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Morphological and Genetic Analysis of Momordica cochinchinensis (Lour.) Spreng. (Gac) from Different Accessions in Malaysia

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Abstract
Momordica cochinchinensis or gac fruit is a 'superfruit' that is well-known in Vietnam. Gac is an orange fruit that is ovoid in shape and has a soft spiny texture. In Malaysia, gac fruit is a new and less known plant. This study aimed to characterize gac fruit using morphological analysis involving both vegetative and reproductive parts and to characterize the genetic diversity in gac fruit by using Inter-simple sequence repeat (ISSR) analysis. Four different gac accessions were collected from different areas (Kota Damansara (Selangor), Melaka Tengah (Melaka), Hulu Langat (Selangor) and Kuantan (Pahang)) were cultivated under tropical conditions in Kuantan, Pahang. The gac accessions showed differences in morphological characters. Generally, the gac fruits were reddish-orange in colour, the leaf was dark green on the adaxial part and light green on the abaxial part, and the female and male flower was light yellow and white in color. The fruit weight ranged from 193.72 g (GD) to 334.70 g (GH) with varied shapes and spike density. DNA extraction was following the CTAB method. All 30 primers showed high levels of polymorphism (83%) and the polymorphism information content (PIC) with the mean of 0.48. Nei's genetic distance coefficient ranged between 0.27 and 0.6 with the mean value of 0.41. Dendrogram based on UP-GMA analysis grouped the four gac accessions into two main groups. Cluster I consisted of accession GD, GM and GH while cluster II consisted of only GX. Results from both morphological and molecular analysis showed genetic diversities in all four gac fruits studied.

Author Keywords
Gac fruit; Genetic analysis; Inter-simpler Sequence Repeat (ISSR); Morphology; Phylogenetic tree

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References

- Phan-Thi, H, Waché, Y
  Isomerization and increase in the antioxidant properties of lycopene from Momordica cochinchinensis (Gac) by moderate heat treatment with UV–Vis spectra as a marker
  (2014) *Food Chemistry*, 156, pp. 58-63.
- Jia, S, Shen, M, Zhang, F, Xie, J
  Recent advances in Momordica charantia: functional components and biological activities
  (2017) *International Journal of Molecular Sciences*, 18 (12), p. 2555.
- Aamir, M, Jittanit, W
  Ohmic heating treatment for Gac aril oil extraction: Effects on extraction efficiency, physical properties and some bioactive compounds
  (2017) *Innovative Food Science & Emerging Technologies*, 41, pp. 224-234.
- Kha, TC, Nguyen, MH, Roach, PD, Parks, SE, Stathopoulos, C
  Gac fruit: nutrient and phytochemical composition and options for processing
  (2013) *Food Reviews International*, 29 (1), pp. 92-106.
- Kubola, J, Siriamornpun, S
  Phytochemicals and antioxidant activity of different fruit fractions (peel, pulp, aril

and seed) of Thai Gac (Momordica cochinchinensis Spreng)
(2011) *Food Chemistry*, 127 (3), pp. 1138-1145.

- Kubola, J, Siriamornpun, S
Phytochemicals and antioxidant activity of different fruit fractions (peel, pulp, aril and seed) of Thai Gac (Momordica cochinchinensis Spreng)
(2011) *Food Chemistry*, 127 (3), pp. 1138-1145.

- Petchsak, P, Sripanidkulchai, B
Momordica cochinchinensis aril extract induced apoptosis in human MCF-7 breast cancer cells
(2015) *Asian Pacific Journal of Cancer Prevention*, 16 (13), pp. 5507-5513.

- *Gac fruit*,
(n.d) Accessed date: January 2022

- Wimalasiri, D
(2015) *Genetic diversity, nutritional and biological activity of Momordica cochinchinensis (Cucurbitaceae)*,
(Doctoral dissertation, RMIT University, Australia). Retrieved date: August 2021

- Bharathi, LK, Parida, SK, Munshi, AD, Behera, TK, Raman, KV, Mohapatra, T
Molecular diversity and phe-netic relationship of Momordica spp. of Indian occurrence
(2012) *Genetic Resources and Crop Evolution*, 59 (5), pp. 937-948.

- Costa, R, Pereira, G, Garrido, I, Tavares-de-Sousa, MM, Es-pinosa, F
Comparison of RAPD, ISSR, and AFLP molecular markers to reveal and classify orchard grass (Dactylis glomerata L.) germplasm variations
(2016) *PloS One*, 11 (4), p. e0152972.

- Abdulqader, A., Ali, F., Ismail, A., Esa, N. M.
Antioxidant compounds and capacities of Gac (Momor-dica cochinchinensis Spreng) fruits
(2019) *Asian Pacific Journal of Tropical Biomedicine*, 9 (4), p. 158.

- Aboul-Maaty, NAF, Oraby, HAS
Extraction of high-quality genomic DNA from different plant orders applying a modified CTAB-based method
(2019) *Bulletin of the National Research Centre*, 43 (1), p. 25.

- Rohlf, FJ
(2000) *NTSYS-pc: numerical taxonomy and multivariate analysis system, Version 2.1. Exeter software*,
Setauket, New York

- Nei, M
Genetic distance between populations
(1972) *The American Naturalist*, 106 (949), pp. 283-292.
Accessed date: November 2021

- Powell, W, Morgante, M, Andre, C, Hanafey, M, Vogel, J, Tingey, S, Rafalski, A
The comparison of RFLP, RAPD, AFLP and SSR (microsatellite) markers for germplasm analysis
(1996) *Molecular breeding*, 2 (3), pp. 225-238.

- Smith, JSC, Chin, ECL, Shu, H, Smith, OS, Wall, SJ, Senior, ML, Ziegle, J
An evaluation of the utility of SSR loci as molecular markers in maize (Zea mays L.): comparisons with data from RFLPs and pedigree
(1997) *Theoretical and Applied Genetics*, 95 (1-2), pp. 163-173.

- Lübberstedt, T, Melchinger, AE, Dußle, C, Vuylsteke, M, Kuiper, M
Relationships among early European maize inbreds: IV. genetic diversity revealed with AFLP markers and comparison with RFLP, RAPD, and pedigree data
(2000) *Crop Science*, 40 (3), pp. 783-791.

- Gaikwad, AB, Behera, TK, Singh, AK, Chandel, D, Kari-haloo, JL, Staub, JE
Amplified fragment length polymorphism analysis provides strategies for improvement of bitter gourd (Momordica charantia L.)
(2008) *American Society of Horticultural Science*, 43 (1), pp. 127-133.

- Nakano, M
(2020) *Red seal landscape horticulturist identify plants and plant requirements*, Victoria, B.C.: BCcampus. Accessed date: December 2022

- Bharathi, LK, John, KJ
(2013) *Momordica Genus in Asia-An Overview*, 1st Edition. New Delhi: Springer

- Wimalasiri, D, Piva, T, Urban, S, Huynh, T
Morphological and genetic diversity of Momordica cochinchinensis (Cucurbitaceae) in Vietnam and Thailand
(2016) *Genetic Resources and Crop Evolution*, 63 (1), pp. 19-33.

- Vuong, LT
Underutilized β-carotene–rich crops of Vietnam
(2000) *Food and Nutrition Bulletin*, 21 (2), pp. 173-181.

- Toan, PD, Van Biet, H, Hue, VTT, Dang Sang, H, Tri, BM, Tuyen, BC
Analysis of genetic diversity of gac ['Momordica cochinchinensis'(Lour.) Spreng] in Southern Vietnam using fruit-morphological and microsatellite markers
(2018) *Australian Journal of Crop Science*, 12 (12), p. 1890.

- Tran, XT, Parks, SE, Roach, PD, Nguyen, MH
Improved propagation methods for gac (Momordica cochinchinensis Spreng.)
(2020) *Experimental Agriculture*, 56 (1), pp. 132-141.

- Loveless, MD, Hamrick, JL
Ecological determinants of genetic structure in plant populations
(1984) *Annual Review of Ecology and Systematics*, 15 (1), pp. 65-95.

- Xia, T, Chen, S, Chen, S, Zhang, D, Zhang, D, Gao, Q, Ge, X
ISSR analysis of genetic diversity of the Qinghai-Tibet Plateau endemic Rhodiola chrysanthemifolia (Cras-sulaceae)
(2007) *Biochemical systematics and Ecology*, 35 (4), pp. 209-214.

- Gallucci, MARCELLO, Perugini, M
The Marker Index: A new method of selection of marker variables in factor analysis
(2007) *TPM-Testing, Psychometrics, Methodology in Applied Psychology*, 14 (1), pp. 3-25.

- Etminan, A, Pour-Aboughadareh, A, Noori, A, Ahmadi-Rad, A, Shooshtari, L, Mahdavian, Z, Yousefiazar-Khanian, M
Genetic relationships and diversity among wild Salvia accessions revealed by ISSR and SCoT markers
(2018) *Biotechnology & Biotechnological Equipment*, 32 (3), pp. 610-617.

- Chaudhary, V, Kumar, M, Sharma, S, Kumar, N, Kumar, V, Yadav, HK, Sirohi, U
Assessment of genetic diversity and population structure in gladiolus (Gladiolus hy-bridus Hort.) by ISSR markers
(2018) *Physiology and Molecular Biology of Plants*, 24 (3), pp. 493-501.

- Pourhosseini, SH, Hadian, J, Sonboli, A, Nejad Ebrahimi, S, Mirjalili, MH
  Genetic and chemical diversity in Perovskia abrotanoides Kar. (Lamiaceae) populations based on ISSRs markers and essential oils profile
  (2018) *Chemistry & Biodiversity*, 15 (3), p. e1700508.

- Khan, MMH, Rafii, MY, Ramlee, SI, Jusoh, M, Al Mamun, M, Halidu, J
  DNA fingerprinting, fixation-index (Fst) and admixture mapping of selected Bambara groundnut (Vigna subterranea [L.] Verdc.) accessions using ISSR markers system
  (2021) *Scientific Reports*, 11 (1), pp. 1-23.

- Tantasawat, P, Trongchuen, J, Prajongjai, T, Seehalak, W, Jittayasothorn, Y
  Variety identification and comparative analysis of genetic diversity in yardlong bean (Vigna unguiculata spp. sesquipedalis) using morphological characters, SSR and ISSR analysis
  (2010) *Scientia Horticulturae*, 124 (2), pp. 204-216.

- Souframanien, J., Gopalakrishna, T.
  A comparative analysis of genetic diversity in blackgram genotypes using RAPD and ISSR markers
  (2004) *Theoretical and Applied Genetics*, 109 (8), pp. 1687-1693.

- Sarwat, M, Das, S, Srivastava, PS
  Analysis of genetic diversity through AFLP, SAMPL, ISSR and RAPD markers in Tribulus terrestris, a medicinal herb
  (2008) *Plant Cell Reports*, 27 (3), pp. 519-528.

- Khajudparn, P, Prajongjai, T, Poolsawat, O, Tantasawat, PA
  Application of ISSR markers for verification of F1 hybrids in mungbean (Vigna radiata)
  (2012) *Genetics and Molecular Research*, 11 (3), pp. 3329-3338.

- Awasthi, AK, Nagaraja, GM, Naik, GV, Kanginakudru, S, Thangavelu, K, Nagaraju, J
  Genetic diversity and relationships in mulberry (genus Morus) as revealed by RAPD and ISSR marker assays
  (2004) *BMC Genetics*, 5 (1), pp. 1-9.

- Du, X, Sun, Y, Li, X, Zhou, J, Li, X
  Genetic divergence among inbred lines in Cucurbita moschata from China
  (2011) *Scientia Horticulturae*, 127 (3), pp. 207-213.

- Vargas-Ponce, O., Zizumbo-Villarreal, D., Martínez- Castillo, J., Coello-Coello, J., Colunga-García Marín, P.
  Diversity and structure of landraces of gave grown for spirits under traditional agriculture: a comparison with wild populations of A. angustifolia (Agavaceae) and commercial plantations of A. tequilana
  (2009) *American Journal of Botany*, 96 (2), pp. 448-457.

- Hamrick, JL, Godt, MJW, Sherman-Broyles, SL
  Factors influencing levels of genetic diversity in woody plant species
  (1992) *population genetics of forest trees*,
  Forestry Sciences. Dordrecht, Springer

- Schaefer, H, Renner, SS
  A phylogeny of the oil bee tribe Ctenoplectrini (Hymenoptera: Anthophila) based on mitochondrial and nuclear data: evidence for Early Eocene divergence and repeated out-of-Africa dispersal
  (2008) *Molecular Phylogenetics and Evolution*, 47 (2), pp. 799-811.

- Torres, E, Iriondo, JM, Pérez, C
  Vulnerability and determinants of reproductive success in the narrow endemic Antirrhinum microphyllum (Scrophulariaceae)

(2002) *American Journal of Botany*, 89 (7), pp. 1171-1179.
Accessed date: December 2021

- Stankiewicz, M, Gadamski, G, Gawronski, SW
Genetic variation and phylogenetic relationships of triazine-resistant and triazine-susceptible biotypes of Solanum nigrum–analysis using RAPD markers
(2001) *Weed Research*, 41 (4), pp. 287-300.

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