EVALUATION OF MORINGA (*Moringa oliefera*.Lam)GENOTYPES FOR SEED OIL YIELD AND QUALITY

Abstract :

A study was carried out at the Department of Vegetable Science, Horticultural College and Research Institute, Periyakulam,induring 2022in ten moringa genotypes to assesspod, seed characters, seed oil yield, and quality. In pod characters, among ten genotypes PKM MO-3 recorded the highest pod length (75 cm) & fresh pod weight (154g),PKM MO 7 recorded the highest dry pod weight (37g),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 yieldper tree. In seed characters PKM MO 3 registered the highest seed length (0.92cm), seed width(0.79cm), seed diameter(1.20cm) and PKM MO 10 recorded the lowest highest seed length (0.72cm), seed width(0.64cm) and seed diameter(0.96cm). The moringa seed oil composition extracted with different methods such as the expeller pressed method, soxhlet extraction method, and Clevengerclevenger extraction method were compared. The oil yield obtained by expeller, soxhlet, and Clevengerclevenger was 27.84, 26.1, and 25.35 percentper centrespectively. Also, specific gravity, density, viscosity, and refractivereftractive indexwerewas measured by different methodsmethod of oil extraction in ten genotypes. These results promoted the use of expeller expeller-pressedpressed method for the extraction of high-qualityhigh quality moringa oil.

Keywords: Genotypes, Pod characters, Seed characters, Extraction methods, Expeller pressed method, Soxhlet apparatus, Clevenger apparatus, Oil yield.

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 “MoringaAdans” and species “*M.oleifera* Lam”. This species originally camecomes from North India but now has spread worldwide in the tropics and subtropics (Enwa*et al*., 2013). 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 oiltree (Prabhu*et al*., 2011).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(Farook *et al*., 2023).The moringa seeds have many bioactive compounds, which are used in anti-microbial, anti-genotoxic, anti-inflammatory, and anti-tumoranti-tumour promoting activities (Prabhu*et al*., 2011). Moringa seed oil is considered equivalent to olive oil in terms of its chemical properties and contains a large quantity of tocopherols, andis also for edible purposespurpose (Middleton *et al*., 2000).Moringa seed kernel oil is called as ben oil, is more stable than canola oil, soybean oil, and palm oil when used for frying of foods (Abdulkarim*et al*., 2005). Blending Benben 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 genotypesgenotype 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.

Materials and methods

The present study was conducted atHorticultural College and Research Institute(HC &RI) Periyakulaminduring 2022. Moringa genotypes maintained at HC&RI Periyakulamwere was used for the present investigation.The following pod and seedcharacters *viz*., pod length, pod girth,fresh pod weight,dry pod weight, and number. of pods per tree,number of seeds per pod, pod yield perha, seed length, seed width, seed diameter, and seed yield perha. A randomrandomly 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-chemicalphysio chemical properties *viz*.,oil yield,Specific gravity,density,viscosity refractive indexwerewas observed.

Table 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

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-driedsun- 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).

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

The 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 ~~into~~ 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~~sulphate~~ (anhydrous) and it was kept at 4°C for further study.

Result and discussion

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~~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

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 (72cm) and PKM MO 1 (61cm). The lowest pod length was observed in the genotype PKM MO 9 (40cm).The girth of the pod was highest in the genotype PKM MO 2 (7.7cm) followed by PKM MO 7 & 9 (7.5 cm) andthe lowestgirth was observed in the genotype PKM MO 6 (5.8 cm). The pod weight was highest in the genotype PKMMO 3 (154g) followed by PKM MO 4 (146g), the lowest pod weight was recordedin the

genotype (70g). The dry pod weight was highest in the genotype PKM MO 7 (37g)followed by PKM MO 2 (34g) and thelowest was in the genotype PKM MO 10 (23g). No ~~of~~ pods per tree were~~was~~ 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 treewas 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~~The similar~~ findings results were observed by Balaguru *et al.*,(2020).

Table 3.Seed characters of different moringa genotypes

S.No	Seed length (cm)	Seed width (cm)	Seed diameter (cm)	Seed yield/tree~~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

From this study it was found that the length of the seedwashighest 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 theseedwas highest in the genotype PKM MO 3 (0.79 cm) followed by PKM MO 7 (0.72 cm) and the lowestwidthwas observed in the genotype PKM MO 10 (0.64) The seed diameter was highest in the genotype PKM MO 3(1.24cm) 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 treewas 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 (2012).

Table ~~Table.~~4:Comparision of physio-chemical~~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 (0.8790kg/m^{-3}) and lowest in the Clevenger~~clevenger~~ extraction method (0.8972$kg/m^{-3)}$The density was highest in the expeller pressed method (0.9165kg/m^3) followed by Soxhlet extraction (0.0.9130 Kg/m^3) and lowest in the Clevenger~~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 thesoxhlet extraction method (285.25mPa.s).The refractive~~Refractive~~ index was highest in the soxhlet extraction method (1.3446) followed by the expeller pressed method (1.2711) and lowest in theclevenger extractionmethod (1.2462). Similar results were obtained by Ogunsina*et al.*,(2014).

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~~over all~~ yield per hectare was found to be less compared to PKM MO 3.

Expeller expeller-pressed~~pressed~~ method showedtechnical viability in the extraction of moringa oilfrom seeds. The lowest oil yield was obtained by Clevenger extraction. The expeller pressed methodproducedthe highest oil qualitycompared to the soxhlet and Clevenger~~clevenger~~extraction methodswith its higher specific gravity and density because ~~of the~~ there are~~is~~ no chemicals used. Hence, the expeller method may be used for the extraction of moringa oil.

Reference :

1. Enwa F O, Omojate C G and Adonu C C. 2013. A review on the phytochemical profile and the antibacterial susceptibility pattern of some clinical isolates to the ethanolic leaves extract of Moringa oleifera. International Journal of Advanced Research 1(5): 226-238.
2. Prabhu, K., K. Murugan, A. Nareshkumar, N. Ramasubramanian, and S. Bragadeeswaran. "Larvicidal and repellent potential of Moringa oleifera against malarial vector, Anopheles stephensi Liston (Insecta: Diptera: Culicidae)." *Asian Pacific journal of tropical biomedicine* 1, no. 2 (2011): 124-129.
3. Farooq, Ahmad, Abdul Mateen Khattak, Ghani Gul, Waqas Habib, Shahbaz Ahmad, Muhammad Asghar, and Tufail Rashid. "Effect of Moringa Leaf Extract on the Performance of Lettuce Cultivars." *GesundePflanzen* (2023): 1-11.
4. Middleton, E. Jr., C. Kandaswami and T.C. Theoharides, 2000. The effects of plant flavonoids on mammalian cells: Implications for inflammation, heart disease cancer. Pharmacol. Rev., 52: 673-751.
5. Abdulkarim, S. M., K. Long, O. M. Lai, S. K. S. Muhammad, and H. M. Ghazali. "Some physico-chemical properties of Moringa oleifera seed oil extracted using solvent and aqueous enzymatic methods." *Food chemistry* 93, no. 2 (2005): 253-263.
6. Nguyen, Hoang N., D. Gaspillo Pag-asa, Julius B. Maridable, Roberto M. Malaluan, Hirofumi Hinode, Chris Salim, and Ha KP Huynh. "Extraction of oil from Moringa oleifera kernels using supercritical carbon dioxide with ethanol for pretreatment: Optimization of the extraction process." *Chemical Engineering and Processing: Process Intensification* 50, no. 11-12 (2011): 1207-1213.
7. Balaguru, P., V. A. Sathiyamurthy, G. J. Janavi, and S. Santha. "Variability in perennial moringa (Moringa oleifera Lam.) genotypes for quantitative and qualitative traits." *Electronic Journal of Plant Breeding* 11, no. 02 (2020): 515-520.
8. Elsorady, Muhammad Elsayed. "Evaluation of Moringa oleifera seed oil extracted with different extraction methods." *Croatian journal of food science and technology* 15, no. 1 (2023): 1-7.
9. Ogunsina, Babatunde S., T. N. Indira, A. S. Bhatnagar, C. Radha, S. Debnath, and A. G. Gopala Krishna. "Quality characteristics and stability of Moringa oleifera seed oil of Indian origin." *Journal of Food Science and Technology* 51 (2014): 503-510.

10. Adejumo, Bo. (2012). Effect of Moisture Content on Some Physical Properties of Moringa Oleifera Seed. IOSR Journal of Agriculture and Veterinary Science. 1. 12-21. 10.9790/2380-0151221.