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Morphological and biochemical profile of *ex situ* conserved *Homalomena aromatica* (Schott) - an underutilised indigenous tuber crop

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Abstract

Two germplasm accessions (CTCRI-PM-HA-01 and CTCRI-PM-HA-02) of rhizomatous herb *Homalomena aromatica* collected from Cachar, Assam were evaluated under *ex situ* conditions (ICAR-CTCRI, Thiruvananthapuram) for 17 quantitative and 28 qualitative characters along with biochemical profile including essential oil for improvement and conservation. Under the quantitative characterisation, the highest standard deviation was observed for tuber weight (18.4) followed by tuber length (16.5) and plant span (9.19). Standard deviation was highest for moisture content (10.4) followed by total starch (4.77) and crude protein (1.14) when considering mean nutrient values of stem, leaf and rhizome. The germplasm accessions exhibited similarity for 57.14% and differed for 42.85% in qualitative characters. The discriminated qualitative traits are leaf base shape (with regard to the petiole attachment), predominant position (shape) of leaf lamina surface, leaf blade margin, leaf blade colour variegation, type of variegation, leaf blade margin colour, petiole junction colour, petiole stripe, rhizome shape, rhizome cortex colour, rhizome flesh colour of central part and root colour. The average estimated values observed for important nutrients *viz*., total starch, fibre, fat and crude protein are 11.4, 2.53,1.48, 2.75 in rhizome 3.3, 1.73, 2.43,0.47 in stem, 2.97, 2.75, 2.63 and 1.55 in leaves, respectively. Rhizome contains 0.235% essential oil. Outcome of this research is that *H. aromatica* exhibited variations for economically important traits and accordingly, trait specific germplasm exploration and conservation are to be undertaken.

Keywords: *Homalomena aromatica,* Germplasm, Phenotypic characters, Biochemical profile

Introduction

Homalomena aromatica is a perennial plant belonging to the family Araceae. It is native to the Indian Eastern Himalayan states such as Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram, and Tripura, as well as in the Chittagong hill tracts of Bangladesh. (Ronald et al., 2019). While the rhizome is the primary economic part of the plant, the leaves and stems are also used for medicinal and culinary purposes. The plant has several ethno botanical uses, including the use of fresh leaves and petioles to make chutney and the application of fresh root paste to treat various skin diseases (Roy et al., 2019). The leaves and stalk are used by tribals to make recipe cooked with pulses (Shukla et al., 2015). The rhizome

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is marketed to the perfume industry, and it is used to produce starch for making noodles (Khan et al., 2010). After extraction of essential oil, the waste is used to make incense stick (Ahmed, 2005). However, local farmers of NE region primarily cultivate it as an ornamental plant, especially indoors, due to its ability to thrive in shade conditions and tolerate medium to low light exposure (Preeti Hatibarua et al., 2023). The whole plant extract is also used to treat muscle weakness and rheumatism. Due to anthropological reasons, many of the genetic resources are fast vanishing particularly in the hot spot areas of North Eastern India. Plant Genetic Resource (PGR) gap analysis carried out by ICAR-NBPGR indicated the importance of collection and conservation of underutilised tuber and indigenous crops. *Hamalomena* type plants are one among various indigenous crops identified as priority items for collection, conservation and mass multiplication (Preeti Hatibarua et al., 2023). Ved et al. (2003) categorised *H. aromatica* as endangered in Assam and vulnerable in Arunachal Pradesh. Ronald et al. (2019) and Kehie et al (2017) emphasized the importance of *ex-situ* conservation for introducing this species to suitable areas and commercial cultivation. Understanding the morphological characteristics of germplasm accessions is crucial for conservation, improvement and utilisation. With this view, germplasm characterisation was undertaken with an objective to elucidate knowledge on phenotypic and biochemical characters of *Hamalomena.*

Materials and Methods

Two accessions (CTCRI-PM-HA-01 and CTCRI-PM-HA-02) of *Homalomena aromatica* were collected from Borkhola, Cachar district, Assam (latitude: 24.9236598, longitude: 92.7406466, elevation: 24 m) in October 2019. The collected specimens (HS24080) were deposited at the National Herbarium of Cultivated Plants (NHCP), ICAR-National Bureau of Plant Genetic Resources (NBPGR), New Delhi. These two accessions (CTCRI-PM-HA-01 and 02) were planted in the field gene bank at ICAR- CTCRI, Thiruvananthapuram, in 2019 for *ex-situ* conservation and maintained since then. Five plants from each accession were evaluated for two years during 2022-23 and 2023-24 for morphological characters of 17 quantitative and 28 qualitative traits by adopting IBPGR descriptor for Taro (IBPGR, 1999) with some additional characters with respect to *Homalomena* crop. Planting commenced using uniform rhizome as propagation materials during July month and harvesting was carried out during August month of succeeding year. The fresh leaves, stems and tubers harvested were subjected to proximate analysis including the parameters namely moisture content, total sugar, total starch, crude fibre, crude fat, total ash and total protein by adopting the AOAC methodology (AOAC, 1995). Two fifty grams fresh rhizome each from two accessions were processed through hydro distillation for 4h in Clevenger apparatus and the distillates were extracted using diethyl ether ethereal layer was dried over anhydrous sodium sulphate, distilled using water bath. Thus, essential oil extracted on fresh weight basis were reported as percentage basis (Rana et al., 2009)

Results and Discussion

Quantitative characters

The quantitative characters of *Homalomena aromatica* germplasm were evaluated for two germplasm accessions planted *ex-situ.* The evaluation results for various

Table 1. Quantitative characters of *Homalomena aromatic* germplasm at *ex-situ* conservation site

Sl. No.	Character	Accession 1 (CTCRI-PM-HA-01)	Accession 2 (CTCRI-PM-HA-02)	Mean	Standard deviation
1	Plant span (cm)	71	58.0	64.5	9.19
2	Plant height (cm)	32	28.0	30	2.83
3	Number of side shoots	2.0	3.0	2.5	0.70
4	Leaf length (cm)	18.9	16.2	17.55	1.90
5	Leaf Breadth (cm)	18.0	14.5	16.25	2.48
6	Leaf lamina length/width ratio	1.05	1.12	1.085	0.05
8	Petiole length (cm)	36.7	34.5	35.6	1.56
9	Lamina length (cm)	18.9	16.2	17.55	1.90
10	Petiole/lamina length ratio	1.94	2.13	2.035	0.13
11	No. of leaves	7	8	7.5	0.70
12	No. of inflorescence	2	2	2	0
13	Inflorescence stalk length (cm)	4.7	4.5	4.6	0.14
14	Inflorescence length (cm)	12.1	9.5	10.8	1.84
15	Tuber length(cm)	41.1	64.5	52.8	16.5
16	Tuber thickness(cm)	4.1	3.8	3.95	0.21
17	Tuber weight (g)	99	125	112	18.4
18	No. of tubers	2	2	2	0

parameters revealed that range of variations exists between two accessions in plant span (64.5-71 cm), plant height (28-32 cm), number of side shoots (2-3), leaf length (16.2-18.9 cm), leaf breadth (14.5-18 cm), leaf lamina length/width ratio (1.05-1.12), petiole length (34.5-36.7 cm), lamina length (16.2-18.9 cm), petiole/lamina length ratio (1.94-2.13), number of leaves (7-8), number of inflorescences (2), inflorescence stalk length (4.5-4.7 cm), inflorescence length (9.5-12.1 cm), tuber length (41.1-64.5 cm), tuber thickness (3.8-4.1 cm), tuber weight (99-125 g), and number of tubers (2) (Table 1). So, under quantitative characterisation, the highest standard deviation was observed for tuber weight (18.4) followed by tuber length (16.5) and plant span (9.19). For rest of the traits, the deviations were either meagre or zero (in case of no. of inflorescence and number of tubers). The observed variations in tuber length, thickness, and weight are particularly notable, as they are important traits for planning future germplasm collection and improvement. The variations in plant span, plant height, number of side shoots, leaf length, leaf breadth, and other morphological characters suggests that *H. aromatica* have adapted to different environments or ecological niches. The accessions with longer tubers, greater thickness, and higher weight may be suitable for cultivation in different regions or for specific uses. The variations in morphological characters can be used to identify accessions with potential for ornamental or medicinal uses.

Qualitative characters

The qualitative characters of evaluated germplasm collected are presented in Table 2. The results show that accession (CTCRI-PM-HA-01 and accession (CTCRI-PM-HA-02) differ in leaf base shape, leaf lamina surface position, leaf blade margin, and leaf blade colour variegation. Both accessions have yellow-green leaf blades, but accession (CTCRI-PM-HA-01) has variegation which was not there in accession 2. The petiole junction pattern and petiole colour are similar in both accessions, but accession 1 has a petiole stripe, this is absent in accession 2. The germplasm accessions exhibited similarity for 57.14% and differed for 42.85 % in qualitative characters from the 28 total qualitative parameters studied. The notable differences of characters are leaf base shape, leaf lamina surface position, leaf blade margin, leaf blade colour variegation and petiole stripe. The results of this study highlight the importance of characterizing germplasm for utilization in crop improvement programs. The presence of variegation in CTCRI-PM-HA-01 and its absence in CTCRI-PM-HA-02 may also indicate genetic diversity in leaf

Fig. 1. *Homalomena* Accession 1 (CTCRI-PM- HA-01)

Fig. 2. *Homalomena* Accession 2 (CTCRI-PM- HA-02)

Table 2. Qualitative characters of *Homalomena aromatica* germplasm collected from Borkhola, Cachar district of Assam

Sl. No.	Characters	Accession 1 (CTCRI-PM-HA-01)	Accession 2 (CTCRI-PM-HA-02)	Different or Same
1	Leaf base shape (with respect to the petiole attachment)	Peltate	Hastate	Different
2	Predominant position (shape) of leaf lamina surface	Horizontal	Cup-shaped	Different
3	Leaf blade margin	Undulate	Entire	Different
4	Leaf blade colour	Yellow green	Yellow green	Same
5	Leaf blade colour variegation	Present	Absent	Different
6	Type of variegation	Mottle	Absent	Different
7	Leaf blade margin colour	Yellow	White	Different
8	Petiole junction pattern	Small	Small	Same
9	Petiole junction colour	Light yellow	Green	Different
10	Leaf main vein colour	Light green	Light green	Same
11	Leaf main vein variegation	Present	Present	Same
12	Petiole colour	Light green	Light green	Same
13	Petiole stripe	Present	Absent	Different

14	Petiole stripe colour	Brown	Brown	Same
15	Cross-section of lower part of petiole	Open	Open	Same
16	Leaf sheath colour	Light green	Light green	Same
17	Leaf waxiness	Waxy	Waxy	Same
18	Flower formation	Flowering	Flowering	Same
19	Inflorescence stalk colour	Light green	Light green	Same
20	Limb colour (upper part of spathe) (recorded at anthesis)	Light yellow	Light yellow	Same
21	Tube colour (lower part of spathe enclosing the flowers)	Green with light yellow	Green with light yellow	Same
22	Flag leaf colour	Light green	Light green	Same
23	Spathe shape at male anthesis	Hooded	Hooded	Same
24	Rhizome shape	Elongated	Elliptical	Different
25	Rhizome cortex colour	Brown	Blackish	Different
26	Rhizome flesh colour (central part)	Pink	Orange	Different
27	Rhizome skin surface	Scales	Scales	Same
28	Root colour	Orange-white	Yellow-white	Different

coloration (Fig. 1 & Fig. 2). The qualitative characters have implications on utilisation and conservation of germplasm. The discrimination observed in leaf shapes (peltate and hastate) and leaf blade colour variegation can be harnessed for developing ornamental plants or indoor potted plants. Specifically, the variegation present in Accession (CTCRI-PM-HA-01) may be a valuable trait for developing new variety for ornamental or potted plants. Likewise, the peltate leaf base shape in Accession (CTCRI-PM-HA-01) may be useful for improving water use efficiency, while the hastate shape in Accession (CTCRI-PM-HA-02 may be beneficial for improvement of leaf area which can contribute to increase rhizome yield. However, it is essential to note that this study only characterized a limited number of accessions, and further research is needed to fully explore the genetic diversity of *Homalomena aromatica* germplasm. Additionally, the relationship between the observed qualitative characters and environmental or ecological factors needs to be investigated to fully understand the adaptive significance of these traits.

Proximate composition of leaves, stem and rhizome

The nutrient profile of the leaves, stem and rhizome are presented in Table 3**.** The moisture content varied between the stem, leaf, and tuber of both accessions, with CTCRI-PM-HA-01 showing higher moisture content in the stem (88.1%) and CTCRI-PM-HA-02 showing higher moisture content in the tuber (70.01%). The total sugar content was similar in the stem and

Table 3. Proximate composition of *Homalomena aromatica* germplasm collected from Borkhola, Cachar district of Assam

Parameter	Stem		Mean	Leaf		Mean	Rhizome		Mean	Grand Mean	Standard deviation (Means of stem, leaf and tuber)
	Acc.1	Acc.2		Acc.1	Acc.2		Acc.1	Acc.2			
Moisture (%)	88.1	88.5	88.3	81.12	82.0	81.56	67.7	70.01	67.88	79.24	10.4
Total sugar (%)	1.2	1.3	1.25	1.1	1.4	1.25	0.75	0.78	0.77	1.09	0.28
Total starch (%)	3.3	3.27	3.3	3.03	2.9	2.97	11.3	11.5	11.40	5.89	4.77
Crude fibre (%)	1.75	1.70	1.73	2.7	2.8	2.75	2.5	2.55	2.53	2.33	0.54
Crude fat (%)	2.4	2.45	2.43	2.6	2.65	2.63	1.45	1.50	1.48	2.18	0.61
Total ash (%)	0.8	0.85	0.83	1.65	1.6	1.63	0.97	0.99	0.98	1.14	0.43
Crude protein (%)	0.46	0.48	0.47	1.5	1.6	1.55	2.7	2.8	2.75	1.59	1.14
Essential oil (%)	-	-	-	-	-	-	0.23	0.24	0.234	0.234	-

Acc. 1: CTCRI-PM-HA-01 and ACC. 2: CTCRI-PM-HA-02

leaf of both accessions, but accession 2 showed higher total sugar content in the leaf (1.4%). The total starch content was higher in the tuber of both accessions, with CTCRI-PM-HA-01 showing 11.3% and CTCRI-PM-HA-02 showing 11.5%. The crude fibre content was higher in the leaf of both accessions, with accession 1 showing 2.7% and accession 2 showing 2.8%. The crude fat content was higher in the leaf of both accessions, with accession 1 showing 2.6% and CTCRI-PM-HA-02 showing 2.65%. The total ash content was similar in the stem and leaf of both accessions, but CTCRI-PM-HA-02 showed higher total ash content in the tuber (0.99%). The crude protein content was higher in the leaf of both accessions, with Acc.1 showing 1.5% and Acc. 2 showing 1.6%. The variations in biochemical characters among stem, leaf, and tuber of *Homalomena aromatica* germplasm suggest different metabolic activities and adaptations in each plant part. The plant constitutes 79.24, 1.09, 5.89, 2.33, 2.18, 1.14, 1.59 and 0.234% for moisture, total sugar (%), total starch (%), crude fibre (%), crude fat (%), total ash (%) and crude protein (%), respectively as per grand mean. The essential oil content in rhizome was estimated for both accessions, with CTCRI-PM-HA-02 showing 0.23% and CTCRI-PM-HA-02 showing 0.24%. Similar result has been reported by Rana et al. (2009) about percentage essential oil (0.64% dry weight basis) and its constituent compounds. Sung et al. (1992) indicated that essential oil from rhizome of *homolomena* has major phytochemicals namely linalool and terpinene-4-01 apart from sesquiterpenoids. Essential oil is predominantly used in perfumery (Policegoudraa et al., 2012). Overall, this study demonstrates the importance of characterizing germplasm for utilization in crop improvement programs and highlights the need for further research to fully explore the genetic diversity of *Homalomena aromatica*.

Conclusion

This study has provided first hand information on qualitative, quantitative characters and proximate composition of two germplasm accessions of *Homalomena aromatica* under *ex-situ* condition. It also has highlighted the discrimination of important qualitative characters having economic importance and differences of nutrient contents in rhizome, stem and leaves. These results are useful to plan trait specific germplasm exploration and conservation strategies.

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References

Ahmed, M. 2005. Hand book on Medicinal and Aromatic Plants. (Package of Practices). NEDFI, Guwahati. 781007: 33-38.

Association of Official Analytical Chemists (AOAC). 1995. Official methods of analytical chemists. Washington DC, USA.

International Plant Genetic Resources Institute (IPGRI). 1999. Descriptors for taro (*Colocasia esculenta*). International Plant Genetic Resources Institute, 56 p.

Kehie, M., Kehie, P. and Neli Lokho P. 2017. Phytochemical and ethnopharmacological overview of endangered *Homalomena aromatica* Schott: An aromatic medicinal herb of Northeast India. *Indian Journal of Natural Products and Resources*, **8**(1):18-31

Khan, T.U., Hore, D. K. and Borthakur, S. K. 2010. Sugandhmantri (*Homalomena aromatica* Schott): A potential aromatic and medicinal plant of North East India. *Pleione*, **4(**1):1-3.

Policegoudraa, R.S., Goswamia, S., Aradhyab, S.M., Chatterjeea, S., Dattaa, S., Sivaswamyb, R., Chattopadhyaya, P. and Singha, L. 2012. Bioactive constituents of *Homalomena aromatica* essential oil and its antifungal activity against dermatophytes and yeasts. *Journal de Mycologie Médicale*, **22**:83-87

Preeti Hatibarua, Sailen Gogoi. and Ningombam Sushma Devi. 2023. Macro Propagation of *Homalomena aromatica* Schott. A potential commercial ornamental plant. *Environment and Ecology*, **41**(4C):2939-2942

Rana, V.S., Pukhrambam, M., Singh, H. B., Verdeguer, M. and BIazquez, M.A. 2009. Essential oil composition of *Homalomena aromatica* roots. *Indian perfumer*, **53**(3):43-45

Ronald, K., Gajurel, P.R. and Singh, B. 2019. Assessment of eco-diversity status of *Homalomena aromatica* (Spreng.) Schott and its habitat in tropical forest of Indian Eastern Himalaya. *Plant Science Today*, **6**(2):71-83

Saurov Jyoti Roy., Prantik Sharma Baruah., Lipika Lahkar., Lisha Gurung., Debanjali Saikia. and Bhaben Tanti, 2019. Phytochemical analysis and antioxidant activities of *Homalomena aromatica* Schott. *Journal of Pharmacology and Phytochemistry*, **8**(1):1379-1385

Shukla, A.C., Lalsangluaii. F., Singh, B., Kumar, A., Lalramnghing lova H. and Dikshit A. 2015. *Homalomena aromatica*: An ethno medicinal plant can be a potential source of antimicrobial drug development. *European J. Env. Eco*., **2**(2):96-104.

Sung, T.V., B. Steffan, Stcglich, W. Klebe, G and Adam, G.1992. Sesquiterpenoids from the roots of *Homalomella aromatica*. *Phytochemistry*, **31**(10):15-20.

Ved, D.K., Kinhal, G.A., Haridasan, K., Ravikumar, K., Ghate, U., Sankar, R.V. and Indresha, J.H. 2003. Conservation assessment and management prioritisation for the medicinal plants of Arunachal Pradesh, Assam, Meghalaya and Sikkim. Proceedings of the workshop 'Conservation assessment and management prioritisation for the medicinal plants of Arunachal Pradesh, Assam, Meghalaya and Sikkim,' Guwahati, 27 February to 1 March 2003. Foundation for Revitalisation of Local Health Traditions (FRLHT), Bangalore, India.