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Fatty acid content estimation in leaf of *Moringa oleifera* Lam. and it used to cure woman diseases in Chhatarpur district (M.P.)

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Abstract
A highly prized plant, Moringa (*Moringa oleifera* Lam. Moringaceae) is mostly grown in tropical and subtropical regions. It is employed in industry, food, and medicine. Known as the "tree of life" or "miracle tree" because of its many uses and remarkable nutritional composition, Moringa oleifera has been used for millennia as a food and in traditional medicine. Because of its nutrient-dense pods, leaves, and seeds, *Moringa oleifera* is cultivated as a crop all over the world. The current study set out to assess the amount of fatty acids present in moringa leaves and it is used to cure the woman diseases in Chhatarpur district of Madhya Pradesh. Approximate all fatty acid content were estimated in leaves extract of *Moringa oleifera* and result represented as mean values of replications along with Stender error (SD). Fatty acid contents of *Moringa oleifera* leaf was shown in table 19. The estimated value shown that total poly unsaturated fatty acids and total mono unsaturated fatty acids contents were found as 53.21% and 4.54% of total fatty acids respectively. The total saturated fatty acids were estimated as 44.31% of total fatty acids. The main saturated fatty acids were palmitic (10.12%), lauric acid (0.78%), stearic (2.53%), linoleic (7.77%) out of that α-Linolenic (42.37%), g Linolenic (0.225%) of total linolic acid.

Keywords: *Moringa oleifera*, fatty acids, woman diseases, medicinal used

Introduction
The Indian subcontinent is the native home of Moringa (*Moringa oleifera* Lam.), which has spread to tropical and subtropical regions worldwide. Local names for the tree include Benzolive, Horseradish tree, Drumstick tree, Kelor, Marango, Mlonge, Mulangay, Saijihan, and Sajna (Fahey, 2005) [8]. Tropical islands are the ideal climate for the plant. It is not greatly impacted by drought and can thrive in hot, dry regions or the humid tropics (Anwar *et al.,* 2007) [4]. It can also endure on less rich soils. The Moringa tree is regarded as one of the most beneficial trees in the world because practically every portion of it can be used for industrial, medicinal, and food reasons. People utilize its leaves, blossoms, and fresh pods as vegetables, while others use it as livestock feed. This tree could promote rural development, increase food security, and enhance nutrition. The nutritional qualities of moringa have recently attracted a lot of renewed attention in most non-native countries. This might be because of the assertions that its nutritional, medicinal, and preventative qualities boost animal productivity (Fahey, 2005) [8].

Animals' capacity to withstand the harmful effects of illnesses and parasites is greatly influenced by their diet (Anwar *et al*., 2007) [4]. A healthy animal is more resilient to illness, even when infected, than one that is already compromised by starvation. The immune system of an animal mounts a defence against infection when it is exposed to microorganisms. This entails employing white blood cells to combat infections and producing antibodies to combat infections (FAO, 2002). The animal need energy, proteins to produce antibodies and cells, minerals (copper, iron, and zinc), and vitamins A and E to communicate with various bodily regions to combat infections to develop immunity.

Moringa oleifera commercially referred to as "Ben oil" or "Behen oil," seed oils have an oil content of 35-41% and are a rich source of omega-9 fatty acids, or oleic acid. Despite this, the seeds are not used much as an oil source Anwar F *et al.,* 2006 [3], which is suitable for edible uses and allows for longer storage and high-temperature frying processing in the food industry because of their good oxidative stability by Palafox JO *et al*., 2012 [13].

Inherent natural antioxidants include tocopherols, phenolic compounds, sterols, and carotenoids. Moringa oil's bioactive components aid in avoiding tissue damage from free radicals and supporting a few bodily physiological processes by Bhatnagar AS and Gopalakrishna AG (2013) [6]. Additionally, the oil has been utilized in skin lotions and perfumes by Mahmood KT *et al.,* 2010 [12], lubrication and lighting by Anwar F *et al.,* 2006 [3], cosmetics by García-Fayos B *et al*., 2010 [10], medicine by Anwar F *et al.,* 2006 [3], antifungal properties by Chuang PH *et al*., 2007 [7], and, more recently, as a possible candidate to produce biodiesel fuel by Palafox JO *et al*., 2012 [13], Rashid U *et al*., 2008 [14]. A variety of food products are treated using ionizing radiation. However, only electrons and electromagnetic waves (visible light, x-rays, γ-rays, ultraviolet rays, infrared rays, etc.) can be utilized in food processing; food is severely damaged by neutrons, deuterons, and α-rays by Rodis P (1995) [16]. According to Stevenson MH (1994) [17], irradiation has little effect on the overall nutritional value of food, and the oxidative changes it causes are comparable to those seen when using traditional food treatment methods. Commonly present in both edible and non-edible plants, plant phenolics have been shown to have a variety of biological effects, including antioxidant activity. The primary cause of phenolics' antioxidant activity is their redox characteristics, which enable them to function as singlet oxygen quenchers, hydrogen donators, and reducing agents. Furthermore, they can chelate metals by Rice-Evans CA *et al.,* 1995 [15].

Moringa leaves have been utilized as traditional treatment for common illnesses for generations in many different nations. At least some of these claims appear to be true, according to clinical research. Historically used to treat cholera, conjunctivitis, anemia, anxiety, asthma, blackheads, blood impurities, bronchitis, catarrh, chest congestion, fever, glandular swelling, headaches, hysteria, joint pain, pimples, psoriasis, respiratory disorders, scurvy, semen deficiency, sore throat, sprain, and tuberculosis. used historically to treat sores and infections of the skin. used to treat intestinal worms in the past. used historically to treat lactation, glandular swelling, and anemia. Regarding contemporary applications, numerous publications detailing its nutritional and therapeutic qualities have been published in reputable scientific journals throughout the previous 20 years. A lot of information has also been written about its use as a non-food product. It is believed that every portion of the moringa tree has advantageous qualities that might benefit humanity. People have utilized these qualities in communities all around the world.

Materials and Methods

Collection of *Moringa oleifera* plant parts as sample and lab work

The sample collection and lab work has been done between 2023-2025. The Healthy and disease-free plant parts as leaves, stems, barks, roots, flowers, and seeds of *Moringa oleifera* were collected from the "Botanical Garden" in front of Department of Botany, Maharaja Chhatrasal Bundelkhand University, Chhatarpur, Madhya Pradesh, India. The chemical analysis was done in Lab of "Centre of Excellence on Soybean Processing and Utilisation (CESPU)" of ICAR-Central Institute of Agricultural Engineering, Bhopal (MP).

Cleaning and sanitizing of sample

The collected plant parts were three time washed out with tap water and after that sterilized with 70% alcohol. The sterilized plant sample were dried in shade
at room temperature and avoid the fungal infection on plant materials. When the sample was completely dried, then it is made into powder form by the used of mortar and pestle. To collected the fine powder for further studies based on Jongrungruangchok, S. *et al.* (2010) [11].

Preparation of sample for further processes

One hundred grams of powdered of *Moringa oleifera* leaves were stored in a thick filter paper thimble that was put into the Soxhlet extractor's main chamber. A 700 ml flask of methanol, the extraction solvent, was placed inside the Soxhlet extractor. A heating mantle then housed the Soxhlet setup. As the solvent began to boil, vapours were released, which were then reduced by the condenser and dropped into the thimble containing the plant material. One could see a change in the solvent's colour as it accumulated in the round-bottom flask as the amount of solvent in the jar increased and the soluble bioactive components dissolved in it based on Bello, O. S. *et al.* (2017) [5].

After being washed, the samples were dried using various techniques. After being pounded into a fine powder and sieved through a 60-mesh screen, the material was kept at room temperature for later use based on Foline, O. *et al.* (2011) [9] and Setiaboma, W. *et al.* (2019) [19]. The plant parts were cleaned, let to air dry, and then placed on filter paper in the sun drying process. For ten hours, the filter paper and tray were positioned in an area with enough sunshine.

The plant materials were pulverized in a mixer grinder after they had dried to a consistent weight. It was easy to ground the leaves, seeds, fruit, and roots into a powder. To get a particle size less than 100 µM, the powder was run through a test sieve with 100 µM pore size (Sonar, India). Once more, the leftover course powder was ground and sieved. Until the material could no longer be ground, the operation was repeated four or five times. The less than 100 µM fine powder was promptly put away for later use in an airtight container based on Ali, M. A. *et al.* (2017) [1].

Estimation of Fatty acids

Using a disposable glass Pasteur pipette, approximately 10 mg of the extracted lipids were transferred into a Teflon-lined screw-top test tube for gas chromatography by methylating the extracted fat using methanol-BF3. Fatty acid methyl esters (FAME) were quantified using a Varian GX 3400 flame ionization GC, with a fused silica capillary column, Chrompack CPSIL 88 (100 m length, 0.25 mm ID, 0.2 µm film thickness). Total lipids from plant material were quantitatively extracted using a Soxhlet extraction (AOAC, 2005). The extracted fats were then stored in a polytop (glass vial, with a push-in top) under a blanket of nitrogen, while awaiting analysis. An initial isothermic period (two minutes at 40°C) was used for analysis. After that, the temperature was raised to 230°C at a rate of 4°C per minute. Ultimately, a 10-minute isothermic period at 230°C ensued. A Varian 8200 CX Autosampler was used to inject 1 µl of fatty acid methyl esters in n-hexane with a 100:1 split ratio into the column. The injection port and detector were both maintained at 250°C. While nitrogen was used as the makeup gas, hydrogen served as the carrier gas at 45 psi. Varian Star Chromatography Software recorded the chromatograms. Total monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), total saturated fatty acids (SFA), PUFA/SFA ratio (P/S), and n-6/n-3 ratio were among the fatty acid combinations and ratios that were computed. The remaining

solvents and reagents were all analytical grade were acquired from IIAE Bhopal.

Results and Discussion

All fatty acid content were estimated in leaves extract of *Moringa oleifera* and result represented as mean values of replications along with Stender error (SD). Fatty acid contents of *Moringa oleifera* leaf was shown in table 1. The estimated value shown that total poly unsaturated fatty acids and total mono unsaturated fatty acids contents were found as 53.21% and 4.54% of total fatty acids respectively. The total saturated fatty acids were estimated as 44.31% of total fatty acids. The main saturated fatty acids were palmitic (10.12%), lauric acid (0.78%), stearic (2.53%), linoleic (7.77%) out of that α-Linolenic (42.37%), gLinolenic (0.225%) of total linolic acid. The ratio of unsaturated fatty acids and saturated fatty acids (PUFA:SFA) was 1.21; poly unsaturated fatty acids (PUFA) and mono unsaturated fatty acids (PUFA: MUFA) was 12.8. The total Omega-3 fatty acids (n-3) and total Omega-6 fatty acids (n-6) was 43% and 7.22% respectively. The approximate similar results were observed in fatty acid estimation on *Moringa oleifera* spp. Plant parts by Al-Kahtani H. A. and Abou-Arab, 1993, Anwar, F., *et al.* (2007) [4] (Table 1). All fatty acid content were estimated in leaves extract of *Moringa oleifera* and result represented as mean values of replications along with Stender error (SD). Fatty acid contents of *Moringa oleifera* leaf. "Characterisation of different parts from *Moringa oleifera* regarding protein, lipid composition and extractable phenolic compound - OCL Journal": United States.

Table 1: Fatty acids composition of dried *Moringa oleifera* leaves

Fatty acid	Quantity (mean+/- %)	Standard error
Ether extract	5.42	0.033
Capric	0.089	0.055
Lauric	0.78	0.312
Myritic	3.21	1.222
Palmitic	10.12	0.554
Palmitoleic	0.15	0.034
Margaric	3.39	0.258
Stearic acid	2.53	0.315
Oleic	3.41	1.85
Vaccenic	0.37	0.028
Linoleic	7.77	0.022
α-Linolenic	42.37	2.313
g-Linolenic	0.225	0.036
Arachidic	1.42	0.121
Heneicosanoic	13.38	0.134
Behenic	1.63	0.333
Tricosanoic	0.88	0.025
Lignoceric	2.99	0
Total saturated fatty acids (SFA)	44.31	0.625
Total mono unsaturated fatty acids (MUFA)	4.54	1.684
Total poly unsaturated fatty acids (PUFA)	53.21	2.592
Total Omega-6 fatty acids (n-6)	7.22	0.014
Total Omega-3 fatty acids (n-3)	43	2.505
PUFA: SFA (PUFA: SFA)	1.21	0.066
PUFA: MUFA (PUFA: MUFA)	12.8	7.821

The most prevalent fatty acid in *Moringa oleifera* seeds was oleic acid (66.2% for entire seeds). "Fatty acids and Macro elements of *Moringa oleifera* (M. peregrina and M. oleifera) Seed Oils - Science Alert": 74.87% to 78.05% oleic acid, 6.18% to 9.86% palmitic acid, 3.92% to 4.19% stearic acid, and very low linoleic acid (0.42% to 0.68%) are reported. "Fatty Acid Profile and Physicochemical Properties of *Moringa oleifera* Seed Oil Extracted at Different Temperatures - PMC": reports that the main fatty acids are arachidic (0.2%), palmitic (6%), stearic (5%), behenic (7%), oleic acid (up to 77.8%), and linolenic acid (3.4%). "Quality characteristics and stability of *Moringa oleifera* seed oil of Indian origin - PMC": reveals that the main fatty acid (78-79%) in *Moringa oleifera* seed oil that has been cold-pressed and extracted with hexane is oleic acid. "Fatty acids in *Moringa oleifera* oil - ResearchGate": 74.99% oleic acid, 12.51% palmitic acid, 2.09% stearic acid, 1.27% linoleic acid, and 1.75 percent linolenic acid are mentioned by Aly, A. A. *et al.* (2016) [2] and Saini, R. K. *et al.* (2014) [18].

Summary and Conclusion

The estimated value shown that total poly unsaturated fatty acids and total mono unsaturated fatty acids contents were found as 53.21% and 4.54% of total fatty acids respectively. The total saturated fatty acids were estimated as 44.31% of total fatty acids. Result shown that leaf have all amino acids as compared to other plant parts. Some amino acids like Alanine, Tyrosine, Proline, HO-Proline, Methionine, Cysteine and Tryptophan were absent in flower. Some amino acids were also absent in pods like Serine, Aspartic acid, Glutamic acid, Glycine, Alanine, Tyrosine, Proline, HO-Proline and Cysteine. The survey result shown that rural woman's consumed *Moringa oleifera* fruits as vegetable, roots and fruits as pickles, leaf powder, sup, tea, oils/paste, capsules, and leaf in cooked form. Historically used to treat cholera, conjunctivitis, anemia, anxiety, asthma, blackheads, blood impurities, bronchitis, catarrh, chest congestion, fever, glandular swelling, headaches, hysteria, joint pain, pimples, psoriasis, respiratory disorders, scurvy, semen deficiency, sore throat, sprain, and tuberculosis. used historically to treat sores and infections of the skin. used to treat intestinal worms in the past. used historically to treat lactation, glandular swelling, and anemia.

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