

Jurnal TEKNOLOGI & INDUSTRI PANGAN

Volume 24 Nomor 2 Tahun 2013



Publikasi Resmi

Perhimpunan Ahli Teknologi Pangan
Indonesia (PATPI)

bekerjasama dengan

Departemen Ilmu dan Teknologi Pangan
Fakultas Teknologi Pertanian
Institut Pertanian Bogor

Member of



DIRECTORY OF
OPEN ACCESS
JOURNALS

Terakreditasi
No: 80/DIKTI/Kep/2012



Jurnal TEKNOLOGI & INDUSTRI PANGAN

ISSN 1979-7788
VOLUME 24 NOMOR 2
Desember 2013

Copyright © 2013 Indonesian Association of Food Technologists in collaboration with the Department of Food Science and Technology, IPB

PENANGGUNG JAWAB

Rindit Pambayun, Prof Dr (Universitas Sriwijaya, Indonesia)
Ketua Perhimpunan Ahli Teknologi Pangan Indonesia (PATPI)

Feri Kusnandar, Dr (Institut Pertanian Bogor, Indonesia)
Ketua Departemen Ilmu dan Teknologi Pangan, FATETA-IPB

PIMPINAN REDAKSI

Harsi D. Kusumaningrum, Dr
(Institut Pertanian Bogor, Indonesia)

DEWAN REDAKSI

Ardiansyah, Dr
(Univ. Bakrie, Indonesia)
C. Hanny Wijaya, Prof Dr
(Ins. Pertanian Bogor, Indonesia)
Indah Epriliati, Dr
(Univ. Katolik Widya Mandala, Indonesia)
Indrawati Oey, Prof Dr
(Otago University, New Zealand)
Sri Widowati, Prof Dr
(Balai Besar Penelitian dan Pengembangan Pasca Panen Pertanian, Bogor, Indonesia)
Tejasari, Dr
(Univ. Jember, Indonesia)
Winiati P. Rahayu, Prof Dr
(Ins. Pertanian Bogor, Indonesia)

Budiatman Satiawihardja, Dr
(Ins. Pertanian Bogor, Indonesia)
Deddy Muchtadi, Prof Dr
(Ins. Pertanian Bogor, Indonesia)
Irwandi Jaswir, Prof Dr
(Int. Islamic University Malaysia, Malaysia)
Ratih Dewanti-Hariyadi, Prof Dr
(Ins. Pertanian Bogor, Indonesia)
Siswa Setyahadi, Dr
(Pusat Teknologi Bioindustri, BPPT, Indonesia)
Umar Santoso, Prof Dr
(Univ. Gajah Mada, Indonesia)
Yonathan Asikin, Dr
(Univ. Ryukyus, Jepang)

REDAKSI PELAKSANA

Anton Rahmadi, Dr	(Univ. Mulawarman, Indonesia)
Eko Hari Purnomo, Dr	(Ins. Pertanian Bogor, Indonesia)
Nancy Dewi Yuliana, Dr	(Ins. Pertanian Bogor, Indonesia)
Nurheni S. Palupi, Dr	(Ins. Pertanian Bogor, Indonesia)
Puspo Edi Giriwono, Dr	(Ins. Pertanian Bogor, Indonesia)

ADMINISTRASI DAN KEUANGAN

Nur Wulandari, Dr
Sutrisno Koswara, MSi
Ifri Hidayah

Jurnal Teknologi dan Industri Pangan (TIP) merupakan jurnal terakreditasi di Indonesia dan sering menjadi referensi bidang teknologi pangan. Jurnal TIP diterbitkan sejak tahun 1990 dengan nama Buletin Penelitian Ilmu dan Teknologi Pangan dan sejak tahun 2001 menjadi publikasi resmi Perhimpunan Ahli Teknologi Pangan Indonesia (PATPI) dengan nama Jurnal Teknologi dan Industri Pangan (JTIP) yang diterbitkan bekerjasama dengan Departemen Ilmu dan Teknologi Pangan, Fakultas Teknologi Pertanian, Institut Pertanian Bogor. Jurnal versi online dapat diakses melalui <http://journal.ipb.ac.id/index.php/jtip>, dengan nomor E-ISSN: 2087-751X.

Jurnal TIP terbit dua kali dalam setahun, yaitu bulan Juni dan Desember, mempublikasikan hasil-hasil penelitian dan komunikasi singkat dalam bidang ilmu dan teknologi pangan dalam Bahasa Indonesia dan Bahasa Inggris.

Perubahan penanggung jawab dan susunan redaksi telah dilakukan kembali pada Volume 23 Nomor 2 Tahun 2012 seiring dengan pergantian Ketua PATPI untuk periode 2012-2014. Selain itu juga ditambahkan Editor Internasional sebagai langkah untuk Internasionalisasi Jurnal Teknologi dan Industri Pangan serta guna meningkatkan kinerja pengelolaan jurnal.

Infomasi dan korespondensi dapat menghubungi sekretariat Jurnal Teknologi dan Industri Pangan, Departemen Ilmu dan Teknologi Pangan, Fakultas Teknologi Pertanian, Institut Pertanian Bogor. Kampus IPB Darmaga Kotak Pos 220, Bogor 16002; Telp/Fax: (0251) 8626725; E-mail: jurnaltip@yahoo.com.

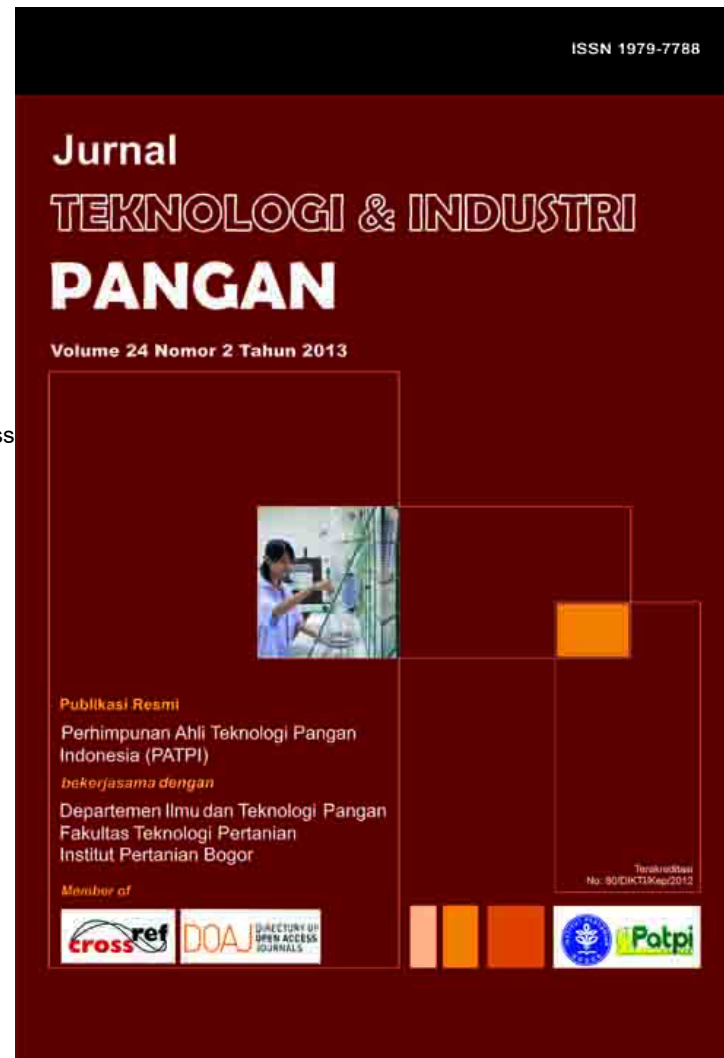
Journal Cover


[View Current Issue](https://journal.ipb.ac.id/index.php/jtip/issue/view/1128)
<https://journal.ipb.ac.id/index.php/jtip/issue/view/1128>

Accreditation


<https://drive.google.com/file/d/1-qQfhMiC9qZz8kHfICzcIBRgX0Xj-l8d/view?usp=sharing>

Publisher

[Home \(https://journal.ipb.ac.id/jtip/index\)](https://journal.ipb.ac.id/jtip/index)
[/ Archives \(https://journal.ipb.ac.id/jtip/issue/archive\)](https://journal.ipb.ac.id/jtip/issue/archive)
[/ Vol. 24 No. 2 \(2013\): Jurnal Teknologi dan Industri Pangan](https://journal.ipb.ac.id/jtip/issue/view/1128)


Research Paper


<https://journal.ipb.ac.id/index.php/jtip/about/submissions>

Submission Preparation


[https://www.dropbox.com/scl/fi/wpj2nxdserk51e9zejkl5/TerrJTIP_draft_Mei_2025.docx?](https://www.dropbox.com/scl/fi/wpj2nxdserk51e9zejkl5/TerrJTIP_draft_Mei_2025.docx?rlkey=yriqbqb3hng3c6n7kqx57sy93&st=x2d1ypdq&dl=1)
[rlkey=yriqbqb3hng3c6n7kqx57sy93&st=x2d1ypdq&dl=1\)](https://www.dropbox.com/scl/fi/wpj2nxdserk51e9zejkl5/TerrJTIP_draft_Mei_2025.docx?rlkey=yriqbqb3hng3c6n7kqx57sy93&st=x2d1ypdq&dl=1)

[https://www.dropbox.com/scl/fi/ug1xkek1pl54w2q5tlhqb/Dr.AGREEMENT_JTIP_ENG_fix.docx?](https://www.dropbox.com/scl/fi/ug1xkek1pl54w2q5tlhqb/Dr.AGREEMENT_JTIP_ENG_fix.docx?rlkey=5wietgr9pinyvw83r1nm5ci54&dl=0)
[rlkey=5wietgr9pinyvw83r1nm5ci54&dl=0\)](https://www.dropbox.com/scl/fi/ug1xkek1pl54w2q5tlhqb/Dr.AGREEMENT_JTIP_ENG_fix.docx?rlkey=5wietgr9pinyvw83r1nm5ci54&dl=0)

Journal Menu

☐ Focus and Scopes

<https://journal.ipb.ac.id/index.php/jtip/focus-and-scope>
☒ Publication Ethics

<https://journal.ipb.ac.id/index.php/jtip/Ethic-in-Publishing>
☐ Author Guidelines

https://drive.google.com/file/d/1O5ce4cxn3Y_VG-u69IVxVjG4ofrrtvdI/view?usp=sharing



(<http://fst.ipb.ac.id/cms/en/home>)

Indonesian Association of Food Technologists (IAFT)

In Collaboration with



IPB University
— Bogor Indonesia —

(<http://fst.ipb.ac.id/cms/en/home>)

Department of Food Science and Technology, Faculty of Agricultural Engineering and Technology, IPB University

Plagiarism Check



(https://www.turnitin.com/login_page.asp?lang=en_us)

Google Scholar Citation

Updated weekly



(<https://scholar.google.com/citations?user=P5Sd9eEAAAAJ&hl=en>)

	All	Since 2020
Citations	6225	3814
h-index	36	26

ACIDIC SOAKING AND STEAM BLANCHING RETAIN ANTHOCYANINS AND POLYPHENOLS IN PURPLE Dioscorea alata FLOUR [Perendaman Asam dan Blanching Uap Mempertahankan Antosianin dan Polifenol Tepung Dioscorea alata Ungu]

(<https://journal.ipb.ac.id/jtip/article/view/7677>)

Nelis Imanningsih, Deddy Muchtadi, Tutik Wresdiyati, Nurheni Sri Palupi, . Komari



Citations

38



121

(<https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.121?domain=https://journal.ipb.ac.id>)



Abstract Views : 1546



Download :1320

10.6066/jtip.2013.24.2.1

(<https://www.doi.org/10.6066/jtip.2013.24.2.1>)

PDF (<https://journal.ipb.ac.id/jtip/article/view/7677/5982>)

PEMBUATAN CRACKERS JAGUNG DAN PENDUGAAN UMUR SIMPANNYA DENGAN PENDEKATAN KADAR AIR KRITIS [Production of Corn Cracker and Prediction of Its Shelf Life Using a Critical Moisture Approach]

(<https://journal.ipb.ac.id/jtip/article/view/7682>)

. Sugiyono, Esther Mariana, Aton Yulianto



Citations

4



129

(<https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.129?domain=https://journal.ipb.ac.id>)



Abstract Views : 3032



Download :2531

10.6066/jtip.2013.24.2.1

(<https://www.doi.org/10.6066/jtip.2013.24.2.1>)

PDF (<https://journal.ipb.ac.id/jtip/article/view/7682/5983>)

POTENSI KENTANG HITAM DALAM MEREDUKSI STRES OKSIDATIF DAN MENGHAMBAT PROLIFERASI SEL KANKER PAYUDARA MCF-7 [Potential of Black Potato in Reducing Oxidative Stress and Inhibiting the Proliferation of Breast Cancer Cells MCF-7]

(<https://journal.ipb.ac.id/jtip/article/view/7683>)

Mutiara Nugraheni, Umar Santoso, . Suparmo, Hastari Wuryastuti



Citations

3



138

(<https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.138?domain=https://journal.ipb.ac.id>)

 Article Publication Charge
(<https://journal.ipb.ac.id/index.php/jtip/AuthorFees>)

 Peer Review Process
(<https://journal.ipb.ac.id/index.php/jtip/review-and-process>)

 Publication Frequency
(<https://journal.ipb.ac.id/index.php/jtip/PublicationFrequency>)

 Crossmark Policy
(<https://journal.ipb.ac.id/index.php/jtip/Crossmark>)

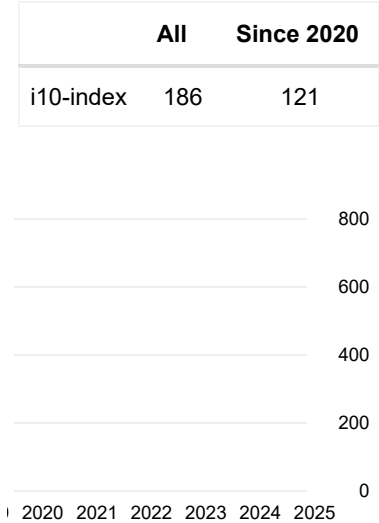
 Open Access Policy
(<https://journal.ipb.ac.id/index.php/jtip/OpenAccessPolicy>)

 Copyright
(<https://journal.ipb.ac.id/index.php/jtip/OpenAccessPolicy>)

Editorial Board

Chief Editor

Prof.Dr. Hanifah Nuryani Lioe
(<https://www.scopus.com/authid/detail.uri?authorId=8846278600>)
Department of Food Science and Technology, Faculty of Agricultural Technology and Engineering, IPB University (Bogor Agricultural University), Indonesia
8846278600
(<https://www.scopus.com/authid/detail.uri?authorId=8846278600>)



Highly Accessed

PEMANFAATAN UBI JALAR UNGU (*Ipomoea batatas* L. Poir) SEBAGAI PENGGANTI SEBAGIAN TEPUNG TERIGU DAN SUMBER ANTIOKSIDAN PADA ROTI TAWAR [Purple Sweet Potato (*Ipomoea batatas* L. Poir) as a Partial Substitute of Wheat flour and Source of Antioxidant on Plain Bread]

(<https://journal.ipb.ac.id/jtip/article/view/2414>)

June 12, 2010

19914

Hardoko, Liana Hendarto, ...

SIFAT FISIK MINYAK SAWIT KASAR DAN KORELASINYA DENGAN ATRIBUT MUTU [Physical Properties of Crude Palm Oil and Their Correlation with Quality Attributes]

Abstract Views : 1879 Download :2240

10.6066/jtip.2013.24.2.1

(<https://www.doi.org/10.6066/jtip.2013.24.2.1>)

PDF (<https://journal.ipb.ac.id/jtip/article/view/7683/6049>)

KARAKTERISTIK FISIK, KIMIA, MIKROBIOLOGI WHEY KEFIR DAN AKTIVITASNYA TERHADAP PENGHAMBATAN ANGIOTENSIN CONVERTING ENZYME (ACE) [Physical, Chemical and Microbiological Characteristics of Whey Kefir and Its Angiotensin Converting Enzyme (ACE) Inhibitory Act]

(<https://journal.ipb.ac.id/jtip/article/view/7694>)

Andi Febrisiantosa, Bagus Priyo Purwanto, Yantyati Widyastuti, Irma Isnafia Arief

Citations 11

(<https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.147?domain=https://journal.ipb.ac.id>)

Abstract Views : 4374 Download :6588

10.6066/jtip.2013.24.2.1

(<https://www.doi.org/10.6066/jtip.2013.24.2.1>)

PDF (<https://journal.ipb.ac.id/jtip/article/view/7694/6050>)

Lactobacillus plantarum PADA FESES INDIVIDU DEWASA SEHAT YANG MENGONSUMSI Lactobacillus plantarum IS-10506 DARI DADIH [Lactobacillus plantarum in Stool of Apparently Healthy Adults Consuming Lactobacillus plantarum IS-10506 from Dadih]

(<https://journal.ipb.ac.id/jtip/article/view/7711>) (<https://journal.ipb.ac.id/index.php/jtip/about/editorialTeam>)

Azmier Adib, Mardiasuti H Wahid, Pratiwi Sudarmono, Ingrid S. Surono

Citations 14

(<https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.154?domain=https://journal.ipb.ac.id>)

Abstract Views : 2057 Download :2783

10.6066/jtip.2013.24.2.1

(<https://www.doi.org/10.6066/jtip.2013.24.2.1>)

PDF (<https://journal.ipb.ac.id/jtip/article/view/7711/6048>)

KAPASITAS ANTIOKSIDAN DAN INHIBITOR ALFA GLUKOSIDASE EKSTRAK UMBI BAWANG DAYAK [Antioxidant and Alpha-Glucosidase Inhibitory Properties of Bawang Dayak Bulb Extracts]

Associate Editors

Prof.Dr. C. Hanny Wijaya

(<https://www.scopus.com/authid/detail.uri?authorId=54880990800>)

Department of Food Science and Technology, IPB University (Bogor Agricultural University), Indonesia

54880990800

(<https://www.scopus.com/authid/detail.uri?authorId=54880990800>)

Prof.Dr. Winiati P. Rahayu

(<https://www.scopus.com/authid/detail.uri?authorId=55622287500>)

Department of Food Science and Technology, IPB University (Bogor Agricultural University), Indonesia

55622287500

(<https://www.scopus.com/authid/detail.uri?authorId=55622287500>)

CC Licensing



(<https://creativecommons.org/licenses/by-sa/4.0/>)

Jurnal Teknologi dan Industri Pangan is using CC BY-SA license. This license lets others distribute, remix, tweak, and build upon JTIP's articles, as long as they credit the authors for the original creation.

Correlations to the Quality Attributes]
(<https://journal.ipb.ac.id/jtip/article/view/4274>)

 December 23, 2011
14600
 Nur Wulandari, Tien R. Much...

KRISTALISASI PELARUT SUHU RENDAH PADA PEMBUATAN FRAKSI KAYA VITAMIN E MENGANDUNG TOKOTRIENOL DARI DISTILAT ASAM LEMAK MINYAK SAWIT [Low Temperature Solvent Crystallizationin Tocotrienol Containing Vitamin E Rich Fraction Preparation from Palm Fatty Acid D

(<https://journal.ipb.ac.id/jtip/article/view/4269>)
 December 29, 2011
12914
 Kgs Ahmadi, Teti Estiasih

Physical and Chemical Characteristics of Mangos (Mangifera indica L.) during Storage with Various Methods of Packaging
(<https://journal.ipb.ac.id/jtip/article/view/4083>)

 October 6, 2025
10657
 Merynda Indriyani Syafutri,...

PRODUKSI DAN EVALUASI KUALITAS SUSU BUBUK ASAL KAMBING PERANAKAN ETTAWA (PE) [Production and Quality Evaluation of Ettawa-

(<https://journal.ipb.ac.id/jtip/article/view/7712>)

Andi Early Febrinda, Made Astawan, Tutik Wresdiyati, Nancy Dewi Yuliana

 Citations 28
(<https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.161?domain=https://journal.ipb.ac.id>)

 Abstract Views : 12818  Download :25044 10.6066/jtip.2013.24.2.1
(<https://www.doi.org/10.6066/jtip.2013.24.2.1>)

PDF (<https://journal.ipb.ac.id/jtip/article/view/7712/6051>)

PERUBAHAN FISIKO-KIMIAWI, MIKROBIOLOGI DAN HISTAMIN BAKASANG IKAN CAKALANG SELAMA FERMENTASI DAN PENYIMPANAN [Physico-Chemical, Microbiological, and Histamine Changes in Skipjack Bakasang During Fermentation and Storage]
(<https://journal.ipb.ac.id/jtip/article/view/7713>)

Sri Purwaningsih, Joko Santoso, Rahmatia Garwan

 Citations 5
(<https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.168?domain=https://journal.ipb.ac.id>)

 Abstract Views : 4722  Download :7535 10.6066/jtip.2013.24.2.1
(<https://www.doi.org/10.6066/jtip.2013.24.2.1>)

PDF (<https://journal.ipb.ac.id/jtip/article/view/7713/6052>)

KARAKTERISTIK FISIKOKIMIA DAN ANTIBAKTERI VIRGIN COCONUT OIL HASIL FERMENTASI BAKTERI ASAM LAKTAT [Physicochemical and Antibacterial Characteristics of Virgin Coconut Oil Fermented with Lactic Acid Bacteria]
(<https://journal.ipb.ac.id/jtip/article/view/7714>)

Anton Rahmadi, Ipnatul Abdiah, Maya Dewi Sukarno, Titin Purnaningsih

 Citations 13
(<https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.178?domain=https://journal.ipb.ac.id>)

 Abstract Views : 5220  Download :6129 10.6066/jtip.2013.24.2.1
(<https://www.doi.org/10.6066/jtip.2013.24.2.1>)

PDF (<https://journal.ipb.ac.id/jtip/article/view/7714/6053>)

This work is licensed under a Creative Commons Attribution 4.0 International License
(<http://creativecommons.org/licenses/by/4.0/>).

Browse Issues

(<https://journal.ipb.ac.id/jtip/issue/view/772>)
First issue
(<https://journal.ipb.ac.id/jtip/issue/view/772>)
Vol. 9 No. 2 (1999)
Jurnal Teknologi dan Industri Pangan

(<https://journal.ipb.ac.id/jtip/issue/view/788>)
Previous issue
(<https://journal.ipb.ac.id/jtip/issue/view/788>)
Vol. 23 No. 1 (2012)
Jurnal Teknologi dan Industri Pangan

(<https://journal.ipb.ac.id/jtip/issue/view/1044>)
Next issue
(<https://journal.ipb.ac.id/jtip/issue/view/1044>)
Vol. 24 No. 1 (2013)
Jurnal Teknologi dan Industri Pangan

(<https://journal.ipb.ac.id/jtip/issue/view/3717>)
Last issue
(<https://journal.ipb.ac.id/jtip/issue/view/3717>)
Vol. 36 No. 1 (2025)
Jurnal Teknologi dan Industri Pangan

(<https://journal.ipb.ac.id/jtip/issue/archive>)
All issues
(<https://journal.ipb.ac.id/jtip/issue/archive>)

Crossbred Goat Milk Powder]
(https://journal.ipb.ac.id/jtip/article/view/6143)
9814 December 22, 2012
. Widodo, Afina Viyunnur Ra...

APLIKASI MUTAN BERFLUORESENS UNTUK
MEMPELAJARI KETAHANAN HIDUP, KOLONISASI DAN
PENETRASI ISOLAT Cronobacter sakazakii SELAMA
PENGERINGAN JAGUNG [Use of GFP Mutant to Study the
Survival, Colonization and Penetration of Cronobacter
sakazakii Isolates Duri
(https://journal.ipb.ac.id/jtip/article/view/7715)
Siti Nurjanah, Maggy T. Suhartono, Ratih Dewanti- Hariyadi, Sri Estuningsih
Citations 4 184
(https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.184?
domain=https://journal.ipb.ac.id)
Abstract Views : 1932 Download :1686 10.6066/jtip.2013.24.2.1
(https://www.doi.org/10.6066

PDF (https://journal.ipb.ac.id/jtip/article/view/7715/6055)
PENGEMBANGAN BERAS ANALOG DENGAN
MEMANFAATKAN JAGUNG PUTIH [Development of White
Corn-Based Rice Analogues]
(https://journal.ipb.ac.id/jtip/article/view/7716)
Santi Noviasari, Feri Kusnandar, Slamet Budijanto
Citations 35 194
(https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.194?
domain=https://journal.ipb.ac.id)
Abstract Views : 7480 Download :9525 10.6066/jtip.2013.24.2.1
(https://www.doi.org/10.6066

PDF (https://journal.ipb.ac.id/jtip/article/view/7716/6056)
KARAKTERISTIK MIKROKAPSUL MINYAK ATSIRI
LENGKUAS DENGAN MALTODEKSTRIN SEBAGAI
ENKAPSULAN [Characteristics of Galangal Essential Oil
Microencapsulation Using Maltodextrin Encapsulant]
(https://journal.ipb.ac.id/jtip/article/view/7717)
. Supriyadi, A. Sakha Rujita
Citations 22 201
(https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.201?
domain=https://journal.ipb.ac.id)
Abstract Views : 3083 Download :4450 10.6066/jtip.2013.24.2.2
(https://www.doi.org/10.6066

Visitor
statcounter
(https://statcounter.com/p10182404/?
guest=1">View My Stats)
View My Stats (Since December
2014)
(http://statcounter.com/p10182404/?
guest=1)
01332123

Keywords
surimi powder snerbsd bios citosl
(https://journal.ipb.ac.id/jtip/article/view/7715/6055)
query=snerbsd bios citosl=vteup
powder)physicochemical knitb
(https://journal.ipb.ac.id/jtip/article/view/7715/6055)
Qdensyphjshobobemialuo\\:zqttr)
partiesjit(wobsonleivto=vteup
(https://journal.ipb.ac.id/jtip/article/view/7715/6055)
Qdensyphjshobobemialuo\\:zqttr)
(https://journal.ipb.ac.id/jtip/article/view/7715/6055)
queryxrelangke)psdqgub(noitqozbs
(https://journal.ipb.ac.id/jtip/article/view/7715/6055)
querysb.(kotalms)beef beib=vteup
(https://journal.ipb.ac.id/jtip/article/view/7715/6055)
query=beef)bstitnoc(sitosl.l=vteup
(https://journal.ipb.ac.id/jtip/article/view/7715/6055)
Qdensyphjshobobemialuo\\:zqttr)
(https://journal.ipb.ac.id/jtip/article/view/7715/6055)
query=lipase)stfohees(eizvlotocvlg
(https://journal.ipb.ac.id/jtip/article/view/7715/6055)
noitsueqssobnsn(muiclsosnsvteup
(https://journal.ipb.ac.id/jtip/article/view/7715/6055)
Chem)spitctrophomenyo\\:zqttr)
(https://journal.ipb.ac.id/jtip/article/view/7715/6055)

query=spectrophotometry) &sort=dsz
(https://journal.ipb.ac.id/jtip/article/view/7717/6057)
ANTIOXIDATIVE CHARACTERISTICS OF BEVERAGES
MADE FROM A MIXTURE OF LEMONGRASS EXTRACT
AND GREEN TEA [Studi Karakteristik Antioksidan Minuman
Campuran Ekstrak Serai dan Teh Hijau]
(https://journal.ipb.ac.id/jtip/article/view/7719)
PENGARUH MEDIA KULTIVASI Chaetoceros gracilis
TERHADAP KANDUNGAN KIMIAWI DAN POTENSI
INHIBITOR PROTEASE [Effect of Chaetoceros gracilis
Cultivation Media to the Chemical Content and Protease
Inhibitor Potential]
(https://journal.ipb.ac.id/jtip/article/view/7721)

Sri Priatni, Anastasia F. Devi, Leonardus B.S. Kardono, Vijay Jayasena

Citations 9

209

(https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.209?
domain=https://journal.ipb.ac.id)

Abstract Views : 2582 Download :2010 10.6066/jtip.2013.24.2.2
(https://www.doi.org/10.6066/jtip.2013.24.2.2)

PDF (https://journal.ipb.ac.id/jtip/article/view/7718/6058)

ANTIOXIDATIVE CHARACTERISTICS OF BEVERAGES
MADE FROM A MIXTURE OF LEMONGRASS EXTRACT
AND GREEN TEA [Studi Karakteristik Antioksidan Minuman
Campuran Ekstrak Serai dan Teh Hijau]
(https://journal.ipb.ac.id/jtip/article/view/7719)

Jeremia Manuel Halim, W. Donald R. Pokatong, Jessica Ignacia

Citations 5

215

(https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.215?
domain=https://journal.ipb.ac.id)

Abstract Views : 2168 Download :2887 10.6066/jtip.2013.24.2.2
(https://www.doi.org/10.6066/jtip.2013.24.2.2)

PDF (https://journal.ipb.ac.id/jtip/article/view/7719/6059)

PENGARUH MEDIA KULTIVASI Chaetoceros gracilis
TERHADAP KANDUNGAN KIMIAWI DAN POTENSI
INHIBITOR PROTEASE [Effect of Chaetoceros gracilis
Cultivation Media to the Chemical Content and Protease
Inhibitor Potential]
(https://journal.ipb.ac.id/jtip/article/view/7721)

Iriani Setyaningsih, Tati Nurhayati, Uzainah Aremhas

 Citations 3 222

([https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.222?](https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.222?domain=https://journal.ipb.ac.id)
domain=<https://journal.ipb.ac.id>)

 Abstract Views : 2148  Download :2148 10.6066/jtip.2013.24.2.2
(<https://www.doi.org/10.6066/jtip.2013.24.2.2>)

PDF (<https://journal.ipb.ac.id/jtip/article/view/7721/6060>)

KARAKTERISTIK PRODUK BUBUK SARI JAGUNG MANIS
INSTAN HASIL PENDINGINAN METODE SPOUTED-
VORTEX-BED [Characteristics of Instant Sweet Corn Extract
Powders Produced by Spouted-Vortex-Bed Drying Method]
(<https://journal.ipb.ac.id/jtip/article/view/7725>)

Iwan Taruna, Neti Surami, . Sutarsi

 Citations 1 228

([https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.228?](https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.228?domain=https://journal.ipb.ac.id)
domain=<https://journal.ipb.ac.id>)

 Abstract Views : 1522  Download :1471 10.6066/jtip.2013.24.2.2
(<https://www.doi.org/10.6066/jtip.2013.24.2.2>)

PDF (<https://journal.ipb.ac.id/jtip/article/view/7725/6061>)

Short Communication

REDUCTION OF GLUCOSINOLATES CONTENT DURING
SAYUR ASIN FERMENTATION [Penurunan Kandungan
Berbagai Glukosinolat selama Fermentasi Sayur Asin]
(<https://journal.ipb.ac.id/jtip/article/view/7724>)

Probo Y. Nugraheidi, Caesariana A. Priatko, Matthijs Dekker, Budi Widianarko,
Ruud Verkerk, Ruud...

 Citations 3 235

([https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.235?](https://badge.dimensions.ai/details/doi/10.6066/jtip.2013.24.2.235?domain=https://journal.ipb.ac.id)
domain=<https://journal.ipb.ac.id>)

 Abstract Views : 2614  Download :1967 10.6066/jtip.2013.24.2.2
(<https://www.doi.org/10.6066/jtip.2013.24.2.2>)

PDF (<https://journal.ipb.ac.id/jtip/article/view/7724/6721>)



IPB University
— Bogor Indonesia —

 Address

Departemen Ilmu dan Teknologi Pangan, Fakultas Teknologi Pertanian, Institut Pertanian Bogor, Bogor.

(Department of Food Science and Technology, Faculty of Agricultural Engineering and Technology, IPB University, Dramaga, Bogor)

Telepon/fax: 0251-8626725

Email: jurnaltip@apps.ipb.ac.id;
jurnaltip@yahoo.com;
jurnaltip@gmail.com

Contact Info

Administrasi Jurnal TIP

Telepon/fax: 0251-8626725

Email: jurnaltip@apps.ipb.ac.id

p-ISSN: 1979-7788

(<https://portal.issn.org/resource/ISSN/1979-7788>) e-ISSN: 2087-751X

(<https://portal.issn.org/resource/ISSN/2087-751X>)



This is an open-access article

distributed under the terms of the **Creative**

Commons Attribution-ShareAlike 4.0 International License.

81332124 (<https://www.statcounter.com/>)

REDUCTION OF GLUCOSINOLATES CONTENT DURING SAYUR ASIN FERMENTATION

[Penurunan Kandungan Berbagai Glukosinolat selama Fermentasi Sayur Asin]

Probo Y. Nugrahed^{1,2)*}, Caesariana A. Priatko¹⁾, Ruud Verkerk²⁾, Matthijs Dekker²⁾ and Budi Widianarko¹⁾

¹⁾ Department of Food Technology, Soegijapranata Catholic University, Semarang, Indonesia

²⁾ Food Quality and Design Group, Department of Agrotechnology and Food Science, Wageningen University, Wageningen, The Netherlands

Accepted June 19th 2013 / Approved December 02th 2013

ABSTRACT

Glucosinolates (GLSs), health promoting compounds commonly found in *Brassica* vegetables, were studied during *sayur asin* fermentation made from Indian mustard (*B. juncea*). The current preliminary study aims to investigate the changes of glucosinolates content during 3 and 7 days of fermentation in two different media, i.e. coconut water and *tajin* liquor, and salt concentrations of 2.5 and 10%. The glucosinolates were analysed by HPLC after sample extraction in hot methanol followed by purification and de-sulphation. Results show that sinigrin was the most dominant glucosinolate among others, i.e. gluconapin, glucobrassicin, 4-hydroxy-glucobrassicin, 4-methoxy-glucobrassicin, and neo glucobrassicin, accounting for about 1000 and 4000 $\mu\text{mol}/10\text{ g dw}$ in raw Indian mustard. Unfortunately, fermentation has substantially reduced the glucosinolates content in *sayur asin*. After 3 days of fermentation the sinigrin content was reduced by 95% as compared to that in the raw vegetable. The indole GLSs 4-methoxy-glucobrassicin and neo-glucobrassicin concentration decreased to 80-90% of the fresh materials. However, the decreasing mechanisms as well as factors contributing to the decrease of the glucosinolates could not be explained yet.

Keywords: fermentation, glucosinolates, health, *sayur asin*

ABSTRAK

Studi awal tentang kandungan glukosinolat, suatu kelompok senyawa fungsional yang biasa dijumpai di sayuran *Brassica*, selama fermentasi sayur asin dari sawi pahit (*B. juncea*) telah dilakukan dengan tujuan untuk mempelajari perubahan kandungan berbagai glukosinolat selama pembuatan sayur asin. Penelitian dilaksanakan dengan melakukan fermentasi sawi pahit selama tujuh hari dengan media air kelapa dan air *tajin* serta dua kadar garam (2.5 dan 10%). Glukosinolat diuji menggunakan HPLC setelah dilakukan ekstraksi, purifikasi, dan desulfatasi pada sampel. Hasil penelitian ini menunjukkan bahwa sinigrin merupakan glukosinolat yang paling dominan, berkisar 1000 dan 4000 $\mu\text{mol}/10\text{ g}$ berat kering, di antara berbagai glukosinolat lain yang dapat diidentifikasi pada sawi pahit. Fermentasi telah menyebabkan turunnya kandungan berbagai glukosinolat secara drastis pada sayur asin dibandingkan pada sawi pahit segar. Pada hari ke-3 fermentasi, kandungan sinigrin turun hingga 95% dibanding pada sampel segar. Kandungan glukosinolat golongan indole (4-methoxy-glucobrassicin dan neo-glucobrassicin) juga menurun hingga 80-90% dibandingkan pada sawi pahit segar. Namun, mekanisme penurunan termasuk faktor-faktor yang mungkin berpengaruh belum dapat dijelaskan.

Kata kunci: fermentasi, glukosinolat, kesehatan, sayur asin

INTRODUCTION

Brassica vegetables, including cabbage, broccoli, and cauliflower, have been studied widely for the health promoting compounds, namely glucosinolates (GLSs). The GLSs are a group of β -thioglucoside N-hydroxysulphates with a sulphur linked β -D-glucopyranose moiety and side-chain group (R), which is derived mainly from one of certain amino acids, such as methionine, tryptophan, and phenylalanine. The GLS can be classified either as aliphatic, aromatic, or indole (Clarke, 2010; Verkerk *et al.* 2009; Halkier and Gershenzon, 2006). Upon damage of plant tissue, GLSs are highly prone to hydrolysis catalysed by myrosinase enzyme (β -thioglucosidase EC 3.2.1.147) (Bones and Rossiter, 2006; Verkerk *et al.* 2009). The GLSs are believed to lower the risk of cancer, particularly due to isothiocyanates, one of the GLSs derivatives, which can inhibit

phase 1 and induce phase 2 enzymes during carcinogen metabolism (Traka and Miethen, 2009). Reviews of epidemiological studies reported inverse associations between intake of *Brassica* vegetables and the risk of certain cancers (Cartea and Velasco, 2008; Herr and Büchler, 2010).

Fermentation is one of the methods to prepare *Brassica* vegetables, e.g. sauerkraut (Ciska and Pathak, 2004; Uva *et al.* 2006). However, fermentation commonly leads to GLSs loss in the product (Daxenbichler *et al.* 1980; Ciska and Pathak, 2004; Martinez-Villaluenga *et al.* 2009). To our knowledge, there is no study on the GLSs behaviour along the *sayur asin* production. *Sayur asin* is prepared by spontaneous fermentation of Indian mustard in the presence of salt. Either *tajin* liquor or coconut water is used as the medium. This paper aims to describe the changes of GLSs content in Indian mustard during *sayur asin* production and how these are affected by the fermentation medium and salt concentration.

*Corresponding Author:
Email: probo@unika.ac.id; Phone: 024-8441555

MATERIALS AND METHODS

Preparation of sayur asin

Raw Indian mustard (*Brassica juncea*), local name: *sawi pahit*, was obtained from a local supplier in Bandung, Central Java. Sampling was performed from the pooled vegetables after randomly divided them into number of treatments and replication. Each treatment contained approximately 1500 grams of Indian mustard or six whole plants for three replications. Each vegetable was washed by running tap water followed by draining. Subsequently it was withered under sunlight for four hours. Each vegetable was added with salt (2.5 or 10% w/w) and rubbed gently by hand simultaneously. Subsequently, it was immersed into a glass jar containing either the *tajin* liquor (1:2 w/v) (Nugrahani *et al.* 2000) or coconut water (1:5 w/v). The ratio was estimated after interviewing two local *sayur asin* producers. Eventually each sample was incubated at 25 - 30°C for 7 days. Each jar represented a replication of one treatment, containing two whole plants. Therefore, there were six samples per treatment for glucosinolates analysis, except for the samples of raw vegetable ($n = 4$) and coconut water-10% salt-day 3 ($n = 5$).

Tajin liquor was prepared by boiling rice (IR-64) in distilled water at a ratio 1:14 (w/v) for 15 min. Subsequently, salt was added at a ratio 1:40 (w/v of added water) and mixed. The liquid was separated and cooled at room temperature. Fresh coconut water was obtained from the local market. The glucosinolates were analysed in raw vegetable and after three and seven days of fermentation based on common practice of local producers. Subsequent experiment was performed to study glucosinolates during a shorter fermentation period, *i.e.* three days. The withered vegetable was fermented in coconut water (1:5 w/v) and 2.5% (w/w) of salt. The glucosinolates were analysed in raw and withered vegetables, one and three hours after immersion into the medium, and one to three days of fermentation. Each treatment was represented by six samples for analysis

Sample preparation

Both raw and processed vegetables were chopped into pieces of approximately less than 1 cm and mixed thoroughly. The chopped vegetable was frozen in liquid nitrogen followed by grinding in a Waring blender and stored in boxes at -20°C until further lyophilisation (ThermoScientific LL150). Samples of fermentation media were stored in freezer at -20°C.

Extraction of glucosinolate

The extraction of glucosinolates (GLSs) was employed twice in each replication and used hot methanol (Merck) as described by Verkerk *et al.* (2001) with minor modifications. Lyophilised sample of 0.1 g was added with 2.4 mL hot methanol 70% and 1 mL glucotropaeolin 3 mM (provided by Food Quality and Design, WU) was added as the internal standard. Sample was incubated in waterbath at 75°C for 20 minutes and it was mixed every 5 minutes. Then, sample was centrifuged for 10 min at 6000 rpm (Hettich EBA20). The supernatant was collected while residue was re-extracted twice with 10 mL of hot methanol following similar procedure. Eventually all supernatants were combined.

Purification and de-sulphation

The extracted GLSs were purified and de-sulphated on a 1.5 cm DEAE Sephadex A-25 (Sigma-Aldrich) anion exchange in glass-wool (Merck) matrix column. The column was washed twice with 1 mL bi-distilled water, and loaded with 2 mL of the GLSs extract and washed twice with 1 mL sodium acetate (Merck) solution 20 mM. Sulphatase (Sigma-Aldrich) was added and it was incubated overnight at room temperature (23–27°C). Then, the de-sulpho-GLSs were eluted three times with 0.5 mL bi-distilled water. Finally, the elute was filtered by a 0.45 µm filter prior to HPLC analysis.

HPLC analysis

HPLC set-up used LC 10 Avp system (Shimadzu) comprising a pump system with low pressure gradient valve, a degasser, a system controller, and a converter board. A UV Vis detector was performed at a wavelength of 229 nm. Results were analysed by using Class VP software. The de-sulpho-GLSs were separated by GraceSmart RP-18 5µ column at 1 mL/min flow rate. The elution was a gradient system of water containing 0.05% tetramethyl-ammonium chloride (code A) and acetonitrile (Merck)/water (20:80, v/v) containing 0.05% tetramethyl-ammonium chloride (code B). Total elution time was 31 min and gradient as follows: 100% A for 1 min, then within 20 min to 100% B and within 5 min back to 100% A followed by maintaining 100% A for 5 min. The GLSs were identified by comparing with standards of sinigrin and glucotropaeolin (provided by Food Quality and Design WU), and known GLS profiles of broccoli, cauliflower, red cabbage, radish, and Brussels sprouts, and confirming literatures. Each GLS was quantified as response factor against glucotropaeolin as internal standard. Values of glucosinolates will be presented in table and figure as mean ± SEM.

RESULTS AND DISCUSSION

Glucosinolates in Indian mustard

The glucosinolates (GLSs) identified in Indian mustard were aliphatics, *i.e.* sinigrin and gluconapin, and indoles, *i.e.* glucobrassicin, 4-hydroxy-glucobrassicin, and 4-methoxy-glucobrassicin and neo glucobrassicin, as shown in the chromatogram (Figure 1). Moreover, the GLS sinigrin accounted for more than 90% of the total GLSs. In general, the GLSs identified are in accordance with previous reports (Font *et al.* 2004; He *et al.* 2003^a). However, He *et al.* (2003^a) reported that gluconapin and progoitrin were dominant GLSs in growing potherb mustard (*B. juncea* Coss). Discrepancies in the GLS profile could be due to the differences in variety, agricultural conditions, and the analytical methods.

Effect of fermentation on the glucosinolates content

Fermentation substantially reduced the GLSs content in Indian mustard during fermentation (Table 1).

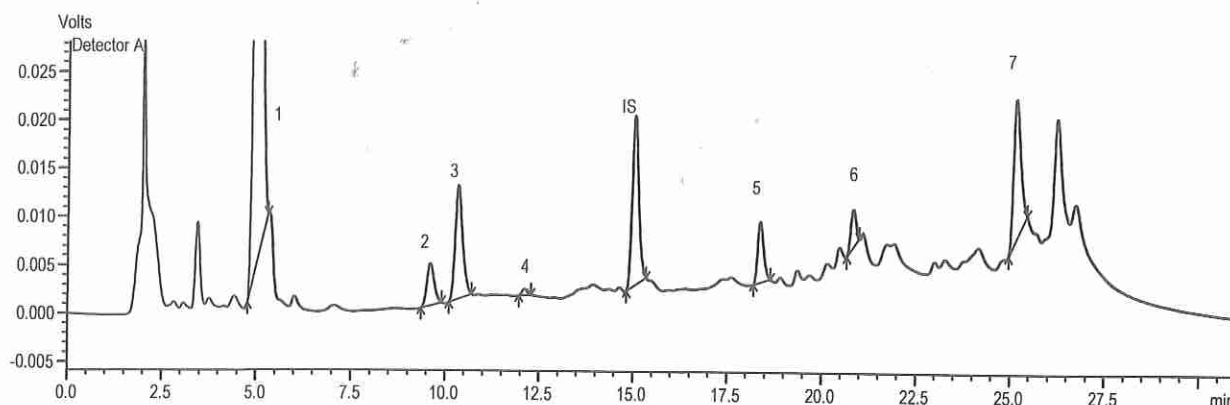


Figure 1. An example of chromatogram of glucosinolates and {the R_t } in Indian mustard: (1) Sinigrin {5.29}, (2) Gluconapin {9.99}, (3) Unknown {10.63}, (4) 4-Hydroxy-glucobrassicin (4-OH-GBR) {12.40}, (IS) Glucotropaeolin {15.25}, (5) Glucobrassicin {18.51}, (6) 4-Methoxy-glucobrassicin (4-Me-GBR) {20.95}, and (7) Neo-glucobrassicin (Neo-GBR) {25.24}

At the third fermentation day, there was a remarkable drop of sinigrin for more than 95% compared to sinigrin in raw vegetable. Meanwhile, the concentration of indole 4-methoxy-glucobrassicin and neo-glucobrassicin decreased at 80-90% as compared to the ones in raw vegetable. Subsequent experiment was performed in a shorter period of fermentation. Sinigrin, as the most dominant GLS among others in the Indian mustard, is chosen to describe the GLS changes during fermentation (Figure 2). This study shows that initial sinigrin content in Indian mustard was about 4 times lower compared to the one in the first experiment. It is likely that biological variability of the vegetable may affect GLS concentrations (He *et al.* 2003b; Krumbein *et al.* 2005; Verkerk *et al.* 2009). Interestingly, sinigrin content slightly increased after withering until three hours of the vegetable immersion into medium. Previous studies also reported an increase of GLSs level, e.g. after microwave processing of red cabbage (Verkerk and Dekker, 2004), boiling of cauliflower (D'Antuono *et al.* 2007), and steaming of broccoli (Gliszczynska-šwiglo *et al.* 2006; Miglio *et al.* 2008). It has been shown previously that such treatments (in this case are withering and fermentation) might increase the extractability of GLS from the sample matrix in analytical methods. Afterward, sinigrin of the day 1 sample decreased drastically at about 80% as compared to the previous hour 3 sample. Subsequent decrease was observed at the day 2 and 3 of fermentation resulting in 7-8% of sinigrin in raw vegetable. Previous studies reported that fermentation significantly reduce GLSs in *Brassica* vegetables. During sauerkraut production, Tolonen *et al.* (2002) observed a very low quantity of 4-methoxy-glucobrassicin while, others reported no GLSs in fermented product (Daxenbichler *et al.* 1980; Martinez-Villaluenga *et al.* 2009). Meanwhile, Suzuki *et al.* (2006) reported smaller quantities of the GLSs in *nozawana-zuke*, a fermented product of *Brassica rapa* L. in Japan, including glucobrassicin and gluconasturtiin as the major GLSs, relative to the fresh *nozawana*. The most recent study on white cabbage fermentation reported that GLSs content can be retained by a thermal treatment prior to fermentation. After 71 h of fermentation the cabbage still contained 35% of total GLSs before fermentation (Sarvan *et al.* 2013).

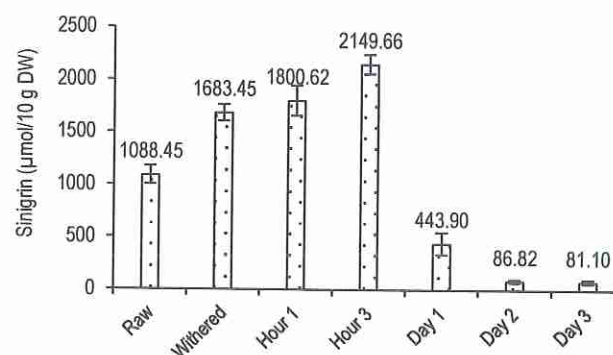


Figure 2. Sinigrin content during sayur asin production in coconut water (1:5, w/w) and 2.5% (w/w) of salt. Values show mean $\pm$ SEM ($n = 6$)

The contents of GLS derived products depend on the fermentation conditions as well as the concentrations of GLS of the raw material (Ciska and Pathak, 2004). Previous studies reported GLS changes during fermentation based on the changes of identified breakdown products, e.g. isothiocyanates (ITCs) and cyanides from aliphatic GLSs, indole-3-carbinol and ascorbigen from glucobrassicin, and 2-phenylethyl ITCs from gluconasturtiin (Ciska and Pathak, 2004; Daxenbichler, 1980).

In the context of significant drops of GLSs content, the current result shows that possible effects of fermentation medium and salt concentration could not be explained clearly. In general, the use of *tajin* liquor may affect to the lower sinigrin than the one using coconut water. While, higher salt concentration (i.e. 10%) may also affect to the lower sinigrin retention at the third day of fermentation even though, this was not clearly indicated in the *sayur asin* in coconut water. Further studies are needed to confirm the finding and to see any interactions between variables influencing GLSs content.

Mechanisms affecting GLSs content during fermentation are different from other processing by applying heat; however, these are scarcely studied (Nugraedi *et al.* 2013). Bacteria and sodium chloride might take significant role to change the GLSs profile (Tolonen *et al.* 2002; Suzuki *et al.* 2006; Martinez-Villaluenga *et al.* 2009). While, leaching of GLSs into the medium is scarcely involved in the *sayur asin*. Accordingly, Suzuki *et al.* (2006) reported the GLSs retention in the tissues after fermentation.

Table 1. Glucosinolates in sayur asin production ($\mu\text{mol}/10\text{ g dw}$)

	Sinigrin	Gluconapin	4-OH-GBR	Glucobrassicin	4-Me-GBR	Neo-GBR
Raw	4216.5 $\pm$ 118.3	189.3 $\pm$ 10.7	5.2 $\pm$ 0.4	68.4 $\pm$ 13.9	30.9 $\pm$ 1.8	106.6 $\pm$ 8.6
C,2.5%,3d*	53.9 $\pm$ 12.7	ND	ND	ND	4.1 $\pm$ 0.6	21.9 $\pm$ 2.6
C,2.5%,7d	33.2 $\pm$ 12.5	ND	ND	ND	2.5 $\pm$ 0.7	4.6 $\pm$ 2.0
C,10%,3d	48.1 $\pm$ 6.3	ND	ND	ND	4.5 $\pm$ 0.8	23.0 $\pm$ 2.8
C,10%,7d	52.6 $\pm$ 10.0	ND	ND	ND	6.5 $\pm$ 1.1	22.2 $\pm$ 5.4
T,2.5%,3d	54.6 $\pm$ 12.5	ND	ND	ND	5.8 $\pm$ 1.0	12.9 $\pm$ 6.2
T,2.5%,7d	16.9 $\pm$ 1.8	ND	ND	ND	4.6 $\pm$ 1.0	20.7 $\pm$ 4.5
T,10%,3d	23.7 $\pm$ 2.5	ND	ND	ND	4.8 $\pm$ 1.5	16.1 $\pm$ 4.4
T,10%,7d	31.4 $\pm$ 9.6	ND	ND	ND	4.9 $\pm$ 1.2	16.2 $\pm$ 2.6

Values show mean $\pm$ SEM. *Sequence of treatment code: medium (C: coconut water; T: *tajin*), salt concentration, days of fermentation; ND – Not Detectable

CONCLUSION

Sinigrin was the most dominant glucosinolate among others, i.e. gluconapin, glucobrassicin, 4-hydroxy-glucobrassicin, 4-methoxy-glucobrassicin, and neo glucobrassicin, accounting for about 1000 and 4000 $\mu\text{mol}/10\text{ g dw}$ in raw Indian mustard. However, fermentation has reduced the glucosinolates content in sayur asin. At the third day of fermentation, there was a substantial drop of sinigrin for more than 95% compared to raw vegetable. There is no clear mechanism of factors contributing the reduction. Further studies are needed to identify the factors, e.g. pH, salinity, substrate, lactic acid bacteria, as well as myrosinase activity, and explain the working mechanisms underlying the glucosinolates degradation.

ACKNOWLEDGEMENT

The project entitled *Glucosinolates Behaviour throughout the Production of "Sayur Asin"* was funded by the International Foundation for Science (IFS, Sweden), grant No. E/5360-1. The authors thank to Mr. Kuntoro, Ms. Putri, and Ms. Sari for laboratory technical assistance.

REFERENCES

- Bones AM, Rossiter JT. 2006. The enzymic and chemically induced decomposition of glucosinolates. *Phytochemistry* 67: 1053-1067. DOI: 10.1016/j.phytochem.2006.02.024.
- Cartea ME, Velasco P. 2008. Glucosinolates in *Brassica* foods: bioavailability in food and significance for human health. *Phytochem Rev* 7: 213-229. DOI: 10.1007/s11101-007-9072-2.
- Ciska E, Pathak DR. 2004. Glucosinolate derivatives in stored fermented cabbage. *J Agr Food Chem* 52: 7938-7943. DOI: 10.1021/jf048986+.
- Clarke DB. 2010. Glucosinolates, structure and analysis in food. *Anal Methods* 2: 310-325. DOI: 10.1039/b9ay00280d.
- Daxenbichler ME, VanEtten CH, Williams PH. 1980. Glucosinolate products in commercial sauerkraut. *J Agr Food Chem* 28: 809-811. DOI: 10.1021/jf60230a027.
- D'Antuono LF, Elementi S, Neri R. 2007. Sensory attributes, health promoting aspects and new uses of edible *Brassicaceae*. *Acta Hort* 741: 65-72.
- Font R, del Rio M, Fernandez-Martinez JM, de Haro-Bailon A. 2004. Use of near-infrared spectroscopy for screening the individual and total glucosinolate contents in Indian mustard seed (*Brassica juncea* L. Czern. & Coss.). *J Agric Food Chem* 52: 3563-3569. DOI: 10.1021/jf0307649.
- Gliszczynska-šwigło A, Ciska E, Pawlak-Lemanska K, Chmielewski J, Borkowski T, Tyrakowska B. 2006. Changes in the content of health-promoting compounds and antioxidant activity of broccoli after domestic processing. *Food Addit Contam* 23: 1088-1098. DOI: 10.1080/02652030600887594.
- Halkier BA, Gershenzon J. 2006. Biology and biochemistry of glucosinolates. *Annu Rev Plant Biol* 57: 303-333. DOI: 10.1146/annurev.arplant.57.032905.105228.
- He H, Fingerling G, Schnitzler WH. 2003a. Changes in glucosinolate concentrations during growing stages of tai tsai (*Brassica campestris* L. Ssp. *Chinensis* var. *Tai-tsai hort.*) and potherb mustard (*Brassica juncea* coss.). *Acta Hort* 620: 77-84.
- He H, Liu L, Song S, Tang X, Wang Y. 2003b. Evaluation of glucosinolate composition and contents in Chinese *Brassica* vegetables. *Acta Hort* 620: 85-92.
- Herr I, Büchler MW. 2010. Dietary constituents of broccoli and other cruciferous vegetables: Implications for prevention and therapy of cancer. *Cancer Treat Rev* 36: 377-383. DOI: 10.1016/j.ctrv.2010.01.002.
- Krumbein A, Schonhof I, Schreiner M. 2005. Composition and contents of phytochemicals (glucosinolates, carotenoids and chlorophylls) and ascorbic acid in selected *Brassica* species (*B. juncea*, *B. rapa* subsp. *nipposinica* var. *chinoleifera*, *B. rapa* subsp. *chinensis* and *B. rapa* subsp. *rapa*). *J Appl Bot Food Qual* 79: 168-174.
- Martinez-Villaluenga C, Peñas E, Frias J, Ciska E, Honke J, Piskula MK, Kozłowska H, Vidal-Valverde C. 2009. Influence of fermentation conditions on glucosinolates, ascorbigen, and ascorbic acid content in white cabbage (*Brassica oleracea* var. *Capitata* cv. *Taler*) cultivated in different seasons. *J Food Sci* 74: C62-C67. DOI: 10.1111/j.1750-3841.2008.01017.x.
- Miglio C, Chiavaro E, Visconti A, Fogliano V, Pellegrini N. 2008. Effects of different cooking methods on nutritional and physicochemical characteristics of selected vegetables. *J Agr Food Chem* 56: 139-147. DOI: 10.1021/jf072304b.
- Nugerahani I, Suseno TIP, Fransisca I. 2000. Pengaruh perbandingan air dan beras pada pembuatan air tajin

- terhadap sifat fisikokimia dan organoleptik sayur asin. J Tek Pangan dan Gizi 1: 45-51.
- Nugraheni PY, Verkerk R, Widianarko B, Dekker M. 2013. A mechanistic perspective on process induced changes in glucosinolate content in *Brassica* vegetables: A review. Accepted Crit Rev Food Sci Nutr xx:xx-xx. DOI: 10.1080/10408398.2012.688076. *in press*.
- Sarvan I, Valerio F, Lonigro SL, de Candia S, Verkerk R, Dekker M, Lavermicocca P. 2013. Glucosinolate content of blanched cabbage (*Brassica oleracea* var. *capitata*) fermented by the probiotic strain *Lactobacillus paracasei* LMG-P22043. Food Res Int 54: 706-710. DOI: 10.1016/j.foodres.2013.07.065.
- Suzuki C, Ohnishi-Kameyama M, Sasaki K, Murata T, Yoshida M. 2006. Behavior of glucosinolates in pickling cruciferous vegetables. J Agr Food Chem 54: 9430-9436. DOI: 10.1021/jf061789l.
- Tolonen M, Taipale M, Viander B, Pihlaja JM, Korhonen H, Ryhanen EL. 2002. Plant-derived biomolecules in fermented cabbage. J Agr Food Chem 50: 6798-6803. DOI: 10.1021/jf0109017.
- Traka M, Mithen R. 2009. Glucosinolates, isothiocyanates and human health. Phytochem Rev 8: 269-282. DOI: 10.1007/s11101-008-9103-7.
- Uva WFL, Cuellar S, Roberts J. 2006. Evaluating consumer preferences and marketing opportunities for new sauerkraut products. J Food Distr Res 37: 168-174.
- Verkerk R, Dekker M, Jongen WMF. 2001. Post-harvest increase of indolyl glucosinolates in response to chopping and storage of *Brassica* vegetables. J Sci Food Agric 81: 953-958. DOI: 10.1002/jsfa.854.
- Verkerk R, Dekker M. 2004. Glucosinolates and myrosinase activity in red cabbage (*Brassica oleracea* L. Var. *Capitata* f. *rubra* DC.) after various microwave treatments. J Agr Food Chem 52: 7318-7323. DOI: 10.1021/jf0493268.
- Verkerk R, Schreiner M, Krumbein A, Ciska E, Holst B, Rowland I, De Schrijver R, Hansen M, Gerhauser C, Mithen R, Dekker M. 2009. Glucosinolates in *Brassica* vegetables: The influence of the food supply chain on intake, bioavailability and human health. Mol Nut Food Res 53: S219-S265. DOI: 10.1002/mnfr.200800065.

ISI

Hasil Penelitian

- 121 **ACIDIC SOAKING AND STEAM BLANCHING RETAIN ANTHOCYANINS AND POLYPHENOLS IN PURPLE *Dioscorea alata* FLOUR** [*Perendaman Asam dan Blanching Uap Mempertahankan Antosianin dan Polifenol Tepung Dioscorea alata Ungu*]
Nelis Imanningsih, Deddy Muchtadi, Tutik Wresdiyati, Nurheni Sri Palupi and Komari
- 129 **PEMBUATAN *CRACKERS* JAGUNG DAN PENDUGAAN UMUR SIMPANNYA DENGAN PENDEKATAN KADAR AIR KRITIS** [*Production of Corn Cracker and Prediction of Its Shelf Life Using a Critical Moisture Approach*]
Sugiyono, Esther Mariana dan Aton Yulianto
- 138 **POTENSI KENTANG HITAM DALAM MEREDUKSI STRES OKSIDATIF DAN MENG-HAMBAT PROLIFERASI SEL KANKER PAYUDARA MCF-7** [*Potential of Black Potato in Reducing Oxidative Stress and Inhibiting the Proliferation of Breast Cancer Cells MCF-7*]
Mutia Nugraheni, Umar Santoso, Suparmo dan Hastari Wuryastuti
- 147 **KARAKTERISTIK FISIK, KIMIA, MIKROBIOLOGI *WHEY KEFIR* DAN AKTIVITAS-NYA TERHADAP PENGHAMBATAN *ANGIOTENSIN CONVERTING ENZYME* (ACE)** [*Physical, Chemical and Microbiological Characteristics of Whey Kefir and Its Angiotensin Converting Enzyme (ACE) Inhibitory Activity*]
Andi Febrisiantosa, Bagus Priyo Purwanto, Irma Isnafia Arief dan Yantyati Widyastuti
- 154 ***Lactobacillus plantarum* PADA FESES INDIVIDU DEWASA SEHAT YANG MEN-NGONSUMSI *Lactobacillus plantarum* IS-10506 DARI DADIH** [*Lactobacillus plantarum in Stool of Apparently Healthy Adults Consuming Lactobacillus plantarum IS-10506 from Dadih*]
Azmi Adib, Mardiasuti H. Wahid, Pratiwi Sudarmono dan Ingrid S. Surono
- 161 **KAPASITAS ANTIOKSIDAN DAN INHIBITOR ALFA GLUKOSIDASE EKSTRAK UMBI BAWANG DAYAK** [*Antioxidant and Alpha-Glucosidase Inhibitory Properties of Bawang Dayak Bulb Extracts*]
Andi Early Febrinda, Made Astawan, Tutik Wresdiyati dan Nancy Dewi Yulian a
- 168 **PERUBAHAN FISIKO-KIMIAWI, MIKROBIOLOGI DAN HISTAMIN BAKASANG IKAN CAKALANG SELAMA FERMENTASI DAN PENYIMPANAN** [*Physico-Chemical, Microbiological, and Histamine Changes in Skipjack Bakasang During Fermentation and Storage*]
Sri Purwaningsih, Joko Santoso dan Rahmatia Garwan

- 178 **KARAKTERISTIK FISIKOKIMIA DAN ANTIBAKTERI VIRGIN COCONUT OIL HASIL FERMENTASI BAKTERI ASAM LAKTAT** [*Physicochemical and Antibacterial Characteristics of Virgin Coconut Oil Fermented with Lactic Acid Bacteria*]
Anton Rahmadi, Ipnatul Abdiah, Maya Dewi Sukarno dan Titin Purnaningsih
- 184 **APLIKASI MUTAN BERFLUORESENS UNTUK MEMPELAJARI KETAHANAN HIDUP, KOLONISASI DAN PENETRASI ISOLAT *Cronobacter sakazakii* SELAMA PENGERINGAN JAGUNG** [*Use of GFP Mutant to Study the Survival, Colonization and Penetration of Cronobacter sakazakii Isolates During Maize Drying*]
Siti Nurjanah, Maggy T. Suhartono, Ratih Dewanti-Hariyadi dan Sri Estuningsih
- 194 **PENGEMBANGAN BERAS ANALOG DENGAN MEMANFAATKAN JAGUNG PUTIH** [*Development of White Corn-Based Rice Analogues*]
Santi Noviasari, Feri Kusnandar dan Slamet Budijanto
- 201 **KARAKTERISTIK MIKROKAPSUL MINYAK ATSIRI LENGKUAS DENGAN MALTODEKSTRIN SEBAGAI ENKAPSULAN** [*Characteristics of Galangal Essential Oil Microencapsulation Using Maltodextrin Encapsulant*]
Supriyadi dan A. Sakha Rujita
- 209 **QUALITY AND SENSORY EVALUATIONS OF TEMPE PREPARED FROM VARIOUS PARTICLE SIZES OF LUPIN BEANS** [*Evaluasi Sensorik dan Kualitas Tempe dari Kacang Lupin Berbagai Ukuran Partikel*]
Sri Priatni, Anastasia F. Devi, Leonardus B.S. Kardono and Vijay Jayasena
- 215 **ANTIOXIDATIVE CHARACTERISTICS OF BEVERAGES MADE FROM A MIXTURE OF LEMONGRASS EXTRACT AND GREEN TEA** [*Studi Karakteristik Antioksidan Minuman Campuran Ekstrak Serai dan Teh Hijau*]
Jeremia Manuel Halim, W. Donald R. Pokatong and Jessica Ignacia
- 222 **PENGARUH MEDIA KULTIVASI *Chaetoceros gracilis* TERHADAP KANDUNGAN KIMIAWI DAN POTENSI INHIBITOR PROTEASE** [*Effect of Chaetoceros gracilis Cultivation Media to the Chemical Content and Protease Inhibitor Potential*]
Iriani Setyaningsih, Tati Nurhayati dan Uzainah Aremhas
- 228 **KARAKTERISTIK PRODUK BUBUK SARI JAGUNG MANIS INSTAN HASIL PENGERINGAN METODE SPOUTED-VORTEX-BED** [*Characteristics of Instant Sweet Corn Milk Powders as Produced by of Spouted-Vortex-Bed Drying Method*]
Iwan Taruna, Neti Surami dan Sutarsi

Komunikasi Singkat

- 235 **REDUCTION OF GLUCOSINOLATES CONTENT DURING SAYUR ASIN FERMEN-TATION** [*Penurunan Kandungan Berbagai Glukosinolat selama Fermentasi Sayur Asin*]
Probo Y. Nugrahedi, Caesariana A. Priatko, Ruud Verkerk, Matthijs Dekker and Budi Widianarko