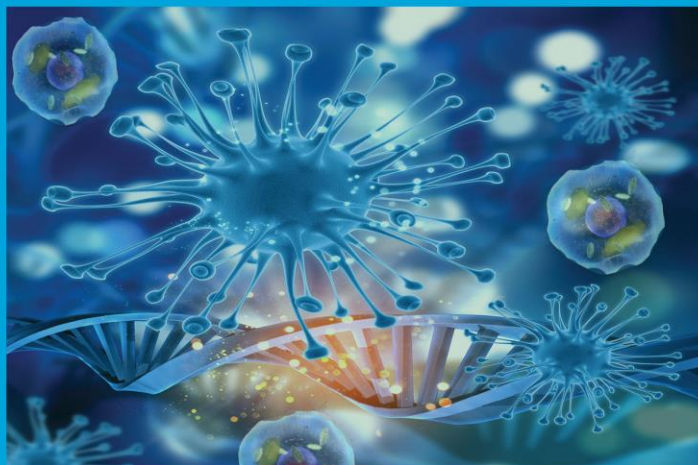


Volume 2019

 **Conference collection**

# The 9th International Conference on Global Resource Conservation (ICGRC) and AJI from Ritsumeikan University



**Malang City, Indonesia**

7-8 March 2018

**Editors**

Dian Siswanto, Retno Mastuti, Fahrul Zaman Bin Huyop and Chairat Treesubsuntorn

**AIP** | Conference Proceedings

[proceedings.aip.org](http://proceedings.aip.org)



AIP Conference Proceedings  
**The 18th International Conference  
 on Positron Annihilation**

ORDER PRINT EDITION

# AIP

Conference Proceedings

HOME

BROWSE

MORE ▾

To support global research during the COVID-19 pandemic, [AIP Publishing is making our content freely available](#) to scientists who register on Scitation.

To gain access, please [log in](#) or [create an account](#) and then [click here](#) to activate your free access. You must be logged in to Scitation to activate your free access.

## • Table of Contents

### THE 9TH INTERNATIONAL CONFERENCE ON GLOBAL RESOURCE CONSERVATION (ICGRC) AND AJI FROM RITSUMEIKAN UNIVERSITY

< PREV NEXT >



Conference date: 7-8 March 2018

Location: Malang City, Indonesia

ISBN: 978-0-7354-1737-3

Editors: Dian Siswanto, Retno Mastuti, Fahrul Zaman Bin Huyop and Chairat Treesubsuntorn

Volume number: 2019

Published: Oct 10, 2018

DISPLAY : 20 50 100 all

## PRELIMINARY


 Free . October 2018

### **Preface: The 9th International Conference on Global Resource Conservation (ICGRC) and AJI from Ritsumeikan University**

AIP Conference Proceedings **2019**, 010001 (2018); <https://doi.org/10.1063/1.5061835>

---



 Free . October 2018


### **Group Photo: The 9th International Conference on Global Resource Conservation (ICGRC) and AJI from Ritsumeikan University**

AIP Conference Proceedings **2019**, 010002 (2018); <https://doi.org/10.1063/1.5061836>

---



## BOTANY

 Free . October 2018

### **Genetic relationships of local durians from Halmahera by clustering analysis based on morphological characters**


Sundari and Chumidach Roini

AIP Conference Proceedings **2019**, 020001 (2018); <https://doi.org/10.1063/1.5061837>

---

SHOW ABSTRACT



 Free . October 2018

## **In vitro enzymatic isolation of protoplasts from tissues of the medicinal plant *Physalis angulata* L.**


Retno Mastuti and Mufidatur Rosyidah

AIP Conference Proceedings **2019**, 020002 (2018); <https://doi.org/10.1063/1.5061838>

---

SHOW ABSTRACT



 Free . October 2018

## **Utilization of a diversity of medicinal plants in Cibeo society, Baduy-Dalam, in Kanekes Village, Leuwidamar District, Lebak Regency, Banten**


Muhamad Nikmatullah, Nisyawati and Eko Baroto Walujo

AIP Conference Proceedings **2019**, 020003 (2018); <https://doi.org/10.1063/1.5061839>

---

SHOW ABSTRACT



 Free . October 2018

## **Utilization of diverse food plants by the Kampung Cibeo Baduy-Dalam community, Kanekes Village, Lebak District, Banten Province**

Ismail N. Salampessy, Nisyawati and Eko Baroto Walujo

AIP Conference Proceedings **2019**, 020004 (2018); <https://doi.org/10.1063/1.5061840>

---

SHOW ABSTRACT



## The effects of scarification on seed germination of porang (*Amorphophallus muelleri*)


Nunung Harijati and Wahyu Widoretno

AIP Conference Proceedings 2019, 020005 (2018); <https://doi.org/10.1063/1.5061841>

---

SHOW ABSTRACT



 Free . October 2018

## Flora krandan (*Canavalia maritima* (Aubl.) Urb. in South Coastal Java, Indonesia


Jati Batoro

AIP Conference Proceedings 2019, 020006 (2018); <https://doi.org/10.1063/1.5061842>

---

SHOW ABSTRACT



 Free . October 2018

## Inventory of plants used as lalapan in Subang, West Java


Tri Cahyanto, Ateng Supriyatna, Mar'atus Sholikha, Aep Saepuloh and Deasy Rahmawati

AIP Conference Proceedings 2019, 020007 (2018); <https://doi.org/10.1063/1.5061843>

---

SHOW ABSTRACT



 Free . October 2018

## Epiphyte mosses (bryophytes) on plants in parking areas along the main line of Brawijaya University

Madinatul Khujjah and Gustini Ekowati


AIP Conference Proceedings 2019, 020008 (2018); <https://doi.org/10.1063/1.5061844>

BROWSE VOLUMES

---

SHOW ABSTRACT



 Free . October 2018

**Effect of paclobutrazol for in vitro medium-term storage of banana variant cv. Kepok (*Musa acuminata x balbisiana* Colla)**


Reni Indrayanti, Riza E. Putri, Agung Sedayu and Adisyahputra

AIP Conference Proceedings 2019, 020009 (2018); <https://doi.org/10.1063/1.5061845>

---

SHOW ABSTRACT



 Free . October 2018

**The effect of ethyl methane sulfonate on the antioxidant content of chili pepper (*Capsicum frutescens* L.)**


Estri Laras Arumingtyas, Joni Kusnadi, Retno Mastuti and Novaria Silvira Paradise

AIP Conference Proceedings 2019, 020010 (2018); <https://doi.org/10.1063/1.5061846>

---

SHOW ABSTRACT



 Free . October 2018

**Phenetic relationship of Pasuruan snakefruits (*Salacca zalacca* (gaertn.) voss.)**


Novita Kartika Indah, Serafinah Indriyani, Estri Laras Arumingtyas and Rodiyati Azrianingsih

AIP Conference Proceedings 2019, 020011 (2018); <https://doi.org/10.1063/1.5061847>

---

SHOW ABSTRACT



 Free . October 2018

## **Active compounds with antioxidant potential in boiled local Papua-Indonesian garlic**


Balqis, Widodo, Betty Lukiati and Mohamad Amin

AIP Conference Proceedings **2019**, 020012 (2018); <https://doi.org/10.1063/1.5061848>

---

SHOW ABSTRACT



 Free . October 2018

## **Landscape utilization as a source of medicinal plants by Baduy-Dalam in Cikeusik, Banten**


Muhamad Nikmatullah, Nisyawati Nisyawati, Windra Suffan and Eko Baroto Walujo

AIP Conference Proceedings **2019**, 020013 (2018); <https://doi.org/10.1063/1.5061849>

---

SHOW ABSTRACT



 Free . October 2018

## **Bromelain content of extract from stem of pineapple (*Ananas comosus* (L.) Merr)**


Fika Agalia Khairunnisa, Markus Vedder, Lisa Evers and Sofy Permana

AIP Conference Proceedings **2019**, 020014 (2018); <https://doi.org/10.1063/1.5061850>

---

SHOW ABSTRACT



 Free . October 2018

BROWSE VOLUMES

## UV absorption spectra of collagen in the presence of plant stability agents


Rizka Pantris Rahayu, Sri Widyarti and Widodo

AIP Conference Proceedings 2019, 020015 (2018); <https://doi.org/10.1063/1.5061851>

---

SHOW ABSTRACT



 Free . October 2018

## Perception and appreciation of tenggerese of medicinal plants in Wonokitri Village, Tosari subdistrict, Pasuruan Regency


Rodiyati Azrianingsih and Alfina Kusumahati

AIP Conference Proceedings 2019, 020016 (2018); <https://doi.org/10.1063/1.5061852>

---

SHOW ABSTRACT



 Free . October 2018

## Characterization of drought tolerance of *GmDREB2* soybean mutants (*Glycine max* (L.) Merr) by ethyl methane sulfonate induction

Evika Sandi Savitri and Shaddiqah Munawaroh Fauziah

AIP Conference Proceedings 2019, 020017 (2018); <https://doi.org/10.1063/1.5061853>

---

SHOW ABSTRACT



**CPE**



## **Efficiency of various sources and doses of humic acid on physical and chemical properties of saline soil and growth and yield of rice**


Wanti Mindari, Purnomo Edi Sasongko, Zaenal Kusuma, Syekhfani and Nurul Aini

AIP Conference Proceedings 2019, 030001 (2018); <https://doi.org/10.1063/1.5061854>

---

SHOW ABSTRACT



 Free . October 2018

## **Competitiveness and development perspective of processed cocoa industries in East Java**


Gyska Indah Harya, Pawana Nur Indah, Sudiyarto, Sri Widayanti and Liana Fatma Leslie Pratiwi

AIP Conference Proceedings 2019, 030002 (2018); <https://doi.org/10.1063/1.5061855>

---

SHOW ABSTRACT



 Free . October 2018

## **Improving the awareness index of government and non-departmental government institutions for landslide cases in Semarang city**

Novie Susanto, Heru Prastawa, Thomas Triadi Putranto and Oyi Aura Zakina

AIP Conference Proceedings 2019, 030003 (2018); <https://doi.org/10.1063/1.5061856>

---

SHOW ABSTRACT



 Free . October 2018

BROWSE VOLUMES

## Developing a groundwater conservation zone in Jepara groundwater basin


Thomas Triadi Putranto and Nestri Martini

AIP Conference Proceedings 2019, 030004 (2018); <https://doi.org/10.1063/1.5061857>

---

SHOW ABSTRACT



 Free . October 2018

## Evaluation of nature school in Indonesia using illuminative evaluation model


Soeprijanto Soeprijanto and Gina Femalia

AIP Conference Proceedings 2019, 030005 (2018); <https://doi.org/10.1063/1.5061858>

---

SHOW ABSTRACT



 Free . October 2018

## Exploring youngest consumers perceptions of traditional foods and fast foods product in Java Island


Sudiyarto Sudiyarto, Nuriah Yuliati, Indrawati Uhertiana and Liana Fatma Leslie Pratiwi

AIP Conference Proceedings 2019, 030006 (2018); <https://doi.org/10.1063/1.5061859>

---

SHOW ABSTRACT



 Free . October 2018

## The use of content and language integrated learning (CLIL) as conservation education methodology: An experience from State University of Semarang


Moh Yasir Alimi

AIP Conference Proceedings 2019, 030007 (2018); <https://doi.org/10.1063/1.5061860>

---

SHOW ABSTRACT



 Free . October 2018

## **Cognitive structure of pre-service biology teachers, the State University of Jakarta on circulatory system concepts using free word - Association test and the drawing-writing technique**


Yulia Irnidayanti and Hakan Kurth

AIP Conference Proceedings 2019, 030008 (2018); <https://doi.org/10.1063/1.5061861>

---

SHOW ABSTRACT



 Free . October 2018

## **An overview of students' choice of biodegradable plastic selection based on environmental knowledge**


Diana Vivanti Sigit, Karina Pravitasari and Ade Suryanda

AIP Conference Proceedings 2019, 030009 (2018); <https://doi.org/10.1063/1.5061862>

---

SHOW ABSTRACT



 Free . October 2018

## **The need for sustainability science education in Indonesia**

Parikesit and Susanti Withaningsih


AIP Conference Proceedings 2019, 030010 (2018); <https://doi.org/10.1063/1.5061863>

[BROWSE VOLUMES](#)

---

SHOW ABSTRACT



 Free . October 2018

## **The effects of using video media in mathematics learning on students' cognitive and affective aspects**

Oktovianus Nau Lalian

AIP Conference Proceedings **2019**, 030011 (2018); <https://doi.org/10.1063/1.5061864>

---

SHOW ABSTRACT



 Free . October 2018

## **Development of Adiwiyata curriculum model based on local wisdom**


Yufiarti, Rika Kurnia Rivai and Ajeng Putri Pratiwi

AIP Conference Proceedings **2019**, 030012 (2018); <https://doi.org/10.1063/1.5061865>

---

SHOW ABSTRACT



 Free . October 2018

## **Social-environment factor as a weak point of sustainable development in Indonesia**


Bagus Sumargo, Kadek Ari Pratiwi Kasuma and Yiu Fai Tsang

AIP Conference Proceedings **2019**, 030013 (2018); <https://doi.org/10.1063/1.5061866>

---

SHOW ABSTRACT



 Free . October 2018

## **Maintaining throughput for high-performance wireless network in diverse environments**


Mochamad Teguh Kurniawan, Ananto Tri Sasongko and Andika Candra Jaya

AIP Conference Proceedings **2019**, 030014 (2018); <https://doi.org/10.1063/1.5061867>

---

SHOW ABSTRACT



 Free . October 2018

## **Pesantren-based environmental management in equatorial areas**


Rihlah Nur Aulia, Izzatul Mardhiah, Ade Gunawan, Dian Elvira Nanda Isnaini, Mohammad Firdaus and Sari Narulita

AIP Conference Proceedings **2019**, 030015 (2018); <https://doi.org/10.1063/1.5061868>

---

SHOW ABSTRACT



 Free . October 2018

## **Perception of medical students of ecopreneurship according to the health belief model**


Lilik Zuhriyah, Wike Astrid Cahayani, Indriati Dwi Rahayu and Ratih Paramita Suprpto

AIP Conference Proceedings **2019**, 030016 (2018); <https://doi.org/10.1063/1.5061869>

---

SHOW ABSTRACT



 Free . October 2018

## **Microseismicity recorded at Cangar, Arjuno-Welirang volcano-hosted geothermal complex, Batu City, East Java, Indonesia**

Sukir Maryanto


AIP Conference Proceedings 2019, 030017 (2018); <https://doi.org/10.1063/1.5061870>

---

SHOW ABSTRACT



## **ECO**

 Free . October 2018

### **On farm application of vegetable intercropping system in Sidoarjo, East Java**


Widiwurjani Widiwurjani, Indra Tjahaja Amir, Djarwatiningsih Pongki S. and Guniarti Guniarti

AIP Conference Proceedings 2019, 040001 (2018); <https://doi.org/10.1063/1.5061871>

---

SHOW ABSTRACT



 Free . October 2018

### **Soil microbial communities below decomposing plant litter from different land uses in Tukur village**

Purnomo Edi Sasongko, Purwanto Purwanto, Widyatmani Sih Dewi and Ramdan Hidayat

AIP Conference Proceedings 2019, 040002 (2018); <https://doi.org/10.1063/1.5061872>

---

SHOW ABSTRACT



## **Bio-larvicidal effervescent preparation development based on locally isolated *Bacillus sphaericus* from Lombok Island (West Nusa Tenggara, Indonesia) against *Anopheles* larvae**


Bambang Fajar Suryadi, Baiq Wiwin Maruni Diarti, Yunan Jiwantarum, Baiq Laily Zainiati and Santi Pristianingrum

AIP Conference Proceedings 2019, 040003 (2018); <https://doi.org/10.1063/1.5061873>

---

SHOW ABSTRACT



 Free . October 2018

## **Assessment of green building score based on greenship rating of the green building council of Indonesia**


Ratna Purwaningsih, Heru Prastawa, Novie Susanto, Singgih Saptadi and Benraen Pirogo

AIP Conference Proceedings 2019, 040004 (2018); <https://doi.org/10.1063/1.5061874>

---

SHOW ABSTRACT



 Free . October 2018

## **Study on microorganisms contaminating particulate matter (PM10) involved in gaseous methyl tert-butyl ether degradation**

Waleeporn Pongkua, Rujira Dolphen and Paitip Thiravetyan

AIP Conference Proceedings 2019, 040005 (2018); <https://doi.org/10.1063/1.5061875>

---

SHOW ABSTRACT



 Free . October 2018

BROWSE VOLUMES

## Local perceptions of oil palm plantation: Case study in Kumai subdistrict, Central Kalimantan


Meilati Ligardini Manggala, Arzyana Sunkar and Rachel Carmenta

AIP Conference Proceedings 2019, 040006 (2018); <https://doi.org/10.1063/1.5061876>

---

SHOW ABSTRACT



 Free . October 2018

## Bird species diversity in various land covers in oil palm plantation of PT GSIP, Central Kalimantan


Diah Eres Dwi Karuniyanti, Yanto Santosa and Windi Sugiharti

AIP Conference Proceedings 2019, 040007 (2018); <https://doi.org/10.1063/1.5061877>

---

SHOW ABSTRACT



 Free . October 2018

## A study of the mangrove community in the coastal area of Dodinga Bay, South Jailolo District, West Halmahera Regency, North Maluku Province


Nuraini Sirajudin, Abdu Mas'ud and Sundari

AIP Conference Proceedings 2019, 040008 (2018); <https://doi.org/10.1063/1.5061878>

---

SHOW ABSTRACT



 Free . October 2018

## Butterfly diversity on different types of land cover in oil palm

plantation (Case study: PT. AMP, Central Kalimantan)

BROWSE VOLUMES



## Indonesia)

Intan Purnamasari and Yanto Santosa

AIP Conference Proceedings 2019, 040009 (2018); <https://doi.org/10.1063/1.5061879>

---

SHOW ABSTRACT



 Free . October 2018

### **Echinoderms of the coral reef ecosystem and their utilisation at Bira Island of the Seribu Islands**


Ratna Komala, Mieke Miarsyah and Ratna Dewi Wulaningsih

AIP Conference Proceedings 2019, 040010 (2018); <https://doi.org/10.1063/1.5061880>

---

SHOW ABSTRACT



 Free . October 2018

### **Detection of microbial presence in the room, equipment, and cell culture media at temporary stem cell laboratory**


Tri Rahayu, Indra Adi Wira Prasetya, Desi Triwahyuni, Ana Mariatul Khiftiyah, Nurul 'Aini, Muhammad Bachruddin, Izdihar Tsana, Lisa Marjayandari, Siti Istiqomah, Selva Rosyta Dewi, Nabela Nur Hanifah, Mar'atus Sholichah, Fatimah and Ni'matuzahroh

AIP Conference Proceedings 2019, 040011 (2018); <https://doi.org/10.1063/1.5061881>

---

SHOW ABSTRACT



 Free . October 2018

### **Tropical plant diversity of Borneo: The role of high conservation value area on species conservation in an oil palm**

BROWSE VOLUMES


Rozza Tri Kwatrina, Yanto Santosa, M. Bismark and Nyoto Santoso

AIP Conference Proceedings 2019, 040012 (2018); <https://doi.org/10.1063/1.5061882>

---

SHOW ABSTRACT



 Free . October 2018

## **Antibacterial test of various ingredients of “Indonesian Jamu”**


Selva Rosyta Dewi, Tri Rahayu, Siti Istiqomah, Lisa Marjayandari, Mar’atus Sholichah, Nurul ‘Aini, Nabela Nur Hanifah, Izdihar Tsana, Ana Mariatul Khiftiyah, Desi Triwahyuni, Muhammad Bachruddin, Indra Adi Wira Prasetya, Fatimah and Ni’matuzahroh

AIP Conference Proceedings 2019, 040013 (2018); <https://doi.org/10.1063/1.5061883>

---

SHOW ABSTRACT



 Free . October 2018

## **Isolation and screening of potential proteolytic and amylolytic microbes from Wonorejo Mangrove forest soil, Surabaya, Indonesia**

Ana Mariatul Khiftiyah, Nabela Nur Hanifah, Muhammad Bachruddin, Mar’atus Sholichah, Siti Istiqomah, Selva Rosyta Dewi, Tri Rahayu, Indra Adi Wira Prasetya, Lisa Marjayandari, Nurul ‘Aini, Izdihar Tsana, Desi Triwahyuni, Fatimah and Ni’matuzahroh

AIP Conference Proceedings 2019, 040014 (2018); <https://doi.org/10.1063/1.5061884>

---

SHOW ABSTRACT





## Resources

[AUTHOR](#)

[LIBRARIAN](#)

[ADVERTISER](#)

---

## General Information

[ABOUT](#)

[CONTACT](#)

[HELP](#)

[PRIVACY POLICY](#)

[TERMS OF USE](#)

FOLLOW AIP PUBLISHING:



Website © 2020 AIP Publishing LLC.

Article copyright remains as  
specified within the article.

**Scitation**



## Academic paper editing

Get Professional academic paper editing by Subject Area Native English Editors Today!

[authorassists.com](http://authorassists.com)

OPEN

# AIP Conference Proceedings

**Country** [United States](#) - [SJR Ranking of United States](#)

**Subject Area and Category** [Physics and Astronomy](#)  
[Physics and Astronomy \(miscellaneous\)](#)

**Publisher** [American Institute of Physics](#)

**Publication type** Conferences and Proceedings

**ISSN** 0094243X, 15517616

**Coverage** 1974-1978, 1983-1984, 1993, 2000-2001, 2003-2020

**Scope** Today, AIP Conference Proceedings contain over 100,000 articles published in 1700+ proceedings and is growing by 100 volumes every year. This substantial body of scientific literature is testament to our 40-year history as a world-class publishing partner, recognized internationally and trusted by conference organizers worldwide. Whether you are planning a small specialist workshop or organizing the largest international conference, contact us, or read these testimonials, to find out why so many organizers publish with AIP Conference Proceedings.



[Homepage](#)

[How to publish in this journal](#)

[Contact](#)



[Join the conversation about this journal](#)

# 64

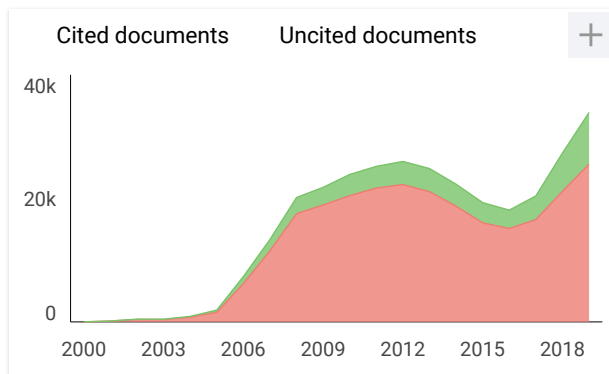
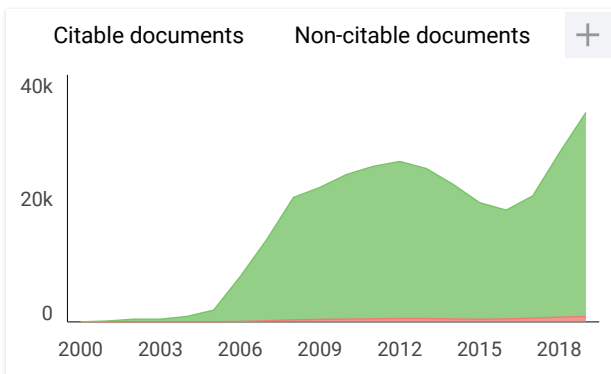
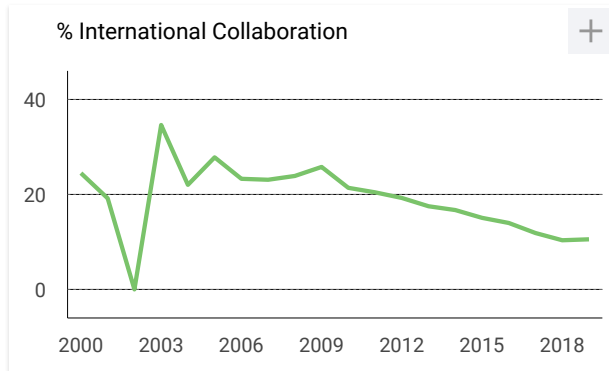
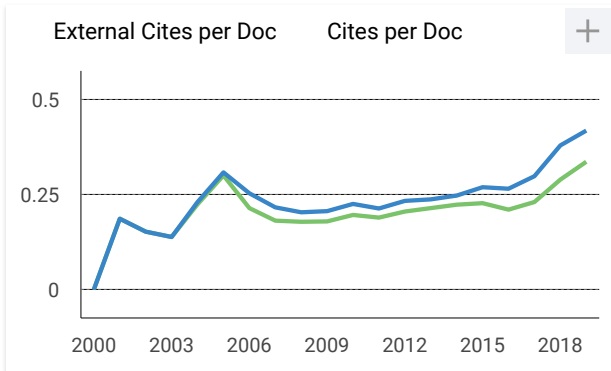
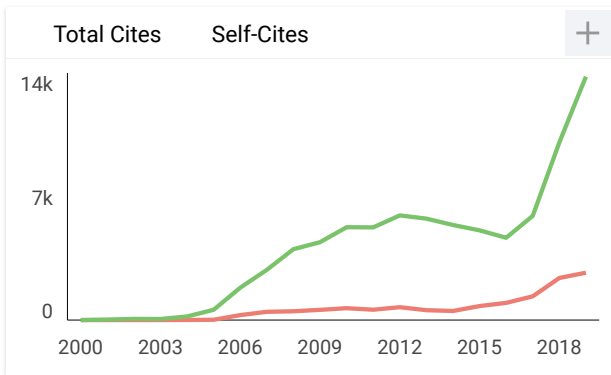
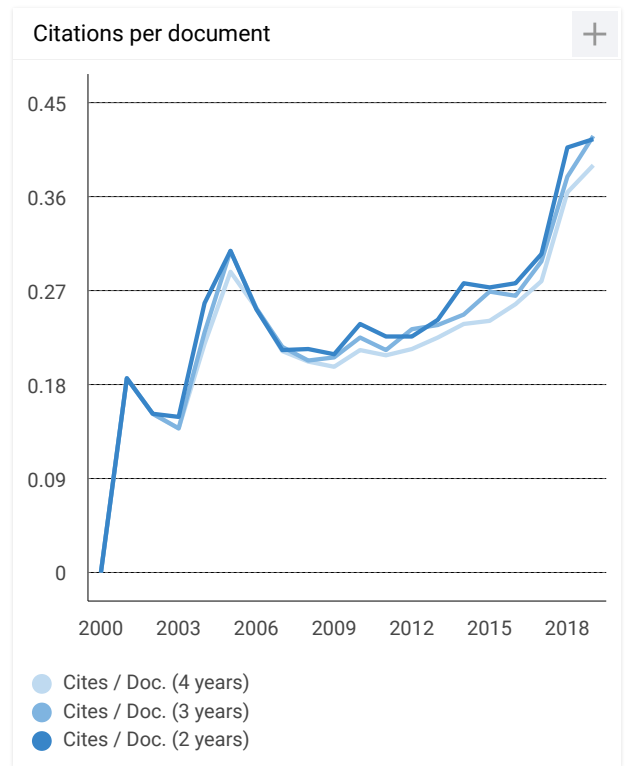
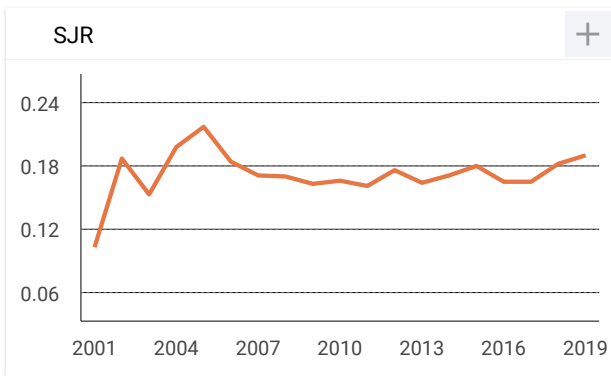
H Index

## Free Grammar Checker

Eliminate grammar errors instantly and enhance your writing with Grammarly

Grammarly

DOWNLOAD



#### AIP Conference Proceedings

← Show this widget in your own website

Not yet assigned quartile

SJR 2019  
**0.19**

powered by scimagojr.com

Just copy the code below and paste within your html code:

```
<a href="https://www.scimagojr.com" style="border: 1px solid #ccc; padding: 2px 5px; display: inline-block;">https://www.scimagojr.com
```

# Antibacterial test of various ingredients of “Indonesian Jamu”

Cite as: AIP Conference Proceedings 2019, 040013 (2018); <https://doi.org/10.1063/1.5061883>  
Published Online: 10 October 2018

Selva Rosyta Dewi, Tri Rahayu, Siti Istiqomah, Lisa Marjayandari, Mar'atus Sholichah, Nurul 'Aini, Nabela Nur Hanifah, Izdihar Tsana, Ana Mariatul Khiftiyah, Desi Triwahyuni, Muhammad Bachruddin, Indra Adi Wira Prasetya, Fatimah, and Ni'matuzahroh



View Online



Export Citation

## ARTICLES YOU MAY BE INTERESTED IN

[Detection of microbial presence in the room, equipment, and cell culture media at temporary stem cell laboratory](#)

AIP Conference Proceedings 2019, 040011 (2018); <https://doi.org/10.1063/1.5061881>

[Isolation and screening of potential proteolytic and amylolytic microbes from Wonorejo Mangrove forest soil, Surabaya, Indonesia](#)

AIP Conference Proceedings 2019, 040014 (2018); <https://doi.org/10.1063/1.5061884>

[A study of the mangrove community in the coastal area of Dodinga Bay, South Jailolo District, West Halmahera Regency, North Maluku Province](#)

AIP Conference Proceedings 2019, 040008 (2018); <https://doi.org/10.1063/1.5061878>

Lock-in Amplifiers  
up to 600 MHz



# Antibacterial Test of Various Ingredients of “Indonesian Jamu”

Selva Rosyta Dewi, Tri Rahayu, Siti Istiqomah, Lisa Marjayandari, Mar’atus Sholichah, Nurul ‘Aini, Nabela Nur Hanifah, Izdiyar Tsana, Ana Mariatul Khiftiyah, Desi Triwahyuni, Muhammad Bachruddin, Indra Adi Wira Prasetya, Fatimah, Ni’matuzahroh<sup>a)</sup>

Laboratory of Microbiology, Department of Biology, Faculty of Science and Technology, Universitas Airlangga, Surabaya 60115, East Java, Indonesia

<sup>a)</sup>Corresponding author: [nimatuzahroh@fst.unair.ac.id](mailto:nimatuzahroh@fst.unair.ac.id)

**Abstract.** Jamu is an Indonesian traditional beverage, made from various Indonesian spices, and believed to possess antibacterial properties. The aim of this research was to determine whether typical Indonesian Jamu ingredients had antibacterial compounds. The study was performed to determine the activity of the filtrate of various ingredients in inhibiting *Staphylococcus aureus* ATCC 25922 and *Escherichia coli* ATCC 25923 growth. Ingredients used in Jamu were *Alpinia galanga*, *Zingiber officinale*, *Curcuma domestica*, *Tamarindus indica*, *Kaempferia galanga*, *Curcuma xanthorrhiza*, *Syzygium aromaticum*, *Syzygium polyanthum*, *Myristica fragrans*, *Cinnamomum burmannii*, *Cymbopogon citratus*, and *Boesenbergia pandurata*. The concentration used for the respective filtrates was 10% (w/v). Filtrates were made according to common Jamu production, i.e. by blending the ingredients together with distilled water. Sensitivity tests were done by agar diffusion method. Qualitative analysis based on diameter of inhibition zone was conducted to determine the antibacterial activity of all Jamu ingredients. Results showed that the Jamu ingredient with the best antibacterial content for inhibiting *E. coli* was *Kaempferia galanga* (9 mm), while for inhibiting *S. aureus* it was *Tamarindus indica* (8 mm). The results indicate that Jamu ingredients have antibacterial compounds as expected by most Indonesian people.

**Keywords:** Jamu, antibacterial, *Escherichia coli*, jamu, *Staphylococcus aureus*.

## INTRODUCTION

The abundance of biodiversity in Indonesia is one natural resource that can be developed, especially in the health and pharmaceutical sectors. Indonesia has a high number of medicinal plants, and most of them have been widely used and mixed as medicines by Indonesia people since ancient times. Jamu is a term for a traditional herbal medicine from Indonesia. Currently, Indonesian Jamu is recognised by the government and has been developed on an industrial scale.<sup>1,2,3</sup> The medicinal plants that are known Jamu ingredients are *Curcuma domestica*, *Curcuma xanthorrhiza*, *Kaempferia galanga*, *Syzygium aromaticum*, and *Zingiber officinale*.<sup>4</sup>

*Cinnamomum burmannii* (bark and leaves) and *Tagetes erecta* (leaves) from Indonesia have been reported to be antimicrobial agents against *Bacillus subtilis*, *Salmonella typhimurium*, and *Candida albicans*.<sup>5,6</sup> Another research study also reported that *Cinnamomum burmannii* essential oil can inhibit the growth of *Staphylococcus aureus* and *Candida albicans*.<sup>7</sup> *Cymbopogon citratus*, *Cymbopogon nardus*, and *Cymbopogon schoenanthus* have antifungal activities that can control superficial mycosis.<sup>8</sup> *Syzygium aromaticum* from the *Myrtaceae* family has known potential antifungal, antiviral, and antibacterial agents based on previous research.<sup>9,10</sup> It also has antimutagenic, antioxidant, anti-inflammatory, and antiparasitic compounds.<sup>11</sup> *Zingiber officinale* belongs to the *Zingiberaceae*

family and has antibacterial activity to inhibit the growth of *Staphylococcus aureus* and *Streptococcus pyogenes*.<sup>12, 13</sup> Ginger has an essential oil that is known as gingerol.<sup>14</sup>

Based on this, it can be determined that the ingredients of Jamu have great potential and should be developed. There is lot of research that refers to the extracts of Jamu ingredients. However, there is little information about the potential of Jamu ingredients based on their water filtrates. Thus, the objective of this study was to screen the antibacterial activity of some natural medicinal plant/herb filtrates. The antibacterial activity test used the distilled water filtrates of Java galangal, fingerroot, cinnamon, turmeric, Java ginger, lemon grass, galangal, nutmeg, clove, bay leaf, tamarind, and ginger against a Gram-positive standard strain of bacteria represented by *Staphylococcus aureus* ATCC 25922 and a Gram-negative standard represented by *Escherichia coli* ATCC 25923.

## EXPERIMENTAL DETAIL

### Plant Filtrates Preparation

The plant materials used in the study consisted of leaves (*Cymbopogon citratus* and *Syzygium polyanthum*), fruits (*Myristica fragrans*, *Tamarindus indica*, and *Syzygium aromaticum*), stems (*Cinnamomum burmannii*), and roots (*Alpinia galangal*, *Boesenbergia pandurata*, *Curcuma domestica*, *Kaempferia galangal*, *Curcuma xanthorrhiza*, and *Zingiber officinale*). These were collected from the traditional market in Surabaya, Indonesia. The fresh plant materials were finely ground using a blender. One gram of each plant material was weighed in an Erlenmeyer flask, to which 100 mL of distilled water was added for pre-filtrate. The Erlenmeyer flask was placed in dark for three days at room temperature. The mixture was filtered using Whatman No. 1 filter paper. The filtrates were kept at 4°C until used in the experiment.

### Microorganisms

Two reference bacteria, *Escherichia coli* ATCC 25923 and *Staphylococcus aureus* ATCC 25922, were used during the study. The tested strains were obtained from the Biology Department of Airlangga University, cultured in nutrient broth at 37°C and stored in nutrient agar slants at 4°C.

### Antibacterial Assay

The antimicrobial activity of Jamu ingredient filtrates were tested using a disk diffusion assay, modified from Bauer *et al.*<sup>15</sup> Bacterial strains were grown on nutrient agar at 37°C for 24 h then suspended in buffer saline (0.85% NaCl) and adjusted to a turbidity of a 0.5 McFarland standard (10<sup>8</sup> CFU/mL). The bacterial suspension (1000 µL) was inoculated in Petri dishes. The dissolution of the plant filtrates was facilitated with the addition of 1% (v/v) distilled water, which affected the growth of microorganisms (as shown by our control experiments). Briefly, the nutrient agar medium (25 mL) was poured into Petri dishes under aseptic conditions in a laminar air flow hood. The Petri dishes were kept in the laminar air flow chamber for solidification of the media. The Petri dishes were then kept in laminar air flow for drying. Once dried, sterile 6 mm filter paper discs (Difco) were placed in the Petri dishes and 25 µL of the test solution was loaded on each disc. The diameters of inhibition zones were measured in mm after incubation at 37°C for 24 h. All experiments were conducted in triplicates for each treatment against each bacteria. Distilled water was used as a negative control and chloramphenicol was used as a control standard.

## RESULTS AND DISCUSSION

The current study was designed to investigate the antibacterial activity of some Jamu ingredient filtrates: *Alpinia galanga*, *Boesenbergia pandurata*, *Cinnamomum burmannii*, *Curcuma domestica*, *Curcuma xanthorrhiza*, *Cymbopogon citratus*, *Kaempferia galanga*, *Myristica fragrans*, *Syzygium aromaticum*, *Syzygium polyanthum*, *Tamarindus indica*, and *Zingiber officinale* against *Escherichia coli* ATCC 25923 and *Staphylococcus aureus* ATCC 25922. The antibacterial activity of the tested plant filtrates was qualitatively assessed by the presence or absence of inhibition zones. The results are represented in Table 1.

According to the results given in Table 1, the distilled water filtrates of *Curcuma domestica*, *Curcuma xanthorrhiza*, *Kaempferia galanga*, and *Tamarindus indica* showed antibacterial activity against *Escherichia coli*



ATCC 25923 and *Staphylococcus aureus* ATCC 25922. Their effect was comparable to the antibiotic used as control. In addition, *E. coli* ATCC 25923 was strongly influenced, with a mean inhibition zone of 9 mm, by *Kaempferia galanga* filtrate. This result is very interesting because *E. coli* is the most common cause of opportunistic infections. Meanwhile, *Staphylococcus aureus* ATCC 25922 was strongly influenced, with a mean inhibition zone of 9 mm, by *Cymbopogon citratus*. *S. aureus* is a pathogenic bacteria that is resistant to antibiotics because it has the ability to survive in the air for days.<sup>16</sup>

**TABLE 1.** Antibacterial activity of Jamu ingredients

Name of sample	Inhibition zone diameter (mm)	
	Antibacterial activity	
	<i>Escherichia coli</i> ATCC 25923	<i>Staphylococcus aureus</i> ATCC 25922
<i>Alpinia galangal</i>	-	7± 0.14
<i>Boesenbergia pandurata</i>	-	-
<i>Cinnamomum burmannii</i>	-	7,5± 0.07
<i>Curcuma domestica</i>	8± 0.14	7± 0.42
<i>Curcuma xanthorrhiza</i>	7.8± 0.42	7± 0.35
<i>Cymbopogon citratus</i>	8± 0.35	9± 0.21
<i>Kaempferia galangal</i>	9± 0.14	7.5± 0.21
<i>Myristica fragrans</i>	-	-
<i>Syzygium aromaticum</i>	-	-
<i>Syzygium polyanthum</i>	-	-
<i>Tamarindus indica</i>	7± 0.28	8± 0.49
<i>Zingiber officinale</i>	-	-
*Chloramphenicol	15± 0.88	10± 0.21

\*Positive control of bacteria

The distilled water filtrate of *Alpinia galanga* and *Cinnamomum burmannii* showed antibacterial activity against *Staphylococcus aureus* ATCC 25922. *S. aureus* and *E. coli* can be inhibited by ginger ethanolic extract.<sup>17,13</sup> Results showed that the *Cinnamomum burmannii* filtrate effect was stronger than *Alpinia galanga*. The essential oil of *Cinnamomum burmannii* causes membrane disruption in the bacteria.<sup>18</sup> This study demonstrated that the Gram-negative bacteria were more resistant to the plant filtrate than Gram-positive bacteria, as *Escherichia coli* ATCC 25923 exhibited more resistant than *Staphylococcus aureus* ATCC 25922 when they were tested with *Cinnamomum burmannii* filtrate. These essential oils have different sensitivities between Gram-negative and Gram-positive bacteria.<sup>19</sup> The membrane of Gram-negative bacteria is composed of peptidoglycan and the outer layer has a hydrophilic surface as a strong permeability barrier.<sup>20</sup> These results supported that essential oil constituents have antibacterial activity dependent on their hydrophobicity.<sup>21</sup>

Results showed that *Boesenbergia pandurata*, *Myristica fragrans*, *Syzygium polyanthum*, and *Zingiber officinale* distilled water filtrates had noticeable activity against *Escherichia coli* ATCC 25923 and *Staphylococcus aureus* ATCC 25922. Meanwhile, the antibacterial activity of *B. pandurata* ethanol extract and essential oils has been shown to inhibit *Listeria monocytogenes* and *Salmonella typhimurium*.<sup>22</sup> The essential oils of *B. pandurata* also obstructed growth of *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus*, and *L. monocytogenes*. *B. pandurata* essential oil have the ability to change the permeability and to alter salt tolerance of the bacterial cell.<sup>23</sup> Many factors affect antibacterial activity from plant filtrates, which vary in different regions of the world, such as the effect of climate, soil composition, age and vegetation cycle stage, the quality, quantity and composition of filtrate product, and different type of bacterial strains.<sup>24,25</sup> Moreover, the process of filtering depends on the type of solvent.<sup>26</sup> These results indicated that Jamu ingredients have antibacterial compounds as expected by most Indonesian people. The compounds from Jamu ingredients are soluble in water. Therefore, it is important to do further studies to detect the specific active compounds.

## SUMMARY

Various Jamu ingredients as distilled water filtrates showed promising antibacterial activity, especially *Curcuma domestica*, *Curcuma xanthorrhiza*, *Cymbopogon citrates*, *Kaempferia galangal*, and *Tamarindus indica*.

## ACKNOWLEDGMENTS

Authors thank Mr. Suwarni for helpful prepare for this study.

## REFERENCES

1. Y. Elfahmi, H. J. Woerdenbag and O. Kayser, *J. Herb. Med.* **69**, 1-23 (2014).
2. S. Riswan, and H. S. Roemantyo, 2002, *South Pacific Study* **23**, 2–10 (2002).
3. A. Saifudin, T. Usia, S. AbLallo, H. Morita, K. Tanaka and Y. Tezuka, *Asian Pac. J. Trop. Biomed.* **6**, 38-43 (2016).
4. A. T. Septiana, M. Samsi and M. Mustaufik, *Agritech* **37**, 7-14 (2017).
5. E. Y. Sukandar, A.G. Suganda and Muslikhati, *Indo. J. Pharm.* **10**, 31-39 (1999).
6. M. S. W. Hartati, S. Wahyuono and N. Khasanah, *Indo. J. Pharm.* **10**, 40-47 (1999).
7. H. Kuspradini, A. S. Putri, E. Sukaton and T. Mitsunaga, *Agric. Agric. Sci. Proc.* **9**, 411-418 (2016).
8. K. Koba, K. Sanda, C. Raynaud, D. Mandin, J. Millet and J. P. Chaumont, *Journal de Mycologie Medicale* **13**, 175-180 (2003).
9. A. Sebiomo, A.D. Awofodu, A.O. Awosanya, F. E. Awotona and A. J. Ajayi, *J. Microbiol. Antibacter.* **3**, 18-22 (2011).
10. K. Chaieb, H. Hajlaoui, T. Zmantar, A. B. Kahla-Nakbi, M. Rouabhia, K. Mahdouani and A. Bakhrouf., *Phytother. Res.* **21**, 501-506 (2007).
11. Y. Li, C. Xu, Q. Zhang, J. Y. Liu and R. X. Tan, *J. Ethno pharmacol.* **98**, 329-333 (2005).
12. M. O'Hara, D. Kiefer, K. Farrell and K. Kemper, *Arch. Fam. Med.* **7**, 523 -536 (1998).
13. S. P. Malu, G. O. Obochi, E. N. Tawo and B. E. Nyong, *Global J. Pure Appl. Sci.* **15**, 365-368 (2009).
14. Y. J. Fu, Y.G. Zu, L. Y. Chen, X. G. Shi, Z. Wang, S. Sun and T. Efferth, *Phytother. Res.* **21**, 989-994 (2007).
15. A. W. Bauer, W. M. M. Kirby, J. C. Sherris and M. Turck, *Am. J. Clin. Pathol.* **45**, 493-496 (1996).
16. D. Amenu, *Am. J. Ethnomed.* **1**, 018-029 (2014).
17. E. Pattaratanawadee, C. Rachtanapun, P. Wanchaitanawong and W. Mahakarnchanakull, *Kasetsart J.* **40**, 159-165 (2006).
18. J. S. Armstrong, *BioEssays* **28**, 253-260 (2006).
19. A. Smith-Palmer, J. Stewart and L. Fyfe, *Lett. Appl. Microb.* **26**, 118-122 (1998).
20. H. Nikaido and M. Vaare, *Microbiol. Rev.* **49**, 1-32 (1985).
21. R. Lan-ciotti, A. Gianotti, N. Patgnani, N. Belletti, M. F. Guerzoni and F. Gardini, *Trends Food Sci. Technol.* **15**, 201-208 (2004).
22. C. Thongson, P. M. Davidson, W. Mahakarnchanakul and P. Vibulsresth, *J. Food Protect.* **68**, 2054-2058 (2005).
23. K. Norajit, N. Laohakunjit and O. Kerdchoechuen, *Molecules* **12**, 2047-2060 (2007).
24. A. Angioni, A. Barra, V. Coroneo, S. Dessi and P. Cabras, *J. Agric. Food Chem.* **54**, 4364-4370 (2006).
25. V. Masotti, F. Juteau, J. M. Bessiere and J. Viano, *J. Agric. Food Chem.* **51**, 7115-7121 (2003).
26. N. Bedi, P. M. S. Bedi, H.S. Bodiwala, I. P. Singh and P. Bansal, *Can. J. Pure Appl. Sci.* **4**, 1249-1255 (2010).