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Evaluation of Moringa (*Moringa oliefera*. Lam) Genotypes for Seed Oil Yield and Quality

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A study was carried out at the Department of Vegetable Science, Horticultural College and Research Institute, Periyakulam,2022 in ten moringa genotypes to assess pod, seed characters, seed oil yield, and quality. In pod characters, among ten genotypes PKM MO-3 recorded the

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highest pod length (75 cm) & fresh pod weight (154 g), PKM MO 7 recorded the highest dry pod weight (37 g), PKM MO 2 recorded the highest pod girth (7.7 cm) and PKM MO 9 recorded the lowest pod length, fresh pod weight, Number of seeds per pod and pod yield per tree. In seed characters PKM MO 3 registered the highest seed length (0.92 cm), seed width(0.79cm), seed diameter(1.20cm) and PKM MO 10 recorded the lowest highest seed length (0.72 cm), seed width (0.64 cm) and seed diameter (0.96 cm). The moringa seed oil composition extracted with different methods such as the expeller pressed method, soxhlet extraction method, and Clevenger extraction method were compared. The oil yield obtained by expeller, soxhlet, and Clevenger was 27.84, 26.1, and 25.35 percent respectively. Also, specific gravity, density, viscosity, and refractive index were measured by different methods of oil extraction in ten genotypes. These results promoted the use of expeller expeller-pressed method for the extraction of high-quality moringa oil.

Keywords: Genotypes; pod characters; seed characters; extraction methods; expeller pressed method; soxhlet apparatus; clevenger apparatus; oil yield.

1. INTRODUCTION

Moringa (*Moringa oleifera* Lam.) is well known to the ancient world, but only recently it has been rediscovered as a multipurpose tree with a tremendous variety of potential uses. The Moringa tree belongs to the family “Moringaceae” with the genus “Moringa Adans” and species “*M. oleifera* Lam”. This species originally came from North India but now has spread worldwide in the tropics and subtropics [1]. In some parts of the world, *M. oleifera* is referred to as the ‘Drumstick tree’ or the ‘Horse radish tree’, whereas, in others, it is known as the Kelor, Marango, Mlonge, Moonga, Mulangay, Nebeday, Saijhan, and Sajna or Ben oil tree [2]. India is the largest producer of moringa with an annual production of about 5 million tonnes of tender pods from an area of 6160 ha. In India, Andhra Pradesh leads in both area (18,000 ha) and production (7,20,000 MT), followed by Karnataka (12000 ha and 4,56,000 MT). Tamil Nadu ranks third with an area of 8,00,000 ha and production of 2,80,000 MT [3]. The moringa seeds have many bioactive compounds, which are used in anti-microbial, anti-genotoxic, anti-inflammatory, and anti-tumor promoting activities [2]. Moringa seed oil is considered equivalent to olive oil in terms of its chemical properties contains a large quantity of tocopherols, and is also for edible purposes [4]. Moringa seed kernel oil called ben oil, is more stable than canola oil, soybean oil, and palm oil when used for frying foods [5]. Blending Ben oil with sunflower oil and soybean oil enhances the oxidative stability of the mixture (Mani *et al*., 2007). Comparing its chemical properties, moringa seed oil is considered equivalent to olive oil and may be used for human consumption. India is known to be the place of origin of moringa and a lot of diversity is available in India. In Tamil Nadu, perennial and annual moringa genotypes are commercially cultivated. Identification of genotypes with high oil yield is important for commercial exploitation. Hence, the present study was conducted at HC&RI Periyakulam, to identify the suitable genotypes for higher oil yield and quality.

2. MATERIALS AND METHODS

The present study was conducted at Horticultural College and Research Institute (HC &RI) Periyakulam in 2022. Moringa genotypes maintained at HC&RI Periyakulam were used for the present investigation. The following pod and seed characters *viz*., pod length, pod girth, fresh pod weight, dry pod weight, and number. of pods per tree, number of seeds per pod, pod yield per ha, seed length, seed width, seed diameter, and seed yield per ha. A random Block design was used for the experiment with 10 genotypes distributed among two replications. For oil yield and quality, a Factorial Completely Randomized Design with two replications was used and physio-chemical properties *viz*., oil yield, Specific gravity, density, viscosity refractive index were observed.

2.1 Processing of Moringa Seeds

Moringa kernels were cleaned to remove stones, dirt, sand, and other extraneous materials. The cleaned kernels were cracked by hand to remove the shell from the nuts. The seeds were divided into three equal parts; a part of the seeds were dried in the cabinet oven at 60ºC for 2 hours; after which it was milled to flour in an attrition mill to obtain a smooth Moringa seeds flour. Another portion was sun-dried at the normal atmospheric temperature for 4 days and milled to obtain the flour while the last part was not subjected to any drying method (serves as a control sample).

Table 1. Different moringa genotypes used for the present study

Accessions No.	Name of the genotypes
PKM MO 1	Vadipatti Moringa
PKM MO 2	Mulanur Moringa
PKM MO 3	PKM-1 Moringa
PKM MO 4	Valaiyapatti Moringa
PKM MO 5	Kannivadi Local Moringa
PKM MO 6	Kappalpatti Moringa
PKM MO 7	Aravakuruchi Local Moringa
PKM MO 8	Karumbu Moringa
PKM MO 9	Nattu Moringa
PKM MO 10	Oddanchathram Local moringa

2.2 Methods of Extraction

1. Expeller - pressed method

Expeller pressing (also called oil pressing) is a mechanical method for extracting oil from raw materials. The raw materials were squeezed under high pressure in a single step. As the raw material was pressed, friction caused it to heat. In the case of harder nuts (which require higher pressures) the material can exceed temperatures of 200˚F.

2. Soxhlet apparatus method

Soxhlet extraction was carried out from powdered seed samples using ethanol and the temperature was set at 50-60°C. The Soxhlet apparatus was operated for 6 h to recover the oil followed by the removal of solvent in the rotary evaporator. The residue oil was kept in colored vials at −18 °C till analysis

3. Clevenger apparatus method

The seeds were washed thoroughly and the seed coats were removed. The separated seed kernels were crushed using a pestle and mortar to make a fine coarse powder. The powder was subjected to hydro distillation for 7 h using a Clevenger apparatus. The essential oil was collected and dried over sodium sulfate (anhydrous) and it was kept at 4°C for further study.

3. RESULTS AND DISCUSSION

From this study, it was found that the length of the pod was highest in the genotype PKM MO 3 (75 cm) followed by PKM MO 8 (72 cm) and PKM MO 1 (61 cm). The lowest pod length was observed in the genotype PKM MO 9 (40 cm). The girth of the pod was highest in the genotype PKM MO 2 (7.7 cm) followed by PKM MO 7 & 9 (7.5 cm) and the lowest girth was observed in the genotype PKM MO 6 (5.8 cm). The pod weight was highest in the genotype PKM MO 3 (154 g) followed by PKM MO 4 (146 g), the lowest pod weight was recorded in the genotype (70g). The dry pod weight was highest in the genotype PKM MO 7 (37 g) followed by PKM MO 2 (34 g) and the lowest was in the genotype PKM MO 10 (23 g). No pods per tree were highest in the genotype PKM MO 5 (385) followed by PKM MO 7 (377) and the lowest in the genotype PKM 1 (175). No. of seeds per pod was highest in the genotype PKM MO 5 (23) followed by PKM MO 4 & 7 (20) and least in the genotype PKM MO 9 (10). The pod yield per tree was highest in the genotype PKM MO 4 (59.86 Kg) followed by PKM MO 10 (57.26 Kg) the lowest in the genotype PKM MO 3 (34.65 Kg). Similar findings results were observed by Balaguru et al. [6].

From this study it was found that the length of the seed was highest in the genotype PKM MO 7 (0.92 cm) followed by PKM MO 3 (0.90 cm) and the lowest seed length was observed in the genotype PKM MO 10 (0.72 cm). The width of the seed was highest in the genotype PKM MO 3 (0.79 cm) followed by PKM MO 7 (0.72 cm) and the lowest width was observed in the genotype PKM MO 10 (0.64) The seed diameter was highest in the genotype PKM MO 3 (1.24 cm) followed by PKM MO 7 (1.20 cm), the lowest seed diameter observed in the genotype PKM MO 10 (0.96 cm). The seed yield per tree was highest in the genotype PKM MO 5 (2.833 kg) followed by PKM MO 7 (2.827 kg) the lowest in the genotype PKM MO 3 (0.89 Kg). Similar results were observed by Adejumo Bo [7].

Table 2. Pod characters of different moringa genotypes

S. No	Pod length (cm)	Pod girth (cm)	Fresh pod weight (g)	Dry pod weight (g)	No. of pods/tree	No. of seeds/pod	Pod yield/tree (kg)
PKM MO 1	61	6.5	128	28	345	16	50.56
PKM MO 2	59	7.7	110	34	375	18	46.75
PKM MO 3	75	7.0	154	24	175	14	34.65
PKM MO 4	57	6.8	146	28	360	20	59.86
PKM MO 5	58	6.1	125	25	385	23	54.37
PKM MO 6	56	5.8	116	26	325	19	43.50
PKM MO 7	52	7.5	118	37	377	20	50.38
PKM MO 8	72	5.2	124	27	302	12	43.64
PKM MO 9	40	7.5	70	26	313	10	25.41
PKM MO 10	55	6.6	139	23	362	19	57.26
Mean	58.5	6.67	123	27.8	332	17.1	46.6407
SE (d)	1.0545	0.0931	2.8999	0.8229	7.4691	0.2197	0.7309

Table 3. Seed characters of different moringa genotypes

S. No	Seed length (cm)	Seed width (cm)	Seed diameter (cm)	Seed yield/tree (kg)
PKM MO 1	0.75	0.66	1.04	1.766
PKM MO 2	0.85	0.73	1.18	2.565
PKM MO 3	0.92	0.79	1.24	0.894
PKM MO 4	0.78	0.68	1.02	2.160
PKM MO 5	0.84	0.75	1.14	2.833
PKM MO 6	0.86	0.72	1.09	1.883
PKM MO 7	0.90	0.78	1.20	2.827
PKM MO 8	0.75	0.69	1.06	1.268
PKM MO 9	0.76	0.65	1.07	1.126
PKM MO 10	0.72	0.64	0.96	2.372
Mean	0.813	0.709	1.1	1.9694
SE (d)	0.0260	0.0177	0.0350	0.0293

Table 4. Comparision of physio-chemical properties of moringa oil extracted from different methods

S.No	Parameters	Expeller pressed method	Soxhlet extraction	Clevenger extraction
1.	Oil yield (%)	27.847	26.1	25.35
2.	Specific gravity (kg/m^3)	0.9335	0.8790	0.8972
3.	Density (Kg/m^3)	0.9165	0.9130	0.8930
4.	Viscosity (mPa.s)	296.65	285.25	290.35
5.	Refractive index	1.2711	1.3446	1.2462

In this study the seed oil yield was highest in the expeller pressed method (27.85%) followed by soxhlet extraction (26.1%) and the lowest oil yield was observed in the clevenger extraction method (25.35%) for PKM1. Similar results were observed by Elsorady and Muhammad, (2020). The specific gravity was highest in the expeller pressed method (0.9335 kg/m^{-3}) followed by soxhlet extraction (0.8790 kg/m^{-3}) and lowest in the Clevenger extraction method (0.8972 kg/m$^{-3)}$ The density was highest in the expeller pressed method (0.9165 kg/m^3) followed by Soxhlet extraction (0. 0.9130 Kg/m^3) and lowest in the Clevenger extraction method (0. 0.8930 kg/m^3) The viscosity was highest in the expeller pressed method (296.65mPa.s) followed by clevenger extraction (290.35mPa.s) and lowest in the soxhlet extraction method (285.25mPa.s). The refractive index was highest in the soxhlet extraction method (1.3446) followed by the expeller pressed method (1.2711) and lowest in the clevenger extraction method (1.2462). Similar results were obtained by Ogunsina et al. [8,9,10].

4. CONCLUSION

An experiment was conducted to evaluate different moringa genotypes for pod, seed, and oil characters. Among the ten genotypes, PKM MO-3 recorded the highest pod and seed characters followed by PKM MO 7 and PKM MO 9 recorded the lowest pod and seed characters. Though the seed yield per tree was highest in the genotype PKM MO-3, because of less population, the overall yield per hectare was found to be less compared to PKM MO 3. Expeller expeller-pressed method showed technical viability in the extraction of moringa oil from seeds. The lowest oil yield was obtained by Clevenger extraction. The expeller pressed method produced the highest oil quality compared to the soxhlet and Clevenger extraction methods with its higher specific gravity and density because there are no chemicals used. Hence, the expeller method may be used for the extraction of moringa oil.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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