

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

BIODIVERSITAS

Journal of Biological Diversity

Volume 22 - Number 4 - April 2021

Front cover: Nycticebus javanicus É. Geoffroy, 1812
(PHOTO: ADENG BUSTOMI)

Published monthly

PRINTED IN INDONESIA

ISSN: 1412-033X

E-ISSN: 2085-4722



9 771412 033757



9 772085 472751

BIODIVERSITAS

Journal of Biological Diversity
Volume 22 – Number 4 – April 2021

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 22 - Number 4 - April 2021

- DNA barcoding of the tidal swamp rice (*Oryza sativa*) landraces from South Kalimantan, Indonesia** 1593-1599
DINDIN HIDAYATUL MURSYIDIN, YUDHI AHMAD NAZARI, BADRUZSAUFARI, MUHAMMAD RIDHO DINTA MASMITRA
- Molecular identification of *blaCTX-M* and *blaTEM* genes encoding extended spectrum β -lactamase (ESBL) producing *Escherichia coli* isolated from raw cow's milk in East Java, Indonesia** 1600-1605
RIBBY ANSHARIETA, SANCAKA CHASYER RAMANDINIANTO, MUSTOFA HELMI EFFENDI, HANI PLUMERIASTUTI
- Short Communication:** 1606-1611
Infanticide of Javan slow loris (*Nycticebus javanicus*) in captivity
PANGDA SOPHA SUSHADI, WIRDATETI, NI LUH PUTU RISCHA PHADMACANTY, MOHAMAD WAHYUDIN
- Population dynamics of mistletoes species on *Cassia fistula* L. in Purwodadi Botanic Garden, Indonesia** 1612-1620
SOLIKIN
- Characterization of *Sardinella fimbriata* and *Clarias gariepinus* bones** 1621-1626
WAN NOR ASIAH TUN MOHD ROSIDI, NURAINNI MOHD ARSHAD, NOR FAZLIYANA MOHTAR
- Architectural and physical properties of fungus comb from subterranean termite *Macrotermes gilvus* (Isoptera: Termitidae) mound** 1627-1634
DINA TIARA KUSUMAWARDHANI, DODI NANDIKA, LINA KARLINASARI, ARINANA, IRMANIDA BATUBARA
- DNA barcode of Enggano hill myna, *Gracula religiosa enganensis* (Aves: Sturnidae) based on mitochondrial DNA cytochrome oxidase subunit I** 1635-1643
JARULIS, CHOIRUL MUSLIM, SANTI NURUL KAMILAH, AHMAT FAKHRI UTAMA, DEBY PERMANA, MELISA MAYANG SARI, ALEX HADI PRAYITNO, IZUL MIFTAKHUL JANNAH
- Genetic variation of longtail tuna *Thunnus tonggol* landed in four fish markets in Indonesia based on mitochondrial DNA** 1644-1651
IDA AYU ASTARINI, ENEX YUNIARTI NINGSIH, DEVY SIMANUNGKALIT, SHELLA AYU ARDIANA, M DANIE AL MALIK, NI LUH ASTRIA YUSMALINDA, ANDRIANUS SEMBIRING, NI PUTU DIAN PERTIWI, NI KADEK DITA CAHYANI, ALLEN COLLINS
- The effect of biological agent and botanical fungicides on maize downy mildew** 1652-1657
JOKO PRASETYO, CIPTA GINTING, HASRIADI MAT AKIN, RADIX SUHARJO, AININ NISWATI, AULIANA AFANDI, REZA ADIWIJAYA, SUDIONO, MUHAMMAD NURDIN
- Six new species and a new record of *Curcuma* L. (Zingiberaceae) from Thailand** 1658-1685
SURAPON SAENSOUK, THAWATPHONG BOONMA, PIYAPORN SAENSOUK
- Combination of plant growth-promoting bacteria and botanical pesticide increases organic red rice yield and reduces the *Leptocorisa acuta* population** 1686-1694
MOHAMMAD HOESAIN, SIGIT PRASTOWO, SUHARTO, ANKARDIANSYAH PANDU PRADANA, IIS NUR ASYIAH, FARIZ KUSTIAWAN ALFARIZY, MUH ADIWENA
- Agronomic characteristics of 30 promising lines of aromatic, red, and black rice and their antioxidant and cytotoxic effects in some cancer cells** 1695-1700
YUSUF LIMBONGAN, RICO RAMADHAN, KUNIYOSHI SHIMIZU, ENOS TANGKE ARUNG

The potential of bird diversity in the urban landscape for birdwatching in Java, Indonesia INSAN KURNIA, HARNIOS ARIEF, ANI MARDIASTUTI, RACHMAD HERMAWAN	1701-1711
Comparison of the effectiveness of pregnancy diagnosis in Aceh cow through measurement of interferon-tau and progesterone concentrations BUDIANTO PANJAITAN, TONGKU NIZWAN SIREGAR, HAFIZUDDIN, ARMAN SAYUTI, MULYADI ADAM, TEUKU ARMANSYAH, SYAFRUDDIN	1712-1716
Potential of fungi isolated from a mangrove ecosystem in Northern Sulawesi, Indonesia: Protease, cellulase and anti-microbial capabilities AGUS TRIANTO, OCKY KARNA RADJASA, SUBAGIYO, HARTUTI PURNAWENI, MUHAMMAD SYAIFUDIEN BAHRY, RIGNOLDA DJAMALUDIN, AIYEN TJOA, IAN SINGLETON, KAREN DIELE, DARREN EVAN	1717- 1724
Isolation, characterization, activity test and molecular identification of thermophilic bacteria producing proteases from Dolok Tinggi Raja Natural Hot Springs, North Sumatra, Indonesia EDY FACHRIAL, VISENSIUS KRISDIANILO, HARMILENI, I NYOMAN EHRICH LISTER, TITANIA T. NUGROHO, SARYONO	1725-1732
Implementation of species protection act for the conservation of Tanimbar corella, <i>Cacatua goffiniana</i> (Finsch, 1863) TRI HARYOKO , MARK O'HARA, BERENIKA MIODUSZEWSKA, HARI SUTRISNO, LILIK BUDI PRASETYO, ANI MARDIASTUTI	1733-1740
Chemical composition, antibacterial and antioxidant activities of essential oils extracted from dry and fresh <i>Brocchia cinerea</i> NISRINE CHLIF, ABDELAZIZ ED-DRA, MOHAMMED DIOURI, NOUREDDINE EL MESSAOUDI, BADR ZEKKORI, FOUZIA RHAZI FILALI, AMAR BENTAYEB	1741-1749
Application of selected teak clone and organic fertilizer to accelerate rehabilitation of lowland forest in Java, Indonesia SURYO HARDIWINOTO, FIQRI ARDIANSYAH, WIDIYATNO	1750-1756
Morphometric analysis of Gorontalo (Indonesia) native chickens from six different regions ALFI SOPHIAN, ABINAWANTO, UPI CHAIRUN NISA, FADHILLAH	1757-1763
DNA barcoding of lamp shells (Brachiopoda: <i>Lingula anatina</i>) from Probolinggo, East Java, Indonesia RENI AMBARWATI, DWI A. RAHAYU, FIDA RACHMADIARTI, FIRAS KHALEYLA	1764-1774
Growth rate and yield response of several sweet potato clones to reduced inorganic fertilizer and biofertilizer HANNY HIDAYATI NAFI'AH, REGINAWANTI HINDERSAH, SYARIFUL MUBAROK, HARIS MAULANA2 ,TARKUS SUGANDA, VERGEL CONCIBIDO, AGUNG KARUNIAWAN	1775-1782
Characterization and delineation of two infraspecific taxa of <i>Dioscorea esculenta</i> (Lour.) Burkill: The leaf architecture approach MENISA A. ANTONIO, INOCENCIO E. BUOT JR.	1783-1789
Snake pet ownership in the city: A case study in Greater Jakarta, Indonesia MIRZA D. KUSRINI, SHARON PRATIWI PALESA, BURHANUDDIN MASY'UD	1790-1798
<i>Azolla microphylla</i> and <i>Pseudomonas aeruginosa</i> for bioremediation of bioethanol wastewater KHOIRUL ANNISA, SUTARNO, SLAMET SANTOSA	1799-1805
Ethnoecology of <i>Zanthoxylum acanthopodium</i> by local communities around Lake Toba, North Sumatra, Indonesia YATI NURLAENI, JOHAN ISKANDAR, DECKY INDRAWAN JUNAEDI	1806-1818
Screening of actinobacteria-producing amyolytic enzyme in sediment from <i>Litopenaeus vannamei</i> (Boone, 1931) ponds in Rembang District, Central Java, Indonesia DIAH AYUNINGRUM, ANINDITIA SABDANINGSIH, OKTAVIANTO EKO JATI	1819-1828

Identification of conserved peptide upstream open reading frames (CPuORFs) in oil palm (<i>Elaeis guineensis</i>) genome ANDREA PUTRI SUBROTO, REDI ADITAMA, ZULFIKAR ACHMAD TANJUNG, CONDRO UTOMO, TONY LIWANG	1829-1838
Antimicrobial activity and GC-MS analysis of bioactive constituents of <i>Aspergillus fumigatus</i> 269 isolated from Sungai Pinang Hot Spring, Riau, Indonesia ZONA OCTARYA, RIRYN NOVIANTY, NABELLA SURAYA, SARYONO	1839-1845
Species richness and conservation priority of dragonflies in the Suranadi Ecotourism Area, Lombok, Indonesia MOHAMMAD LIWA ILHAMDI, AGIL AL IDRUS, DIDIK SANTOSO, GITO HADIPRAYITNO, MUHAMMAD SYAZALI	1846-1852
The diversity and abundance of phytoplankton and benthic diatoms in varying environmental conditions in Kok River, Chiang Rai, Thailand as bio-indicators of water quality TIPPAWAN PRASERTSIN, KRITTAWIT SUK-UENG, KITTIYA PHINYO, EKKACHAI YANA	1853-1862
Evaluation of a promising tomato line (<i>Solanum lycopersicum</i>) derived from mutation breeding ENIK NURLAILI AFIFAH, RUDI HARI MURTI, ADITYA WAHYUDHI	1863-1868
Short Communication: Diversity of cellulolytic bacteria isolated from coastal mangrove sediment in Logending Beach, Kebumen, Indonesia HENDRO PRAMONO, AFIFAH MARIANA, DINI RYANDINI	1869-1878
Modified culture assay to obtain a diversity of hyphal structures of <i>Ceratobasidium theobromae</i>-VSD pathogen on cocoa MUHAMMAD JUNAID, DAVID GUEST	1879-1886
Fieldwork during pandemic: Backyard bird survey and making student's biological field practice works NURUL L. WINARNI, BHISMA G. ANUGRA, SHANIA ANISAFITRI, NABILLA N. KAUNAIN, DIMAS H. PRADANA	1887-1894
Epiphytic yeasts from Piperaceae as biocontrol agents for foot rot of black pepper caused by <i>Phytophthora capsici</i> DIAN SAFITRI, SURYO WIYONO, BONNY POERNOMO WAHYU SOEKARNO, ACHMAD	1895-1901
Species composition, diversity and traditional uses of plants in homegardens in Kampung Masjid Ijok, Perak, Malaysia MOHD RAZNAN RAMLI, POZI MILOW, SORAYYA MALEK	1902-1911
The activity budgets of captive orangutan (<i>Pongo pygmaeus</i>) in two different Indonesian zoos NURZAIDAH PUTRI DALIMUNTHE, HADI SUKADI ALIKODRA, ENTANG ISKANDAR, SRI SUCI UTAMI ATMOKO	1912-1919
Effect of single and mixed inoculation of arbuscular mycorrhizal fungi and phosphorus fertilizer application on corn growth in calcareous soil LILY ISHAQ, A.S.J. ADU TAE, MORESI A. AIRTHUR, PETERS O. BAKO	1920-1926
Mucin-1 expression in endometrial tissue of <i>Macaca nemestrina</i> during mid-luteal phase after controlled-ovarian hyperstimulation NURHUDA SAHAR, PONCO BIROWO, KUSMARDI, DIYAH KRISTIANTY, KARINA RAHMANINGRUM, ADRIANA VIOLA MIRANDA, AFIF RASYAD, VIVITRI DEWI PRASASTY	1927-1933
Genetic identification of hydrocarbons degrading bacteria isolated from oily sludge and petroleum contaminated soil in Basrah City, Iraq ENTISAR MUHSON ABOUD, AHMED ABD BURGHAL, ABDULLAH HAMAD LAFTAH	1934-1939
Flower development, pollen viability and pollen storage test of <i>Aeschynanthus radicans</i> FRISCA DAMAYANTI, R. VITRI GARVITA, HARY WAWANGNINGRUM, SRI RAHAYU	1940-1945

Coleoptera of the Penza region, Russia based on fermental crown trap A.B. RUCHIN, L.V. EGOROV, O.A. POLUMORDVINOV	1946-1960
Taxonomic investigation of the <i>Xanthium strumarium</i> L. complex (Asteraceae) distributed in Iran inferred from morphological, palynological and molecular data FARIBA NOEDOOST, JAMIL VAEZI, SEDIGHEH NIKZAT SIAHKOLAE	1961-1974
The infection of ectoparasitic protozoa on farmed Nile tilapia (<i>Oreochromis niloticus</i>) at three reservoirs in Central Java, Indonesia WALEED SULIMAN KRPOS KOLIA, SUNARTO, TETRI WIDIYANI	1975-1980
The potential of cellulose-degrading fungi at various peat maturities in Teluk Bakung Peat Area, Kubu Raya District, Indonesia SITI KHOTIMAH, SUHARJONO, TRI ARDYATI, YULIA NURAINI	1981-1990
Morphological characteristics of <i>Phaius</i> spp. orchids from Indonesia SRI HARTATI, SAMANHUDI, IDA RUMIA MANURUNG, ONGKO CAHYONO	1991-1995
Population, habitat characteristic, and modelling of Endangered Orchid, <i>Paphiopedilum javanicum</i> in Mt. Lawu, Java, Indonesia MUH. ARIF ROMADLON, FATIMAH AZZHARA, GILANG DWI NUGROHO, ARI PITOYO	1996-2004
Evaluation of diversity in some genotypes of Algerian durum wheat using agronomical and biochemical markers AICHA ATOUI, LEILA BOUDOUR, GHANIA CHAIB, BOUDERSA NABIL	2005-2011
Physicochemical and microbiological properties of yogurt made with microencapsulation probiotic starter during cold storage EVY ROSSI, FAJAR RESTUHADI, RASWEN EFENDI, YOSSIE KHARISMA DEWI	2012-2018
Compendium of plants used for preparation of traditional alcoholic beverages by different major ethnic communities of Assam, northeast India DIPANKAR BORAH, TRIDIP GOGOI, JINTU SARMA, PUNAM JYOTI BORAH, BICHITRA GOHAIN, CHIRANJIB MILI, ANKUR UPADHYAYA, JENIMA BASUMATARY, KASTURI NEOG, TONLONG WANGPAN, SUMPAM TANGJANG	2019-2031
The structure of permaculture landscapes in the Philippines JABEZ JOSHUA M. FLORES, INOCENCIO E. BUOT JR.	2032- 2044
Traditional market, social relations, and diversity of edible plants traded in Beringharjo Market, Yogyakarta, Indonesia BUDIAWATI SUPANGKAT ISKANDAR, JOHAN ISKANDAR, DEDE MULYANTO, RAHMAN LATIF ALFIAN, SUROSO	2045-2057
Effects of copper on the leaf morpho-anatomy of <i>Rhizophora mucronata</i>: Implications for mangrove ecosystem restoration KERSTIN LEI DJ. PEREZ, MARILYN O. QUIMADO, LERMA SJ. MALDIA, CRUSTY E. TINIO, JONATHAN O. HERNANDEZ, MARILYN S. COMBALICER	2058-2065
Species diversity and composition, and above-ground carbon of mangrove vegetation in Jor Bay, East Lombok, Indonesia ZULHALIFAH, ABDUL SYUKUR, DIDIK SANTOSO, KARNAN	2066-2071
Short Communication: Assessing the state and change of forest health of the proposed arboretum in Wan Abdul Rachman Grand Forest Park, Lampung, Indonesia RAHMAT SAFE'I, FRANSINA S. LATUMAHINA, BAINAH SARI DEWI, FERDY ARDIANSYAH	2072-2077
The ethnobotany of <i>Ngusaba</i> ceremonial plant utilization by Tenganan Pegringsingan community in Karangasem, Bali, Indonesia DEWA AYU SRI RATNANI, I KETUT JUNITHA, ENIEK KRISWIYANTI, I NYOMAN DHANA	2078-2087
Projecting expansion range of <i>Selaginella zollingeriana</i> in the Indonesian archipelago under future climate condition AHMAD DWI SETYAWAN, JATNA SUPRIATNA, NISYAWATI, ILYAS NURSAMSU, SUTARNO, SUGIYARTO, SUNARTO, PRAKASH PRADAN, SUGENG BUDIHARTA, ARI PITOYO, SAPTA SUHARDONO, PRABANG SETYONO, MUHAMMAD INDRAWAN	2088-2103

Morphological and anatomical characters variation of <i>Indigofera</i> accessions from Java, Indonesia	2104-2116
MUZZAZINAH, SURATMAN, NURMIYATI, SRI RETNO DWI ARIANI	
Exogenous acetic acid pre-treatment increases drought tolerance of two Indonesian foxtail millet (<i>Setaria italica</i>) accessions	2117-2124
CHOIROTIN NISA, NURUL JADID	
Effect of termite activity on soil chemical properties using baiting systems at an arboretum area in Pontianak, West Kalimantan, Indonesia	2125-2130
YULIATI INDRAYANI, SOFWAN ANWARI	
Feeding habits of Tinfoil barb, <i>Barbonymus schwenenfeldii</i> in the Tasik River, South Labuhanbatu, North Sumatra, Indonesia	2131-2135
DESRITA, FANNI K. HASUGIAN, ERI YUSNI, VINDY R. MANURUNG, RIDAHATI RAMBEY	
Diversity of sea cucumber from intertidal area of Pacitan and Bangkalan, East Java, Indonesia	2136-2141
ELSA DIANITA AULIA, FARID KAMAL MUZAKI, DIAN SAPTARINI, EDWIN SETIAWAN, DAVIN SETIAMARGA, ISWATUL DIAH LUTVIANTI, SANIAH KUSNATUR ROSYIDAH, NUR ALI MUHAMMAD	
Carbon emissions as impact of mangrove degradation: A case study on the Air Telang Protected Forest, South Sumatra, Indonesia (2000-2020)	2142-2149
SYAIFUL EDDY, NORIL MILANTARA, MOHAMMAD BASYUNI	

Molecular identification of *bla*_{CTX-M} and *bla*_{TEM} genes encoding extended-spectrum β -lactamase (ESBL) producing *Escherichia coli* isolated from raw cow's milk in East Java, Indonesia

RIBBY ANSHARIETA¹, SANCAKA CHASYER RAMANDINIANTO¹, MUSTOFA HELMI EFFENDI^{2,3,*}, HANI PLUMERIASTUTI⁴

¹Faculty of Veterinary Medicine, Universitas Airlangga. Jl. Raya Mulyorejo, Surabaya 60115, East Java, Indonesia

²Department of Veterinary Public Health, Faculty of Veterinary Medicine, Universitas Airlangga. Jl. Raya Mulyorejo, Surabaya 60115, East Java, Indonesia. Tel.: +62-31-5992785 ext. 5993016, *email: mheffendi@yahoo.com

³Halal Research Center, Universitas Airlangga. Jl. Raya Mulyorejo, Surabaya 60115, East Java, Indonesia

⁴Department of Veterinary Pathology, Faculty of Veterinary Medicine, Universitas Airlangga. Jl. Raya Mulyorejo, Surabaya 60115, East Java, Indonesia

Manuscript received: 5 December 2020. Revision accepted: 4 February 2021.

Abstract. Ansharieta R, Ramandinianto SC, Effendi MH, Plumeriastuti H. 2021. Molecular identification of *bla*_{CTX-M} and *bla*_{TEM} genes encoding extended-spectrum β -lactamase (ESBL) producing *Escherichia coli* isolated from raw cow's milk in East Java, Indonesia. *Biodiversitas* 22: 1600-1605. The emergence of extended-spectrum β -lactamase (ESBL) producing bacteria and its increasing level has become public health issue. The presence of these bacteria in food of animal origin is quite alarming. The objective of this study was to detect and characterize *Escherichia coli* producing ESBL encoding genes, isolated from 200 raw cow milk samples in East Java, Indonesia. The results of this study showed that 70.5% of isolates were confirmed as *E. coli*, based on the morphological growth of colonies on the EMB Agar and biochemical IMViC tests. In this study, the double-disc synergy test (DDST) method was used to confirm the ESBL, and previously sorted out presumptively by using Aztreonam antibiotic disc. The antibiotics used were amoxicillin-clavulanate, ceftazidime, and cefotaxime for DDST. In addition, ESBL confirmation with Multiplex PCR method for *bla*_{CTX-M} and *bla*_{TEM} genes were done. The presence of ESBL-producing by *E. coli* isolated from raw cow's milk in East Java were 2.12% (3/141). The PCR results showed that the double *bla*_{CTX-M} and *bla*_{TEM} gene harbored by 2 ESBL isolates and one *bla*_{TEM} gene as many as 1 ESBL isolate. Thus, the findings of our study indicate that milk can be a good reservoir of bacteria carrying *bla*_{CTX-M} and *bla*_{TEM} ESBL resistance genes with the potential to affect human health.

Keywords: *bla*_{CTX-M} gene, *bla*_{TEM} gene, ESBL, *Escherichia coli*, human health, raw cow's milk

INTRODUCTION

Extended-spectrum β -lactamase (ESBL) producing bacteria are a major threat to public health today. The presence of ESBL bacteria is often caused by inappropriate use of antibiotics in handling infections and their irrational administration (Abayneh et al. 2018). *Escherichia coli* (*E. coli*) is a major pollutant in the environment which is often associated with ESBL encoding genes, namely *bla*_{CTX-M} and *bla*_{TEM} (Jena et al. 2017). Milk is a food source of animal origin that can act as a reservoir in transmitting infectious bacterial diseases. The presence of *E. coli* bacteria in raw milk is often reported with regard to sources of food-borne disease (Odenthal et al. 2016).

The prevalence of ESBL-producing *E. coli* in animal origin food products is very high (Geser et al. 2012; Wibisono et al. 2020a). The existence of livestock and livestock products such as milk can be a mode of transmission and circulation of ESBL producing bacteria and act as a potential new threat because they are directly related to the food chain in humans. Livestock and livestock products are one of the main sources of animal protein, including the most commonly consumed sources of meat and milk and being one of the main elements in the

food chain in humans. Livestock manure in the form of large-capacity feces has the potential to transmit bacterial infectious agents to humans through contamination. Most intestinal diseases in humans come from animals that are transmitted directly from animals to humans or indirectly through food of animal origin or water contaminated with feces (Widodo et al. 2020).

The distribution pattern of ESBL enzymes globally in humans and animals can be a reference and consideration in efforts to prevent and treat ESBL bacterial infections. The type of CTX-M enzyme is a variant of the enzyme found in isolates from humans, animals and the environment. The CTX-M-15 strain has been widely reported on all continents and has been detected in all major ecological aspects including humans, animals and the environment. Treatment of ESBL-producing bacterial infections in clinical trials has rarely been successful (Widodo et al. 2020). This study aimed to detect the presence of ESBL-producing bacteria from dairy cows milk by double-disc synergy test (DDST) and molecular tests to identify the encoding *bla*_{CTX-M} and *bla*_{TEM} genes for ESBL producing *E. coli*.

MATERIALS AND METHODS

Research design, location and sampling

Raw milk was taken from dairy farm with a total of 200 samples, located in Probolinggo, Pasuruan, Batu, and Blitar districts, East Java Province, Indonesia, in the period between September 2019-January 2020. The farms selected to take as research samples have belonged to farmers who had an average of 3 to 5 cows. About 10 mL of milk sample from dairy cows milk was taken and placed in a sterile tube. Raw milk samples contained in wrapped sterile plastic were taken to the laboratory using a cool box container at 4°C.

Isolation and identification of *E. coli*

Each 100 µL milk sample was cultured into 10 mL enrichment media of Brilliant Green Bile Lactose Broth (Merck, 105454) and incubated at 37 °C for 18-24 hours. The positive results are characterized by change in media from green color to cloudy green and presence of gas in Durham tube (Putra et al. 2019). Then 100 µL of the resulted samples were streaked onto Eosin Methylene Blue (EMB) agar (Merck, 101347) and incubated at 37 °C for 18-24 hours (Effendi et al. 2018). Presumptive 3-5 colonies of *E. coli* that showed metallic green color was purified and continued to identification with the IMViC test (Wibisono et al. 2020b).

Antibiotic sensitivity test

Antibiotic sensitivity testing was done using Kirby-Bauer disc diffusion assay on Mueller-Hinton agar medium (Oxoid, CM0337). Firstly, screened for presumptive ESBL using Aztreonam and other antibiotic discs for checking the multidrug resistance profile. Antibiotics discs used were Tetracycline 30 µg (Oxoid, CT0054), Streptomycin 10 µg (Oxoid, CT0047), Chloramphenicol 30 µg (Oxoid, CT0013), Trimethoprim 5 µg (Oxoid, CT0057), Aztreonam 30 µg (Oxoid, CToid02). Antibiotics discs used for Double Disc Synergy Test (DDST) were Amoxicillin-Clavulanate

20/10 µg (Oxoid, CT0223B), Cefotaxime 30 µg (Oxoid, CT0166), Ceftazidime 30 µg (Oxoid, CT0412). Interpretation of results was done by measuring the diameter of the inhibitory zone formed, after overnight incubation at 37 °C, based on Clinical and Laboratory Standards Institutions (CLSI 2018, Putra et al. 2020).

Preparation for polymerase chain reaction

The initial step of DNA extraction from bacterial culture was referred to Kristianingtyas et al. (2020) and tested by specific primers for the *bla*_{CTX-M} and *bla*_{TEM} genes (Table 1) as described in Ali et al. (2016), with slight modifications in cycling conditions. Taq DNA polymerase enzyme, deoxyribonucleotide triphosphates and buffers used in the PCR mixture were obtained from Thermo Fisher Scientific Inc. (Massachusetts, USA). Thermocycling reaction was conducted for initial denaturation at 94°C for 2 minutes followed by 30 cycles of: denaturation at 94°C for 1 minute, annealing for 52°C for 30 sec, extended at 72°C at 45 sec, and final extension at 72°C for 5 minutes. PCR products were visualized in mini gel electrophoresis and documented in the UV Reader/ Gel Documentation System.

RESULTS AND DISCUSSION

Isolation and identification of *Escherichia coli*

The results of the isolation and identification of 200 raw milk samples obtained as many as 200 (100%) isolate suspected of *E. coli* on the basis of macroscopic characters, on the Brilliant Green Lactose Broth medium, the color is cloudy green and all of them cause gas in the Durham tube after incubation at 37°C for 24 hours. A total of 141 (70.5%) samples on EMB Agar medium with two times purification showed the growth of convex colonies in metallic green with a round black center (Figure 1) after incubation at 37°C for 24 hours, can be seen in Table 2.

Table 1. Details of primers used in this study

Primers	Sequences (5' to 3')	Target gene	Amplicons size	References
CTX-MA	CGC TTT GCG ATG TGC AG	<i>bla</i> _{CTX-M}	550-bp	Villegas et al. (2004)
CTX-MB	ACC GCG ATA TCG TTG GT			
TEM-F	ATA AAA TTC TTG AAG ACG AAA	<i>bla</i> _{TEM}	1086-bp	Yao et al. (2007)
TEM-R	GAC AGT TAC CAA TGC TTA ATC			

Table 2. Results for detection multidrug-resistant (MDR) and ESBL producing *Escherichia coli*

Location	Sample size	Confirmed <i>E. coli</i>	Multidrug-resistant	Presumptive ESBL (Aztreonam disc)	DDST positive	<i>bla</i> _{CTX-M} gene	<i>bla</i> _{TEM} gene
Probolinggo (A)	50	36	2	0	0	0	0
Pasuruan (G)	50	30	4	1	1	1	1
Batu (H)	50	37	6	0	0	0	0
Blitar (S)	50	38	2	2	1	1	2
Total	200	141	14	3	2	2	3

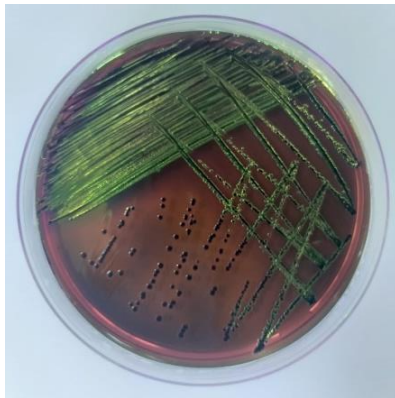


Figure 1. EMBA with *Escherichia coli* colonies in metallic green

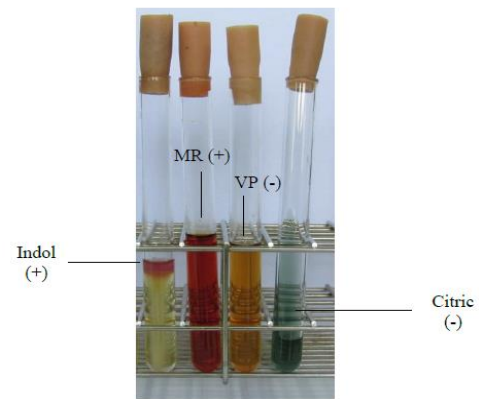


Figure 2. Positive biochemical test for *Escherichia coli*

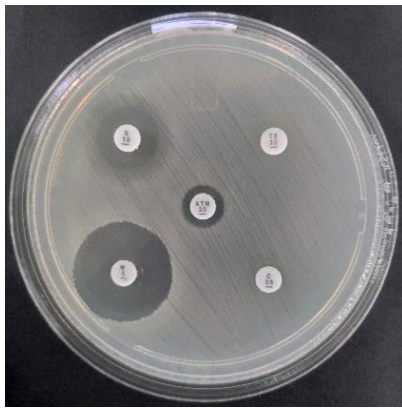


Figure 3. Sample code of S-25 showed Aztreonam resistant isolate as presumptive ESBL

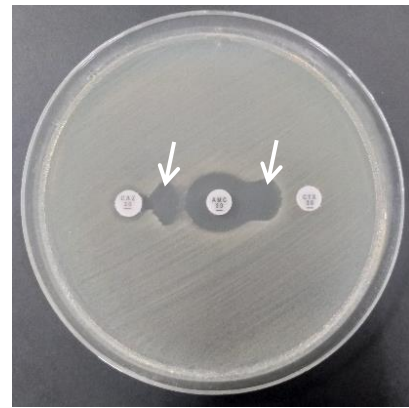


Figure 4. Sample code of S-25 DDST positive result (white arrow shows positive synergy)

Gram staining was performed and stained bacterial smear was viewed under a microscope with a magnification of 1000x. to ensure that the bacteria are Gram-negative rod-shaped bacteria. Microscopically, *E. coli* bacterial cells appeared in the form of short rods and were red in Gram stain. The next test was a biochemical test with IMViC and then incubated at 37 °C for 24 hours. Isolates used for the IMViC test came from separate colonies on EMBA media. It was found that 141(70.5%) isolates tested positive for *E. coli*. Isolates were stated as *E. coli* with negative Sulphide test results, positive indole, positive motile, positive MR, negative VP, and negative citrate (Figure 2).

The study has been carried out on 200 milk samples obtained from Probolinggo, Pasuruan, Batu, and Blitar, showed that 70.5% were contaminated with *E. coli* bacteria. From each area, *E. coli* bacteria were found which were multidrug-resistant to various antibiotics that had been tested (Table 2 and Table 3), and shown in Figure 3.

Identification for bla_{CTX-M} and bla_{TEM} Genes in ESBL-Producing *E. coli*

A total of two ESBL producer isolates showed the presence of 'keyhole' in DDST testing (Figure 4.) The three isolates were tested by multiplex PCR method to find out

encoded ESBL genes. The two positive DDST isolates produced 2 double bands for the bla_{CTX-M} and bla_{TEM} genes. Whereas, one negative DDST isolate gave 1 single band for bla_{TEM}, due to resistant to Aztreonam (Figure 5).

Discussion

Based on this study, antibiotics Trimethoprim, Chloramphenicol, and Aztreonam may still be used to treat multidrug-resistant (MDR) bacteria found because there are still some MDR of *E. coli* isolates that are sensitive to it. Trimethoprim is usually combined with sulfonamides which work synergistically with a broad spectrum of activities. Chloramphenicol is also a broad-spectrum antibiotic. In the case of urinary tract infections, Trimethoprim is proven to be effective in killing infections caused by *E. coli* bacteria (AlRabiah et al. 2018), while in the case of gastrointestinal tract and reproductive tract infections due to *E. coli*, Chloramphenicol is a good antibiotic (Santos et al. 2010). The antibiotic monobactam (Aztreonam) is rarely used in veterinary practice and human medicine today (Kennedy et al. 2015). The discovery of isolates that are resistant to Aztreonam, increases the possibility of finding the ESBL of *E. coli* bacteria in raw milk.

Table 3. Detail samples of MDR and ESBL of *Escherichia coli* isolates

Sample code	Resistant to					Multidrug resistant (MDR)	ESBL producer
	TE	S	W	C	ATM		
	30 µg	10 µg	5 µg	30 µg	30 µg		
A-26	+	+	+	+	-	+	-
A-44	-	+	+	+	-	+	-
G-12	+	+	+	-	-	+	-
G-31	-	+	+	-	+	+	+
G-35	+	+	+	-	-	+	-
G-43	+	+	-	+	-	+	-
H-11	+	+	+	+	-	+	-
H-15	+	+	+	-	-	+	-
H-28	+	+	-	+	-	+	-
H-37	+	+	-	+	-	+	-
H-44	+	+	-	+	-	+	-
H-45	+	+	-	+	-	+	-
S-25	+	-	-	+	+	+	+
S-38	-	+	-	-	+	-	+

Note: TE: Tetracycline, S: Streptomycin, W: Trimethoprim, C: Chloramphenicol, ATM: Aztreonam, MDR is resistant to three or more classes, ESBL producer is resistant to ATM, +: positive resistant

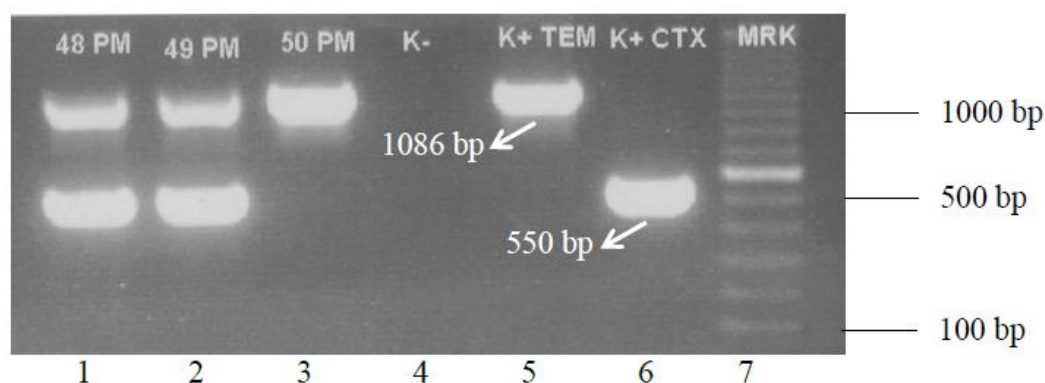


Figure 5. Electrophoresis result for 2 ESBL producer isolates and one contain bla_{TEM} Isolate with negative DDST. Lane 1: G-31 (From Pasuruan), 2: S-25 (From Blitar), 3: S-38 (From Blitar), 4: Negative Control, 5: Positive Control for bla_{TEM} gene, 6: Positive Control for bla_{CTX-M} gene, 7: Marker

The occurrence of antibiotic resistance is known to originate from bacterial plasmids that are able to accommodate resistance genes and spread them to other bacteria (Ramírez-Castillo et al. 2018). Various resistance genes can accumulate in bacterial plasmids, usually in R (resistant) plasmids which is the reason for finding bacterial isolates that are resistant to various kinds of antibiotics and are able to create new gene sequences (Nikaido 2009).

Multidrug-resistant *E. coli* isolates are very common in many countries and are responsible for a series of infections with high severity and difficulty to treat. In Canada, a study of cases of urinary tract infection due to *E. coli* bacteria, 60% of which were the cases of *E. coli* infection with resistance to more than 3 classes of antibiotics. Consumption of food from raw undercooked animals, travel habits between regions, and contact with reservoir animals are associated with an increased risk of

urinary tract infections caused by MDR of *E. coli* (Ukah et al. 2017).

Escherichia coli is a bacterium that can be a reservoir of various antibiotic resistance genes, including genes encoding beta-lactam resistance β-lactamase encoding genes (Effendi et al. 2021). ESBLs enzymes are produced several strains belonging to the Enterobacteriaceae family. They can hydrolyze penicillin and third-generation cephalosporins, monobactams, and other antibiotics, except carbapenems (meropenem, imipenem, and ertapenem) (Pitout 2012). These enzymes are mainly encoded by several specific genes, namely the bla_{SHV}, bla_{CTX-M} and bla_{TEM} genes (Bush 2013, Wibisono et al. 2020).

The presence of bla_{CTX-M} and bla_{TEM} genes is often reported in food of animal origin. In this study, the findings of ESBL producing *E. coli* isolates were dominated by the bla_{TEM} gene. Similar to the research of Hinthong et al. (2017) stated that *E. coli* contamination found in milk from

dairy farms tends to find the bla_{TEM} gene in ESBL-producing *E. coli* bacteria. This showed that pathogenic *E. coli* sourced from milk is also exposed to antibiotics and has the potential to transfer these genes to other pathogenic bacteria under certain conditions (Effendi et al. 2019; Rahmahani et al. 2020). This study was detected ESBL and bla_{CTX-M} gene in milk since it is rarely reported worldwide to find ESBL in milk. ESBL is mainly reported in feces of poultry and porcine (Wibisono et al. 2020c). The presence of ESBL bacteria is quite dangerous if found in food of animal origin. ESBL-producing *E. coli* strains obtained from cow's milk samples are of particular concern because these pathogens can affect human consumers and calves and lead to the spread of these antibiotic-resistant pathogens to humans and animals (Batabyal et al. 2018).

In dairy cows during lactation, ESBL producing *E. coli* can also be found in raw milk with and/or without symptoms of mastitis, this indicates that the cleanliness of the cage that contaminates milk cages is also a risk factor for contamination of ESBL producing *E. coli* into raw milk products. (Su et al. 2014). In cases of mastitis due to infection with ESBL-producing *E. coli* bacteria infection, it is often associated with several antibiotics that have also been inactive against the bacteria causing it, making it difficult to find other replacement antibiotics to treat it (Ali et al. 2016).

Many sources of exposure have the potential to transmit ESBL-producing *E. coli*, making epidemiological investigations extremely difficult. Interactions at the microbial level in humans and animals, especially between commensal bacteria and pathogenic bacteria, facultative bacteria and obligate bacteria in the same environment and horizontal gene transfer from bacteria make the distribution of ESBL encoding genes between various bacterial species becomes wider. In order to understand and identify the possibility of preventing the spread of the ESBL encoding genes and infection in humans, an integrative approach such as 'One Health' is required (Calistri et al. 2013). The application of the concept of One Health integration is assumed to accelerate disease prevention and prediction as an effort to control ESBL-producing *E. coli* (Wendt et al. 2014).

Food-borne diseases are a major concern throughout the world. This is an important problem in developing countries that lack the application of high sanitation management during the collection and processing of cow's milk. *E. coli* contamination found in raw milk may be caused by cross-contamination of milk with impurities or the lack of hygienic measures during milk collection and processing (Tanzin et al. 2016). According to Ukah et al. (2017), one of the factors causing the occurrence of antibiotic resistance in humans is due to consuming food of animal origin in raw or undercooked form. A multi-sectoral approach to medical treatment in the field of veterinary medicine, animal food production, can realize global cooperation in controlling the ecological development of antibiotic-resistant *E. coli*, for public health (Landers et al. 2012).

In conclusion, molecular identification showed the bla_{CTX-M} gene found in raw cow milk collected from several

regions in East Java, Indonesia which was used to identify ESBL producing *E. coli*, and the bla_{TEM} for molecular identification of penicillinase-producing *E. coli*. These results showed that ESBL producing *E. coli* from raw cow's milk has a relatively low prevalence. However, ESBL producing *E. coli* showed the potential for spreading and poses a threat to public health from *E. coli* isolates.

ACKNOWLEDGEMENTS

This research was in part funded by the Direktorat Riset dan Pengabdian Masyarakat, Deputy Bidang Penguatan Riset dan Pengembangan Kementerian Riset dan Teknologi/ Badan Riset dan Inovasi Nasional, Indonesia in fiscal year 2020 with grant number : 756/UN3.14/PT/2020.

REFERENCES

- Abayneh M, Tesfaw G, Abdissa A. 2018. Isolation of extended-spectrum β -lactamase-(ESBL-) producing *Escherichia coli* and *Klebsiella pneumoniae* from patients with community-onset urinary tract infections in Jimma University Specialized Hospital, Southwest Ethiopia. *Can J Infect Dis Med Microbiol* 2018:4846159. DOI: 10.1155/2018/4846159.
- AlRabiah H, Allwood JW, Correa E, Xu Y, Goodacre R. 2018. pH plays a role in the mode of action of trimethoprim on *Escherichia coli*. *PLoS One* 13 (7): e0200272. DOI: 10.1371/journal.pone.0200272.
- Ali T, Rahman S, Zhang L, Shahid M, Zhang S, Liu G, Gao J, Han B. 2016. ESBL producing *Escherichia coli* from cows suffering mastitis in China contain clinical class 1 integrons with CTX-M linked to ISCR1. *Front Microbiol* 7:1931. DOI: 10.3389/fmicb.2016.01931.
- Batabyal K, Banerjee A, Pal S, Dey S, Joardar SN, Samanta I, Isore DP, Singh AD. 2018. Detection, characterization, and antibiogram of extended-spectrum beta-lactamase *Escherichia coli* isolated from bovine milk samples in West Bengal, India. *Vet World* 11 (10): 1423-1427. DOI: 10.14202/vetworld.2018.1423-1427.
- Bush K. 2013. Proliferation and significance of clinically relevant β -lactamases. *Ann N Y Acad Sci* 1277: 84-90. DOI: 10.1111/nyas.12023.
- Calistri P, Iannetti S, Danzetta L, Narcisi M, Cito V, Di Sabatino F. 2013. The components of 'One World-One Health' approach. *Transbound Emerg Dis* 60 (2): 4-13. DOI: 10.1111/tbed.12145.
- Clinical and Laboratory Standards Institute [CLSI]. 2018. M100 Performance Standards for Antimicrobial Susceptibility Testing 28th ed. Clinical and Laboratory Standards Institute, USA.
- Effendi MH, Harijani N, Budiarto, Triningtya NP, Tyasningsih W, Plumeriastuti H. 2019. Prevalence of pathogenic *Escherichia coli* isolated from subclinical mastitis in East Java Province, Indonesia. *Indian Vet J* 96 (3) : 22-25.
- Effendi MH, Harijani N, Yanestria SM, Hastutie P. 2018. Identification of shiga toxin-producing *Escherichia coli* in raw milk samples from dairy cows in Surabaya, Indonesia. *Philipp J Vet Med* 55 (SI): 109-114.
- Effendi MH, Tyasningsih W, Yurianti YA, Rahmahani J, Harijani N, Plumeriastuti H. 2021. Presence of multidrug resistance (MDR) and extended-spectrum beta-lactamase (ESBL) of *Escherichia coli* isolated from cloacal swabs of broilers in several wet markets in Surabaya, Indonesia. *Biodiversitas* 22 (1): 304-310. DOI: 10.13057/biodiv/d220137.
- Geser N, Stephan R., Hächler H. 2012. Occurrence and characteristics of extended-spectrum β -lactamase (ESBL) producing Enterobacteriaceae in food-producing animals, minced meat and raw milk. *BMC Vet Res* 8: 21. DOI: 10.1186/1746-6148-8-21.
- Hinthong W, Pumipuntu N, Santajit S, Kulpeanprasis S, Buranasinsup S, Sookrung N, Chaicumpa W, Aiumurai P, Indrawattana N. 2017. Detection and drug resistance profile of *Escherichia coli* from subclinical mastitis cows and water supply in dairy farms in Saraburi Province, Thailand. *PeerJ* 5: e3431. DOI: 10.7717/peerj.3431.

- Jena J, Sahoo RK, Debata NK, Subudhi E. 2017. Prevalence of TEM, SHV, and CTX-M genes of extended-spectrum β -Lactamase-producing *Escherichia coli* strain isolated from urinary tract infections in adults. *3 Biotech* 7 (4): 244. DOI: 10.1007/s13205-017-0879-2.
- Kennedy H, Wilson S, Marwick C, Malcolm W, Nathwani D. 2015. Reduction in broad-spectrum Gram-negative agents by diverse prescribing of aztreonam within NHS Tayside. *J Antimicrob Chemother* 70 (8): 2421-2423. DOI: 10.1093/jac/dkv127.
- Kristianingtyas L, Effendi MH, Tyasningsih W, Kurniawan F. 2020. Genetic identification of bla_{CTX-M} Gene and bla_{TEM} gene on extended-spectrum beta-lactamase (ESBL) producing *Escherichia coli* from dogs. *Indian Vet J* 97 (1): 17-21.
- Landers TF, Cohen B, Wittum TE, Larson EL. 2012. A review of antibiotic use in food animals: Perspective, policy, and potential. *Public Health Rep* 127 (1): 4-22. DOI: 10.1177/003335491212700103.
- Nikaido H. 2009. Multidrug resistance in bacteria. *Annu Rev Biochem* 78: 119-146. DOI: 10.1146/annurev.biochem.78.082907.145923
- Odenthal S, Akineden Ö, Usleber E. 2016. Extended-spectrum β -lactamase producing Enterobacteriaceae in bulk tank milk from German dairy farms. *Int J Food Microbiol* 238: 72-78. DOI: 10.1016/j.ijfoodmicro.2016.08.036.
- Pitout JDD. 2012. Extraintestinal pathogenic *Escherichia coli*: A combination of virulence with antibiotic resistance. *Front Microbiol* 3: 9. DOI: 10.3389/fmicb.2012.00009.
- Putra AR, Effendi MH, Koesdarto S, Suwarno S, Tyasningsih W, Estoe pangestie AT. 2020. Detection of the extended-spectrum β -lactamase produced by *Escherichia coli* from dairy cows by using the Vitek-2 method in Tulungagung regency, Indonesia. *Iraqi J Vet Sci* 34 (1): 203-207. DOI: 10.33899/ijvs.2019.125707.1134.
- Putra ARS, Effendi MH, Koesdarto S, Tyasningsih W. 2019. Molecular identification of extended-spectrum beta-lactamase (ESBL) producing *Escherichia coli* isolated from dairy cows in East Java Province, Indonesia. *Indian Vet J* 96 (10): 26-30.
- Rahmahani J, Salamah, Mufasirin, Tyasningsih W Effendi MH. 2020. Antimicrobial resistance profile of *Escherichia coli* from cloacal swab of domestic chicken in Surabaya traditional market. *Biochem Cell Arch* 20 (1): 2993-2997. DOI: 10.35124/bca.2020.20.S1.2993.
- Ramírez-Castillo FY, Moreno-Flores AC, Avelar-González FJ, Márquez-Díaz F, Harel J, Guerrero-Barrera AL. 2018. An evaluation of multidrug-resistant *Escherichia coli* isolates in urinary tract infections from Aguascalientes, Mexico: Cross-sectional study. *Ann Clin Microbiol Antimicrob* 17 (1): 34. DOI: 10.1186/s12941-018-0286-5.
- Santos TMA, Gilbert RO, Caixeta LS, Machado VS, Teixeira LM, Bicalho RC. 2010. Susceptibility of *Escherichia coli* isolated from uteri of postpartum dairy cows to antibiotic and environmental Bacteriophages. Part II: in vitro antimicrobial activity evaluation of a bacteriophage cocktail and several antibiotics. *J Dairy Sci* 93 (1): 105-114. DOI: 10.3168/jds.2009-2299.
- Su Y, Yu CY, Tsai Y, Wang SH, Lee C, Chu C. 2016. Fluoroquinolone resistant and extended-spectrum β -lactamase (ESBL)-producing *Escherichia coli* from milk of cow with clinic mastitis in Southern Taiwan. *J Microbiol Immunol Infect* 49 (6): 892-901. DOI: 10.1016/j.jmii.2014.10.003.
- Tanzin T, Nazir KHMNH, Zahan MN, Parvej SM, Zesmin K, Rahman MT. 2016. Antibiotic resistance profile of bacteria isolated from raw milk samples of cattle and buffaloes. *J Adv Vet Anim Res* 3 (1): 62-67. DOI: 10.5455/javar.2016.c133.
- Ukah UV, Glass M, Avery B, Daignault D, Mulvey MR, Reid-Smith RJ, Parmley EJ, Portt A, Boerlin P, Manges AR. 2017. Risk factors for acquisition of multidrug-resistant *Escherichia coli* and development of community-acquired urinary tract infections. *Epidemiol Infect* 146 (1): 46-57. DOI: 10.1017/S0950268817002680.
- Villegas MV, Correa A, Perez F, Zuluaga T, Radice M, Gutkind G. 2004. CTX-M-12 Beta-Lactamase in a *Klebsiella pneumoniae* clinical isolate in Colombia. *Antimicrob Agents Chemother* 48 (2): 629-631. DOI: 10.1128/aac.48.2.629-631.2004.
- Wendt A, Kreienbrock L, Campe A. 2015. Zoonotic disease surveillance-inventory of systems integrating human and animal disease information. *Zoonoses Public Health* 62 (1): 61-74. DOI: 10.1111/zph.12120.
- Wibisono FJ, Sumiarto B, Untari T, Effendi MH, Permatasari DA, Witaningrum AM. 2020a. The presence of extended-spectrum beta-lactamase (ESBL) producing *Escherichia coli* on layer chicken farms in Blitar area, Indonesia. *Biodiversitas* 21 (6): 2667-2671. DOI: 10.13057/biodiv/d210638.
- Wibisono FJ, Sumiarto B, Untari T, Effendi MH, Permatasari DA, Witaningrum AM. 2020b. CTX gene of extended-spectrum beta-lactamase (ESBL) producing *Escherichia coli* on broilers in Blitar, Indonesia. *Sys Rev Pharm* 11 (7): 396-403. DOI: 10.31838/srp.2020.7.59.
- Wibisono FJ, Sumiarto B, Untari T, Effendi MH, Permatasari DA, Witaningrum AM. 2020c. Pattern of antibiotic resistance on extended-spectrum beta-lactamases genes producing *Escherichia coli* on laying hens in Blitar, Indonesia. *Biodiversitas* 21 (10): 4631- 4635. DOI: 10.13057/biodiv/d211022.
- Widodo A, Effendi MH, Khairullah AR. 2020. Extended-spectrum beta-lactamase (ESBL)-producing *Escherichia coli* from livestock. *Sys Rev Pharm* 11 (7): 382-392.
- Yao F, Qian Y, Chen S, Wang P, Huang Y. 2007. Incidence of extended-spectrum beta-lactamases and characterization of integrons in extended-spectrum beta-lactamase producing *Klebsiella pneumoniae* isolated in Shantou, China. *Acta Biochim Biophys Sin (Shanghai)* 39 (7): 527-532. DOI: 10.1111/j.1745-7270.2007.00304.x.