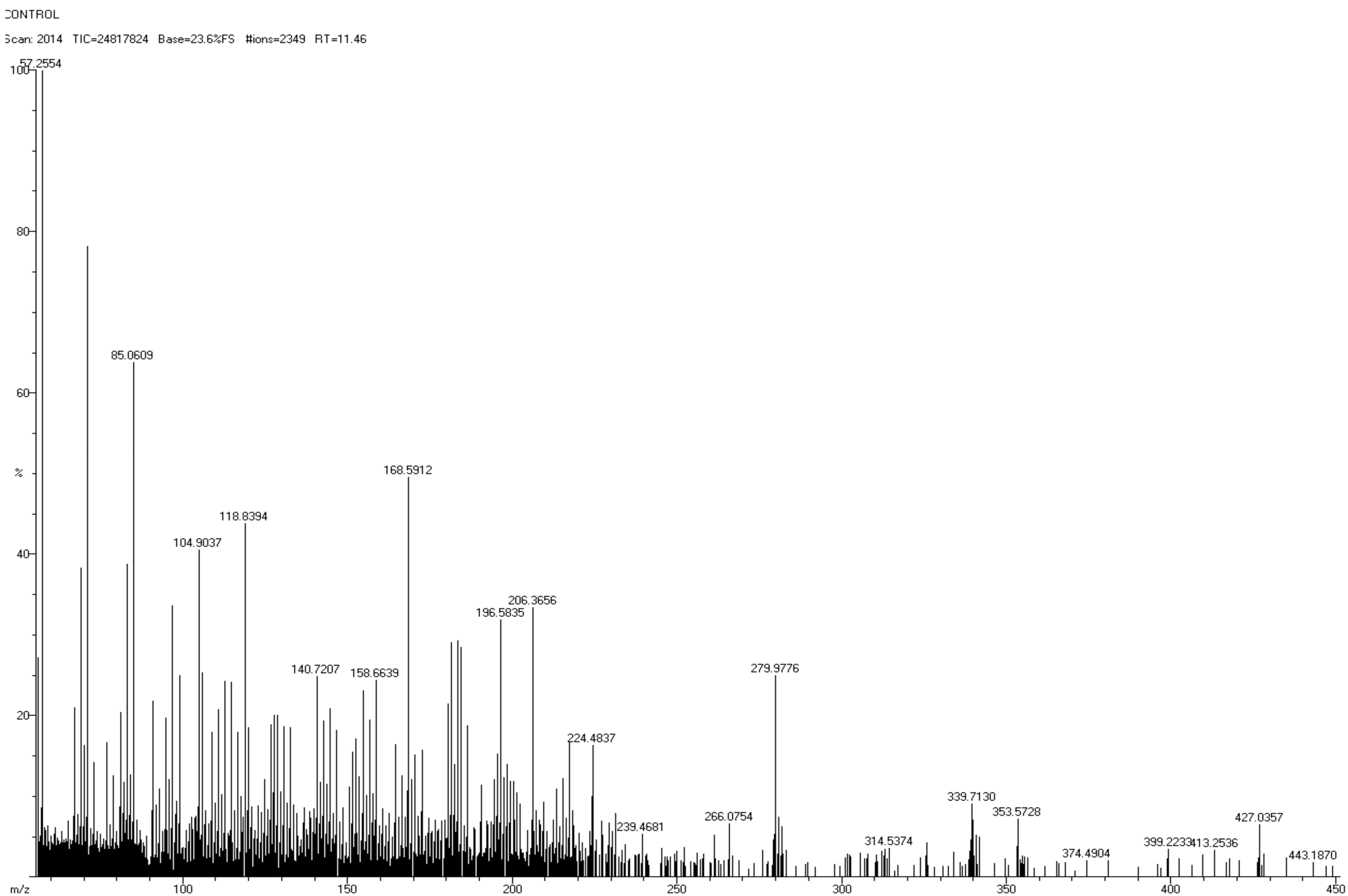

Figure 2. Mass spectromtery (MS) graph of the control sample.

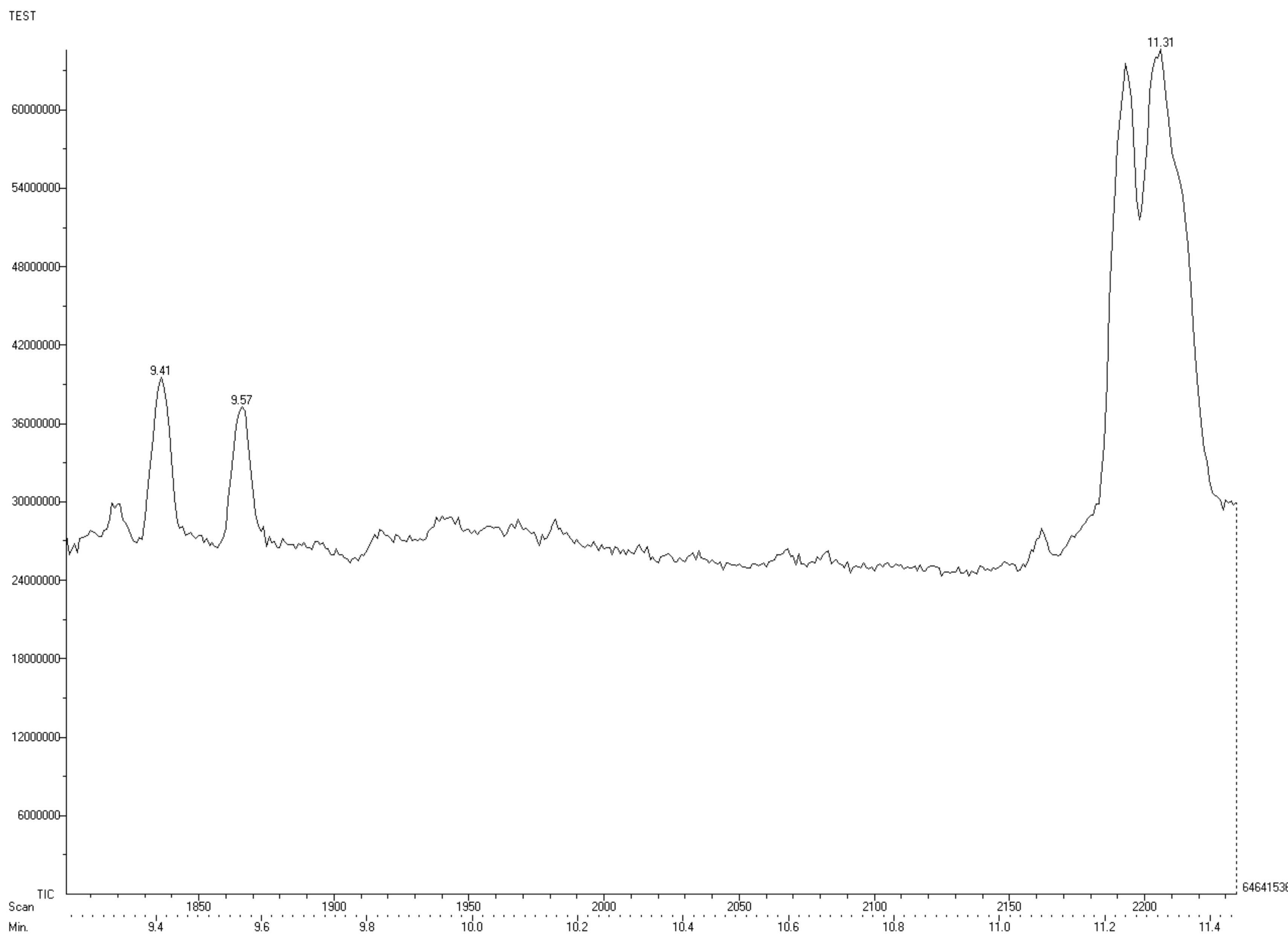

Figure 3. Gas chromatography (GC) graph of the test sample.

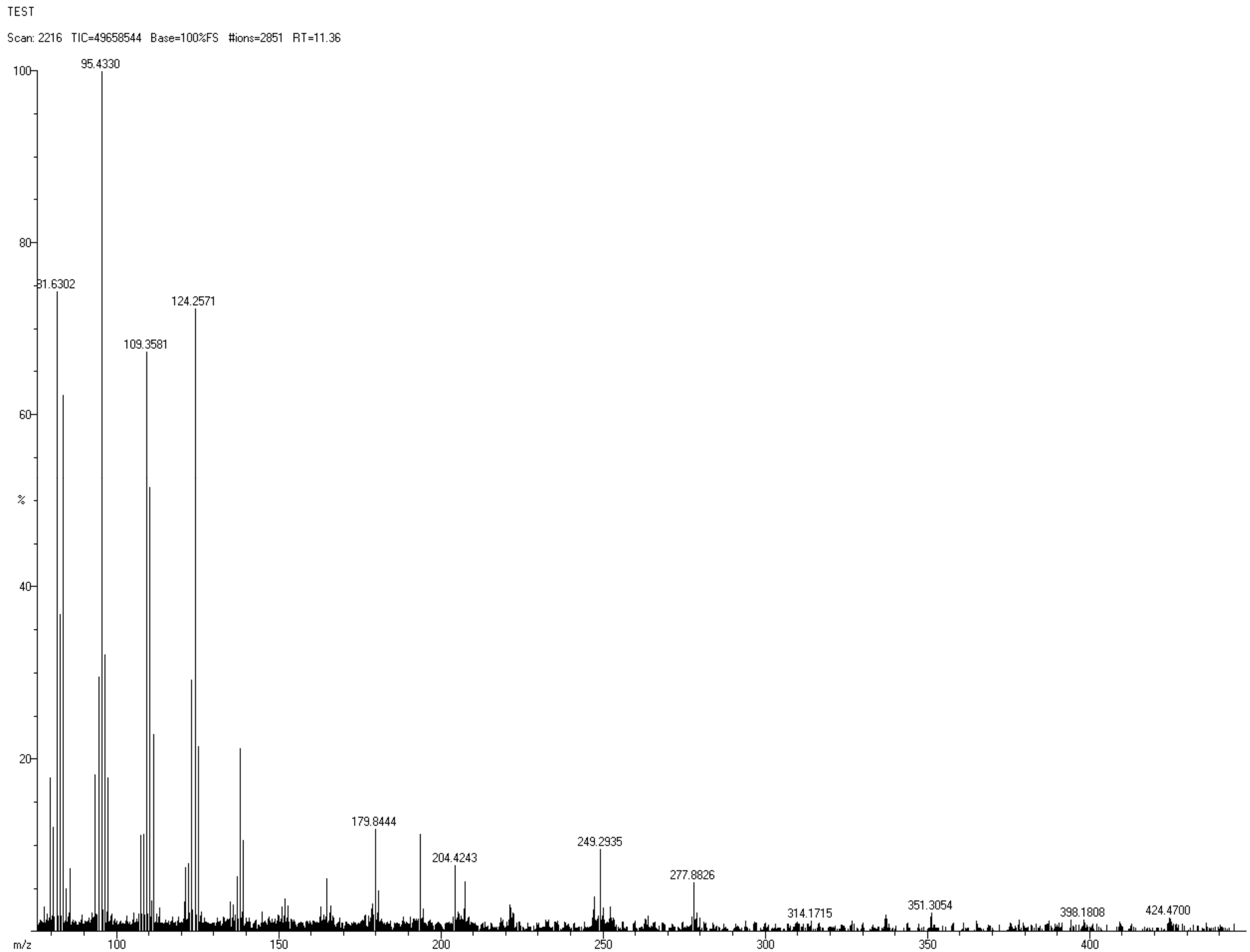

Figure 4. Mass spectromtery (MS) graph of the test sample.

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