

ISSN: 1412-033X
E-ISSN: 2085-4722

BIODIVERSITAS

Journal of Biological Diversity

Volume 21 - Number 3 - March 2020



BIODIVERSITAS

Journal of Biological Diversity
Volume 21 – Number 3 – March 2020

ISSN/E-ISSN:

1412-033X (printed edition), 2085-4722 (electronic)

EDITORIAL BOARD:

Abdel Fattah N.A. Rabou (Palestine), **Agnieszka B. Najda** (Poland), **Ajay Kumar Gautam** (India), **Alan J. Lymbery** (Australia), **Annisa** (Indonesia), **Bambang H. Saharjo** (Indonesia), **Daiane H. Nunes** (Brazil), **Darlina Md. Naim** (Malaysia), **Ghulam Hassan Dar** (India), **Hassan Pourbabaei** (Iran), **Joko R. Witono** (Indonesia), **Kartika Dewi** (Indonesia), **Katsuhiko Kondo** (Japan), **Kusumadewi Sri Yulita** (Indonesia), **Livia Wannorp** (Sweden), **M. Jayakara Bhandary** (India), **Mahdi Reyahi-Khoram** (Iran), **Mahendra K. Rai** (India), **Mahesh K. Adhikari** (Nepal), **Maria Panitsa** (Greece), **Mochamad A. Soendjoto** (Indonesia), **Mohib Shah** (Pakistan), **Mohamed M.M. Najim** (Srilanka), **Nurhasanah** (Indonesia), **Praptiwi** (Indonesia), **Rasool B. Tareen** (Pakistan), **Sayed Aliakbar Hedayati** (Iran), **Sayed Mehdi Talebi** (Iran), **Shahabuddin** (Indonesia), **Shahir Shamsir** (Malaysia), **Shri Kant Tripathi** (India), **Subhash C. Santra** (India), **Sugeng Budiharta** (Indonesia), **Sugiyarto** (Indonesia), **Taufiq Purna Nugraha** (Indonesia), **Yosep S. Mau** (Indonesia)

EDITOR-IN-CHIEF:

S u t a r n o

EDITORIAL MEMBERS:

English Editors: **Graham Eagleton** (grahameagleton@gmail.com), **Suranto** (surantouns@gmail.com); Technical Editor: **Solichatun** (solichatun_s@yahoo.com), **Artini Pangastuti** (pangastuti_tutut@yahoo.co.id); Distribution & Marketing: **Rita Rakhmawati** (oktia@yahoo.com); Webmaster: **Ari Pitoyo** (aripitoyo@yahoo.com)

MANAGING EDITORS:

Ahmad Dwi Setyawan (unsjournals@gmail.com)

PUBLISHER:

The Society for Indonesian Biodiversity

CO-PUBLISHER:

Department of Biology, Faculty of Mathematics and Natural Sciences, Sebelas Maret University, Surakarta

ADDRESS:

Jl. Ir. Sutami 36A Surakarta 57126. Tel. +62-271-7994097, Tel. & Fax.: +62-271-663375, email: editors@smujo.id

ONLINE:

biodiversitas.mipa.uns.ac.id; smujo.id/biodiv

.....



**Society for Indonesia
Biodiversity**



**Sebelas Maret University
Surakarta**

GUIDANCE FOR AUTHORS

Aims and Scope *Biodiversitas*, *Journal of Biological Diversity* or abbreviated as *Biodiversitas* encourages submission of manuscripts dealing with all biodiversity aspects of plants, animals and microbes at the level of the gene, species, and ecosystem as well as ethnobiology.

Article types The journal seeks original full-length research papers, reviews, and short communication. Manuscript of original research should be written in no more than 8,000 words (including tables and picture), or proportional with articles in this publication number. Review articles will be accommodated, while, short communication should be written at least 2,000 words, except for pre-study.

Submission The journal only accepts online submission, through open journal system (<https://smujo.id/biodiv/about/submissions>) or email to the editors at unsjournals@gmail.com. Submitted manuscripts should be the original works of the author(s). The manuscript must be accompanied by a cover letter containing the article title, the first name and last name of all the authors, a paragraph describing the claimed novelty of the findings versus current knowledge. Submission of a manuscript implies that the submitted work has not been published before (except as part of a thesis or report, or abstract); and is not being considered for publication elsewhere. When a manuscript written by a group, all authors should read and approve the final version of the submitted manuscript and its revision; and agree the submission of manuscripts for this journal. All authors should have made substantial contributions to the concept and design of the research, acquisition of the data and its analysis; drafting of the manuscript and correcting of the revision. All authors must be responsible for the quality, accuracy, and ethics of the work.

Ethics Author(s) must obedient to the law and/or ethics in treating the object of research and pay attention to the legality of material sources and intellectual property rights.

Copyright If and when the manuscript is accepted for publication, the author(s) still hold the copyright and retain publishing rights without restrictions. Authors or others are allowed to multiply article as long as not for commercial purposes. For the new invention, authors are suggested to manage its patent before published.

Open access The journal is committed to free-open access that does not charge readers or their institutions for access. Readers are entitled to read, download, copy, distribute, print, search, or link to the full texts of articles, as long as not for commercial purposes. The license type is CC-BY-NC-SA.

Acceptance The only articles written in English (U.S. English) are accepted for publication. Manuscripts will be reviewed by editors and invited reviewers(double blind review) according to their disciplines. Authors will generally be notified of acceptance, rejection, or need for revision within 1 to 2 months of receipt. The manuscript is rejected if the content does not in line with the journal scope, does not meet the standard quality, inappropriate format, complicated grammar, dishonesty (i.e. plagiarism, duplicate publications, fabrication of data, citations manipulation, etc.), or ignoring correspondence in three months. The primary criteria for publication are scientific quality and biodiversity significance. **Uncorrected proofs** will be sent to the corresponding author by email as *.doc* or *.docx* files for checking and correcting of typographical errors. To avoid delay in publication, corrected proofs should be returned in 7 days. The accepted papers will be published online in a chronological order at any time, but printed in the early of each month (12 times).

A charge Starting on January 1, 2019, publishing costs waiver is granted to authors of graduate students from **Least Developed Countries**, who first publish the manuscript in this journal. However, other authors are charged USD 250 (IDR 3,500,000). Additional charges may be billed for language editing, USD 75-150 (IDR 1,000,000-2,000,000).

Reprints The sample journal reprint is only available by special request. Additional copies may be purchased when ordering by sending back the uncorrected proofs by email.

Manuscript preparation Manuscript is typed on A4 (210x297 mm²) paper size, in a single column, single space, 10-point (10 pt) Times New Roman font. The margin text is 3 cm from the top, 2 cm from the bottom, and 1.8 cm from the left and right. Smaller lettering size can be applied in presenting table and figure (9 pt). Word processing program or additional software can be used, however, it must be PC compatible and Microsoft Word based (*.doc* or *.rtf*, not *.docx*). **Scientific names** of species (incl. subspecies, variety, etc.) should be written in italic, except for italic sentence. Scientific name (genera, species, author), and cultivar or strain should be mentioned completely for the first time mentioning it in the body text, especially for taxonomic manuscripts. Name of genera can be shortened after first mentioning, except generating confusion. Name of the author can be eliminated after first mentioning. For example, *Rhizopus oryzae* L. UICC 524, hereinafter can be written as *R. oryzae* UICC 524. Using trivial name should be avoided, otherwise generating confusion. **Biochemical and chemical nomenclature** should follow the order of the IUPAC - IUB. For DNA sequence, it is better used Courier New font. Symbols of standard chemical and abbreviation of chemistry name can be applied for common and clear used, for example, completely written butilic hydroxyl toluene (BHT) to be BHT hereinafter. **Metric measurement** use IS denomination, usage other system should follow the value of equivalent with the denomination of IS first mentioning. Abbreviations set of, like g, mg, mL, etc. do not follow by dot. Minus index (m⁻², L⁻¹, h⁻¹) suggested to be used, except in things like "per-plant" or "per-plot". **Equation of mathematics** does not always can be written

down in one column with text, in that case can be written separately. **Number** one to ten are expressed with words, except if it relates to measurement, while values above them written in number, except in early sentence. The fraction should be expressed in decimal. In the text, it should be used "%" rather than "percent". Avoid expressing ideas with complicated sentence and verbiage, and used efficient and effective sentence.

Title of the article should be written in compact, clear, and informative sentence, preferably not more than 20 words. Name of author(s) should be completely written. **Name and institution** address should also be completely written with street name and number (location), postal code, telephone number, facsimile number, and email address. Manuscript written by a group, author for correspondence along with address is required. First page of the manuscript is used for writing above information.

Abstract should not be more than 200 words. **Keywords** is about five words, covering scientific and local name (if any), research theme, and special methods which used; and sorted from A to Z. All important **abbreviations** must be defined at their first mention. **Running title** is about five words. **Introduction** is about 400-600 words, covering the background and aims of the research. **Materials and Methods** should emphasize on the procedures and data analysis. **Results and Discussion** should be written as a series of connecting sentences, however, for manuscript with long discussion should be divided into subtitles. Thorough discussion represents the causal effect mainly explains for why and how the results of the research were taken place, and do not only re-express the mentioned results in the form of sentences. **Concluding** sentence should be given at the end of the discussion. **Acknowledgments** are expressed in a brief; all sources of institutional, private and corporate financial support for the work must be fully acknowledged, and any potential conflicts of interest are noted.

Figures and Tables of maximum of three pages should be clearly presented. Title of a picture is written down below the picture, while title of a table is written above the table. Colored figures can only be accepted if the information in the manuscript can lose without those images; chart is preferred to use black and white images. Author could consign any picture or photo for the front cover, although it does not print in the manuscript. All images property of others should be mentioned source. **There is no appendix**, all data or data analysis are incorporated into Results and Discussions. For broad data, it can be displayed on the website as a supplement.

References Author-year citations are required. In the text give the authors name followed by the year of publication and arrange from oldest to newest and from A to Z. In citing an article written by two authors, both of them should be mentioned, however, for three and more authors only the first author is mentioned followed by et al., for example: Saharjo and Nurhayati (2006) or (Boonkerd 2003a, b, c; Sugiyarto 2004; El-Bana and Nijs 2005; Balagadde et al. 2008; Webb et al. 2008). Extent citation as shown with word "*cit*" should be avoided. Reference to unpublished data and personal communication should not appear in the list but should be cited in the text only (e.g., Rifai MA 2007, pers. com. (personal communication); Setyawan AD 2007, unpublished data). In the reference list, the references should be listed in an alphabetical order (better, if only 20 for research papers). Names of journals should be abbreviated. Always use the standard abbreviation of a journal's name according to the **ISSN List of Title Word Abbreviations** (www.issn.org/2-22661-LTWA-online.php). The following examples are for guidance.

Journal:

Saharjo BH, Nurhayati AD. 2006. Domination and composition structure change at hemic peat natural regeneration following burning; a case study in Pelalawan, Riau Province. *Biodiversitas* 7: 154-158.

Book:

Rai MK, Carpinella C. 2006. Naturally Occurring Bioactive Compounds. Elsevier, Amsterdam.

Chapter in book:

Webb CO, Cannon CH, Davies SJ. 2008. Ecological organization, biogeography, and the phylogenetic structure of rainforest tree communities. In: Carson W, Schnitzer S (eds) *Tropical Forest Community Ecology*. Wiley-Blackwell, New York.

Abstract:

Assaad AM. 2007. Seed production and dispersal of *Rhazya stricta*. 50th annual symposium of the International Association for Vegetation Science, Swansea, UK, 23-27 July 2007.

Proceeding:

Alikodra HS. 2000. Biodiversity for development of local autonomous government. In: Setyawan AD, Sutarno (eds.) *Toward Mount Lawu National Park; Proceeding of National Seminary and Workshop on Biodiversity Conservation to Protect and Save Germplasm in Java Island*. Universitas Sebelas Maret, Surakarta, 17-20 July 2000. [Indonesian]

Thesis, Dissertation:

Sugiyarto. 2004. Soil Macro-invertebrates Diversity and Inter-Cropping Plants Productivity in Agroforestry System based on Sengon. [Dissertation]. Universitas Brawijaya, Malang. [Indonesian]

Information from internet:

Balagadde FK, Song H, Ozaki J, Collins CH, Barnet M, Arnold FH, Quake SR, You L. 2008. A synthetic *Escherichia coli* predator-prey ecosystem. *Mol Syst Biol* 4: 187. www.molecularsystemsbiology.com

Front cover: Male *Copsychus malabaricus* (Scopoli, 1788)
(PHOTO: NELSON WONG)

Published monthly

PRINTED IN INDONESIA

ISSN: 1412-033X

E-ISSN: 2085-4722



Current Issue



(<https://smujo.id/biodiv/issue/view/257>)

Vol. 21 No. 4 (2020)

[View All Issues](https://smujo.id/biodiv/issue/archive) ➤ (<https://smujo.id/biodiv/issue/archive>)

Online biodiversitas.mipa.uns.ac.id, smujo.id/biodiv (<https://smujo.id/biodiv/>)

ISSN: 1412-033X, **E-ISSN:** 2085-4722

Publisher: Society for Indonesian Biodiversity

Co-publisher: Department of Biology, FMNS, Universitas Sebelas Maret Surakarta

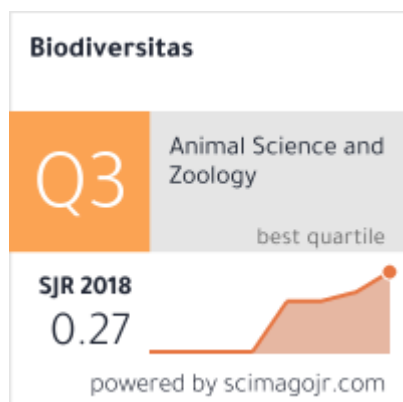
First Publication: 2000

Period of issuance: Starting on January 1, 2019, Biodiversitas will be issued monthly

Aims and Scope *Biodiversitas, Journal of Biological Diversity* or abbreviated as *Biodiversitas* encourages submission of manuscripts dealing with all biodiversity aspects of plants, animals and microbes at the level of the gene, species, and ecosystem as well as ethnobiology.

Article types The journal seeks original full-length research papers, reviews, and short communication. Manuscript of original research should be written in no more than 8,000 words (including tables and picture), or proportional with articles in this publication number. Review articles will be accommodated, while, short communication should be written at least 2,000 words, except for pre-study.

Indexing The journal has been indexed/registered in SCOPUS, DOAJ, Google Scholar, Crossref, EBSCO, etc.



([https://www.scimagojr.com/journalsearch.php?](https://www.scimagojr.com/journalsearch.php?q=21100332431&tip=sid&clean=0)

[q=21100332431&tip=sid&clean=0](https://www.scimagojr.com/journalsearch.php?q=21100332431&tip=sid&clean=0))

Information

For Readers (<https://smujo.id/biodiv/information/readers>)

For Authors (<https://smujo.id/biodiv/information/authors>)

For Librarians (<https://smujo.id/biodiv/information/librarians>)

Usage Statistics Information

We log anonymous usage statistics. Please read the privacy information (<https://smujo.id/biodiv/usageStats/privacyInformation>) for details.

Journals List

Biodiversitas Journal of Biological Diversity (<https://smujo.id/biodiv>)

Nusantara Bioscience (<https://smujo.id/nb>)

Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia (<https://smujo.id/psnmbi>)

Asian Journal of Agriculture (<https://smujo.id/aja>)

Asian Journal of Ethnobiology (<https://smujo.id/aje>)

Asian Journal of Forestry (<https://smujo.id/ajf>)

Biofarmasi Journal of Natural Product Biochemistry (<https://smujo.id/jnpb>)

Bioteknologi Biotechnological Studies (<https://smujo.id/bbs>)

Bonorowo Wetlands (<https://smujo.id/bw>)

Cell Biology and Development (<https://smujo.id/cbd>)

Ocean Life (<https://smujo.id/ol>)

Tropical Drylands (<https://smujo.id/td>)

Reviewers List

Reviewers (<https://smujo.id/biodiv/reviewers/index>)

Visitor Statistics

Statistics (<https://smujo.id/info/stats>)



(<https://info.flagcounter.com/JKar>)



(<https://www.scopus.com/sourceid/21100332431>)

(<http://doaj.org/toc/3eda1e70aa014e1e8bd1fc367b4df956>)



(<http://scholar.google.co.id/citations?hl=id&user=rae-lrEAAAAJ>)



(<http://search.crossref.org/?q=biodiversitas&type=Journal>)



(<https://academic.microsoft.com/#/detail/2738269101>)

Home (<https://smujo.id/biodiv/index>) / Archives (<https://smujo.id/biodiv/issue/archive>)
/ Vol. 21 No. 3 (2020)



(<https://smujo.id/biodiv/issue/view/256>)

Vol. 21 No. 3 (2020)

Full Issue

Front Cover (<https://smujo.id/biodiv/issue/view/256/113>)

Articles

Traditional agro-management practices, utilization and nutritional composition of momala: A local maize variety of Gorontalo, Indonesia
(<https://smujo.id/biodiv/article/view/4837>)

NOVRI YOULA KANDOWANGKO, MARGARETHA SOLANG, ERNA RETNAWATY

PDF (<https://smujo.id/biodiv/article/view/4837/3695>)

Potency of aloe extract as immunostimulant for carp (*Cyprinus carpio*) against *Aeromonas salmonicida*
(<https://smujo.id/biodiv/article/view/4926>)

SRI ANDAYANI, M. SULAIMAN DADIONO, WIDYA TRI ELWIRA, FEBBY HADI SETYAWAN

PDF (<https://smujo.id/biodiv/article/view/4926/3696>)

Ex-situ population of White-rumped Shama (*Copsychus malabaricus*): studies of density, distribution and bird keepers in Bengkulu, Sumatra (<https://smujo.id/biodiv/article/view/4920>)

HERI DWI PUTRANTO, BIENG BRATA, YOSSIE YUMIATI

PDF (<https://smujo.id/biodiv/article/view/4920/3697>)

Floristic diversity and demographic structure of the Sidi R'Ghies forest, north-eastern of Algeria (<https://smujo.id/biodiv/article/view/4892>)

MALIKA RACHED-KANOUNI, KARIMA KARA, HICHEM KHAMMAR, LABED ABABSA

PDF (<https://smujo.id/biodiv/article/view/4892/3698>)

Morphological variations and phylogenetic analysis of *Oryzias nigrimas* Kottelat, 1990 (Rice fish) from Lake Poso, Central Sulawesi, Indonesia (<https://smujo.id/biodiv/article/view/5141>)

NOVALINA SERDIATI, DIANA ARFIATI, MAHENO SRI WIDODO, TRI JOKO LELONO, SAMLIOK NDOBE, RUDY SARANGA

PDF (<https://smujo.id/biodiv/article/view/5141/3699>)

The egg characteristics of malon broiler, Japanese quails and their cross (<https://smujo.id/biodiv/article/view/4463>)

ENDANG SUJANA, ASEP ANANG, IWAN SETIAWAN, TUTI WIDJASTUTI

PDF (<https://smujo.id/biodiv/article/view/4463/3700>)

Physical and chemical characteristic of stem starch and sheath flour from oil palm tree (*Elaeis guineensis*) (<https://smujo.id/biodiv/article/view/4720>)

SYARIFAH YUSRA, YUDI PRANOTO, Chairil Anwar, CHUSNUL HIDAYAT

PDF (<https://smujo.id/biodiv/article/view/4720/3707>)

Coat protein gene of a PStV-Bm isolate from West Nusa Tenggara, Indonesia (<https://smujo.id/biodiv/article/view/4970>)

NUR INDAH JULISANIAH, SUHARJONO, RETNO MASTUTI, ESTRI LARAS ARUMINGTYAS

PDF (<https://smujo.id/biodiv/article/view/4970/3701>)

Environmental factors influence on flowering and fruiting period of

selected essential oil plants from Annonaceae
(<https://smujo.id/biodiv/article/view/5134>)

DEWI AYU LESTARI, ABBAN PUTRI FIQA

PDF (<https://smujo.id/biodiv/article/view/5134/3702>)

Temporal overlap of carnivorous mammal community and their prey in
Khao Ang Rue Nai Wildlife Sanctuary, Chachoengsao Province, Thailand
(<https://smujo.id/biodiv/article/view/5158>)

RONGLARP SUKMASUANG, KHWANRUTAI CHARASPET, JITTIMA REONTIK, MANANYA
PLA-ARD

PDF (<https://smujo.id/biodiv/article/view/5158/3703>)

Morphometric diversity and phenotypic relationship among indigenous
buffaloes of Banten, Indonesia (<https://smujo.id/biodiv/article/view/4745>)

DEWI MURNI, UMIE LESTARI, SRI ENDAH INDRIWATI, ACHMAD EFENDI, NANI MARYANI,
MOHAMAD AMIN

PDF (<https://smujo.id/biodiv/article/view/4745/3704>)

Short communication: The genotype of growth hormone gene that affects
the birth weight and average daily gain in crossbred beef cattle
(<https://smujo.id/biodiv/article/view/4973>)

TETY HARTATIK, AHMAD FATHONI, SIGIT BINTARA, ISMAYA, PANJONO, B.P.
WIDYOBROTO, ALI AGUS, IGS. BUDISATRIA, PASCAL LEROY

PDF (<https://smujo.id/biodiv/article/view/4973/3706>)

Identification of active compounds and antioxidant activity of teak
(*Tectona grandis*) leaves (<https://smujo.id/biodiv/article/view/5154>)

VENTY SURYANTI, TRIANA KUSUMANINGSIH, SOERYA DEWI MARLIYANA, HILDA
ALFIANI SETYONO, ELYNA WAHYU TRISNAWATI

PDF (<https://smujo.id/biodiv/article/view/5154/3705>)

Nutritional values of swamp grasses as feed for Pampangan Buffaloes in
South Sumatra, Indonesia (<https://smujo.id/biodiv/article/view/4672>)

MUHAKKA, RUJITO AGUS SUWIGNYO, DEDIK BUDIANTA, YAKUP

PDF (<https://smujo.id/biodiv/article/view/4672/3708>)

Molecular characterization of lactic acid bacteria producing edible biofilm
isolated from kimchi (<https://smujo.id/biodiv/article/view/4961>)

FADILLA SAPALINA, ENDAH RETNANINGRUM

PDF (<https://smujo.id/biodiv/article/view/4961/3709>)

Ultrastructure of royal palm (*Roystonea regia*) leaf sheath
(<https://smujo.id/biodiv/article/view/4985>)

ULFA ADZKIA, NARESWORO NUGROHO, ISKANDAR Z. SIREGAR, LINA KARLINASARI

PDF (<https://smujo.id/biodiv/article/view/4985/3710>)

Screening and characterization of sponge-associated bacteria from Seribu Island, Indonesia producing cellulase and laccase enzymes
(<https://smujo.id/biodiv/article/view/5098>)

WENANG MAHARSIWI, RIKA INDRI ASTUTI, ANJA MERYANDINI, ARIS TRI WAHYUDI

PDF (<https://smujo.id/biodiv/article/view/5098/3711>)

Direct economic benefits and human dependence toward Gunung Merapi National Park, Indonesia (<https://smujo.id/biodiv/article/view/4804>)

RUKY UMayA, HARDJANTO, RINEKSO SOEKMADI, SATYAWAN SUNITO

PDF (<https://smujo.id/biodiv/article/view/4804/3712>)

Molecular identification of amylase-producing thermophilic bacteria isolated from Bukit Gadang Hot Spring, West Sumatra, Indonesia
(<https://smujo.id/biodiv/article/view/4956>)

AULIA ARDHI, ARINA NADENGGAN SIDAURUK, NABELLA SURAYA, NOVA WAHYU PRATIWI, USMAN PATO, SARYONO

PDF (<https://smujo.id/biodiv/article/view/4956/3713>)

Biodiversity of Enterobacteriaceae on masin (fermented sauce) from Sumbawa, West Nusa Tenggara, Indonesia
(<https://smujo.id/biodiv/article/view/5086>)

BASO MANGUNTUNGI, DINAR S. SAPUTRI, CHAIRUL A. AFGANI, APON Z. MUSTOPA, FATIMAH, AMIRIN KUSMIRAN

PDF (<https://smujo.id/biodiv/article/view/5086/3714>)

Short Communication: Characterization of Rhizoctonia-like mycorrhizae associated with five Dendrobium species in Java, Indonesia
(<https://smujo.id/biodiv/article/view/4557>)

R. SOELISTIJONO, D.S. UTAMI, DARYANTI, M. FAIZIN, R. DIAN

PDF (<https://smujo.id/biodiv/article/view/4557/3715>)

Plankton biodiversity in various typologies of inundation in Paminggir peatland, South Kalimantan, Indonesia on dry season
(<https://smujo.id/biodiv/article/view/5196>)

YUNANDAR, HEFNI EFFENDI, WIDIATMAKA, YUDI SETIAWAN

PDF (<https://smujo.id/biodiv/article/view/5196/3716>)

The The diversity and abundance of Hymenoptera insects on tidal swamp rice field in Indragiri Hilir District, Indonesia
(<https://smujo.id/biodiv/article/view/4524>)

ZAHLUL IKHSAN, HIDRAYANI, YAHERWANDI, HASMIANDY HAMID

PDF (<https://smujo.id/biodiv/article/view/4524/3719>)

Morphometric variations of Asian Common Palm Civet (*Paradoxurus hermaphroditus*, Pallas 1777) from Bali Island, Indonesia as the basis of morphometrics diversity data (<https://smujo.id/biodiv/article/view/4984>)

ARIS WINAYA, MAFTUCHAH, CARLA MOROS NICOLÁS, DWI PRASETYO

PDF (<https://smujo.id/biodiv/article/view/4984/3720>)

The diversity of leaves and asiaticoside content on three accessions of *Centella asiatica* with the addition of chicken manure fertilizer
(<https://smujo.id/biodiv/article/view/5089>)

HAPPY MARATUL MUMTAZAH, YULI WIDYASTUTI, SUPRIYONO, AHMAD YUNUS

PDF (<https://smujo.id/biodiv/article/view/5089/3721>)

Comparing morphological traits of legs of understory birds inhabiting forest areas with closed canopies and forest gaps
(<https://smujo.id/biodiv/article/view/5148>)

SUPALAK SIRI, YUWADEE PONPITUK, MONGKOL SAFOOWONG, WIMONMART NUIPAKDEE, DOKRAK MAROD, PRATEEP DUENGKAE

PDF (<https://smujo.id/biodiv/article/view/5148/3722>)

Avian diversity in geothermal power plant areas: Case studies in Kamojang, Darajat, and Gunung Salak, West Java, Indonesia
(<https://smujo.id/biodiv/article/view/5150>)

TEGUH HUSODO, KHEMAL PASHA MOCHTAN, SYA SYA SHANIDA, SYAHRAS FATHIN AMINUDDIN, INDRI WULANDARI, IRWANANDA SATRIA PUTRA, ERRI NOVIAR MEGANTARA

PDF (<https://smujo.id/biodiv/article/view/5150/3725>)

Short Communication: Optimization of extraction of sulfhydryl compounds from several legumes seeds in Indonesia with various ethanol concentrations (<https://smujo.id/biodiv/article/view/4665>)

SRI WARDATUN, YAHDIANA HARAHAH, ABDUL MUN'IM, NOORWATI SUTANDYO

PDF (<https://smujo.id/biodiv/article/view/4665/3726>)

Morphological and agronomical characters of four black rice varieties from West Kalimantan, Indonesia (<https://smujo.id/biodiv/article/view/4693>)

TANTRI PALUPI, FRANKY PANGARIBUAN, HEARNES, FADJAR RIYANTO, WASIAN, DWI ZULFITA

PDF (<https://smujo.id/biodiv/article/view/4693/3727>)

Temporal effects of cutting intensity on Diptera assemblages in eastern Borneo rainforest Indonesia (<https://smujo.id/biodiv/article/view/5009>)

AHMAD BUDIAMAN, NOOR FARIKHAH HANEDA, INDAHWATI, DINI FEBRIAN, LAELA NUR RAHMAH

PDF (<https://smujo.id/biodiv/article/view/5009/3728>)

Anatomical features and SCoT profiles provide new insight into phenotypic plasticity in the halophyte *Suaeda maritima* in Thailand (<https://smujo.id/biodiv/article/view/5376>)

KANOKPHORN RITTIRONGSAKUL, ANITTHAN SRINUAL, ONGKARN VANIJAJIVA

PDF (<https://smujo.id/biodiv/article/view/5376/3729>)

The growth, pilodyn penetration, and wood properties of 12 *Neolamarckia cadamba* provenances at 42 months old (<https://smujo.id/biodiv/article/view/4746>)

NELLY ANNA, SUPRIYANTO, LINA KARLINASARI, DEDE J. SUDRAJAT, ISKANDAR Z. SIREGAR

PDF (<https://smujo.id/biodiv/article/view/4746/3730>)

Genetic diversity analysis of yardlong bean genotypes (*Vigna unguiculata* subsp. *sesquipedalis*) based on IRAP marker (<https://smujo.id/biodiv/article/view/4830>)

MUHAMMAD HABIB WIDYAWAN, SRI WULANDARY, TARYONO

PDF (<https://smujo.id/biodiv/article/view/4830/3731>)

Morpho-molecular identification and pathogenicity test on fungal

parasites of guava root-knot nematode eggs in Lampung, Indonesia
(<https://smujo.id/biodiv/article/view/5037>)

I GEDE SWIBAWA, YUYUN FITRIANA, SOLIKHIN, RADIX SUHARJO, F.X. SUSILO, EKA RANI,
MEI SRI HARYANI, RACHMANSYAH A. WARDANA

PDF (<https://smujo.id/biodiv/article/view/5037/3732>)

Stomata cells studies of *Paraphalaenopsis* spp. from in vitro and
greenhouse condition (<https://smujo.id/biodiv/article/view/4706>)

R. VITRI GARVITA, HARY WAWANGNINGRUM

PDF (<https://smujo.id/biodiv/article/view/4706/3734>)

Vegetation analysis, physico-chemical properties and economic potential
of damar (*Agathis dammara*) in Mount Halimun Salak National Park, West
Java, Indonesia (<https://smujo.id/biodiv/article/view/4773>)

YELIN ADALINA, RENY SAWITRI

PDF (<https://smujo.id/biodiv/article/view/4773/3735>)

Short Communication: Population structure and habitat characteristics of
Goniothalamus macrophyllus in Bukit Pembarisan forest, West Java,
Indonesia (<https://smujo.id/biodiv/article/view/5224>)

ILHAM ADHYA, PUDJI WIDODO, CECEP KUSMANA, EMING SUDIANA, IMAM
WIDHIONO, TOTO SUPARTONO

PDF (<https://smujo.id/biodiv/article/view/5224/3736>)

Methylene blue decolorizing bacteria isolated from water sewage in
Yogyakarta, Indonesia (<https://smujo.id/biodiv/article/view/5042>)

MICHELLE, RACHEL ARVY NABASA SIREGAR, ASTIA SANJAYA, JAP LUCY, REINHARD
PINONTOAN

PDF (<https://smujo.id/biodiv/article/view/5042/3737>)

Harvesting trends of Amboina box turtles (*Cuora amboinensis*) seventeen
years after listing in Appendix II CITES
(<https://smujo.id/biodiv/article/view/4593>)

MUHAMMAD ALIF FAUZI, AMIR HAMIDY, NIA KURNIAWAN

PDF (<https://smujo.id/biodiv/article/view/4593/3739>)

Diversity and distribution of microalgae in coastal areas of East Java,
Indonesia (<https://smujo.id/biodiv/article/view/4951>)

UMI ZAKIYAH, MULYANTO, LUCIA TRI SUWANTI, MOCHAMAD DONNY KOERNIAWAN,
EKO AGUS SUYONO, ARIEF BUDIMAN, ULFAH JUNIARTI SIREGAR

PDF (<https://smujo.id/biodiv/article/view/4951/3738>)

Short Communication: Adoption level of indigenous communities on
agricultural technology in East Kalimantan, Indonesia: Problem and
adaptive solutions (<https://smujo.id/biodiv/article/view/4651>)

NDAN IMANG

PDF (<https://smujo.id/biodiv/article/view/4651/3740>)

Comparative and competitive advantages of nutmeg farming in two
regions in Maluku Province, Indonesia
(<https://smujo.id/biodiv/article/view/5178>)

TIENNI MARIANA SIMANJORANG, IRHAM, LESTARI RAHAYU WALUYATI, JANGKUNG
HANDOYO MULYO

PDF (<https://smujo.id/biodiv/article/view/5178/3743>)

Genetic variation and phylogenetic relationships of *Thelymitra javanica*
(Orchidaceae: Orchidoideae) in East and Central Java, Indonesia
(<https://smujo.id/biodiv/article/view/4969>)

I MADE SAKA WIJAYA, BUDI SETIADI DARYONO, PURNOMO

PDF (<https://smujo.id/biodiv/article/view/4969/3744>)

Diversity of gall-inducing insect associated with a superhost plant species:
Plant architecture, resource availability and interspecific interactions
(<https://smujo.id/biodiv/article/view/4891>)

MARCILIO FAGUNDES, ÉLLEN MARIANE LOPES SANTOS, KAREN LUIZA RODRIGUES
DUARTE, LARISSA MENDES SANTOS, JAQUELINE SILVA VIEIRA, CIRILO HENRIQUE DE
OLIVEIRA, PRISCILA SOUSA SILVA

PDF (<https://smujo.id/biodiv/article/view/4891/3746>)

Short communication: Effects of the various source areas of Indonesian
bay leaves (*Syzygium polyanthum*) on chemical content and antidiabetic
activity (<https://smujo.id/biodiv/article/view/4967>)

INDAH DWIATMI DEWIJANTI, WIBOWO MANGUNWARDYO, ASTARI DWIRANTI,
MUHAMMAD HANAFI, NINA ARTANTI

PDF (<https://smujo.id/biodiv/article/view/4967/3747>)

Short Communication: Proximate analysis, amino acid profile and albumin
concentration of various weights of Giant Snakehead (*Channa*

micropeltes) from Kapuas Hulu, West Kalimantan, Indonesia
(<https://smujo.id/biodiv/article/view/4840>)

WAHYU WIRA PRATAMA, HAPPY NURSYAM, ANIK MARTINAH HARIATI, R. ADHARYAN ISLAM, VERYL HASAN

PDF (<https://smujo.id/biodiv/article/view/4840/3749>)

Diversity, consumption dynamics and ethnomedical claims of traditional leafy vegetables consumed by a rural community in the KwaMbonambi area, northern KwaZulu-Natal, South Africa
(<https://smujo.id/biodiv/article/view/4928>)

N.C. MNCWANGO, S. MAVENGHAMA, N.R. NTULI, C.M. VAN JAARSVELD

PDF (<https://smujo.id/biodiv/article/view/4928/3748>)

Genetic diversity of local corn (*Zea mays*) cultivars from South Amarasi, Kupang District, Indonesia by Inter Simple Sequence Repeats marker
(<https://smujo.id/biodiv/article/view/5095>)

USLAN, NUR JANNAH

PDF (<https://smujo.id/biodiv/article/view/5095/3750>)

Short communication: The crustaceans fauna from Natuna Islands (Indonesia) using three different sampling methods
(<https://smujo.id/biodiv/article/view/4886>)

RIANTA PRATIWI, DEWI ELFIDASARI

PDF (<https://smujo.id/biodiv/article/view/4886/3752>)

Short Communication: DNA barcodes and phylogenetic of striped snakehead and ocellated snakehead fish from South Sumatra, Indonesia
(<https://smujo.id/biodiv/article/view/4950>)

MOCHAMAD SYAIFUDIN, MARINI WIJAYANTI, SEFTI HEZA DWINANTI, MUSLIM, MUHAMMAD MAHENDRA, SHELLY MARLIANA

PDF (<https://smujo.id/biodiv/article/view/4950/3753>)

Optimization and characterization of enterocin *Enterococcus faecalis* K2B1 isolated from Toraja's Belang Buffalo Milk, South Sulawesi, Indonesia
(<https://smujo.id/biodiv/article/view/5016>)

HASRIA ALANG, JONI KUSNADI, TRI ARDYATI, SUHARJONO

PDF (<https://smujo.id/biodiv/article/view/5016/3754>)

Short Communication: *Sarocladium oryzae* associated with sheath rot disease of rice in Indonesia
(<https://smujo.id/biodiv/article/view/5014>)

SYAFIQA PRAMUNADIPTA, ANI WIDIĀSTUTI, ĀRIF WIBOWO, HARUHISA SUGA, ACHMADI PRIYATMOJO

PDF (<https://smujo.id/biodiv/article/view/5014/3757>)

Local indigenous strategy to rehabilitate and conserve mangrove ecosystem in the southeastern Gulf of Kupang, East Nusa Tenggara, Indonesia (<https://smujo.id/biodiv/article/view/4845>)

RONGGO SADONO, DJOKO SOEPRIJADI, ARI SUSANTI, JERIELS MATATULA, EKO PUJIONO, FAHMI IDRIS, PANDU YUDHA ADI PUTRA WIRABUANA

PDF (<https://smujo.id/biodiv/article/view/4845/3755>)

Impact of green revolution on rice cultivation practices and production system: A case study in Sindang Hamlet, Rancakalong Village, Sumedang District, West Java, Indonesia (<https://smujo.id/biodiv/article/view/5128>)

RAHMI AULIA HIDAYAT, JOHAN ISKANDAR, BUDHI GUNAWAN, RUHYAT PARTASASMITA

PDF (<https://smujo.id/biodiv/article/view/5128/3756>)

Morphological diversity, total phenolic and flavonoid content of Echinacea purpurea cultivated in Karangpandan, Central Java, Indonesia (<https://smujo.id/biodiv/article/view/5096>)

DWI FAJAR SIDHIQ, YULI WIDIYASTUTI, DYAH SUBOSITI, BAMBANG PUJIASMANTO, AHMAD YUNUS

PDF (<https://smujo.id/biodiv/article/view/5096/3758>)

Information

For Readers (<https://smujo.id/biodiv/information/readers>)

For Authors (<https://smujo.id/biodiv/information/authors>)

For Librarians (<https://smujo.id/biodiv/information/librarians>)

Usage Statistics Information

We log anonymous usage statistics. Please read the privacy information (<https://smujo.id/biodiv/usageStats/privacyInformation>) for details.

Journals List

Biodiversitas Journal of Biological Diversity (<https://smujo.id/biodiv>)

Nusantara Bioscience (<https://smujo.id/nb>)

Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia (<https://smujo.id/psnmbi>)

Asian Journal of Agriculture (<https://smujo.id/aja>)

Asian Journal of Ethnobiology (<https://smujo.id/aje>)

Asian Journal of Forestry (<https://smujo.id/ajf>)

Biofarmasi Journal of Natural Product Biochemistry (<https://smujo.id/jnpb>)

Bioteknologi Biotechnological Studies (<https://smujo.id/bbs>)

Bonorowo Wetlands (<https://smujo.id/bw>)

Cell Biology and Development (<https://smujo.id/cbd>)

Ocean Life (<https://smujo.id/ol>)

Tropical Drylands (<https://smujo.id/td>)

Reviewers List

Reviewers (<https://smujo.id/biodiv/reviewers/index>)

Visitor Statistics

Statistics (<https://smujo.id/info/stats>)



(<https://info.flagcounter.com/JKAr>)



(<https://www.scopus.com/sourceid/21100332431>)



(<http://doaj.org/toc/3eda1e70aa014e1e8bd1fc367b4df956>)



(<http://scholar.google.co.id/citations?hl=id&user=rae-lrEAAAAJ>)



(<http://search.crossref.org/?q=biodiversitas&type=Journal>)



(<https://academic.microsoft.com/#/detail/2738269101>)

Traditional agro-management practices, utilization and nutritional composition of momala: A local maize variety of Gorontalo, Indonesia

NOVRI YOULA KANDOWANGKO^{1,2,*}, MARGARETHA SOLANG^{2,**}, ERNA RETNAWATY^{3,***}

¹Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Gorontalo. Jl. Jenderal Sudirman No. 6, Gorontalo 96128, Indonesia. Tel./Fax.: +62-435-821125, *email: novrikandowangko@ung.ac.id

²Center for Local Wisdom-based Coastal Ecology Research, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Gorontalo. Jl. Jenderal Sudirman No. 6, Gorontalo 96128, Indonesia. Tel./Fax.: +62-435-821125, **email: margarethasolang@ung.ac.id

³Gorontalo Assessment Institute for Agricultural Technology. Jl. Kopi No. 270, Iloheluma, Bone Bolango 96583, Gorontalo, Indonesia. Tel.: +62-435) 827627, 8700075, Fax.: +62-435-827627, ***email: ernaretnawati@pertanian.go.id

Manuscript received: 13 November 2019. Revision accepted: 1 January 2020.

Abstract. Kandowangko NY, Solang M, Retnawaty E. 2020. Traditional agro-management practices, utilization and nutritional composition of Momala—a local maize variety of Gorontalo, Indonesia. *Biodiversitas* 21: 853-859. Maize (*Zea mays*, L.) or corn, locally called *milu* or *binthe* (Gorontalo language), has been a popular crop among Gorontalo people for a long time. People mostly use baby corn as the main ingredient of *binthe biluhuta*, famous traditional food in Gorontalo. momala is a local maize variety of Gorontalo the cultivation of which is decreasing. The cause is a shift in farmers' preference of the crop, most of them preferring hybrid variety over momala. Decrease in cultivating local maize has also led to a decline in the local farmers' traditional knowledge of the crop. Therefore, initiatives to raise awareness of the importance of cultivating local crops are essential for their popularization and conservation purposes. This research is aimed at (i) exploring the traditional knowledge of local farmers pertaining to agro-management of maize or corn, (ii) describing the utilization of momala, and (iii) investigating the nutritional composition of momala, both by qualitative and quantitative methods. The results revealed that the corn farmers apply the principle of *huyula* or *gotong royong* (communal work) in their agriculture activities. The people are using momala corn as the main ingredient of local food preparations, such as *binthe biluhuta* (clear corn soup), *balobinthe* (corn rice), and *kokole* (soft, pudding-like corn cake), in addition to some traditional rituals. Nutritional analysis indicated that its ash content is 1.34-2.86%, crude protein is 9.09-11.67% crude fat is 4.29-4.96%, and carbohydrate is 67.68-68.16%. Furthermore, the composition of nitrogen-free extract ranges from 57.85-72.96% and metabolic energy content ranges from 2896.94-3352.77 Kcal/kg. Measures to conserve and improve momala are necessary to promote food security of people.

Keywords: Gorontalo, local food, momala maize variety, nutritional composition, traditional agro-management practices

INTRODUCTION

Corn has played a very important role in industrial development. Almost every part of corn or maize crop can be used as the ingredient of food, animal feed, fuel, and even medicines. For example, corn extract is utilized as an anti-diabetic agent in diabetes mellitus treatment (Karigidi and Olaiya 2019). The orange-yellow maize is well-known as the source of provitamin A carotenoid. Vitamin A precursor has a major role in boosting health and preventing diseases (Hwang et al. 2016).

Maize varies in shape and structure of its kernel; varieties of this crop include sweet corn, *Zea mays* everta (a variety of maize that its kernels can be processed into popcorn), dent corn, flint corn, pod corn, waxy corn, and QPM or quality protein maize (Subekti et al. 2007). Maize also shows variation in colors, e.g., yellow, white and black. In fact, color is one of the factors used to distinguish between varieties of this crop.

In Indonesia, farmers cultivate maize varieties, such as hybrid maize (Bisi, Pioneer or popular hybrid varieties) and composite or local maize (Arjuna, Manado Yellow, and Bisma). The advantage of planting local maize varieties is their adaptability to local environmental conditions

(Runtunuwu et al. 2014).

One of the local varieties of maize cultivated in Gorontalo, Indonesia is momala, registered in 2018, according to the official report of Plant Variety Protection no. publ.: 27/BR/PVL/01/2018 (PVP 2018), momala is used as a staple food by people in Gorontalo, its utilization is second only to rice. This crop is used as an alternative staple food and also in the preparations such as *binthe biluhuta* (clear corn soup) or even as an additional ingredient for rice meal, such as *balobinthe*. momala is widely known for its kernel, which has distinctive red-violet color. Within its silk, anthocyanin pigment is present. Cultivation of this variety is significant in some villages of Gorontalo City and Boalemo Districts, such as Pangeya, Sari Tani, Bongo I, Bongo II, Bongo III Village, Raharja, Tanjung Harapan, Dimito, and Dulohupa Villages (PVP 2018).

Base on observations, some maize farmers are losing interest in growing momala as it is becoming difficult for them to get the seeds. The color of momala kernel which is different from other conventional maize varieties is also worsening the issue. As a result, momala is not preferred by sellers. Most farmers prefer to grow hybrid variety because of easy seed availability, some farmers even get it

freely. All these are leading to rapid decline in momala variety. Moreover, no detailed scientific evaluation of the nutritional aspects of this variety has been undertaken so far. Therefore, immediate attention and measures are needed to document, evaluate, popularize and preserve this local variety. This research is aimed at filling this information gap, with the objectives of (i) exploring and documenting the traditional knowledge of local farmers in cultural agro-management of maize or corn, (ii) describing the traditional utilization of momala, and (iii) investigating the nutritional composition of momala.

MATERIALS AND METHODS

Research sites

This study was conducted from March to December 2018 in two villages of Gorontalo Province, Indonesia, namely Biluhu Barat Village (Bonebolango District) and Wumialo Village (Gorontalo City) (Figure 1).

A combination of qualitative and quantitative research methods was employed. It relied on observations and in-depth interviews with the participants to collect qualitative ethnobotanical information pertaining to traditional agricultural management and utilization of maize variety (Montagne 1997).

This study used method was qualitative which is based on the ethnoecological biological approach (Martin 1995) Albuquerque et al. 2014) The field data to collect with

techniques observation, participant observation, and interview. The observation was undertaken in the field, particular observation of the ecological condition of maize gardens, maize crops, and activities of farmers in managing of maize crop and processing of maize productions. The observation participation was carried out by involving researchers in various activities of farmers in managing the maize farming, including planting and harvesting of maize in the gardens, and processing of maize production in the farmers' houses. While the interview was applied with a deep interview or semi-structured-interview with local experts or competent informants which are purposively selected by the snowball technique (ef. Martin 1995).

The quantitative method was applied to analyze and evaluate the nutritional value of the momala maize. The proximate composition analysis focused on examining the composition of ash, protein, fat, and carbohydrate, while the mineral analysis examined the composition of Magnesium (Mg), zinc (Zn), phosphate (P), calcium (Ca), potassium (K), copper (Cu) and manganese (Mn). Proximate analysis was conducted in the laboratory of the Faculty of Veterinary Medicine, Universitas Airlangga, Surabaya, Indonesia using analysis method from National Standardization Agency of Indonesia (SNI) (SNI 01-2891-1992) and Association of Official Analytical Chemists (AOAC 2001). Analysis of mineral composition was conducted in the Center for Health Laboratory, Universitas Airlangga, Surabaya, Indonesia using AAS method (Atomic Absorbent Spectrophotometry) (Murningsih et al. 2018).

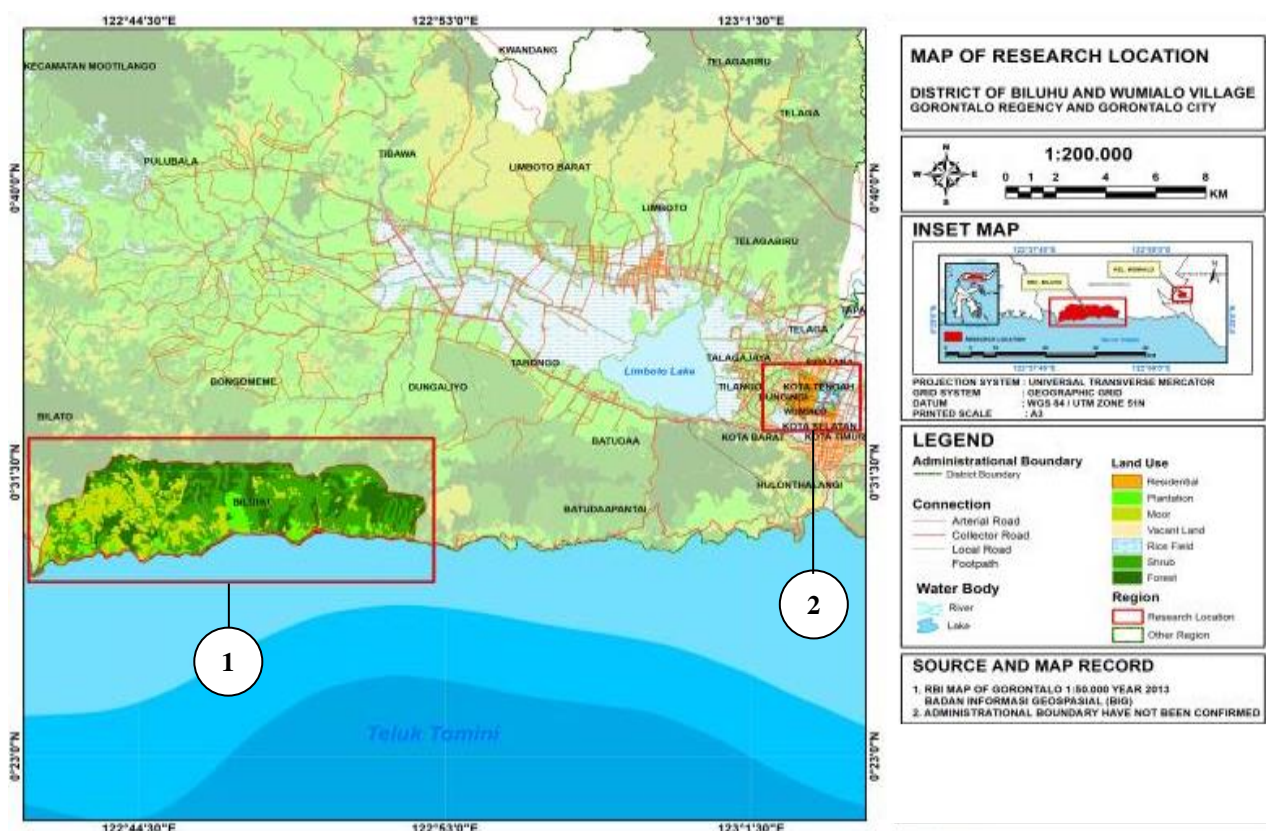


Figure 1. Research sites in Biluhu Barat Village, Bonebolango District (1), and Wumialo Village, Gorontalo City (2), Gorontalo Province, Indonesia

Analysis of ash content (SNI 01-2891-1992)

As many as two to three grams of the sample was inserted into an evaporating dish, the sample in the dish was charred on top of a Bunsen burner. The sample was further charred again in an electric arc furnace with a maximum temperature of 550 °C until the charring process was completed (the door of the furnace is usually left open a bit for allowing the oxygen flow into the furnace). Following this process, the sample was allowed to cool down in a desiccator. The sample was also weighed until its weight remained constant.

$$\text{Ash content} = \frac{W_1 - W_2}{W} \times 100\%$$

W : weight before charring process (g)

W₁ : weight of the sample + dish after the charring process (g)

W₂ : weight of the empty dish (g)

Crude protein analysis (AOAC 2001)

As many as 0.1 g of the sample was mixed with 1 g of catalyst (made by mixing 1 g of copper sulfate CuSO₄ and 1.2 g of NaSO₄ or sodium sulfate) and 2.5 mL of concentrated sulfuric acid (H₂SO₄). This mixture was heated in a Kjeldahl Flask until its color turned vivid. The mixture was then cooled and diluted until 100 mL. 5 mL of the sample was inserted into a distillation apparatus, the distillation process was stopped once the distillate volume becomes twice the original volume (the volume before the distillation process). The distillate was further titrated with 0.02 N sodium hydroxide NaOH, two drops of red methylate and blue methylate (Mengsel) was also added. The same treatment can also be applied to blank solution.

$$\text{Protein} = \frac{\text{mL titration (blank solution - titration)} \times N \ 14.007 \times 6.25}{\text{Weight of the sample (g)} \times 1000} \times 100\%$$

Analysis of crude fat content (SNI 01-2891-1992)

One to two grams of sample was inserted into a paper tube, the bottom side of the paper was covered with cotton. The sample was dried in an oven with a temperature not exceeding 80° for approximately an hour. Further, the sample was inserted into a soxhlet apparatus that had been connected to a boiling flask containing dried boiling stone of known weight. The process was followed by the extraction using hexane or other fat solvents for about six hours. The hexane was filtered, and the fat extract was dried in an oven at the temperature of 105 °C. Afterward, the sample was cooled down and weighed. The drying was replicated until the sample's weight remained constant.

$$\% \text{ fat} = \frac{W - W_1}{W_2} \times 100\%$$

W : weight of sample (g)

W₁ : weight of flask before extraction (g)

W₂ : weight of flask after extraction

Analysis of carbohydrate content (SNI 01-2891-1992)

As many as five grams of sample was inserted to a 500 mL Erlenmeyer flask. Further 200 mL of 3% hydrochloric acid or HCl was added; the mixture was heated for three hours using a Liebig condenser. The mixture was cooled down and neutralized using sodium hydroxide 30% NaOH (using litmus or phenolphthalein). 3% CH₃COOH (acetic acid) was added to the mixture, so that the solution becomes a bit acidic. The mixture was moved to a 500 mL of volumetric flask until it reached the marked line, and was filtered. 10 mL of filter was added into a 500 mL Erlenmeyer flask. Following this step was adding 25 mL of luff solution (using a pipette), boiling stones, and 15 mL of distilled water. All of the mixtures were heated at a constant temperature. The solution brought to its boiling temperature in three minutes (using a timer). The boiling process continued until 10 minutes right after the mixture reached its boiling temperature and cooled down in a tub of ice immediately. Once the mixture was cooled, 15 mL of 20% potassium iodide and 25 mL of 25% sulfuric acid was poured slowly. The mixture was titrated using 0.1 N thio (using the 0.5% of starch solution), and then proceed with the blank solution.

$$\text{Glucose content} = \frac{W_1 \times fp}{W} \times 100\%$$

Level of carbohydrate: 0.90 x level of glucose

W₁ : weight of sample (g)

W₂ : content of glucose for every mL of thio used from the list

fp : dilution factor

Data analysis

The collected data was analyzed by crosschecking, summarizing, synthesizing, and built up a narrative with descriptive analysis and evaluative (Newing et al. 2011)

RESULTS AND DISCUSSION**Traditional agro-management of maize**

Agricultural land for maize planting in Biluhu Village is 180 Ha. The total maize yield is 846 tons, and its productivity is around 2.6 tons/Ha. The agricultural land of the village is dominated by hills. Maize farmers in the village grow maize in area having 25 to 40% slope (BPS 2016). The agricultural areas in Wumialo Village are mostly flatlands, and the percentage of the area used for growing maize is only 0.54% (BPS 2018).

The farmer community in Biluhu Village implements the principle of *huyula* (a term derived from Gorontalo language) in managing the agricultural area. In this practice, each farmer takes turn in organizing the agricultural activities, which range from land clearing, planting, weeding, harvesting, and removing corn kernels. The maize farmers in Wumialo Village, in contrast, apply different concepts in their agricultural activities; they apply mainly the daily wage system.

Maize filled with mature kernels on all sides of the cob or ear is the preference of farmers for preparing corn seeds for planting. The husks of the corn are put together and tied on a bamboo. The bamboo is then put on a fireplace (which is called *dodika* in Gorontalo language); the fuel used is mostly firewoods or coconut shells. This process is to ensure that the prepared kernels are free from pests.

Momala, the local maize variety, is recognized for its long size and unique clumping characteristic. Each maize plant may contain two to five cobs or ears. The plant height is 146.47 cm on average; the average cob height is 73.88 cm, with the average stem perimeter of 8.46 cm. In one plant, the number of the leaves is 12 on average, where the average leaves strand is 86.59 cm; the average leaves midrib is 16.25 cm with an average width of 8.71 cm. The leaves are a bit curving with pointed tips. Besides, the average axilla corner is 39.950; the grain is 5.86%, and the husk is 83.76%. Average cob length is 12.58 cm; average cob diameter is 3.34 cm; average cob weight with its husk is 88.58 g, average cob weight without husk measures at 60.74 g, average kernel number per line is 20, and weight of 1000 grains measures at 272 g (Suleman et al. 2019).

The farmers plant two kernels per planting pot; this is to ensure at least one germinates. Male and female farmers have their roles distributed while planting the corn. Men generally prepare the land and planting plots while the women plant the kernels. In growing local maize, farmers are not accustomed to irrigation or fertilization. They harvest the maize for specific purposes. For example, the farmers harvest the crop in 45 to 60 days after planting, if their preference is baby corn. Stover that is still fresh is used for feeding cows. The farmers let the corn to dry and harvest it after 90 to 100 days of planting, if they need old corn. The stem and leaves are cut and left to rot. During the new planting season, farmers grow the maize manually using traditional methods or relying on animals, such as cows, to plow the land (this process is referred to as *pajeko* in Gorontalo language).

The maize farmers to start planting corn usually pay attention to the right planting time, according to the instructions of the Elders who know the astronomy system. Astrologers (*Panggoba*, in Gorontalo language) with their local experience and knowledge can determine the right time to start an activity, including the time to plant a cultivation crop. Such an agricultural practice shares some similarities with the system of dryland farming of Baduy community. Local knowledge of the Baduy forest community is adaptive to their environment. They rely on environmental indicators, such as the position of constellations, flowering period, and traditional, custom-based agricultural calendar system (Iskandar 2015).

Utilization of momala

Details regarding the utilization of momala in preparation of various food items are provided in Table 1. According to the interview data as shown in Table 1, the kernels of momala (both young and old kernels) are used as the ingredient of some traditional foods. The kernels are processed to corn starch to be used as the ingredient of

some traditional cakes. The byproduct of the plant, consisting of stalk and leaf of the plant, are also processed into straw for animal feeds. The utilization of momala is similar to the use of Manado Kuning variety which has been reported to be utilized for purposes, including as ingredient of food (processed into starch), and as animal feed. In Tompaso, Manado Kuning variety is used as animal feed since the area has a lot of racehorses (Runtunuwu et al. 2014). The use of coconut in some maize or corn dishes is similar to *Kukuruwu*, a traditional food of Baduy tribe (Iskandar 2015). Information about the utilization of maize or corn as the ingredient of many high nutrient foods has been integrated into learning activities at schools. This has been stipulated in the Regulation of Regional Government of the Province of Gorontalo No. 3 of 2015 considering the Gorontalo Traditional Cuisine-Based Nutrition Studies. Maize is among the main ingredients of traditional food of Gorontalo (Peraturan Daerah Provinsi Gorontalo 2015).

Nutritional value of momala maize

The results of analysis of proximate composition of momala maize found in Biluhu and Wumialo Villages are summarized in Table 2. This table indicates a difference in the composition of protein and basal energy without nitrogen, between the samples of Biluhu and Wumialo villages. The difference is thought to be influenced by soil fertility. Especially when planting maize without fertilization. The distribution of carbohydrates and nutrients varies significantly among the corns' stover fraction and research sites (Mourtzinis et al. 2016). The protein content of momala is different from that of Pena Tunu 'Ana', the local variety of Nusa Tenggara Timur, which has protein content of $11.78 \pm 0.05\%$. However, the protein content of momala is higher than other local varieties, such as Piet Kuning, Gumarang and Lamuru (Murningsih et al. 2018). The protein content of momala is also greater than Manado Kuning variety, having 7.71% of protein (Landeng et al. 2017). When compared with hybrid corn, the protein content of momala corn is higher than Bisi 2, while the carbohydrate content in Bisi 2 is higher than momala. Bisi 2 has a protein content of 8.40%, carbohydrates 75.10% (Suarni 2017). Maize or corn with the protein content above 9% meets the SNI standard (1998) of a minimum percentage of 7.5%; the maize is also considered high-protein corn, and such corn can be used as the ingredient of foods, e.g., bread, biscuits, cakes, and other high-protein foods. The proximate composition of momala is also higher than other maize varieties of Kaduna, Nigeria, in which the carbohydrate percentage range was 44.8-69.6%, protein content 4.5-9.87%, moisture content 11.6-20%, fiber content 2.10-26.77%, fat content 2.17-4.43%, and the ash content was 1.10-2.95% (Enyisi et al. 2014). All genotypes of maize have substantial differences in terms of their chemical and mineral composition (Kabir et al. 2019). On the other hand, the lowest amount of carbohydrate and protein was found in BHM-15 (77.67%) and BHM-8 (10.96%). BHM-13 contains the lowest amount of fiber (1.24%) and fat (4.27%) (Kabir et al. 2019).

Table 1. The utilization of momala maize of Gorontalo Province, Indonesia

Name of food product	Utilized maize part	Other ingredients	Method of preparation
<i>Balobinthe</i> (rice mixed with corn)	Old corn	Rice	<ul style="list-style-type: none"> Add finely crushed old corn kernel to rice, in the ratio of 1: 3. Rinse the mixture of corn and rice. Pour the mixture into a pan, add water to the pan and start cooking the rice in a rice cooker.
<i>Binthe biluti</i> (pan-toasted corn kernels served with Ebi shrimp and shredded coconut)	Baby corn	Shredded semi-ripe coconut, fish or ebi shrimp, basil, chili/pepper, chives, onion, calamansi lemon (<i>Citrus microcarpa</i>), coconut oil, salt.	<ul style="list-style-type: none"> Boil corn and shrimp for 20 minutes. Lift the boiled corn and drain. Pan sear the corn. In a bowl, stir shredded coconut, shrimp or fish, basil, sliced green onion, and salt. Add calamansi lemon juice to the bowl. Add the corn to the bowl, stir it and add fried onions for the topping.
<i>Binthe biluhuta</i> (clear corn soup)	Baby corn	Cakalang fufu (smoked skipjack tuna), ebi shrimp, shredded semi-ripe coconut, rawit (bird's eye chili), shallots, basil, lemongrass, chives, calamansi lemon, salt, soy sauce.	<ul style="list-style-type: none"> Boil corn and 1 stalk of lemon grass for 20 minutes until done. Sauce: Grind together 15 bird's eye chili and 2 cloves of shallots, add salt. Remove bones from the smoked fish, shred the fish. Add slices of green onion, shredded fish, basils, salt, and lemon juice to the boiled corn. Stir it well. Binthe biluhuta can be served with chili paste and soy sauce.
<i>Nagasari milu</i> (coconut, corn and rice flour cake with sliced banana filling)	Baby corn	Coconut milk, hunkwe (mung bean) flour, sugar, pandan leaves	<ul style="list-style-type: none"> Shred or mash corn until smooth. In a bowl, pour some water, sugar, and pandan leaves; boil until cooked. Add the mashed corn to the bowl. Pour hunkwe powder, set the stove to medium heat. Add the corn batter to the hunkwe batter. Stir the mixture until thickened. Chill the batter. Scoop the mixture onto the center of the banana leaf. Fold into a nice packet. Place the wrapped cake into a steamer. Steam it for 20 minutes until done. Takes the cake out from the steamer and serve at room temperature.
Gamie (traditional maize dish of Gorontalo)	Baby corn	Papaya leaf, banana blossom (<i>putungo</i>), shallot, chili, salt, shredded coconut.	<ul style="list-style-type: none"> Boil baby corn. Shred semi-ripe coconut. Slice papaya leaf and banana blossom, pour these into mashed shallot and chili. Add shredded coconut to the mixture. Stir it well. The mixture is served with boiled corn.
<i>Kokole</i> (pudding-like corn cake)	Baby corn	Coconut milk, brown sugar	<ul style="list-style-type: none"> Blend kernels of the corn until smooth. The blended corn is then filtered, so that corn extract is obtained. Melt brown sugar until it melts. In a bowl pour the corn extract, shredded coconut, and melted brown sugar; stir it well. Cook the mixture until boiling and thickened. Pour the mixture into a pan that has been greased with coconut oil to keep the batter from sticking. Chill the dough or batter. <i>Kokole</i> is better served cold.

The mineral composition of momala corn is shown in Table 3. The mineral content of momala is lower than Tunu 'Ana', the local maize variety of East Nusa Tenggara, Indonesia. Tunu 'Ana' contains 127.50 ±0.00 mg/100g of magnesium, 310.00 ±0.01 mg/100g of Potassium, 450.00 ±0.00 mg/100g of phosphor, which is greater than three

varieties of maize, such as Gumarang), Lamuru and Piet Kuning (Murningsih et al. 2018). In comparison with these maize varieties, the content of magnesium in momala is only 0.122 mg/kg, contains 0.316 mg/kg of phosphate and contains 0.413 mg/kg potassium.

Table 2. Proximate composition of momala variety of corn

Proximate composition	Momala of Biluhu Village (Bonebolango District)	Momala of Wumialo Village (Gorontalo City)
Dried material (%)	90.37 ± 3.58	87.83 ± 2.67
Ash (%)	2.39 ± 0.66	1.35 ± 0.01
Protein (%)	9.56 ± 0.66	11.51 ± 0.24
Crude fat (%)	4.64 ± 0.11	4.62 ± 0.48
Carbohydrate (%)	68.16 ± 0.43	67.68 ± 0.67
Basal energy without nitrogen	71.09 ± 2.64	58.36 ± 0.93
Energy kcal/100 g	3274.42 ± 110.81	2886.25 ± 14.68

Note: Data is the average ± standard deviation of 2 replications

Table 3. Mineral composition of momala variety of corn

Parameter	Result (mg/kg)
Magnesium (Mg)	0.122 ± 0.0028
Zinc (Zn)	0.005 ± 0.0021
Phosphate (P)	0.316 ± 0.0057
Calcium (Ca)	0.046 ± 0.0071
Potassium (K)	0.413 ± 0.0071
Copper (Cu)	0.001 ± 0.0001
Manganese (Mn)	0.003 ± 0.0007

Momala is also recognized with its distinctive purple kernels and female flowers (PVP 2018); Suleman et al. 2019). These diverse morphological characters could possibly be influenced by many factors, such as genetic factors and environmental factors. That variations in the phenotypic appearance of plants can be caused by differences in plant characters (genetic), differences in environmental conditions, or interactions of the two factors (Sinay and Karuwal 2018). In addition to this, the presence of purple color in the momala corn plant is suspected that the momala corn has a high anthocyanin content. The presence of anthocyanin acts as an antioxidant to prevent atherosclerosis, a blood vessel obstruction. High anthocyanin content is assumed to be the cause of such uniqueness of momala. Anthocyanin, as an antioxidant, can prevent atherosclerosis, a disease obstructing blood flow (Balitsereal 2019).

Momala plays a major role in the food security of local people. In spite of that, this local variable is not preferred by most farmers, as it is difficult for them to get the seeds of this maize. This issue demands solutions, such as conserving and developing momala maize. One of the efforts is to improve the national maize productivity by setting time for cultivation and determining the spaces between the plants during the planting of hybrid and local maize (this is to prevent natural hybridization between these maize varieties). In addition, momala corn should be properly fertilized to improve its proximate composition and mineral content which can make it nutritionally rich.

ACKNOWLEDGEMENTS

We extend our gratitude to all the local farmers for their willingness to participate in the interview process and share their knowledge.

REFERENCES

- Albuquerque UP, Cruz da Cunha LVF, Lucena RFP, Alves RRN (eds.). (2014). *Methods and Techniques in Ethnobiology and Ethnoecology*. Springer, New York.
- AOAC. 2001. *AOAC Guidelines for Single Laboratory*. AOAC International, Rockville, MD.
- BPS [Badan Pusat Statistik]. 2016. Kabupaten Boalemo dalam Angka 2016. BPS Kabupaten Boalemo. BPS, Boalemo. [Indonesian]
- BPS [Badan Pusat Statistik]. 2018. Kota Gorontalo dalam angka. BPS, Kota Gorontalo. [Indonesian]
- Balitsereal. 2019. Jagung Ungu. Balai Penelitian Serealia, Maros. [Indonesian]
- Enyisi SI, Umoh V, Whong C, Abdullahi I, Alabi O. 2014. Chemical and nutritional value of maize and maize products obtained from selected markets in Kaduna State, Nigeria. *African J Food Sci Tech* 5 (4): 2141-5455. DOI: 10.14303/ajfst.2014.029
- Hwang T, Ndolo VU, Katundu M, Nyirenda B, Bezner-Kerr R, Arntfield S, Beta T. 2016. Provitamin A potential of landrace orange maize variety (*Zea mays* L.) grown in different geographical locations of central Malawi. *Food Chem* 196: 1315-1324. DOI: 10.1016/j.foodchem.2015.10.067
- Iskandar J. 2015. Studi etnobotani keanekaragaman tanaman pangan pada "Sistem Huma" dalam menunjang keamanan pangan Orang Baduy. In *Pros Sem Nas Masy Biodiv Indon* 1265-1272. DOI: 10.13057/psnmbi/m010601. [Indonesian]
- Kabir SH, Das AK, Rahman MS, Singh MS, Morshed M, Marma ASH. 2019. Effect of genotype on proximate composition and biological yield of maize (*Zea mays* L.). *Archive Agri Envir Sci* 4 (2): 185-189. DOI: 10.26832/24566632.2019.040209
- Karigidi KO, Olaiya CO. 2019. Antidiabetic activity of corn steep liquor extract of *Curculigo pilosa* and its solvent fractions in streptozotocin-induced diabetic rats. *J Trad Comp Med*. DOI: 10.1016/J.JTCME.2019.06.005
- Landeng PJ, Suryanto E, Momuat LI. 2017. Komposisi proksimat dan potensi antioksidan dari biji jagung manado kuning (*Zea mays* L.). 10 (1): 36-44. R
- Martin GJ. 1995. *Ethnobotany: a Methods Manual*. Chapman and Hall, London.
- Montagne M. 1997. *Ethnobotany: Principles and Applications* By Cotton CM. John Wiley and Sons Ltd, Baffins Lane, Chichester, West Sussex, England. *J Med Chemis* 40 (13): 2108-2108. DOI: 10.1021/jm9701841
- Mourtzinis S, Cantrell KB, Arriaga FJ, Balkcom KS, Novak JM, Frederick JR, Karlen DL. 2016. Carbohydrate and nutrient composition of corn stover from three southeastern USA locations. *Biomass Bioener* 85: 153-158. DOI: 10.1016/j.biombioe.2015.11.031
- Murningsih T, Yulita KS, Bora CY, Arsa IGB. 2019. Proximate and mineral content of maize landrace (tunu'ana') from East Nusa Tenggara. *Pros Sem Nas Masy Biodiv Indon* 5: 107-111. DOI: 10.13057/psnmbi/m050120
- Newing H, Eagle CM, Puri WC. 2011. *Conducting Research in Conservation: A Social Science Perspective/Social Science Methods and Practice*. Routledge, London.
- Peraturan Daerah Provinsi Gorontalo. 2015. *Perda Provinsi Gorontalo Nomor 3 Tahun 2015 tentang Pembelajaran Ilmu Gizi berbasis Makanan Volume 151*. Gorontalo. [Indonesian]
- PVT [Pusat Perlindungan Varietas]. 2018. *Berita Resmi PVT Pendaftaran Varietas Lokal*. Retrieved from <http://pvtpp.setjen.pertanian.go.id/berita-resmi/pendaftaran-varietas-lokal/>. [Indonesian]
- Runtuwunu SD, Pamandungan Y, Mamarimbing RM. 2014a. The exploration of manadonese yellow maize germplasm in North Sulawesi. *Jurnal Bios Logos* 2 (1): 56-64. DOI: 10.35799/jbl.4.2.2014.6353. [Indonesian]

- Sinay H, Karuwal RL. 2018. Short communication: Genetic variability of local corn cultivars from Kisar island, Maluku, Indonesia based on morphological characters. *Biodiversitas* 19 (6): 2302-2307. DOI: 10.13057/biodiv/d190638
- Suarni SW. 2017. Struktur, Komposisi dan Nutrisi Jagung. In *Jagung: Teknologi dan Pengembangan Jagung*. Balai Penelitian Tanaman Serealia, Maros. [Indonesian]
- Suleman R, Kandowangko NY, Abdul A. 2019. Karakterisasi morfologi dan analisis proksimat jagung (*Zea mays* L.) varietas momala gorontalo. *Jambura Edu Biosfer Journal* 1 (2): 72-81. DOI: 10.34312/jebj.v1i2.2432.
- Subekti N, Syafruddin R, Sunarti S. 2007. Morfologi tanaman dan fase pertumbuhan jagung. Balai Penelitian Tanaman Serealia, Maros. [Indonesian]
- SNI. 1992. SNI 01-2891-1992 Cara Uji Makanan dan Minuman. [Indonesian]