



Studies on Nutritional Compositions of Sacha Inchi Seed and Physicochemical Characteristics of Sacha Inchi Oil

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ABSTRACT

This research focuses on the study of nutritional composition of sacha inchi (*Plukenetia volubilis* L.) seed and physicochemical characteristics of sacha inchi seed oil. The seeds of sacha inchi were collected from Pyinsa village, Pyinoolwin Township, Mandalay Region, Myanmar. The phytochemical investigation of seed sample indicated the presence of alkaloids, flavonoids, glycosides, phenolic compounds, polyphenol, reducing sugar, carbohydrates, saponins, steroids and terpene whereas tannin was not detected. The nutritional values of sacha inchi seed were determined by AOAC method revealing the values of (3.30%) moisture, (8.63%) fiber, (24.80%) protein, (14.40%) carbohydrate, (42.30%) oil and (4.20%) ash based on dried sample. The oil extracted from sacha inchi seed was done with petroleum ether by using Soxhlet extraction method. The physicochemical parameters, such as specific gravity, acid value, saponification value, iodine value, peroxide value and unsaponifiable matter were determined by AOCS (American Oil Chemists Society) method revealing the values of (0.92 mg) specific gravity, (0.416 cP) viscosity, (190.85 mg KOH/g) saponification value,(0.78%) unsaponifiable matter, (183.69) iodine value, (0.59 mg KOH/g) acid value and (2.00 milliequi peroxide oxygen/kg) peroxide value based on extracted seed oil. The mineral contents in seed sample were investigated by using EDXRF method. The minerals present in sacha inchi seed were K (0.7750%), P (0.5803%), Ca (0.2972%), S (0.1371%), Al (0.1020%),Cl (0.0288%), Zn (0.0059%) and Fe(0.0057%). Moreover, the fatty acid composition of sacha inchi seed oil was analyzed by Gas Chromatography Mass Spectrometry (GC-MS) method. Sacha inchi oil contains a high level of omega-3 and omega-6 fatty acids.

Keywords : Sacha inchi, AOAC method, EDXRF, GC-MS, AOCS method

1 INTRODUCTION

Sacha inchi (*Plukenetia volubilis* L.) or Inca nut, native to the Peruvian jungles, has widely grown in Myanmar. It has been cultivated and used as a food source for 3,000 years in the Amazon rainforest. It is also being cultivated as an economic plant in South East Asia, most notably in Thailand. It is a plant of the Euphorbiaceae family. Inca nut contains a high level of omega-3 and omega-6 fatty acids. These types of fatty acids can prevent various diseases including cardiovascular disease, stroke, Alzheimer disease, rheumatoid arthritis, inflammation and

cancer. Thus, many researches on medicinal plants have been carried out in order to discover the new sources of alternative medicine the areas of pharmaceuticals, healthcare products and cosmeceuticals[9].

Moreover, sacha inchi seeds contain high in protein, fat and fiber. The taste is pleasant with a nutty flavor. These seeds are made into oil and powder, but its seeds are more commonly eaten after roasting. The roasted seed is a quality snack choice due to its high concentration of omega-3 and complete proteins. Sacha inchi seed oil is valued as a nutritional supplement because it contains a high concentration of polyunsaturated fatty acids, no cholesterol, antioxidants, vitamin A and vitamin E. Vegetable oils have an important functional and sensory role in vitamins (A, D, E and K). They are also sources of energy and essential fatty acids like linolenic (omega-3) and linoleic (omega-6) that are responsible for growth and the health of organisms [2]. The present study aims to investigate the nutritional compositions of inca nut and physicochemical characteristics of nut oil.

2 Materials And Methods

Botanical Description



Figure 1. Plant, Seeds, Powder and Oil Sample of Sacha inchi

Family - Euphorbiaceae

Scientific name- *Plukenetia volubilis* L.

Myanmar name- Kyal Pe

English name - Sacha inchi

Part used - Seeds

2.1 General experimental techniques

Sacha inchi seeds were collected from Pyinsa village, Pyinoolwin Township, Mandalay Region, Myanmar. They were cut into small pieces and air dried at room temperature. This sample was ground into powder in an electric grinder and stored in airtight container. Preliminary phytochemical analysis was performed by using test tube method in order to know different types of organic compounds present in the seeds of sacha inchi. Nutritional values were determined by AOAC method. The oil extracted from Sacha inchi seed was done with petroleum ether by using Soxhlet extraction method. The physicochemical parameters, such as specific gravity, acid value, saponification value, iodine value, peroxide value and unsaponifiable matter were measured by AOCS method. Then elemental analysis of sacha inchi seed was performed by using Energy Dispersive X-ray Fluorescence (EDXRF) method. Moreover, the fatty acid composition of sacha inchi seed oil was analyzed by Gas Chromatography Mass Spectrometry (GC-MS) method.

2.2 Preliminary phytochemical test

A few grams of dried powder was subjected to the tests of alkaloids, flavonoids, glycosides, phenolic compounds, polyphenol, reducing sugars, carbohydrates, saponins, steroids, tannins and terpene according to the standard procedures[6],[8],[7],[3],[4].

2.3 Determination of nutritional values by AOAC method

The moisture content was determined by the oven drying method. The nitrogen content was determined by Kjeldahl digestion method and protein content was calculated by multiplying percent nitrogen by the factor 6.25. The fat content was determined by Soxhlet extraction

method using petroleum ether (b.p 60-80°C) run for 8 h. The ash content was determined by placing sample in pre-weighed crucible and placed in muffle furnace at 500°C for 6 h. Carbohydrate percentage was determined by calculation [5],[1],[10].

2.4 Determination of elemental content

Energy dispersive X-ray fluorescence (EDXRF) spectrometry (shimaduz EDX-700) can analyze the elements from Na to U under vacuum condition. Relative abundance of elements present in sample was determined by EDXRF spectrometry.

2.5 Determination of physicochemical properties

The physicochemical parameters, such as specific gravity, acid value, saponification value, iodine value, peroxide value and unsaponifiable matter were determined by AOCS (American Oil Chemists Society) method.

2.6 Determination of fatty acid composition

The extracted oil from Sacha inchi seed was analyzed by using GC-MS spectrometry at University of Research Center (URC), Mandalay, Myanmar.

3 RESULTS AND DISCUSSION

Phytochemical screening of sachu inchi seed

The phytochemical constituents were investigated by test tube method. Alkaloids, flavonoids, glycosides, phenolic compounds, polyphenol, reducing sugar, carbohydrates, saponins, steroids and terpene were found to be present in sachu inchi seed sample whereas tannin was not detected. Therefore, this sample contains valuable phytochemical constituents for human health.

Nutritional values of sachu inchi seed

AOAC method was used to determine nutritional values in sachu inchi seed sample. The nutritional values of moisture, fiber, protein, carbohydrate and ash content were found to be recorded in Table 1.

Table 1 Results of nutritional values of sachu inchi seed

No	parameters	Experimental value (%)	Literature Value (%)
1	oil	42.30	35-60
2	Moisture	3.30	3.30
3	Fiber	8.63	-
4	Protein	24.80	24.70
5	Carbohydrate	14.40	22.16
6	Ash	4.20	-

The moisture content was determined by using oven drying method. It was found to be 3.30%. The ash content of sachu inchi seed was found to be 4.20%. The oil content was determined by Soxhlet extraction method. It was found to be 42.30%. Therefore, it is the crop that yields high content of oil.

According to the experimental results, the fiber content of sachu inchi seed was found to be 8.63%. The protein content was determined by Kjeldahl method. It was found to be 24.80%. Sachu inchi seed is nutrient rich. Protein is essential to human health and also can be used to provide energy. Carbohydrates are major sources of food energy for men. They are needed to build and maintain muscle, blood, skin, bones,

organs of the body and other tissue. The carbohydrate content of sacha inchi seed was found to be 14.40 %. Among them, protein content was found to be high values in the seed of sacha inchi.

Elemental composition of sacha inchi seed

The elemental composition of seed sample was also analyzed by EDXRF spectroscopy. The results are shown in Table 2.

Table 2 Results of elemental composition in sacha inchi seed

No.	Elements	Symbols	Relative abundance(%)
1.	Potassium	K	0.7750
2.	Phosphorus	P	0.5803
3.	Calcium	Ca	0.2972
4.	Sulfur	S	0.1371
5.	Aluminum	Al	0.1020
6.	Chlorine	Cl	0.0288
7.	Zinc	Zn	0.0059
8.	Iron	Fe	0.0057
9.	Titanium	Ti	0.0046
10.	Vanadium	V	0.0030
11.	Manganese	Mn	0.0038
12.	Copper	Cu	0.0014

From the experimental results, potassium was found to be highest amount in this sample. These minerals are essential dietary constituents for human life.

Physicochemical characteristics of sacha inchi oil

The physicochemical characteristics of sacha inchi oil such as specific gravity, viscosity, saponification value, unsaponifiable matter, iodine value, acid value and peroxide value were performed. These results are tabulated in Table 3.

Table 3 Results of physicochemical characteristics of sacha inchi oil

No	Parameters	Results
1	Specific gravity (at 30°C)	0.92
2	Viscosity(cP)	0.416
3	Saponification value (mg KOH/gm)	190.85
4	unsaponifiable matter(%)	0.78
5	Iodine value (Wij's)	183.69
6	Acid value (mg KOH per gm)	0.59
7	Peroxide value (milliequi peroxide oxygen per kg)	2.00


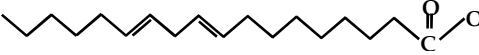
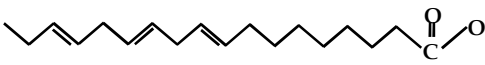
According to table (3), the specific gravity value of oil increases as increases in unsaturation or molecular weight decreases. Low molecular weight required more alkali for saponification. Hence, the saponification value is inversely proportional to the mean of the molecular weight of the fatty acid in the glycoside. The vegetable oils, which have saponification value between 182-194, can be taken as suitable for human. The viscosity of seed oil was found to be 0.416 cP. Therefore, sacha inchi seed oil could be used in the production of body cream. The iodine value of sacha inchi oil was found to be 183.69. The higher iodine value, the greater will be degree of unsaturation.

This value indicates the presence of large portion of unsaturated acid (oleic, linoleic, linolenic and etc.). The acid value is the measurement of free fatty acid presence in the sample. It was found to be 0.59 mg KOH per g. The peroxide value of sacha inchi was found to be 2.0 milliequi peroxide oxygen per kg. From the point of view of human consumption, sacha inchi oil is suitable to eat in terms of their low acid value, which is less than one.

Determination of the fatty acid composition of extracted seed oil

Fatty acid composition of extracted sacha inchi seed oil was analyzed by GC-MS method and identified chemical compounds with their molecular weight, retention time, molecular formula and structure are tabulated in Table 4.

Table 4 Identified Compounds in sacha inchi seed oil by GC-MS

No.	Retention time (min)	Compounds	Structure
1	5.915	Palmitic acid methyl ester Formula – C ₁₇ H ₃₄ O ₂ Molecular weight – 270	
2	8.430	Linoleic acid methyl ester Formula – C ₁₉ H ₃₄ O ₂ Molecular weight – 294	
3	8.545	Linolenic acid methyl ester Formula – C ₁₉ H ₃₂ O ₂ Molecular weight – 292	

According to this table, sacha inchi seed oil contains palmitic acid, linoleic acid (omega-6) and linolenic acid (omega-3), respectively. From the peak intensities in GC-MS chromatogram, linolenic acid (omega-3) was found to be the highest amount. These unsaturated fatty acids are of great importance from a dietary point of view for human health. Consequently, it can be remarked that sacha inchi seed oil may be consumed as edible oil.

4 CONCLUSION

This study investigated the phytochemical constituents and some nutritional values of sacha inchi seed sample. Moreover, physicochemical characteristics of seed oil were determined. According to phytochemical test, alkaloids, flavonoids, glycosides, phenolic compounds, polyphenol, carbohydrates, saponins, steroids and terpene were present in seed sample. From the examination of nutritional values, sacha inchi seeds were rich in oil (42.30%), moisture (3.30%), fiber (8.63%), protein (24.80%), carbohydrate (14.40%) and ash (4.20%). Protein is essential to human health. They are needed to build and maintain muscle, blood, skin, bones, other tissues and organs of the body. Carbohydrates include sugars, starch and fiber. Carbohydrates and proteins are source of food energy for man. The main minerals present in sacha inchi seed were potassium (0.7750 %), phosphorous (0.5803 %), calcium (0.2972%), sulphur (0.1371%), aluminum (0.102%), chlorine(0.0288%), zinc(0.0059%), iron(0.0057%), respectively. These minerals are essential dietary constituents for human life.

Moreover, physicochemical properties of sacha inchi seed oil include specific gravity (0.92), viscosity (0.416 cP), saponification value (190.85 mg KOH per g), unspontifiable matter (0.78%), iodine value (183.69), acid value (0.59 mg KOH per g) and peroxide value (2.00 milliequi peroxide oxygen per kg). Fatty acid composition of sacha inchi seed oil was analyzed by GC-MS. It can be seen that seed oil contains palmitic acid, linoleic acid (omega-6) and linolenic acid (omega-3), respectively. According to intensities of peaks in GC-MS chromatogram, linolenic acid (omega-3) was found to be the highest amount. These unsaturated fatty acids are of great importance from a dietary point of view for human health. The highest amounts in omega-3 and omega-6 in the oil help to balance the nervous system and lower the risk of cardiovascular disease. According to these results, sacha inchi seed is a nutritious crop and sacha inchi seed oil is most suitable for

human health.

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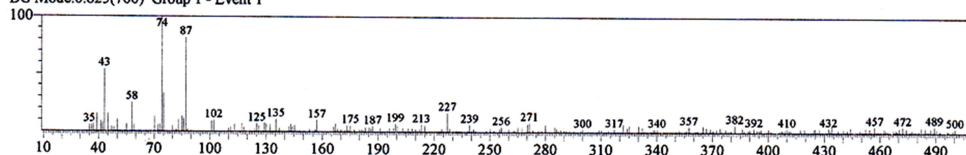
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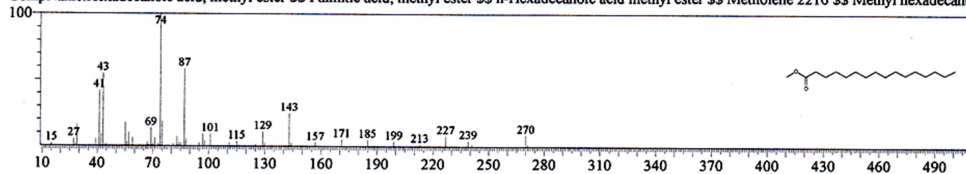
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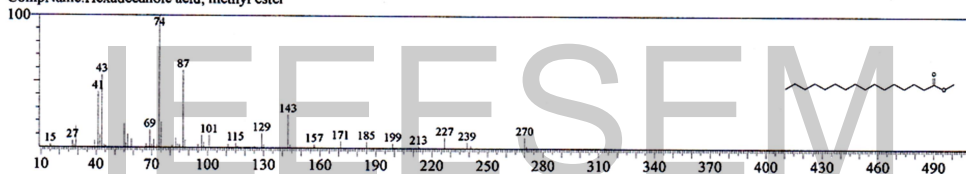
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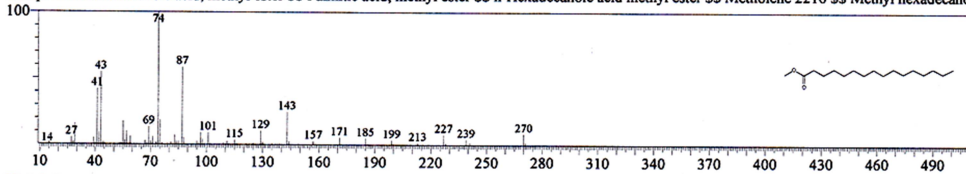
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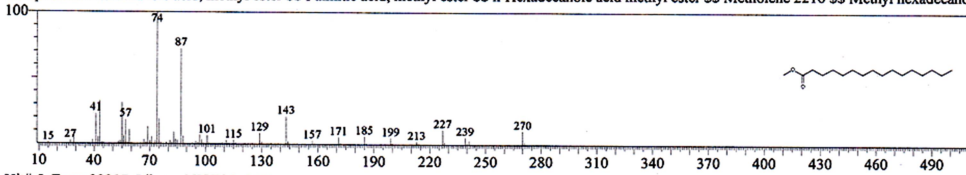
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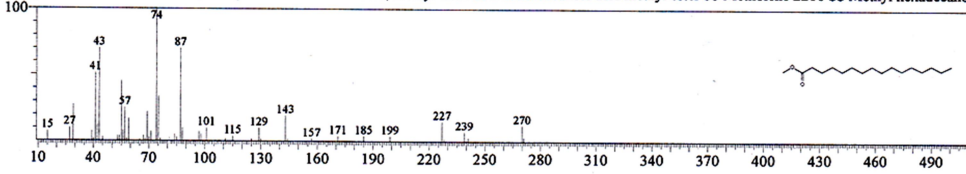


Figure 2 GC-MS Chromatogram of Palmitic Acid

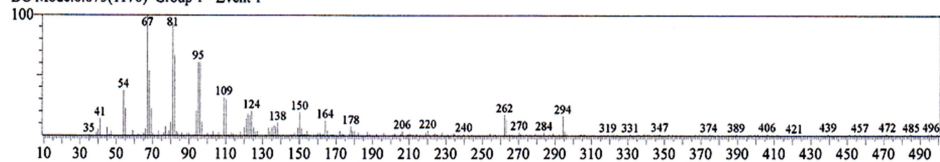
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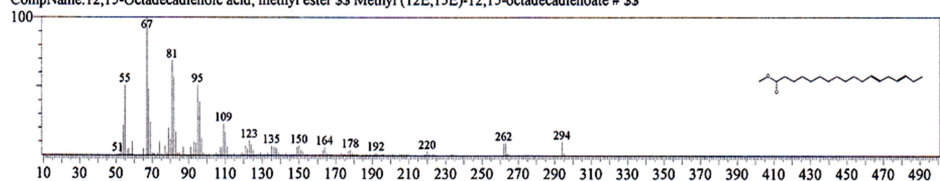
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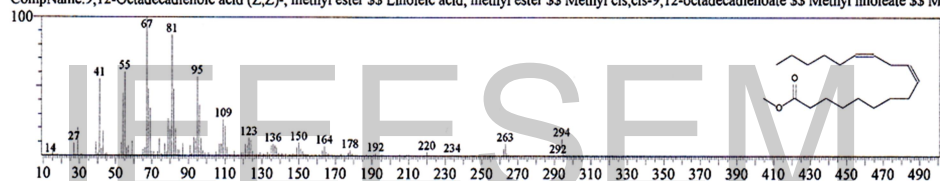
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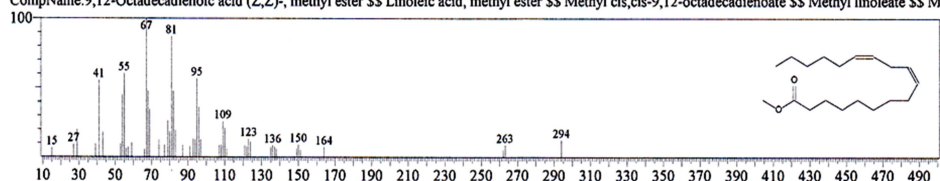
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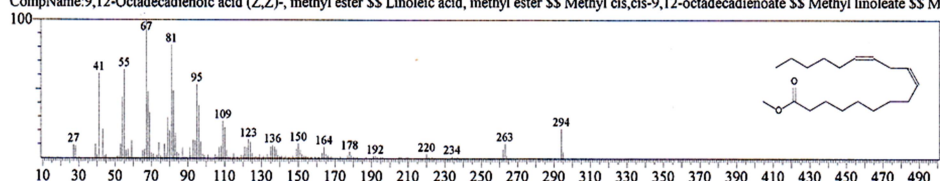
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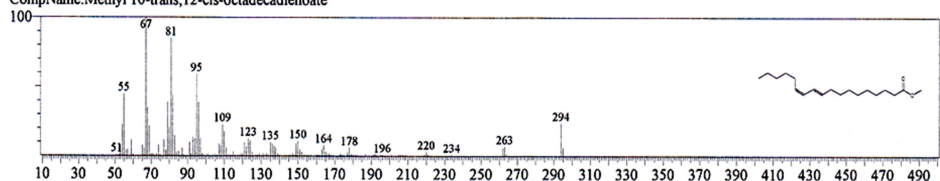


Figure 3 GC-MS Chromatogram of Linoleic Acid

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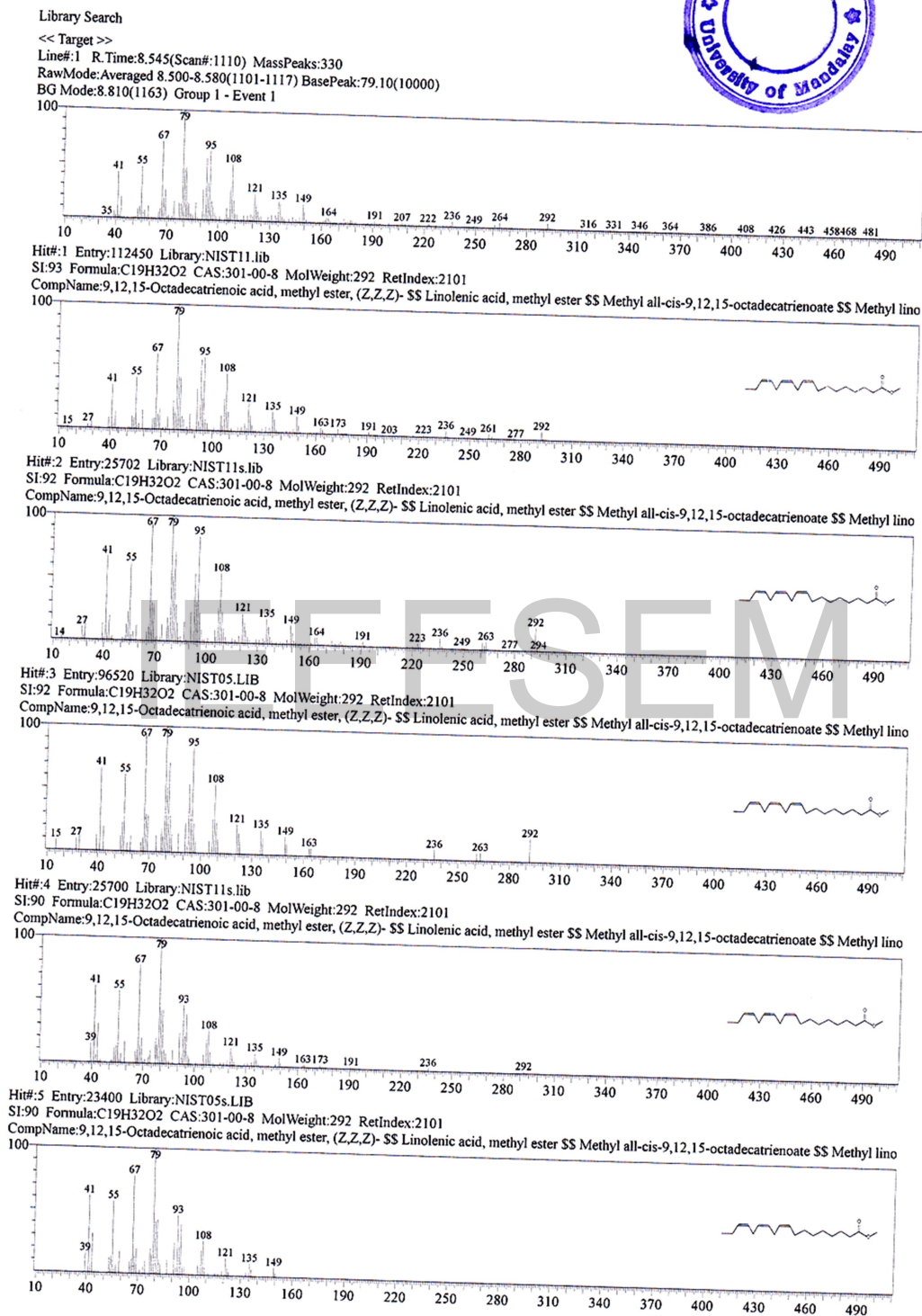


Figure 4 GC-MS Chromatogram of Linolenic Acid