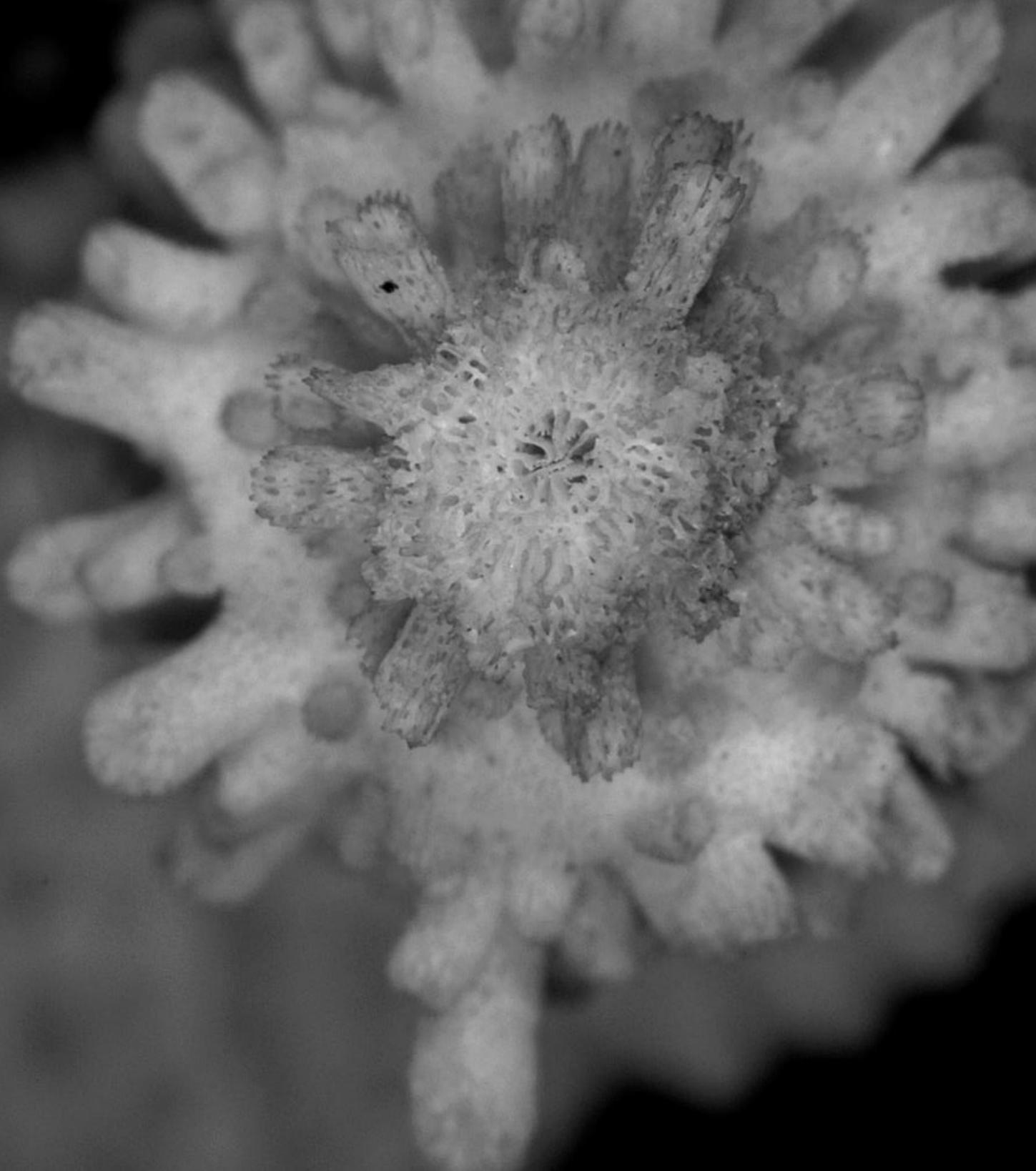


ISSN: 1412-033X
E-ISSN: 2085-4722

BIODIVERSITAS

Journal of Biological Diversity

V o l u m e 2 1 - N u m b e r 5 - M a y 2 0 2 0



Front cover: *Acropora copiosa* Nemenzo, 1971
(PHOTO: DLSU.EDU.PH)

Published monthly

PRINTED IN INDONESIA

ISSN: 1412-033X

E-ISSN: 2085-4722



9 771412 033764



9 772085 472768

BIODIVERSITAS

Journal of Biological Diversity
Volume 21 – Number 5 – May 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 Wanntorp** (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), **Seyed Aliakbar Hedayati** (Iran), **Seyed 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:

Assaed 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

BIODIVERSITAS

Journal of Biological Diversity
Volume 21 - Number 5 - May 2020

- Anatomical examination of the petiole of eupolypods I (Polypodiales)** 1767-1777
JEANETTE MARA P. TAN, MARIA CELESTE BANATICLA-HILARIO,
PASTOR MALABRIGO, MARJORIE DELOS ANGELES, INOCENCIO E. BUOT, JR.
- The growth of three varieties of black pepper (*Piper nigrum*) under different light intensities related to indigenous hormones role** 1778-1785
ISSUKINDARSYAH, ENDANG SULISTYANINGSIH, DIDIK INDRADEWA,
EKA TARWACA SUSILA PUTRA
- Short Communication: The composition of undergrowth vegetation in the Gendol River bank, Sleman District, Yogyakarta, Indonesia** 1786-1792
ATUS SYAHBUDIN, ALNUS MEINATA, RIDLA ARIFRIANA, WIYONO
- Diversity of soil organic carbon and water characteristics under different vegetation types in northern Bengkulu, Indonesia** 1793-1799
BANDI HERMAWAN, HERY SUHARTOYO, BAMBANG SULISTYO,
BAMBANG GONGGO MURCITRO, WELLY HERMAN
- Distribution of *Gyrinops versteegii* in varying vegetation structures, soil properties, and microclimates in western part of Flores Island, Indonesia** 1800-1808
TITUT YULISTYARINI, ABBAN PUTRI FIQA, SUGENG BUDIHARTA,
RIDESTI RINDYASTUTI
- Short Communication: Isolation and characterization of the endophytic bacteria, and their potential as maize diseases control** 1809-1815
ENDANG MUGIASTUTI, SUPRAYOGI, NUR PRIHATININGSIH, LOEKAS SOESANTO
- Coral transplantation on a multilevel substrate of Artificial Patch Reefs: effect of fixing methods on the growth rate of two *Acropora* species** 1816-1822
MUNASIK, AGUS SABDONO, AZELIA N ASSYFA, DIAH PERMATA WIJAYANTI,
SUGIYANTO, IRWANI, RUDHI PRIBADI
- Morphological variation of two common sea grapes (*Caulerpa lentillifera* and *Caulerpa racemosa*) from selected regions in the Philippines** 1823-1832
JEREMIAH L. ESTRADA, NONNATUS S. BAUTISTA, MARIBEL L. DIONISIO-SESE
- Effects of supplementation with phosphorus, calcium and manganese during oil palm frond fermentation by *Phanerochaete chrysosporium* on ligninase enzyme activity** 1833-1838
RONI PAZLA, NOVIRMAN JAMARUN, FAUZIA AGUSTIN, MARDIATI ZAIN, ARIEF,
NESYA OKTIA CAHYANI
- Toxicity of entomopathogenic fungal culture filtrate of lowland and highland soil of South Sumatra (Indonesia) against *Spodoptera litura* larvae** 1839-1849
MIMMA GUSTIANINGTYAS, SITI HERLINDA, SUWANDI, SUPARMAN, HARMAN
HAMIDSON, HASBI, ARUM SETIAWAN, MARIESKA VERAWATY, ELFITA, ARSI
- Ethnobotany and conservation of indigenous edible fruit plants in South Aceh, Indonesia** 1850-1860
ADI BEJO SUWARDI, ZIDNI ILMAN NAVIA, TISNA HARMAWAN, SYAMSUARDI,
ERIZAL MUKHTAR
- Ethnobotanical knowledge and conservation practices of indigenous people of Mbeliling Forest Area, Indonesia** 1861-1873
MARLINDA MULU, ZEPHISIUS R.E. NTELOK, PETRUS SII, HILDEGARDIS MULU

| | |
|--|-----------|
| <p>Short Communication: Community of phytoplankton in peatland canal, Riau, and wet dune slacks of Parangtritis, Yogyakarta, Indonesia ANNISA MAWARNI, FIRDA N.N. AZIZAH, HENI W. SARTIKA, SUWARNO HADISUSANTO, DWINDA M. PUTRI, AKBAR REZA</p> | 1874-1879 |
| <p>Assessment on the growth performance of planted <i>Dryobalanops beccarii</i> at reforestation sites after implementation of selective girdling MOHD EFFENDI WASLI, DOUGLAS BUNGAN AMBUN, MEEKIONG KALU, MOGERET SIDI, HAFSAH NAHRAWI, HASHIMAH ELIAS</p> | 1880-1889 |
| <p>Better providers of habitat for Javan slow loris (<i>Nycticebus javanicus</i> E. Geoffroy 1812): A species distribution modeling approach in Central Java, Indonesia MAHFUT SODIK, SATYAWAN PUDYATMOKO, PUJO SEMEDI HARGO YUWONO, MUHAMMAD TAFRICHAN, MUHAMMAD ALI IMRON</p> | 1890-1900 |
| <p>Identification of growth genes diversity of swamp buffalo using RFLP in Kabaena Island, Bombana District, Southeast Sulawesi, Indonesia LA ODE NAFIU, MUZUNI, MUHAMMAD AMRULLAH PAGALA, WIDHI KURNIAWAN, SYAM RAHADI</p> | 1901-1907 |
| <p>Short Communication: Genetic diversity of lemon (<i>Citrus</i> spp.) from Ternate Island (Indonesia) based on morphological and molecular characters ABDULRASYID TOLANGARA, ALOYSIUS DURAN COREBIMA, ABDU MAS'UD, SUNDARI</p> | 1908-1913 |
| <p>Short Communication: The type and sound diversity of <i>Kukuak Balenggek</i> chicken (<i>Gallus gallus domesticus</i>) reared in West Sumatra, Indonesia FIRDA ARLINA, RUSFIDRA, DICKY ANDRIANO, CECE SUMATRI,</p> | 1914-1919 |
| <p>The potency of endophytic bacteria isolated from <i>Ficus septica</i> as phytoremediation promoting agent of Cr (VI) contaminated soil NITA SHILFIANI ROHMAH, SUHARJONO, YOGA DWI JATMIKO, DIAN SISWANTO, IRFAN MUSTAFA</p> | 1920-1927 |
| <p>Assessment of plants as lead and cadmium accumulators for phytoremediation of contaminated rice field NURIL HIDAYATI, DWI SETYO RINI</p> | 1928-1934 |
| <p>Effectiveness of biological control of <i>Trichoderma harzianum</i> on soybean leaf rust disease and the production in West Papua Lowland, Indonesia EKO AGUS MARTANTO, ADELIN E. TANATI, SAMEN BAAN, HERMAN R. TATA, AGUSTINUS MURDJOKO</p> | 1935-1939 |
| <p>Fauna diversity, production potential and total economic value of mangrove ecosystems in Mentawir Village, East Kalimantan, Indonesia ROCHADI KRISTININGRUM, ABUBAKAR M. LAHJIE, MASJAYA, SYAHRIR YUSUF, YOSEP RUSLIM, AMIR MA'RUF</p> | 1940-1953 |
| <p>Fungal isolates from marine sponge <i>Chelonaplysilla</i> sp: Diversity, antimicrobial and cytotoxic activities DIAN HANDAYANI, MUH. ADE ARTASASTA, NILDA SAFIRNA, DIANA FITRI AYUNI, TRINA EKAWATI TALLEI, TRIANA HERTIANI</p> | 1954-1960 |
| <p>Helminth fauna of <i>Microtus cf. arvalis</i> (Rodentia, Cricetidae) in Russia and adjacent countries NADEZHDA Y. KIRILLOVA, ALEXANDER A. KIRILLOV, ALEXANDER B. RUCHIN, MAXIM V. TRUKHACHEV</p> | 1961-1979 |
| <p>Assessment of the health status of the Sidi R'Ghies forest, Oum El Bouaghi, north-east Algerian MALIKA RACHED-KANOUNI, ALIA ZERROUKI, MAROUA LAHMAR, AMINA BELDJAZIA, KARIMA KARA, LABED ABABSA</p> | 1980-1988 |

| | |
|---|-----------|
| Floristic analysis of semi-arid mountain ecosystems of the Griqualand West centre of plant endemism, Northern Cape, South Africa NANETTE VAN STADEN, STEFAN JOHN SIEBERT, DIRK PETRUS CILLIERS, DIAN WILSENACH, ARNOLD WALTER FRISBY | 1989-2002 |
| Spontaneous plant recolonization on reclaimed post-coal mining sites in East Kalimantan, Indonesia: Native versus alien and succession progress LIA HAPSARI, TRIMANTO, SUGENG BUDIHARTA | 2003-2018 |
| Growth prediction for rubber tree and intercropped forest trees to facilitate environmental services valuation in South Thailand NARUN NATTHAROM, SAOWALAK ROONGTAWANREONGSRI, SARA BUMRUNGSRI | 2019-2034 |
| Dispersion of <i>Tongkat Langit</i> Banana in Buru and Seram, Maluku Province, Indonesia, based on topographic and climate factors HALVINA GRASELA SAIYA, ADRIANA HIARIEJ, ANNEKE PESIK, ELIZABETH KAYA, MEITTY LOUISE HEHANUSSA, FERAD PUTURUHU | 2035-2046 |
| Genetic variability of Indonesian <i>Oryctes rhinoceros nudivirus</i> (OrNV) as the genus of <i>Alphanudivirus</i> SAT RAHAYUWATI, YAYI MUNARA KUSUMAH, SUDHARTO PRAWIROSUKARTO, DADANG, TEGUH SANTOSO | 2047-2055 |
| Population ecology size and habitat preference of the ghost orchid <i>Didymoplexis pallens</i> in Bogor Botanic Gardens, Indonesia RIZMOON NURUL ZULKARNAEN, R. VITRI GARVITA, HARY WAWANGNINGRUM, KARTIKA NING TYAS | 2056-2061 |
| Antioxidant activity screening of seven Indonesian herbal extract JOHAN SUKWEENADHI, OEKE YUNITA, FINNA SETIAWAN, KARTINI, MAYA THERESA SIAGIAN, ANGGREYNI PRATIWI DANDURU, CHRISTINA AVANTI | 2062-2067 |
| Short Communication: First record of <i>Hirschmanniella mucronata</i> (Nematoda: Pratylenchidae) in Yogyakarta, Indonesia SIWI INDARTI, ALAN SOFFAN, MUHAMMAD MAULANA FARDANI ANDRASMARA | 2068-2073 |
| Short Communication: Polymorphism at third exon of the Myostatin gene and its association with growth and carcass traits in Batur sheep HASSAN ISHAG HASSAN HAREN, DATTADEWI PURWANTINI, MAS YEDI SUMARYADI, PRAYITNO | 2074-2078 |
| Abundance of ants (Hymenoptera: Formicidae) and the functional groups in two different habitats ANANTO TRIYOGO, BUDIADI, SM WIDYASTUTI, SENA ADI SUBRATA, SUWITO SETYO BUDI | 2079-2087 |
| Nesting behavior of reintroduced Bornean Orangutan in Bukit Batikap Conservation Forest, Central Kalimantan, Indonesia IKE NURJUITA NAYASILANA, SRI SUCI UTAMI ATMOKO, AHMAT SUYOKO, SUWARNO HADISUSANTO | 2088-2096 |
| Genetic diversity of blue swimming crab (<i>Portunus pelagicus</i> Linn 1758) from Indonesian waters (Sunda and Sahul Shelf, Wallacea region): Phylogenetic approach ANDI ALIAH HIDAYANI, YUSHINTA FUJAYA, DODY DH. TRIJUNO, NITA RUKMINASARI, ALIMUDDIN ALIMUDDIN | 2097-2102 |
| Isolation and identification of cellulolytic bacteria at fibric, hemic and sapric peat in Teluk Bakung Peatland, Kubu Raya District, Indonesia SITI KHOTIMAH, SUHARJONO, TRI ARDYATI, YULIA NURANI | 2103-2112 |
| Short Communication: Preliminary phylogenetic analysis of bacteria producing laccase isolated from Gunung Pancar, Bogor, Indonesia WIN WIN MAR, ALI ROHMAN, NUR H MUWAFIQI, GALIH AYHUSTA LARAS, DYAH AGUSTINA, ONE ASMARANI, NI NYOMAN TRI PUSPANINGSIH | 2113-2118 |

| | |
|--|-----------|
| Short Communication: Biological control of <i>Fusarium</i> wilt on banana plants using biofertilizers ARIEF WIDYANTORO, HADIWIYONO, SUBAGIYA | 2119-2123 |
| The impact of bioinsecticide overdoses of <i>Beauveria bassiana</i> on species diversity and abundance of not targeted arthropods in South Sumatra (Indonesia) freshwater swamp paddy KHOIRUL IKHSANUDIN HANIF, SITI HERLINDA, CHANDRA IRSAN, YULIA PUJIASTUTI, GHANNI PRABAWATI, HASBI, TILI KARENINA | 2124-2136 |
| Autecology of <i>Drosera burmanni</i> in the Wolobobo Botanic Gardens, Ngada District, Flores Island, Indonesia JOKO RIDHO WITONO, DIDI USMADI, WIHERMANTO, DANANG WAHYU PURNOMO, DINA SAFARINANUGRAHA, YANUAR PAKIDING, NELWAN NETOSES | 2137-2145 |
| An inventory of useful threatened plant species in Vhembe Biosphere Reserve, Limpopo Province, South Africa LUAMBO JEFFREY RAMARUMO, ALFRED MAROYI | 2146-2158 |
| The genetic relationships and Indo-Pacific connectivity of whale sharks (<i>Rhincodon typus</i>) with particular reference to mitochondrial COI gene sequences from Cendrawasih Bay, Papua, Indonesia ABDUL HAMID A. TOHA, MUHAMMAD DAILAMI, SAIFUL ANWAR, JUSWONO B. SETIAWAN, YUSUP JENTEWO, IDA LAPADI, SANNY SUTANTO, RATIH ARYASARI, AMBARIYANTO, FERAWATI RUNTUBOI, HAWIS MADDUPPA | 2159-2171 |
| Nesting behavior of Bornean immature Orangutan (<i>Pongo pygmaeus wurmbii</i>) in Nyaru Menteng Arboretum School, Palangka Raya, Central Kalimantan, Indonesia FOUAD FAUZI, SUEMARNO, AMINUDIN AFANDHI, AMIN SETYO LEKSONO | 2172-2179 |
| The effect of drying treatment to metabolite profile and cytotoxic potential of <i>Rhizophora apiculata</i> leaves MADA TRIANDALA SIBERO, ANGGUN PUSPITARINI SISWANTO, RUDHI PRIBADI, AGUS SABDONO, OCKY KARNA RADJASA, AGUS TRIANTO, EVAN HANSEL FREDERICK, ALDI PRATAMA WIJAYA, DWI HARYANTI, DESY WULAN TRININGSIH, SASTRA JENDRA HAYUNINGRAT, YASUHIRO IGARASHI | 2180-2187 |
| Germination and salinity tolerance of seeds of sixteen Fabaceae species in Thailand for reclamation of salt-affected lands YONGKRIAT KU-OR, NISA LEKSUNGNOEN, DAMRONGVUDHI ONWIMON, PEERAPAT DOOMNIL | 2188-2200 |
| Short Communication: Antioxidant and antibacterial properties of tree fern <i>Cyathea contaminans</i> AHMAD FAIZAL, INTAN TAUFIK, ANISAH FIRDA RACHMANI, ALDA WYDIA PRIHARTINI AZAR | 2201-2205 |
| The identification of plant reliefs in the Lalitavistara story of Borobudur temple, Central Java, Indonesia DESTARIO METUSALA, FAUZIAH, DEWI AYU LESTARI, JANIS DAMAIYANI, SHOFIYATUL MAS'UDAH, HARI SETYAWAN | 2206-2215 |
| Microbiological and physicochemical characteristics of <i>bakasang laor</i>, a traditional fermented fishery product from Maluku, Indonesia FERYMON MAHULETTE, TRI SANTI KURNIA | 2216-2223 |
| Distribution survey of Kloss's Gibbons (<i>Hylobates klossii</i>) in Mentawai Islands, Indonesia ARIF SETIAWAN, CHRISTIAN SIMANJUNTAK, ISMAEL SAUMANUK, DAMIANUS TATEBURUK, YOAN DINATA, DARMAWAN LISWANTO, ANJAR RAFIASTANTO | 2224-2232 |
| Feeding selectivity of <i>Holothuria atra</i> in different microhabitat in Panjang Island, Jepara (Java, Indonesia) RETNO HARTATI, MUHAMMAD ZAINURI, AMBARIYANTO AMBARIYANTO, WIDIANINGSIH WIDIANINGSIH | 2233-2239 |

| | |
|--|-----------|
| Short Communication: Application of bacteriocin from <i>Lactobacillus plantarum</i> SRCM 1 004 34 strain isolated from okara as a natural preservative in beef sausage SALAM N. ARITONANG, ELLY ROZA, AFRIANI SANDRA | 2240-2243 |
| Orchid exploration in Tanjung Peropa Wildlife Reserves for Kendari Botanic Gardens collection, Indonesia SRI HARTINI, POPI APRILIANI | 2244-2250 |
| Diversity of capsaicin content, quantitative, and yield components in chili (<i>Capsicum annuum</i>) genotypes and their F1 hybrid ZULFIKAR DAMARALAM SAHID, MUHAMAD SYUKUR, AWANG MAHARIJAYA | 2251-2257 |
| Potential mitochondrial diversity role in the productivity of three lines of Japanese quails TAMADHUR H. HUSSEIN, MOHAMMED BAQUR S. AL-SHUHAIB, TAHREER M. AL-THUWAINI | 2258-2265 |
| Environment carrying capacity and willingness to pay for bird-watching ecotourism in Kerandangan Natural Park, Lombok, Indonesia I WAYAN SUANA, HILMAN AHYADI, GITO HADIPRAYITNO, SALEH AMIN, LALU ACHMAD TAN TILAR WANGSAJATI SUKMARING KALIH, FRANCISCUS XAVERIUS SUDARYANTO | 2266-2274 |
| The combination of mare's milk and grape polyphenol extract for treatment of dysbiosis induced by dextran sulfate sodium SAMAT KOZHAKHMETOV, DMITRIY BABENKO, MADIYAR NURGAZIYEV, ALTYNAY TUYAKOVA, AYAULYM NURGOZHINA, NURISLAM MUHANBETGANOV, LAURA CHULENBAYEVA, SHYNGGYS SERGAZY, ALEXANDR GULYAYEV, TIMUR SALIEV, ALMAGUL KUSHUGULOVA | 2275-2280 |
| Synthesis of lactic acid from sugar palm trunk waste (<i>Arenga pinnata</i>): Preliminary hydrolysis and fermentation studies WHINY HARDIYATI ERLIANA, TRI WIDJAJA, ALI ALTWAY, LILY PUDJIASTUTI | 2281-2288 |
| Effectiveness of anemia herbal formula containing <i>Curcuma zanthorrhiza</i>, <i>Elephantopus scaber</i> and <i>Amaranthus tricolor</i> in iron deficiency anemia patients ULFA FITRIANI, ZURAI DA ZULKARNAIN, FAJAR NOVIANTO, ENGGAR WIJAYANTI, AGUS TRIYONO | 2289-2296 |
| Biodecolorization of methyl orange by mixed cultures of brown-rot fungus <i>Daedalea dickinsii</i> and bacterium <i>Pseudomonas aeruginosa</i> ADI SETYO PURNOMO, MITHA OCDYANI MAWADDAH | 2297-2302 |
| Autecology of <i>Melastoma malabathricum</i>, an invasive species in the Way Kambas National Park, Indonesia JANI MASTER, IBNUL QAYIM, DEDE SETIADI, NYOTO SANTOSO | 2303-2309 |
| Diversity, abundance, activity period, and factors affecting the appearance of wildlife around the corridors between Khao Yai-Thap Lan National Parks, Thailand by camera trapping RONGLARP SUKMASUANG, KHWANRUTAI CHARASPET, TARAPORN PANGANTA, MANANYA PLA-ARD, NORASET KHIOESREE, JIDAPA THONGBANTHUM | 2310-2321 |
| Tiger grass (<i>Thysanolaena maxima</i>) cultivation in CALSANAG watershed in Romblon, Philippines: dilemmas and prospects for sustainable natural resources management LEILA D. LANDICHO, MARIA THERESA NEMESIS P. OCAMPO, ROWENA ESPERANZA D. CABAUG, ROMNICK S. BALITON, EDGARDO ANDALECIO, RAYMUND INOCENCIO, MARCELINA SERVANEZ, RUSSEL SON A. COSICO, MARYANNE G. ABADILLOS, ARNOLD KARL A. CASTILLO | 2322-2330 |
| Isolation and characterization of <i>Botryococcus braunii</i> from a freshwater environment in Tenggarong, Kutai Kartanegara, Indonesia RUDY AGUNG NUGROHO, DIRGARINI JULIA NURLIANTI SUBAGYONO, ENOS TANGKE ARUNG | 2331-2336 |

Short Communication: Polymorphism at third exon of the Myostatin gene and its association with growth and carcass traits in Batur sheep

HASSAN ISHAG HASSAN HAREN^{1,✉}, DATTADEWI PURWANTINI^{2,✉✉}, MAS YEDI SUMARYADI^{2,✉✉✉}
PRAYITNO^{2,✉✉✉✉}

¹Department of Animal Production, Faculty of Agriculture, Omdurman Islamic University, Fetahab st., Omdurman 283, Khartoum, Sudan.
Tel./fax. +68-2-223631145, ✉email: haren20101@gmail.com

²Department of Animal Breeding, Faculty of Animal Science, Universitas Jenderal Soedirman. Jl. Dr. Soeparno, Purwokerto Utara, Banyumas 53122, Central Java, Indonesia. Tel.: +62-281-624792, 638792, ✉✉email: dattadewi2002@yahoo.com, ✉✉✉yedi.sumaryadi@yahoo.com, ✉✉✉✉prayitnofapet@gmail.com

Manuscript received: 13 February 2020. Revision accepted: 18 April 2020.

Abstract. *Haren HIH, Purwantini D, Sumaryadi MY, Prayitno. 2020. Short Communication: Polymorphism at third exon of the Myostatin gene and its association with growth and carcass traits in Batur sheep. Biodiversitas 21: 2074-2078.* The present study aimed to investigate the association between myostatin (MSTN) genotype and two traits, growth and carcass, in Batur sheep. Blood samples representing thirty head were collected and genomic DNA was extracted. A specific primer designed to amplify the MSTN gene, samples sequenced then, used the BioEdit program to identify any mutation. Calculation of genotypes, gene and allele frequencies, heterozygosities, and Chi-square test was performed. Only two alleles observed (G and C) resulted in three genotypes. 11 polymorphic sites were observed, transversion at c.*121G>C, and one individual G>A which disrupted reading frame of whole MSTN sequenced, genotypic and allelic frequencies were 0.552 GG, 0.379 GC, and 0.069 CC, where the allele frequency was 0.741 G and 0.259 C. Lambs that carrying genotype GC had slightly more pre-slaughter weight, hot carcass weight, cold carcass weight, carcass length, and total yield (lion, shoulder, leg yield, and thigh) compared to those carrying genotype GG. There was no significant effect of the MSTN genotype on carcass traits (p=0.05). Polymorphic site c.*121 G>C is present in Batur sheep for the first time about the association with the MSTN gene however, it has not effects weaning weight, 6-month weight, and studied carcass traits.

Keywords: Batur sheep, carcass traits, growth traits, MSTN gene, third exon

INTRODUCTION

Myostatin which is also known as a growth and differentiation factor 8 (GDF8), acts as a negative regulator of skeletal muscle growth. Variation in the Myostatin gene (MSTN) has been associated with muscling in mammalian including mice (McPherron et al. 1997), cattle (Grobet et al. 1997; Dunner et al. 2003), humans (Schuelke et al. 2004), dogs (Mosher et al. 2007), and sheep (Kijas et al. 2007; Boman and Våge 2009; Johnson et al. 2009; Hickford et al. 2010; Han et al. 2013). The polymorphism of this gene has been determined in various breeds of sheep (Zhou et al. 2008) and goat (Han et al. 2015). The ovine MSTN gene is 4991bp in size and is present on chromosome no. 2 (Boman et al. 2009). Single Nucleotide Polymorphisms (SNPs) within the coding region of the Myostatin gene are associated with double muscling (Hadjipavlou et al. 2008). Moreover; the Myostatin sequence analysis of double-muscled European breed revealed 7 DNA sequence polymorphisms and concluded that five of them were responsible for modulating the functions of protein (Jouliia-Ekaza and Cabello 2007). Different methods for determining carcass and body composition of domestic animals have been extensively studied because of their nutritional and economic

importance (De Paula et al. 2013). However, some methods are limited to use in laboratory conditions, and others due to their expensive cost (Scholz et al. 2015). Carcass quality traits are important for predicting the final amount of saleable meat per animal. These traits are correlated with live weight, affecting sheep farmers' income. Live measures (weights at different stages; ultrasound images of muscle transversal area and fat thickness) and post-mortem traits (carcass weight, length, and conformation; Knight et al. 2014; Ciappesoni et al. 2014) help to assess muscularity, fattening, and other carcass properties, and are usually included in genetic evaluation systems. Only three polymorphisms have been observed in the coding region of the ovine MSTN gene so far. One nonsynonymous single-nucleotide polymorphism (SNP) in the 34th codon was identified in the New Zealand Romney sheep (Zhou et al. 2008). Moreover, a deletion of one base pair in the position of the 960th nucleotide (c.960delG) was found in Norwegian White sheep (Boman et al 2009), whereas insertion of one base pair in the position of the 120th nucleotide was identified in the Norwegian Spælsau (Boman and Våge 2009). These two nucleotide variations, located in the coding region of the MSTN gene, resulted in nonfunctional protein formation (Boman et al. 2010). The present study was aimed to investigate the association

between MSTN genotype, and growth traits, and carcass traits in Batur lambs.

MATERIALS AND METHODS

Animals and Experimental Design

Batur sheep are the predominant breed in the upland areas of Banjarnegara - Indonesia - where they are well adapted to the local cold and humid environment. This breed developed by crossing between local breeds (Fat and Thin Tailed Sheep) and imported breed (Merino) (Prayitno 2010). Thirty heads of Batur sheep used for this experiment, the number of lambs born for every birth of each ewe was recorded and the suckling program of the lambs lasted for three months (90th day). Batur lambs were reared at the Batur area under an intensive feeding system until six months of age. All lambs were fed by concentrated feed consist of mixed feedstuff gave 3% of their body weight. Bodyweight measured monthly after weaning to six months of age. Male lambs were slaughtered by the Islamic method at weights (ranged from 25 to 45 kg). Then, the carcasses were split off into two identical longitudinal halves and sectioned into five regions (neck, shoulder, ribs, loin, and leg). Hot carcass weights were measured directly at slaughter, HCW is the weight in kilograms of the carcass components minus the pelt, head, and gut. Then, carcasses chilled under -4°C for 24 hours in the big refrigerator room by hanging them up. Cold carcass weight measured 24 hours after slaughtering, other carcass data including loin yield, leg yield, total yield, and shoulder yield. The total yield is the sum of the leg, loin and shoulder yield for any given carcass.

DNA Extraction

Blood samples (3 ml) were collected from the jugular vein of each head of experimental lambs and put it into the vacutainer tubes contained EDTA (10 mL EDTA spray dried). For DNA extraction 200 µl of whole blood samples were used and performed according to the manufacturer protocol (Genetika science). To amplify the exon 3 region of MSTN gene a specific primer designed using the Primer3 software from the NCBI website in (Table 1).

The concentration and purity of isolated DNA were measured using Nano-Drop 8000 Spectrophotometer (Thermo Scientific, Waltham, Massachusetts, USA) by Absorbance method. About 1.5 µl isolated DNA for measuring the concentration and purity in each spectrophotometer well. The absorbance reading recorded at A260/A280 nm. Then, the DNA concentration (ng/µl) and DNA purity A260/280 were calculated.

Polymerase Chain Reaction Conditions

Each 25 µl PCR reaction contained 25 ng of genomic DNA, 12.5 µl 2x Reaction mix of each primer, and 1.0 units of Taq DNA polymerase as shown in table 2, The cycling protocol was 5 minutes at 95°C as an initial denaturation, 35 cycles of denaturing at 94°C for 45 seconds, annealing at 73.9 for 45 seconds, extending at 72°C for 40 s, with final extension for 10 minutes.

Coding region of MSTN sequencing

All samples were sent to Malaysia for sequencing and the BioEdit program was used to identify a nucleotide substitution or mutation, and sequenced results compared with MSTN gene reference (accession number DQ530260) coding regions. The chromosome ovr2 of the MSTN region used to identify a candidate gene by the Ensembl database (www.ensembl.org). A candidate gene was chosen based on their known function or potential involvement with growth and muscularity.

Data analysis

Genotypes, and allele frequencies, heterozygosity rates were counted and Chi-square test was performed. The mathematical model for gene and allele frequency (Nei and Kumar 2000) as:

$$\text{Genotype frequency} = X_i = \frac{G_i}{N} \times 100\%$$

$$\text{Allele frequency} = X_i = \frac{2n_{ii} + 2n_{ij}}{2N}$$

Where:

X_i = Genotype or allele frequency,

i^{th} = homozygous alleles,

j^{th} = heterozygous alleles,

G_i = number samples of i genotype

N = total samples.

Statistical analysis using ANOVA procedure (software SPSS program version 17.0) was utilized to determine the correlation between MSTN genotype and body weight and weaning weight.

Table 1. Primer forward and reverse for MSTN Amplification

| Amplified fragment | Size (bp) | Primer name | Primer sequence | T _m (°C) |
|--------------------|-----------|-------------|----------------------------------|---------------------|
| MSTN | 487 | Forward | 5'-TGCGGTAGGAGA : GTGTTTGG-3' | 61.2 |
| | | Reverse: | AAAATTGTTGAGG GGAAGACC-3' | 59.3 |

Table 2. PCR reaction mixture for amplification of MSTN gene of sheep

| Reaction components | Quantity (µL) |
|---------------------|---------------|
| Kapa mix | 12.5 |
| Forward primer | 1.0 |
| Reverse primer | 1.0 |
| DNA template | 1.0 |
| dH2O | 9.5 |
| Total | 25 |

RESULTS AND DISCUSSION

MSTN Genotyping

A 487 bp fragment for the 3rd exon of MSTN locus in Batur sheep was proliferated by manual PCR technique. The analysis revealed a total of seventeen polymorphic sites in the MSTN coding region (Figure 1). There were only two observed alleles (G and C) resulting in three genotypes, the animals with both alleles were considered as GC genotype, whereas those possessed only G or C alleles assigned as GG or CC genotypes. Eleven polymorphic sites were observed in the 3rd exon region, transversions at locus c.*121 G>C, one individual G>A which disrupted the reading frame in whole MSTN sequenced, and one individual polymorphic sites seen a del-T at c.*129, c.*139 and c.*158 positions as in the figure. In an investigated population, this locus was in Hardy-Weinberg equilibrium with X² test of 0.0034 and probability of (p=0.95). This confirmed that factors leading to disequilibrium, especially selection and migration, may affect the genetic structure of the population. The studied population showed a low degree of genotypic variability for the MSTN gene. This may be explained by the conservation and no breeding plans have been applied, because there are many rams that have been used randomly as sires in a breeding system which is a result of the inbreeding effect. As previously reported by the authors (Haren et al. 2019) the high similarity of the MSTN gene in Batur sheep observed because of their coding region are similar, a genetic variation found at the 3rd exon region may not influence mRNA splicing and therefore affect the amino acid sequences produced from a process of the transcription.

Moreover, a breed-specific influence of the locus under study.

Effect of MSTN genotype on growth traits

Table 3 indicates that genotypic and allele frequencies in the 3rd exon of Myostatin genotype were 0.552 (GG), 0.379 (GC), and 0.069 (CC), where the allele frequency was 0.74 G and 0.26 C, however; weaning weight of Batur lambs were 19.99 GG, 21.3 GC, and 19.7 CC and 6-month weight 30.49 (GG), 31.87 (GC), and 29.9 (CC), respectively. Lambs with heterozygous (GC) genotype were heavier than homozygous (GG) and recessive (CC) genotype by 1.6 and 2 kg at weaning and 6-months weight, respectively. However, there was no significant difference at weaning weight (p=0.99), 6-month body weights (p=0.98) at a locus (c.*121G>C) of the MSTN gene in Batur sheep. Similar findings for the non-significant effect of genetic variants in exon 3 of the MSTN gene with growth traits were reported in Zel sheep (Dehnavi et al. 2012).

Effect of MSTN genotype on carcass traits

The carcass traits and their proportion yield are present in Table 4, lambs that carry the GC genotype have slightly more pre-slaughter weight, hot carcass weight, cold carcass weight, carcass length and total yield (loin, shoulder, leg yield, and rump) comparing to those carry's the GG genotype. The results showed there was no significant effect of the MSTN genotype on carcass traits (P > 0.05). It might be due to the increase in muscle mass.

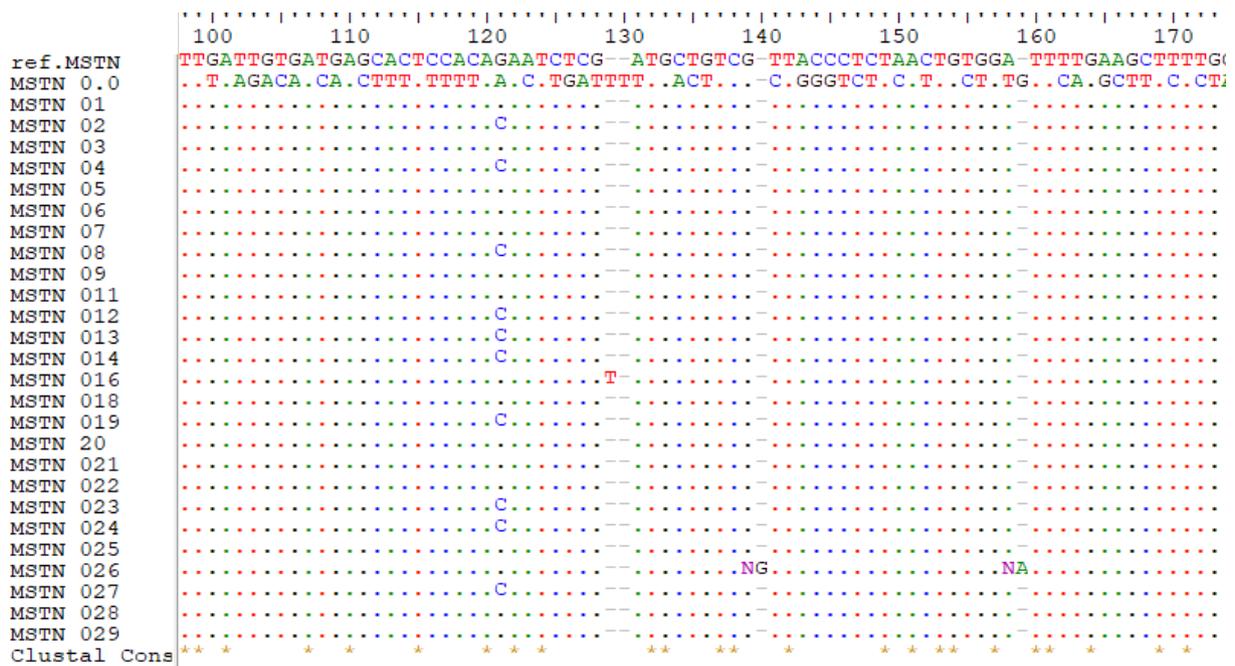


Figure 1. Chromatogram of BioEdit program used to identify if any nucleotide substitution in the 3rd exon of MSTN gene, all sequence plotted to a standard as a dot, compared to the reference sequence (NCBI) there are 17 different variants on the matched sequence

positions, 11 variants appeared at c.*121, del-T at c.*129, one individual at c.*139, and one individual at c.*158 positions, however, one individual sequence disrupted reading frame in MSTN

Table 3. Genotypic, allelic frequencies and heterozygosity of exon 3 of locus c.*121G>C and its association with weaning and body weight in Batur sheep

| Genotype | (16) GG | (11) GC | (2) CC | G | C | X ² | p-value |
|---------------------|-----------|----------|----------|------|------|----------------|---------|
| Genotypic frequency | 0.552 | 0.379 | 0.069 | 0.74 | 0.26 | | - |
| Expected frequency | 0.549 | 0.384 | 0.067 | | | 0.0034 | 0.95 |
| Weaning | 19.99±1.3 | 21.3±1.5 | 19.7±4.5 | | | | 0.99 |
| 6-month weight | 30.49±1.6 | 31.9±1.9 | 29.9±1.8 | | | | 0.98 |

Table 4. Means, standard deviation (S.D), minimum and maximum weights (kg) for carcass traits

| | Genotype GG | | | | Genotype GC | | | | p-value |
|---------------------|-------------|------|------|------|-------------|-------|------|------|---------|
| | Mean | S. D | Min | Max | Mean | S. D | Min | Max | |
| PSW (kg) | 32.7 | 2.8 | 30.7 | 34.7 | 34.3 | 2.85 | 31 | 36.3 | 0.59 |
| HCW (kg) | 13.4 | 0.0 | 13.4 | 13.4 | 14.6 | 1.55 | 13.1 | 16.2 | 0.38 |
| CCW (kg) | 13.3 | 0.07 | 13.2 | 13.3 | 14.4 | 1.50 | 13 | 16 | 0.37 |
| Carcass length (cm) | 75 | 0.0 | 75.0 | 75.0 | 78.0 | 3.46 | 74 | 80 | 0.33 |
| Total yield (kg) | 8.05 | 0.07 | 8.00 | 8.10 | 8.10 | 1.49 | 6.4 | 9.2 | 0.97 |
| Lean yield (kg) | 7.4 | 0.85 | 6.80 | 8.00 | 8.87 | 0.95 | 7.8 | 9.6 | 0.18 |
| Bone yield (kg) | 3.6 | 0.28 | 3.40 | 3.80 | 3.87 | 1.03 | 3.0 | 5.0 | 0.58 |
| Fat yield (kg) | 2.1 | 0.14 | 2.00 | 2.20 | 2.07 | 0.61 | 1.4 | 2.6 | 0.95 |
| Dressing % | 41 | 0.04 | 39 | 44 | 43 | 0.03 | 40 | 46 | 0.64 |
| Boneless % | 56 | 0.07 | 51 | 61 | 61 | 0.025 | 60 | 64 | 0.26 |

Note: HCW = hot carcass weights, CCW = cold carcass weight, PSW = Pre-slaughter weight

Discussion

The inability to find any association of weaning and body weight with the polymorphic status of the MSTN gene in the present study might be due to the breed-specific effect of the locus under study. This study in line with (Sahu et al. 2017) which mentioned that, a non-significant effect of this mutation that observed on birth, weaning (three months) and six months weight in Indian Mecheri and Madras Red sheep. (Sumantri et al. 2008) reported that genetic diversity based on molecular marker MSTN c.del960G locus in Indonesia local sheep are very low. This is indicated by the value of one genotype frequency and allele which has a value of 1, which marks the fixation process. The absence of deletion in 1-bp deletion at MSTN c.del960G can be caused by a tropical adaptation process which suggested that the animal which can survive in this environment is having small performance. In this case, presence of the c.960delG mutation in both alleles means that no functional Myostatin protein is expected to be produced (Boman et al. 2009).

If Myostatin did not express, so the negative growth regulation will fail and the number of muscle fibers increases (hyperplasia). (Boman et al. 2010) reported the homozygous c.960delG (AA) animals had lower daily gain and weaning weight, but higher carcass weight. While the genotypes (del-G)-AG and (del-G)-GG resulted in significant ($p < 0.001$) effects, towards more meat and less fatty animals. However, mutations in the third exon affect conformation and fat class in NWS lambs, yielding a carcass with less fat and increased muscle mass these findings are not far to our study concerning fat, muscles, and carcass yield.

In conclusion, the present study investigated the allelic and genotypic effects of the MSTN gene on growth and carcass traits, polymorphism is present in Batur sheep for the first-time regarding assessment of the association with the 3rd exon of the MSTN gene. Moreover, non-significant genotypic effects of the MSTN gene have detected concerning weaning weight, 6-month weight, and studied carcass traits. Moreover, these results may not be useful for developing future selection programs unless further investigation of the MSTN gene and its interaction performed with other genes that involve in muscle growth and carcass traits through analyzing association studies at large scale.

ACKNOWLEDGEMENTS

This research has been supported by Jenderal Soedirman University Program (*Riset Institusi Unsoed* No. P/495/UN23/14/PN/2019), Purwokerto, Indonesia.

REFERENCES

- Boman IA, Klemetsdal G, Blichfeldt T, Nafstad, Våge DI. 2009. A frameshift mutation in the coding region of the Myostatin gene (MSTN) affects carcass conformation and fatness in Norwegian White Sheep (*Ovis Aries*). *Anim Genet* 40: 418-422. DOI: 10.1111/j.1365-2052.2009.01855.x.
- Boman I, Våge D. 2009. An insertion in the coding region of the Myostatin (MSTN) gene affects carcass conformation and fatness in the Norwegian Spælsau (*Ovis aries*). *BMC Res Notes* 2 (1): 98. DOI: 10.1186/1756-0500-2-98.

- Boman I, Klemetsdal G, Nafstad O, Blichfeldt T, Våge D. 2010. Impact of two Myostatin (MSTN) mutations on weight gain and lamb carcass classification in Norwegian White Sheep (*Ovis aries*). *Genet Sel Evol* 42 (1): DOI: 10.1186/1297-9686-42-4.
- Ciappesoni G, San Julián R, Navajas E, Gimeno D, Gutierrez-Zamit E, Goldberg V, Brito G. 2014. Genetic evaluation of the Texel breed in Uruguay. Carcass quality traits. 60th International Congress of Meat Science and Technology, 17-22 August 2014. Punta del Este.
- Dehnavi E, Azari MA, Hasani S, Nassiry MR, Mohajer M, Ahmadi AK, Shahmohamadi L, Yousefi S. 2012. Polymorphism of Myostatin gene in Intron 1 and 2 and Exon 3, and their associations with yearling weight, using PCR-RFLP and PCR-SSCP techniques in Zel sheep. *Biotechnol Res Int*. DOI: 10.1155/2012/472307.
- De Paula NF, Tedeschi LO, Paulino MF, Fernandes HJ, Fonseca MA. 2013. Predicting carcass and body fat composition using biometric measurements of grazing beef cattle. *J Anim Sci* 91: 3341-3351. DOI: 10.2527/jas.2012-5233.
- Dunner S, Miranda ME, Amigues Y, Canón J, Georges M, Hanset R, Williams JL, Ménessier F. 2003. Haplotype diversity of the Myostatin gene among beef cattle breeds. *Genet Sel Evol* 35: 103-118. DOI: 10.1186/1297-9686-35-1-103.
- Grobet L, Martin LJR, Poncelet D, Pirottin D, Brouwers B, Riquet J, Schoeberlein A, Dunner S, Menissier F, Massabanda J, Fries R, Hanset R, Georges M. 1997. A deletion in the bovine Myostatin gene causes the double-muscling phenotype in cattle. *Nat Genet* 17: 71-74. DOI: 10.1038/ng0997-71.
- Hadjipavlou G, Matika O, Clop A, Bishop S. 2008. Two single nucleotide polymorphisms in the Myostatin (GDF8) gene have significant association with muscle depth of commercial Charollais sheep. *Anim Genet* 39 (4): 346-353. DOI: 10.1111/j.1365-2052.2008.01734.x.
- Han J, Forrest RH, Hickford JGH. 2013. Genetic variations in the Myostatin gene (MSTN) in New Zealand sheep breeds. *Mol Biol Rep* 40 (11): 6379-6384. DOI: 10.1007/s11033-013-2752-7.
- Han J, Forrest R H, Sedcole J R, Hickford J G H. 2015. Myostatin (MSTN) gene haplotypes and their association with growth and carcass traits in New Zealand Romney lambs. *Small Ruminant Res* 127: 8-19. DOI: 10.1016/j.smallrumres.2015.03.015.
- Haren HHH, Purwantini D, Sumaryadi MY, Prayitno. 2019. Polymorphism of Myostatin Gene (MSTN) Coding Region in Batur Sheep. *Anim Prod* 21 (1): 10-15.
- Hickford JGH, Forrest RH, Zhou H, Fang Q, Han J, Frampton CM, Horrell AL. 2010. Polymorphisms in the ovine Myostatin gene (MSTN) and their association with growth and carcass traits in New Zealand Romney sheep. *Anim Genet* 41: 64-72. DOI: 10.1111/j.1365-2052.2009.01965.x.
- Johnson PL, Dodds KG, Bain WE, Greer GJ, McLean NJ, McLaren RJ, Galloway SM, van Stijn TC, McEwan JC. 2009. Investigations into the GDF8 g+6273G-A polymorphism in New Zealand Texel sheep. *J Anim Sci* 87: 1856-1864. DOI: 10.2527/jas.2008-1508.
- Joulia-Ekaza D, Cabello G. 2007. The Myostatin gene physiology and pharmacological relevance. *Curr Opin Pharmacol* 7 (3): 310-315. DOI: 10.1016/j.coph.2006.11.011.
- Kijas JW, McCulloch R, Edward JEH, Oddy VH, Lee SH, Van der Werf J. 2007. Evidence for multiple alleles effecting muscling and fatness at the ovine GDF8 locus. *BMC Genet* 8 (1): 80. DOI: 10.1186/1471-2156-8-80.
- Knight MI, Daetwyler HD, Hayes BJ, Hayden MJ, Ball AJ, Pethick DW, McDonagh MB. 2014. An independent validation association study of carcass quality, shear force, intramuscular fat percentage and omega-3 polyunsaturated fatty acid content with gene markers in Australian lamb. *Meat Sci* 96: 1025-1033. DOI: 10.1016/j.meatsci.2013.07.008.
- McPherron AC, Lawler AM, Lee SJ. 1997. Regulation of skeletal muscle mass in mice by a new TGF- superfamily member. *Nature* 387: 83-90. DOI: 10.1038/387083a0.
- Mosher DS, Quignon P, Bustamante CD, Sutter NB, Mellersh CS, Parker HG, Ostrander EA. 2007. A mutation in the Myostatin gene increases muscle mass and enhances racing performance in heterozygote dogs. *PLoS Genet* 3 (5): 779-786. DOI: 10.1371/journal.pgen.0030079.
- Nei Mn, Kumar S. 2000. Molecular evaluation and phylogenetics. Oxford Univ Press, New York.
- Prayitno. 2010. Analisis Genetik dan Kekerabatan Domba Batur dengan Domba Lokal dan Merino Menggunakan Marker RAP-DNA. Laporan Penelitian Hibah Doktor. Universitas Gadjah Mada, Yogyakarta. [Indonesian]
- Sahu A, Jeichitra V, Rajendran R, Raja A. 2017. Polymorphism in exon 3 of Myostatin (MSTN) gene and its association with growth traits in Indian sheep breeds. *Small Ruminant Res* 149: 81-84. DOI: 10.1016/j.smallrumres.2017.01.009.
- Scholz AM, Bünger L, Kongsro J, Baulain U, Mitchell AD. 2015. Non-invasive methods for the determination of body and carcass composition in livestock: dual-energy X-ray absorptiometry, computed tomography, magnetic resonance imaging, and ultrasound: invited review. *Animal* 9:1250-1264. DOI: 10.1017/s1751731115000336.
- Schuelke M, Wagner KR, Stolz LE, Hübner C, Riebel T, Kömen W, Lee SJ. 2004. Myostatin mutation associated with gross muscle hypertrophy in a child. *New England J Med* 350 (26): 2682-2688. DOI:10.1056/nejm200409023511018.
- Sumantri CR, Diyono A, Farajallah, Inounu I. 2008. Polymorphism of calpastatin gene and its effect on body weight of local sheep's. *JITV* 13: 117-126.
- Zhou H, Hickford JGH, Fang Q. 2008. Variation in the coding region of the Myostatin (GDF8) gene in sheep. *Mol Cellular Probes* 22: 67- 68. DOI: 10.1016/j.mcp.2007.08.004.