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Evaluation of seed composition of *Abelmoschus moschatus* Medik. (*muskdana*), an aromatic medicinal plant from Eastern India

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ABSTRACT

Abelmoschus moschatus Medik., commonly known as *muskdana* or *ambrette,* an important aromatic and medicinal plant of family Malvaceae, is native to India. It is used traditionally in the treatment of various health ailments across the world. The aromatic seeds of this plant are aphrodisiac, ophthalmic, cardio-tonic, antispasmodic and used in the treatment of intestinal complaints. The plant has been extensively studied by various workers for its biological activities and therapeutic potential. In the present paper, the species was explored from Odisha and West Bengal, morphologically described and conserved in the National Gene Bank. The aromatic seeds of *A. moschatus* were analysed to study the seed composition viz. moisture, mucilage, extractive yield, total sugars, crude oil, phenols, flavonoids, tannins and ash content. It is valued for its scented seeds which contained essential oil content of 0.20 to 0.28% with a strong musky and brandy odour. Seed fixed oil is primarily composed of unsaturated essential fatty acids, such as linoleic and oleic acids which are beneficiary for human health and diet. *A.moschatus* may therefore, be a good candidate for functional foods, cosmetics as well as pharmaceutics.

Key words: *Abelmoschus moschatus,* essential oil, *muskdana,* phyto-chemical, seed germplasm

INTRODUCTION

Abelmoschus moschatus (family: Malvaceae), popularly known as *ambrette* or *muskdana*, is an important aromatic and medicinal plant of India. The plant is widely cultivated in tropical countries for their musk-scented seeds useful in perfumery and medicine (Anonymous, 1959). It is mainly distributed in South-East Asia viz. China, Bangladesh, Indo-Chinese peninsula, West Indies, Indonesia, Malaysia, and Thailand. Plant is valued for its scented seeds yielding ambrette oil of commerce, which finds application both in flavour and fragrance formulations apart from its potential use in traditional medicines (Chopra et al., 2005). The seeds of *Abelmoschus moschatus* yield an essential oil with a strong musky and brandy odour due to the presence of ambrettolide, a macro-cyclic lactone in the seed coat (Du et al., 2008; Nautiyal and Tiwari, 2011). The other major components are farnesol and farnesyl esters, acyclic aliphatic esters and terpenes (Cravo et al., 1992). The seeds are used for various therapeutic purposes which include treating headache, cramps, muscular aches and pains, depression and other nervous complaints. Ambrette seeds are exported to China, Germany, France, Netherlands, Nepal, Spain, Belgium, UAE, Switzerland, Singapore and United Kingdom to the extent of about 116 quintals in a year because of its diversified uses. This species is extremely important from the therapeutic point of view. Because of their effectiveness against "kapha" and "vata," intestinal complaints, stomachic and heart diseases, the aromatic seeds are highly valued as medicines. Ambrette seeds are considered as cardio-tonic,

digestive, carminative, diuretic and deodorant, apart from possessing antiseptic, anti-spasmodic, and anti-vomiting properties (Pawar et al., 2017). The oil extracted from this crop has a great national and international demand. This increasing demand has motivated the farmers to cultivate this important medicinal crop fairly in a large scale.

The species is native to India and found in almost all states, especially in West Bengal, Bihar, Uttar Pradesh, Odisha and Andaman and Nicobar Islands. It is widely distributed and cultivated as an oil seed crop in Bangladesh, China, Indo-Chinese peninsula, Thailand, Malaya Peninsula, Indonesia, Fiji Islands. It is also grown in gardens for its ornamental potential. Sometimes, it is found as an escape in wastelands, river banks, along railway tracks and roadsides. Every part of this medicinal plant is used in one or in the other way. Despite substantial demand in the cosmetics industry, research efforts aimed to uncover the yield potential of Indian *muskdana* remain unknown or less-known, requiring attention to introduce new cultivars into commercial farming. The objective of this study was to explore, document, conserve and to evaluate the phyto-chemical composition of *muskdana* seeds, collected from Odisha and West Bengal.

MATERIALS AND METHODS

Plant material

While conducting the exploration mission for germplasm collection of wild *Abelmoschus* and other crops, the authors observed the occurrence of *Abelmoschus moschatus,* a wild scented-seed okra, locally called as "*Kasturi Bhendi* (Odia) and *Kal-kastari* or *mushak-dhana* (Bengali)", in disturbed sites on wastelands and fallow lands in parts of Odisha(Fig. 1A) and West Bengal. The seed germplasm samples of plant species free from insect damage and disease symptoms and without any mechanical injury were collected from the collection site in ripe fruiting stage and conserved in the National Gene Bank, ICAR-NBPGR, New Delhi for long term storage. The ethno-botanical/ economic uses collected from local tribes and relevant literatures were documented. The plant specimens bearing vegetative and floral parts were collected and deposited in the herbarium of the centre along with one set at the National Herbarium of Cultivated Plants (NHCP), ICAR-NBPGR, New Delhi.

Extraction of essential oil

The seeds collected during the exploration were multiplied and the germplasm were maintained at the experimental plot, ICAR-NBPGR, Cuttack. Freshly harvested seeds of *A. moschatus* (500 g) without any mechanical injury were assembled, shade dried and stored for further chemical analysis. Dried seeds were hydro-distilled in a Clevenger apparatus for 4 hours, for extraction of the essential oil. The oils were measured, collected in a glass vial and dehydrated by adding anhydrous $Na_2SO_4$and stored in a glass vial at 4 ºC temperature until further analysis.

Proximate composition analysis

Fifty-gram of dry *muskdana* seeds were homogenized using a stainless-steel mixer grinder. Fine powder was prepared by grinding and then sieved using a test sieve of ASTM 35 to ensure homogeneity for further investigation. *Muskdana* samples were analysed in duplicates following official standard methods (AOAC, 2016) and the results are expressed as the mean of replications. Proximate seed composition analysis was performed as follows: moisture content was obtained by drying 2 g of homogenized seed flour in the hot air oven at 80° C for 2 hr and repeat drying for 2 h, until constant dry weight was obtained. Ash content was obtained by incineration of flour sample in a muffle furnace at 450° C for 5 hr; crude fat was extracted using non-polar solvent petroleum ether (40-60° C) in a Soxhlet extractor for 24 h.

Fatty acid profiling of seed oil

Muskdana seed powder was used to extract crude oil using a solvent mixture of chloroform, hexane, and methanol (8:5:2 *v*/*v*/*v*) in 10 ml. The resulting extracts were dried for 30 min. at 60°C in nitrogen gas and methyl esters of oil samples were prepared (Neff et al., 1994). Fatty acid analyses were done on Agilent Gas Chromatograph (Model 7890A)

with a flame ionization detector (FID), 5975C GC/MS and HP-5MS capillary column (30 m length × 0.25 mm internal diameter; 0.25 µm film coating). Helium was used as a carrier gas (1mL/min). Temperatures for the injector and detector were kept at 260°C and 275°C, respectively. The oven temperature was designed to rise from 175ºC with a hold time of 5 min to 250ºC at a rate of 5 ºC/min with final hold time of 10 min. Fatty acid methyl esters peaks were identified by comparing the retention times of fatty acid peaks with those of FAMES standard mixture done running under similar separation circumstances. The individual fatty acids (%) is expressed as percent peak area relative to total peak area. All analyses were performed in duplicates and results were expressed as mean ± standard deviation (SD).

Estimation of phyto-constituents

About 500 mg of seed powder was extracted three times in hot 80% ethanol and centrifuged at 10,000 g for 10minutes, and supernatants were pooled, and volume was made up to 20ml. Ethanolic extract was dried on a boiling water bath and the residue was re-suspended in 20ml for further analysis by standard spectrophotometric methods (AOAC, 2016). This extract was used for estimation of total sugars by anthrone reagent method (Roe 1955), total phenols (Singleton et al., 1999), total flavonoids (Chang et al., 2002) and total tannins (Price et al., 1978) respectively.

RESULTS AND DISCUSSION

The plant species was noticed in wild/ naturalized state in disturbed habitats on the wastelands, fallow fields and river banks viz. Tangi-Chowdwar block, Cuttack district; Bhandaripokhari block, Bhadrak district; Indupur, Kendrapada district; Nimapada block, Puri district; Karlapat, Kalahandi district of Odisha and Barrackpore and Sagar islands of West Bengal. The species distribution was very rare, found in isolated moist habitats and the germplasm status was tending to decline rapidly due to habitat loss. The morphological features of vegetative and floral parts were examined and the detailed taxonomic characters were described (Fig. 1).

Fig. 1. *Abelmoschus moschatus*: A. Natural occurrence in Bhadrak district, Odisha; B. Maintained at ICAR-NBPGR, Cuttack; C. Twig bearing flowers and fruits; D. Flower; E. Ripe fruits; F. Seeds

Abelmoschus moschatus Medik.

Abelmoschus moschatus Medik. Malv. 46. 1787; Borssum, Blumea 14:91. 1966; Paul & Nayar, Fasc. FI. India 19:77.t. 16. 1988. *Hibiscus abelmoschus* L. Sp.Pl. 696. 1753; Mast. in Hook. f. Fl. Brit. India 1:342. 1874; Gamble, FI. Madras 1:97(69). 1915; Haines, Bot. Bihar & Orissa 1:65 (67). 1921.

Vernacular name

Kasturi Bhendi, Bano bhendi (Odia); *Muskdana* (Hindi, Beng.); *Kasturi benda* (T); Musk mallow, Ambrette, vegetable musk (Eng.); *Latakasturikam* (Sans.); *Kasturibende* (Kan.); *Gorukhia-korai* (Assam).

Species morphological description

Erect undershrub upto 2.5 m high; stem and branches dense hirsute, hairs usually long, stiff, not bristly, retrorse, 3-4 mm long; nodes deep

purple spotted. Leaves variable, mostly orbicular, 8-25 cm across, usually cordate, angular or 3-7-lobed or-parted, palmatifid or palmatisect, lobes coarsely serrate, of the upper leaves usually narrower, basal part of lobe mid-vein deep purple, both surfaces hairy, lower surface with scattered stellate hairs; petiole 3-20 cm; stipules linear, 8-20 mm, hairy. Flowers solitary, deep yellow with dark purple centre, 8-12 cm across; pedicels 3-5 cm, upto 9 cm in fruit, puberulent. Epicalyx segments 7-10, linear, free, 10-30 mm long, hirsute, caducous. Calyx 2.5-3.7 cm long, tomentose outside, sericeous, glabrous inside, purple veined, apex acute, 3-lobed. Corolla thinly veined. Staminal column thick, 1.5-2.5 cm long, stamens dense, deep yellow; stigma 5-lobed, dark-purple. Capsule ovoid to oblong or lanceolate, 5-8 cm × 2-3 cm, 5-angled, with a short beak, densely soft strigulose. Dehiscing laterally, rostrum ca 1 cm long. Seeds brown to blackish-brown, reniform, 3-4 mm. across, glabrous, minutely warty in concentric rings, musk-scented; hilum 0.2 × 0.1 cm, ovate. FIowering: October-November, Fruiting. November- January.

Germplasm collected and conserved

i) Site 1: India, state: West Bengal, district: Barrackpore, block: Barrackpore, nearby village: Nilganj, *R.C.Misra*, HS number 325 (Herbarium of ICAR-NBPGR Base Centre, Cuttack), dated 05.04.2017; seed germplasm acc. no. IC624511 (Collection no. : RCM/MS/01); source: disturbed wild, fallow land; frequency: rare; 22° 46' N lat. 88° 26' E long. Local name: *Muskdana*.

ii) Site 2: India, state: West Bengal, district: South 24 Parganas, block: Namkhana, nearby village: Biswa Laxmipur, Sagar islands; *R.C.Misra,*HS number 326 (Herbarium of ICAR-NBPGR Base Centre, Cuttack), dated 08.04.2017; seed germplasm acc. no. IC624513 (Collection no. : RCM/MS/22); source: wild, partlydisturbed, weedy, wasteland; frequency: rare; 21° 50' N lat. 88° 14' E long.

iii) Site 3: India, state: Odisha, district: Cuttack, block: Tangi-Chowdwar, nearby village: Tarota-Nirgundi, dated 27.11.2024; seed germplasm accession no. IC-655314 (Collection no. : RCM/PK/24/02); source: disturbed wild, frequency: rare; 20° 33' N lat. 85° 58' E long. Local name: *Kasturi Bhendi*.

iv) Site 4: India, state: Odisha, district: Bhadrak, block: Bhandaripokhari, nearby village: Puripada, dated 27.11.2024; seed germplasm accession no. IC-655316 (collection no. : RCM/PK/24/04); source: wild, partly disturbed; frequency: rare; 20° 56’ N lat. 86° 19’ E long. Local name: *Kasturi Bhendi*.

Economic uses

Seeds are used as a stimulant, tonic and carminative. Essential oil obtained from the seeds is used in high grade perfumery and spiritual purposes. Tender leaves and young shoots are consumed in preparing scented soups. The bark yields a good quality fibre. The species is also cultivated in gardens as ornamental plant for its showy flowers. Seeds are effective aphrodisiac and antispasmodic, and used in tonics. They check vomiting and are useful in treating intestinal disorders, urinary discharge, nervous disorders, hysteria, skin diseases etc. The mucilaginous seeds are emollients and demulcents. Flower infusion is contraceptive. Different parts of the plant have uses in traditional and complementary medicine, not all of which have been scientifically proven. It is used externally to relieve spasms of the digestive tract, cramp, poor circulation and aching joints. It is also considered an insecticide and an aphrodisiac. The roots, leaves and seeds of ambrette are considered valuable traditional medicines.

Proximate seed composition

The analysis of seeds of *A. moschatus* revealed the nutritional and anti-nutritional components as presented in Table 1. The seed moisture content ranged between 10.34 and 10.51% on dry weight and 100 seed weight was found 1.22-1.25g. *Abelmoschus* species contains mucilage (11.50-14.64%) which has several food and medicinal applications. It is useful in cleaning the sugar cane juice in jaggery preparation. Isolation and identification of many compounds from wild species proved to have diverse medicinal properties along with extraordinary nutritional potential.

Extractive yield obtained from seeds was 19.59-20.97% in methanol which was found best solvent for extraction purpose.

Table 1. Chemical composition of seeds of *A. moschatus*

Quality Trait	Mean ± SD*	Range
100 Seed Weight (g)	1.22 ±0.03	1.22-1.25
Moisture (%)	10.42 ± 0.12	10.34-10.51
Mucilage (%)	13.08 ± 2.23	11.50-14.65
Extractive Yield (%)	20.28 ± 0.98	19.59 - 20.97
Essential Oil (%)	0.24±0.06	0.20-0.28
Total Phenols (mg/g)	8.44 ± 0.63	7.99 - 8.88
Total Flavonoids (mg/g)	16.88 ± 1.02	16.16 - 17.60
Tannins (%)	6.50 ± 1.16	5.68 - 7.32
Total Sugars (%)	4.09 ± 0.17	3.97 - 4.21
Crude Oil (%)	19.30 ± 0.52	18.93 - 19.66
Ash (%)	4.57 ± 0.45	- 4.89

*SD (Standard Deviation)

The ambrette seeds showed presence of essential oil content of 0.20-0.28% with mean value of 0.24 ± 0.06% (v/w) on hydro-distillation. Oil was pale yellow coloured with a characteristic musk-like odour (Pandey et al., 2025).The major compounds noted were farnesyl acetate, farnesol and (Z)-Oxacycloheptadec-8-en-2-one (ambrettolide). The characteristic musk-like odour of the *muskdana* oil is attributed to the presence of a ketone, ambrettolide, which is lactone of ambrettolic acid (16-hydroxy-7-hexadecenoic acid). The seeds are the source of ambrette, an aromatic oil, used in perfumery (Rout et al., 2004; Arokiyaraj et al., 2014).Ambrette oil is used in luxury perfumery, cosmetics and as an additive in the preparation of some kinds of chewing tobacco, baked products, sweets, alcoholic (e.g. vermouth and bitters) and non-alcoholic drinks. India, Colombia, Ecuador and Martinique are the main producers of ambrette oil, worldwide. In India, the area cultivated with *muskdana* is gradually increasing. The ash content of dry seed powder ranged from 4.25 to 4.89%, indicating presence of more minerals in this species. The ash content is considered a measure of the mineral content in the seeds, indicating they are a good source of essential minerals. These minerals play major roles in the cell repair and maintenance, as well as regulation of the human body. The seeds were measured the total crude fat content ranging from 18.93 to 19.66% and total sugars from 3.97 to 4.21%.Total phenols content of *A. moschatus* seeds varied from 7.99 to 8.88 mg/g^{-1} gallic acid equivalent(GAE). Phenolic compounds serve as the key roles as primary antioxidants or free radical scavengers. The antioxidant activity of the phenolic compounds is mainly due to their redox properties, which can play an important role in absorbing and neutralizing free radicals, quenching singlet and triplet oxygen or decomposing peroxides (Mishra et al., 2020). It has been suggested that poly-phenolic compounds impart anti-mutagenic and anti-carcinogenic properties on daily consumption of ~1.0 g of diet rich in vegetables and fruits. Total flavonoid content ranged between 16.16 and 17.60 mg quercetin equivalent/g DW and total tannin content ranged from 5.68 to 7.32%. The seed composition in present study was found close to earlier reports (Pawar et al., 2017).

Fatty acid profiling

A. moschatus seeds contain a significant amount of fixed oil content varying from 18.93 to 19.66%. Evaluation of quality of crude oils, fatty acid composition has a special significance due to the fact that some fatty acids cause hyper-lipidemic and cholestermic effects in the body. Saturated fatty acids have a more hyper-lipidemic effect than the unsaturated fatty acids. Fatty acid composition of *A. moschatus* seed oil by gas chromatography and flame ionization (GC/FID) showed presence of nine major fatty acids (Table 2). The relative percentage of fatty acids showed presence of four major fatty acids in seed oil namely linoleic (C18:2), oleic (C18:1), palmitic (C16:0) and stearic (C18:0) acid (Fig. 2). Fatty acid profile revealed presence of higher amounts of unsaturated fatty acids of oleic acid (41.90-52.18%) and linoleic acid (19.59-22.16%) considered to be nutritionally important. Linoleic acid is the important unsaturated essential fatty acids required for growth, physiological functions and maintenance of body. Oleic acid content estimated

in the present study was comparatively higher than the other species of *Abelmoschus esculentus* (Jarret et al., 2011). Among saturated fatty acids palmitic acid (20.21-20.43%) and stearic acids (3.42-3.85%) were found in predominant amounts. The total polyunsaturated fatty acids (PUFAs) of the seed oil ranged from 66.03–73.07%, while total saturated fatty acids (SFAs) had a very low level content (24.83-26.06%). The oleic acid/ linoleic acid (O/L) ratio was 1.98 used as stability index. Fatty acids are used in cosmetics industry because of skin care properties such as anti-inflammatory, acne-reduction and moisture retention properties and play important role in lowering of blood pressure, relaxation of coronary arteries, and inhibition of platelet aggregation. Lipid and fatty acid composition in foods, contributes to their physical, nutritional, and sensory qualities.

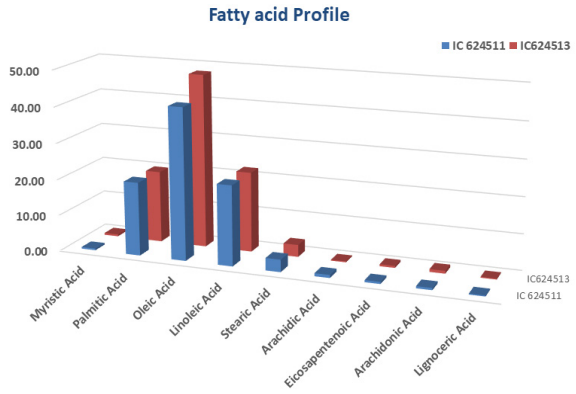

Fig. 2. Relative fatty acid (%) in seed crude oil of Abelmoschus moschatus genotypes

Table 2. Fatty acid composition (%) of crude oil of *A. moschatus* seeds

Fatty Acid	Class	IC624513		IC64511		Mean	Range
		R1#	R2#	R1#	R2#		
Myristic Acid (C14:0)	SFA	0.51	0.54	0.52	0.47	0.50	0.47-0.54
Palmitic Acid (C16:0)	SFA	20.21	21.43	21.43	20.32	20.87	20.21-21.43
Oleic Acid (C18:1)	UFA	51.68	52.18	52.18	41.90	47.04	41.90-52.18
Linoleic Acid (C18:2)	UFA	20.17	19.59	19.59	22.16	20.37	19.59-22.16
Stearic Acid (C18:0)	SFA	3.79	3.85	3.85	3.42	3.63	3.42-3.85
Arachidic Acid (C20:0)	UFA	0.27	0.13	0.13	0.83	0.48	0.13-0.83
Eicosapentaenoic Acid (C20:5)	UFA	0.63	0.53	0.53	0.56	0.55	0.53-0.63
Arachidonic Acid (C20:4)	UFA	0.32	0.24	0.24	0.58	0.41	0.24-0.58
Lignoceric Acid (C24:0)	SFA	0.23	0.23	0.26	1.60	0.91	0.23-1.60
*SFA (%)		24.83	25.78	26.06	25.81	25.91	24.83-26.06
**UFA (%)		73.07	72.67	72.67	66.03	68.85	66.03-73.07
TOTAL (%)		97.90	98.45	98.73	91.84	94.76	91.84-98.73

*Saturated Fatty Acid (SFA); **Unsaturated Fatty acid (UFA)

#R1 (Year 2020); R2 (Year 2021)

CONCLUSION

The ambrette seed oil has a promising value for fragrance and fixative purposes. Based on the results of this study, it is revealed that ambrette can also produce good quality essential oil. The present study indicated that *A. moschatus* contains considerable amount of total polyphenols and flavonoids and exhibited good antioxidant activity. The antioxidant and biological activities might be due to the synergistic actions of bioactive compounds present in the seeds. However, it is still unclear that which components are playing vital roles for these activities. Therefore, further studies are still needed to elucidate mechanistic way, how the plant contributes to these properties.

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