

## Table of Contents - Volume 8 Number 2

[Home](#) » [TOC](#)

### Review Articles

#### Factors Responsible for Childhood Malnutrition: A Review of the Literature

Pages : 360-370

Smritikana Ghosh\* 

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.01>






 Views: 30,967  PDF Downloads: 3460

### Case Study

#### Fast Food Consumption Behaviour among College Students- A Case Study in Tinsukia

Pages : 371-379

Lipika Jyoti Dowarah<sup>1\*</sup> , Debyani Roy Bhowmick<sup>1</sup> , Subhadeep Chakraborty<sup>2</sup> 

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.02>



 Views: 24,852  PDF Downloads: 2220

### Research Articles

#### Evaluation of Diverse Barley Cultivars and Landraces for Contents of Four Multifunctional Biomolecules with Nutraceutical Potential

Pages : 380-390

Zaynab Derakhshani<sup>1</sup> , Francois Malherbe<sup>1</sup> , Joseph F Panozzo<sup>2</sup>  and Mrinal Bhawe<sup>1\*</sup> 

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]





DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.03>



 Views: 1,414  PDF Downloads: 669

#### Bioactive Compounds and Sensory Properties of Organic Rice: The Impact of Degree of Milling

Pages : 391-401

Wahyudi David<sup>1\*</sup> , Ardiansyah<sup>1</sup> , Slamet Budijanto<sup>2</sup> , Johannes Kahl<sup>3</sup>, Carola Strassner<sup>4</sup> 

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.04>

Web of Science Coverage  
**Emerging Sources Citation Index (ESCI)**  
**2022 Journal Impact Factor: 0.8**

#### Scopus Journal Metrics

**CiteScore 2022: 1.9**

[CiteScore Details](#)

**SJR 2022**



JM14653

This journal is a member of, and subscribes to the principles of, the Committee on Publication Ethics (COPE)

Journal is Indexed in:

**CABELLS**

SCHOLARLY ANALYTICS

Cabells Whitelist

Follow us on:



[Submit Manuscript Online](#)

[Join our team of Reviewers](#)

[Journal is indexed in...](#)

### Most Popular Articles

Low Alkaline Phosphatase (ALP) In Adult Population an...

(222,650)

Colostrum - its Composition, Benefits as a...

(134,831)

Importance of Exclusive Breastfeeding and Complementary...

(123,117)

Processing and Nutritional Composition of Rice Bran

(47,463)

Processing and Nutritive Value of Mango Seed Kernel Flour

(44,947)



Views: 1,162 PDF Downloads: 891

## Physicochemical Characterization of Pectin Extracted from Six Wild Edible Fruits in Odisha, India

Pages : 402-409

Pragyan Aparichita Patra and Uday Chand Basak\*

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.05>



Views: 1,360 PDF Downloads: 840

## Assessment of Heavy Metals in Milk Produced by Black-and-White Holstein Cows from Moscow

Pages : 410-415

Vladimir Safonov

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.06>



Views: 1,180 PDF Downloads: 867

## Association between BMI and Iron Status among Diabetic Patients in Oujda-Angad-Morocco

Pages : 416-423

Asmae Hsaini\* , Youssef Aboussaleh , Samir Bikri and Ahmed Ahami

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.07>



Views: 615 PDF Downloads: 678

## Improvement of Lipid Profile and Antioxidant of Hyperlipidemic albino Rats by Functional Plantago psyllium Cake

Pages : 424-437

Naglaa M. M. Ismael<sup>1</sup> and Mohamed G. Shehata<sup>2\*</sup>

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.08>



Views: 864 PDF Downloads: 886

## Dietary Diversity and Associated Health Status of Newly Diagnosed Type 2 Diabetic Patients in Jashore Region of Bangladesh

Pages : 438-453

Sharmin Sultana<sup>1</sup>, Nazia Nawshad Lina<sup>1</sup>, Md. Tarek Hasan<sup>1</sup>, Md. Jannatul Ferdaus<sup>1</sup> , Biplab Kumar Dash<sup>2</sup> , Tanvir Ahmad<sup>1,3</sup> and Rajib Kanti Roy<sup>1,3\*</sup>

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.09>



Views: 1,858 PDF Downloads: 978

## Factors Related to Stunting among Children Age 6-59 Months in Babakan Madang Sub-District, West Java, Indonesia

Pages : 454-461

Sri Yuliastini , Trini Sudiarti\* , Ratu Ayu Dewi Sartika

[ HTML Full Text ] [ Abstract ] [ PDF ] [ XML ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.10>



Views: 1,865 PDF Downloads: 1216

## The Effect of Various Dosages of Poly-Cereal Raw Materials on the Drying Speed and Quality of Cooked Pasta During Storage

Pages : 462-470

Abdymaᅁap A. Ospanov<sup>1\*</sup> , Nurzhan Zh. Muslimov<sup>2</sup> , Aigul K. Timurbekova<sup>1</sup> , Laura A. Mamayeva<sup>1</sup> and Gulnara B. Jumabekova<sup>3</sup>

[ HTML Full Text ] [ Abstract ] [ PDF ] [ XML ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.11>



Views: 605 PDF Downloads: 695

## High Fiber Diets Enhance Gene Expression and Il-10 Level on Hyperlipidemic Rats Model

Pages : 471-478

Rifkind Malik<sup>2</sup>, Ahmad Hamim Sadewa<sup>1</sup>, Sunarti<sup>1\*</sup>

[ HTML Full Text ] [ Abstract ] [ PDF ] [ XML ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.12>



Views: 1,127 PDF Downloads: 757

## Discrimination of the Indonesian Roasted Arabica Coffees using 1H NMR-based Metabolomics

Pages : 479-488

Nizar Happyana\* , Elvira Hermawati , Yana Maolana Syah , Euis Holisotan Hakim

[ HTML Full Text ] [ Abstract ] [ PDF ] [ XML ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.13>



Views: 898 PDF Downloads: 959

## Implementing Precede-Proceed Model toward the Mothers Perception on the Importance of Feeding of Home-Made Complementary Food to Wasting and Stunting Toddlers

Pages : 489-495

Fitriani<sup>1\*</sup> , Teungku Nih Farisni<sup>1</sup> , Veni Nella Syahputri<sup>2</sup> , Lily Arsanty Lestary<sup>3</sup> , Siti Helmyati<sup>3</sup>

[ HTML Full Text ] [ Abstract ] [ PDF ] [ XML ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.14>



Views: 2,357 PDF Downloads: 1045

## Rheological, Tribological, and Sensory Analysis of Coconut-Oil-Modified Coconut Milk Kefir

Pages : 496-503

Aunchalee Aussanasuwannakul<sup>1\*</sup> , Kassamaporn Puntaburt<sup>2</sup> , Witcha Treesuwan<sup>3</sup>

[ HTML Full Text ] [ Abstract ] [ PDF ] [ XML ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.15>



Views: 1,718 PDF Downloads: 1055

## Optimization of Sand Puffing Characteristics of Quinoa using Response Surface Methodology

Pages : 496-503

Deepak Subramani\* , Sharmila Tamilselvan , Maheswari Murugesan , Shivaswamy M S 

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]




DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.16>



  Views: 1,760  PDF Downloads: 992

## Antioxidants Effect of Two Aminomethyl Derivatives of 2-Methoxyphenol on Thermal and Storage Oxidative Stability of Coconut Oil

Pages : 504-515

Hayun Hayun\* , Annisa Zahra , Hidayatul Lutfika 

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.17>



  Views: 756  PDF Downloads: 665

## Development of Pumpkin Powder Incorporated Instant Noodles

Pages : 524-530

Nunchanok Nanthachai\* , Intira Lichanporn , Palida Tanganurat , Pradit Kumnongphai 

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]




DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.18>



  Views: 2,385  PDF Downloads: 1169

## Effect of Arthrospira Microalga Fortification on Physicochemical Properties of Yogurt

Pages : 531-540

Wanida Pan-utai<sup>1\*</sup> , Jariya Atkonghan<sup>2</sup> , Tipakorn Onsamar<sup>3</sup> , Wachiraya Imthalay<sup>2</sup> 

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]



DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.19>



  Views: 1,710  PDF Downloads: 1058

## The Effect of Vitamin D Administration on Leptin, Adiponectin and mRNA MCP-1 Levels in Adipose Tissue of Obese Female Wistar Rats

Pages : 541-549

Luh Putu Ratna Sundari<sup>1\*</sup> , Made Bakta<sup>2</sup> , Nyoman Mantik Astawa<sup>3</sup> , Putu Gede Adiatmika<sup>1</sup> , Gusti Kamasan Nyoman Arijana<sup>4</sup> , Ketut Tunas<sup>5</sup> 

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.20>



  Views: 1,151  PDF Downloads: 768


## Effects of Supplementation with Furikake Ulvamina Made of Algae (Ulva sp.) and Tuna (Thunnini) on Cognitive Function of Malnourished Mice (Rattus norvegicus)

Pages : 550-555

Toto Sudargo<sup>1\*</sup> , Alim Isnansetyo<sup>2</sup> , Indun Dewi Puspita<sup>2</sup> , Siti Ari Budiyanti<sup>2</sup> , Rahadyana Muslichah<sup>1</sup> , Tira Aristasari<sup>1</sup> , Sheila Rosmala Putri<sup>2</sup> , Khusnul Alfionita<sup>2</sup> 

Yosephin Anandati Pranoto<sup>1</sup> [\[ HTML Full Text \]](#) [\[ Abstract \]](#) [\[ PDF \]](#) [\[ XML \]](#)DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.21>  Views: 707  PDF Downloads: 677

## Optimization Ultrasonic Assisted Extraction (UAE) of Bioactive Compound and Antibacterial Potential from Sea Urchin (*Diadema setosum*)

*Pages : 556-569*Muhammad Yusuf<sup>1\*</sup> , Nur Fitriani Usdyana Atthamid<sup>2</sup> , Sri Indriati<sup>3</sup>, Rahmawati Saleh<sup>4</sup>, Mahyati Latief<sup>5</sup> , Akhmad Rifai<sup>6</sup> [\[ HTML Full Text \]](#) [\[ Abstract \]](#) [\[ PDF \]](#) [\[ XML \]](#)DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.22>  Views: 1,459  PDF Downloads: 1047






## Analysis of Physicochemical Characteristics of Pauttika Honey Procured from Uttar Pradesh, India

*Pages : 570-583*Veena<sup>1</sup>, Vandana Verma<sup>1\*</sup>, Amala Udayakumar<sup>2</sup>, Shikha Pandhi<sup>3</sup>, Arvind Kumar<sup>3</sup> and Vinod Kumar Paswan<sup>3</sup>[\[ HTML Full Text \]](#) [\[ Abstract \]](#) [\[ PDF \]](#) [\[ XML \]](#)DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.23>  Views: 917  PDF Downloads: 860

## Supplementation of Low Ratio n-6:n-3 PUFA Reduces Body Fatness in Young Obese Balinese Women: A Randomized Study with Optimized Energy Regulation

*Pages : 584-595*I Wayan Weta<sup>1</sup> , Wayan P Sutirayasa<sup>2</sup>, Wayan C Sucipta<sup>1</sup>, Safarina G Malik<sup>3</sup> , A.A.Ngurah Subawa<sup>4</sup> and I Putu Eka Widyadharma<sup>5\*</sup> [\[ HTML Full Text \]](#) [\[ Abstract \]](#) [\[ PDF \]](#) [\[ XML \]](#)DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.24>  Views: 976  PDF Downloads: 811

## Optimization of Extraction Process Parameter for Rice Bran Protein Concentrate and its Utilization in High Protein Biscuit Formulation

*Pages : 596-608*Dilruba Akter<sup>1</sup> , Rokeya Begum<sup>1\*</sup> , Md. Nannur Rahman<sup>1,2</sup> , Nasim Talukder<sup>3</sup> , Md. Jahangir Alam<sup>1</sup> [\[ HTML Full Text \]](#) [\[ Abstract \]](#) [\[ PDF \]](#) [\[ XML \]](#)DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.25>  Views: 2,189  PDF Downloads: 1221

## Impact of Mother-to-Mother Support Groups in Promoting Exclusive Breastfeeding in a Low-Resource Rural Community in Kenya: A Randomized Controlled Trial

*Pages : 609-621*Joseph Kobia M\*Liria , Judith Kimiywe  and Sophie Ochola [\[ HTML Full Text \]](#) [\[ Abstract \]](#) [\[ PDF \]](#) [\[ XML \]](#)

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.26>



Views: 1,798 PDF Downloads: 970

---

## Selected Engineering Properties and Drying Behavior of Tendu (Diospyros melanoxylon Roxb.) Fruit

Pages : 622-629

Zeba Jamil, Ashish M. Mohite and Neha Sharma

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.27>



Views: 693 PDF Downloads: 777

---

## Foods Consumed with Rice that Elicit a Reduction in Glucose Response among Healthy Individuals

Pages : 630-639

Siti Rohaiza Ahmad

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.28>



Views: 5,564 PDF Downloads: 999

---

## Glycemic and Insulinemic Responses of Multi-Grain Types of Bread Marketed in Jordan

Pages : 640-648

Refat Ahmad Alkurd<sup>1\*</sup> , Hamed Rabah Takturi<sup>1</sup> , Marwan M. Muwalla<sup>2</sup> , Tawfiq A. Arafat<sup>3</sup>

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.29>



Views: 1,322 PDF Downloads: 898

---

## Studies on the Effect of Natural Preservatives and Packing Materials on Physico-Chemical Quality of pinni.

Pages : 649-655

Ravinder Singh<sup>1\*</sup> and Kaushik Khamrui<sup>2</sup>

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.30>



Views: 985 PDF Downloads: 774

---

## Determinants of Dietary Diversity among Households in Central River Region South, the Gambia

Pages : 656-666

W. Drammeh<sup>1,2</sup> , B. Njie<sup>1</sup> , N. A. Hamid<sup>2</sup> and A. J. Rohana<sup>2\*</sup>

[ [HTML Full Text](#) ] [ [Abstract](#) ] [ [PDF](#) ] [ [XML](#) ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.31>



Views: 1,350 PDF Downloads: 1003

---

## Effect of Sago Analogue Rice and Red Bean Diet to the Improvement of $\beta$ -cell Pancreas in Streptozotocin-Nicotinamide (STZ-NA) Induced Diabetic Rats

Pages : 667-673

Sri Budi Wahjuningsih<sup>1\*</sup> , Haslina Haslina<sup>1</sup> , Agus Tri Putranto<sup>2</sup>  and Mita Nurul Azkia<sup>1</sup> 

[ HTML Full Text ] [ Abstract ] [ PDF ] [ XML ]

DOI : <https://dx.doi.org/10.12944/CRNFSJ.8.2.32>



 Views: 1,093  PDF Downloads: 966

### Links

- [About](#)
- [Archives](#)
- [Article Processing Charges](#)
- [Coming Issue](#)
- [Contact](#)
- [Current Issue](#)
- [Order Print Issue](#)
- [Reviewers-2021](#)
- [Reviewers-2022](#)
- [Social Media](#)
- [Submission](#)

### Contact Us

Your Name (required)

Your Email (required)

Your Message

**8 p 3 3**

Type the above text in box below (Case sensitive)

Complte the quiz  
3+3=?

**Send**

Follow us on:



### License



This work is licensed under a Creative Commons Attribution 4.0 International License.

### Recent Articles

Health Concern of Phenomenally Premium Boba Milk Tea and Pearls Beverages in Kuala Lumpur: Sugary Content and Physico-chemical Profiles Analysis

Physicochemical and Functional Properties of Banana Starch and Its Alternative Returns

Green Energy Process "Ozonation" and Food Safety: A Comprehensive Review



**Current Research in  
Nutrition and Food Science**

[Home](#)

[About](#)

[Current Issue](#)

[Coming Issue](#)

[Archives](#)

[Submission](#)

[Contact](#)

ISSN: 2347-467X, Online ISSN: 2322-0007



## Editorial Board

Home » About » Editorial Board

### Chief Editor



**Dr. Shih-Min Hsia**

Distinguished Professor,  
School of Nutrition and Health Sciences,  
Taipei Medical University,  
Taiwan.  
Email: bryanhhsia@tmu.edu.tw  
Scopus ID: 13409857600

### Co-Editor in Chief



**Dr. Ravi Shukla, Ph.D**

Associate Professor,  
STEM- School of Science,  
RMIT University,  
Australia.  
Email: ravi.shukla@rmit.edu.au  
Scopus ID: 9437484300

### Managing Editors

**Dr. Neha Sanwalka**  
Founder & Director Nutri Canvas,  
Mumbai, MH, India.  
Email: neha.sanwalka@gmail.com  
Scopus ID: 22954784500

**Dr. Adele Papetti**  
Associate Professor  
Department of Drug Sciences  
Universita degli Studi di Pavia,  
Pavia, Italy.  
Email: adele.papetti@unipv.it  
Scopus ID: 6603497119

**Prof. R. Jeewon**  
Associate Professor  
Dept. of Health Sciences,  
The University of Mauritius,  
Moka, Mauritius.  
Email: r.jeewon@uom.ac.mu  
Scopus ID: 6602641191

**Prof. Y. Kourkoutas**  
Associate Professor,  
Department of Molecular Biology & Genetics  
Democritus University of Thrace  
Alexandroupolis, Greece.  
Email: ikourkou@mbg.duth.gr  
Scopus ID: 55919995700

**Dr. Amalia Tsiami**  
Associate Professor,  
London School of Hospitality and Tourism  
University of West London,  
London, United Kingdom.  
Email: Amalia.Tsiami@uwl.ac.uk  
Scopus ID: 6506464729

### Associate Editors

**Prof. Reema F. Tayyem**  
Department of Nutrition and Food Technology,  
Faculty of Agriculture,  
The University of Jordan,  
Amman, Jordan.  
Email: r\_tayyem@yahoo.com  
Scopus ID: 22959129200

### Statistical Editors

**Dr. Ravindra Boojhawon**  
Associate Professor  
The University of Mauritius,  
Moka, Mauritius.  
Email: r.boojhawon@uom.ac.mu  
Scopus ID: 6507224879

### Editorial cum Advisory Board

Web of Science Coverage  
**Emerging Sources Citation Index  
(ESCI)**  
**2022 Journal Impact Factor: 0.8**

### Scopus Journal Metrics

**CiteScore 2022: 1.9**

CiteScore Details

**SJR 2022**



This journal is a member of, and subscribes to the principles of, the Committee on Publication Ethics (COPE)

Journal is Indexed in:

**CABELLS**  
SCHOLARLY ANALYTICS

Cabells Whitelist

Follow us on:



[Submit Manuscript Online](#)

[Join our team of Reviewers](#)

[Journal is indexed in...](#)

### Most Popular Articles

Low Alkaline Phosphatase (ALP) In Adult Population an...  
(222,650)

Colostrum - its Composition, Benefits as a...  
(134,831)

Importance of Exclusive Breastfeeding and Complementary...  
(123,117)

Processing and Nutritional Composition of Rice Bran  
(47,463)

Processing and Nutritive Value of Mango Seed Kernel Flour  
(44,947)

**Dr. Vikas Kumar**  
Assistant Food Technologist,  
Department of Food Science and  
Technology, Punjab Agricultural University,  
Ludhiana, Punjab, India.  
Email: vkchoprafst@rediffmail.com  
Scopus ID: 57193417700

**Prof. Shwu-Huey Sherry Yang**  
School of Nutrition and Health Sciences  
Taipei Medical University,  
Taipei, Taiwan.  
Email: sherry@tmu.edu.tw  
Scopus ID: 8676122700

**Dr. Maria Papageorgiou**  
Associate Professor  
Department of Food Technology  
Alexander Technological Educational  
Institute of Thessaloniki (ATEITH)  
Thessaloniki, Greece.  
Email: mariapapage@food.teithe.gr  
Scopus IDscopus: 8645438400

**Dr. Miguel Herrero**  
Institute of Food Science Research (CIAL-  
CSIC), Laboratory of Foodomics,  
Madrid, Spain.  
Email: m.herrero@csic.es  
Scopus ID: 7102420113

**Dr. Ardiansyah**  
Associate Professor,  
Department of Food Technology,  
Universitas Bakrie,  
Jakarta, Indonesia.  
Email: ardiansyah.michwan@bakrie.ac.id  
Scopus ID: 12798333700

**Prof. Ana Laura Isabel De la Garza  
Hernández**  
School of Public Health and Nutrition,  
Autonomous University of Nuevo Leon,  
Nuevo Leon, Mexico.  
Email: ana.dlgarzah@uanl.mx  
Scopus ID: 57195297780

**Prof. Dr. Dariusz Dziki**  
Professor  
Department of Thermal Technology and  
Food Process Engineering,  
Faculty of Production Engineering,  
University of Life Sciences in Lublin, Lublin,  
Poland.  
Email: dariusz.dziki@up.lublin.pl  
Scopus ID: 24314765900

**Prof. Suhad Maatoug Bahijri**  
Professor  
Clinical Biochemistry Department,  
Faculty of Medicine, King Abdulaziz  
University,  
Jeddah, Saudi Arabia.  
Email: sbahijri@gmail.com  
Scopus ID: 6603404358

**Dr. Pasquale Russo**  
Department of Science of Agriculture,  
Food and Environment, University of  
Foggia, Foggia, Italy.

**Dr. Dan-Cristian Vodnar**  
Faculty of Food Science and Technology,  
University of Agricultural Science and  
Veterinary Medicine,  
Cluj-Napoca, Romania.  
Email: dan.vodnar@usamvcluj.ro  
Scopus ID: 35604846100

**Prof. Sitthipong Nalinanon**  
Associate Dean  
Faculty of Agro-Industry, King Mongkut's  
Institute of Technology Ladkrabang  
Ladkrabang,  
Bangkok, Thailand.  
Email: sitthipong.na@kmitl.ac.th  
Scopus ID: 16245779000

**Prof. Aly El Sheikha**  
Visiting Professor, School of Nutrition  
Sciences, University of Ottawa, Canada;  
Full Professor at College of Bioscience and  
Bioengineering, Jiangxi Agricultural  
University, China.  
Email: elsheikha\_aly@yahoo.com  
Scopus ID: 35174115900

**Dr. Mattia Di Nunzio**  
Interdepartmental Centre for Agri-Food  
Industrial Research, Alma Mater Studiorum  
Universita di Bologna, Bologna, Italy.  
Email: mattia.dinunzio@unibo.it  
Scopus ID: 23093741900

**Dr. Jeyan A. Moses**  
Assistant Professor and In-charge  
Computational Modeling and Nanoscale  
Processing Unit  
Indian Institute of Food Processing  
Technology (IIFPT)  
Ministry of Food Processing Industries |  
Government of India  
Thanjavur, Tamil Nadu, India.  
Email: moses.ja@iifpt.edu.in  
Scopus ID: 22981136400

**Prof. Victor J. Temple**  
School of Medicine and Health Sciences,  
University of Papua New Guinea,  
Port Moresby,  
Papua New Guinea.  
Email: templevj@upng.ac.pg  
Scopus ID: 57194389852

**Dr. Keshab Chandra Mondal**  
Professor  
Department of Microbiology,  
Vidyasagar University Midnapur,  
West Bengal, India.  
Email: kcmondal@mail.vidyasagar.ac.in  
Scopus ID: 7004865977

**Dr. Krešimir Mastanjević**  
Assistant Professor  
Faculty of Food Technology,  
University of Osijek,  
Osijek, Croatia.  
Email: kmastanj@ptfos.hr  
Scopus ID: 26655948300

**Prof. Gabriel O. Adegoke**  
Department of Food Technology,  
University of Ibadan, Ibadan.  
Nigeria.

Email: pasquale.russo@unifg.it  
Scopus ID: 35726052700

**Dr. Netsanet Fentahun**  
Associate Professor of Public Health  
Nutrition  
Nutrition and Qualitative Research  
Consultant  
Founder and Executive Director for Ethio-  
Star Consulting PLC  
Department of Nutrition and Dietetics  
School of Public Health  
College of Medicine and Health Sciences  
Bahir Dar University -Ethiopia.  
Email: netsanet\_fentahun@yahoo.com  
Scopus ID: 56394665400

**Dr. Nurul Huda**  
Associate Professor  
Faculty of Food Science and Nutrition,  
Universiti Malaysia Sabah,  
Sabah, Malaysia.  
Email: drnurulhuda@yahoo.com  
Scopus ID: 6701695514

**Prof. Dr. Harun AKSU**  
Faculty of Veterinary Faculty  
Food Hygiene and Technology  
Department, Istanbul University,  
Avclar-Istanbul, Turkey.  
Email: h.aksu@istanbul.edu.tr  
Scopus ID: 56235721300

**Dr. Norazmir Md Nor**  
Senior Lecturer  
Faculty of Health Sciences, Universiti  
Teknologi,  
Selangor, Malaysia.  
Email: azmir2790@gmail.com  
Scopus ID: 54417702600

**Dr. Prasad S. Variyar**  
Professor, Homi Bhabha National Institute  
Scientific Officer (H) & Head,  
Food Flavor and Aroma Chemistry Section  
Food Technology Division  
Bhabha Atomic Research centre  
Mumbai, Maharashtra, India.  
Email: prasadpsv@rediffmail.com  
Scopus ID: 6603637229

**Prof Quazi Syed Zahir Uddin**  
Director Research & Development  
Associate Dean (Global Health)  
Professor, Community Medicine  
J N Medical College, Datta Meghe Institute  
of Medical Sciences  
Wardha, Maharashtra, India.  
Email: zahirquazi@gmail.com  
Scopus ID: 36337182700

Email: goadegoke@hotmail.com  
Scopus ID: 7003766493

**Prof. Jiwan S. Sidhu**  
Director,  
Department of Food Science and Nutrition,  
College of Life Sciences,  
Kuwait University,  
Safat, Kuwait.  
Email: dr.jiwan.sidhu@gmail.com  
Scopus ID: 7004614004

**Dr Jose Manuel Lorenzo Rodriguez**  
Head of Research  
Department of Food Science and  
Technology, Centro Tecnológico de la Carne  
de Galicia, Parque Tecnológico de Galicia,  
Spain.  
Email: jmlorenzo@ceteca.net  
Scopus ID:57195195602

**Prof. Chunpeng Wan**  
Jiangxi Key Laboratory for Postharvest  
Technology and Nondestructive Testing of  
Fruits & Vegetables,  
Jiangxi Agricultural University  
China  
Email: chunpengwan@jxau.edu.cn  
Scopus ID: 36731790300

**B.N. Dar**  
UGC Research Awardee  
Assistant Professor  
Department of Food Technology  
Islamic University of Science & Technology,  
Jammu & Kashmir, India.  
Email: darnabi@gmail.com  
Scopus ID: 56068490400

**Dr. Nikhil Kumar Mahnot**  
Assistant Professor  
Department of Food Technology  
Rajiv Gandhi University (A central  
University)  
Itanagar, India.  
Email: nikhil.mahnot@gmail.com  
Scopus ID: 56254346400

**Dr K. V Sunooj**  
Assistant professor and President AFST(I)  
Department of Food Science & Technology,  
Pondicherry University  
Union territory of Pondicherry,  
India.  
Email: sunoojpufst786@gmail.com  
Scopus ID: 25822810100

### Links

- [About](#)

---

- [Archives](#)

---

- [Article Processing Charges](#)

---

- [Coming Issue](#)

---

- [Contact](#)

---

- [Current Issue](#)

---

- [Order Print Issue](#)

---

- [Reviewers-2021](#)

---

- [Reviewers-2022](#)

---

- [Social Media](#)

---

- [Submission](#)

---

### Contact Us

Your Name (required)

Your Email (required)

Your Message

**2 G Z R**  
 Type the above text in box below (Case sensitive)

Complte the quiz  
 3+2=?

**Send**

Follow us on:



### License



This work is licensed under a Creative Commons Attribution 4.0 International License.

---

### Recent Articles

Health Concern of Phenomenally Premium Boba Milk Tea and Pearls Beverages in Kuala Lumpur: Sugary Content and Physico-chemical Profiles Analysis

---

Physicochemical and Functional Properties of Banana Starch and Its Alternative Returns

---

Green Energy Process “Ozonation” and Food Safety: A Comprehensive Review

---



## Optimization Ultrasonic Assisted Extraction (UAE) of Bioactive Compound and Antibacterial Potential from Sea Urchin (*Diadema Setosum*)

MUHAMMAD YUSUF<sup>1\*</sup>, NUR FITRIANI USDYANA ATTHAMID<sup>2</sup>, SRI INDRIATI<sup>3</sup>,  
RAHMAWATI SALEH<sup>4</sup>, MAHYATI LATIEF<sup>5</sup> and AKHMAD RIFAI<sup>6</sup>

<sup>1,3,5,6</sup>Chemical Engineering Department, Politeknik Negeri Ujung Pandang, Makassar, Indonesia.

<sup>2,4</sup>Agroindustry Department, Politeknik Pertanian Negeri Pangkajene Kepulauan, Pangkep, Indonesia.

### Abstract

Sea urchins can be used in medicine, has potential as a new type of antibiotic to developed in the pharmaceutical field, which is rich in bioactive compounds as a steroid, triterpenoids, saponins, and antioxidant properties. Conventional extraction generally takes a long time, is less environmentally friendly, and potentially triggers bioactive compound damage, so it needs alternative methods such as Ultrasound-Assisted Extraction (UAE). The extracting technology, including ultrasonic-assisted extraction (UAE) and solvent variation (ethyl acetate and methanol) of bioactive compounds from sea urchin (*Diadema setosum*) were optimized and compared. The purpose of this study was to study the application of UAE and solvent variation methods for sea urchin extraction from the Barrang Lompo Island in South Sulawesi. Comparing the maceration and ultrasonic assisted extraction methods. Optimization of extraction with UAE was carried out on the variable of extraction duration and type of solvent. Gas Chromatography-Mass Spectrometry results show that ultrasound-assisted extraction generally produces compounds of CHOLEST-5-EN-3-OL (3. BETA.), palmitic acid, 9-Octadecenoic acid (Z)-, methyl ester, stearic acid, oleic acid, flavonoids, phenols, pentadecanoic acid and batilol and streoid, which has a function as an antioxidant, anti-inflammatory, anti-tumor, anti-cancer agents and antibacterial. The results showed the best results using ultrasound-assisted extraction with a duration of 30 minutes and using solvent ethyl acetate. These results implied that extracts obtained by sonication showed the highest bioactive compounds and antioxidant activity, thus proving that this activity depends directly on the antibacterial properties.



### Article History

Received: 26 November 2019

Accepted: 22 June 2020


### Keywords

Antibacterial Properties;  
Extraction;  
Maceration;  
Sea Urchin;  
Ultrasound-Assisted  
Extraction.

**CONTACT** Muhammad Yusuf ✉ [yusufitri@poliupg.ac.id](mailto:yusufitri@poliupg.ac.id) 📍 Chemical Engineering Department, Politeknik Negeri Ujung Pandang, Makassar, Indonesia.



© 2020 The Author(s). Published by Enviro Research Publishers.

This is an  Open Access article licensed under a Creative Commons license: Attribution 4.0 International (CC-BY).

Doi: <http://dx.doi.org/10.12944/CRNFSJ.8.2.22>

## Introduction

Indonesia, especially in the Barrang Lompo Island, South Sulawesi Province, is a famous area for the diversity of species of invertebrate animals such as starfish (*Asterias vulgaris*), snake star (*Ophioderma superba*), sea urchin (*Diadema setosum*), sea urchin (*Echinus esculentus*) and many more. Sea urchins are small and spiny, has a high selling value and mostly consumed by Japanese people (sushi),<sup>1</sup> South America and France as well as in the United States (Boston, California, New York, British Columbia).<sup>2</sup> The shell that is known to contain various pigments is polyhydroxylated naphthoquinone (PHNQ) spinochromes<sup>3</sup> of antibacterial effect. Sea urchin part gonads have potential as antibacterial because has a compound polyhydroxylated naphthoquinone,<sup>4</sup> according to research,<sup>5</sup> extraction polyhydroxylated naphthoquinone from the spines and shell sea urchin *evchinus chloroticus* from New Zealand with six separate macroporous resins as an alternative to organic solvent extraction. The instrument HPLC and GC-MS have been found to be susceptible to degradation in light exposure, with PHNQ aminated being the least stable. Research,<sup>6</sup> extracting sea urchin *Echinometra mathaei* shell and spine parts by using a solvent diethyl ether. Screening uses HPLC instrument and radical scavenging assay (antioxidant) 1-diphenyl-2-picrylhydrazyl. It is confirmed with the use of photodiode array detector and LC-ESI – MS PHNQ acquired (Spinochrome B and C, Echinochrome A and Spinochrome A). Results show that marine urchin shells and spines, which are mainly disposed of as waste, can act as a new biologically active resource.

The compounds' chemical nature influences the extraction of phenolic and bacterial compounds from sea urchin materials, sample size, method of extraction, time and storage and the occurrence of agents such as proteins and carbohydrates.<sup>7-9</sup> Has been reported that the use of aquades solutions of ethanol, methanol, and acetone dramatically improves the extraction of polyphenols compared to a single-compound solvent system.<sup>10</sup> Extraction methods that most reported is maceration with solvents, hot-water extraction, alkaline extraction, resin-based extraction, enzyme-assisted extraction, extractions based on gamma and electron-beam irradiation and extraction using supercritical fluids. Some of these methods can cause a loss

of bioactive compounds due to the use of high temperatures and long extraction times, or, in the case of irradiation, it can represent a health risk if the proper care does not take.<sup>11</sup> Sustainable innovative green techniques have been used to reduce time, to consume energy, to increase the efficiency of the extraction and to help preserve the natural environment, by reducing the use of solvents and water in Ultrasound-Assisted Extraction (UAE) and Ultrasound Microwave-Assisted Extraction (UMAE),<sup>12</sup> generation of hazardous substances and fossil energy.<sup>13-15</sup> Ultrasonic radiation use power 20-100 kHz to extract natural compounds provides high reproducibility, secure handling, low solvent, and energy consumption, low-temperature processing and a smaller loss of bioactive compounds.<sup>16</sup> The extraction techniques can be compared with the microwave-assisted extraction, the ultrasound equipment is cheaper and the operation is easier. In addition, ultrasonic extraction, such as maceration, can be used for the extraction of a wide range of natural compounds with any solvent.<sup>17</sup>

Ultrasound can hydrate and facilitate swelling of vegetal tissue. According to research,<sup>10</sup> ultrasound can allow high rates of diffusion across the cell and increase the transfer of mass. On the other hand, cavitation produced by ultrasonic waves can also disrupt the cell, and then release the contents. In research,<sup>18</sup> the reported use frequency of 25 kHz from orange peel using an ultrasonic processor operated can produce higher extraction yields of polyphenols. Sonication is a faster, simpler, and more effective technique than maceration to extract organic compounds.<sup>19</sup> Extraction of a bioactive compound from sea urchin using Ultrasonic Assisted Extraction (UAE). Therefore, the aim of this study was to assess the effect of ultrasonic treatment on the total bioactive compound content of the sea urchin and shell gonad.<sup>18</sup>

## Material and Methods

### Sea Urchin

Sea urchin (*Diadema setosum*) was obtained by trawling off the coast Barrang Lompo Island in Makassar, South Sulawesi, Indonesia. The gonads separated from the sea urchin shell (fig.1), then washed to remove other components and taken to the laboratory by carrying in the coolbox, and stored in the freezer (-20°C) until the gonads

and shell sea urchin processed in Food Science and Instrumental Analysis Laboratory, Chemical Engineering Department, Politeknik Negeri Ujung Pandang, Indonesia.

#### Chemicals and Tools

All chemicals substances were of analytical grade, methanol (CAS: 67-56-1), aquadestilate (CAS: 7732-18-5), and ethyl acetate (CAS: 141-78-6), supplied by Merck Millipore (Burlington, Massachusetts, United States). The tools used are water bath (Memmert WNB 7 Basic control) Hettich Zentrifugen EBA-20, and Hitachi centrifuge brands, Ultrasonic Assisted

Extraction instrument (Elmasonic P30), Shimadzu GC-MS 2010 brand Gas Chromatography-Mass Spectrometry plus.

#### Preparation of Extract

Sea urchin was bled to death; tissues and various organs dissected out carefully and collected. Sea urchin divided into intestinal organs, gills, eggs, and body walls (including plates, feet, and spines).<sup>20</sup> After removal of the internal organs (shell and gonad) a stream of cold water washed and cut into small pieces.



Fig:1 Sea urchin (*Diadema setosum*): a) Sea urchin harvest in the sea by fishers; b) Sea urchin collected; c) Sea urchin shell, and 4) Sea urchin gonad

### Solvent Extraction

The extraction process began with the weighing stage of the sample, two hundred grams of sea urchin (gonad and shells) and 300 ml of methanol, added in a 500 ml glass flask. The mixture put in a water bath (Elmasonic P30 instrument) with a power of 40 kHz at 35°C for 30 min and 60 min to remove bioactive compounds from the sea urchin materials.<sup>17</sup> Same treatment for ethyl acetate solvents. The extract was purified and evaporated at 39°C by a rotary evaporator, working principle of the rotary evaporator not only lies in heating but by lowering the pressure and regulating the velocity at a certain point so that the solvent methanol and ethyl acetate will evaporate and the soluble compounds in the solvent do not follow Evaporate but settlers. The boiling point of methanol and ethyl acetate solvent ranges from 64.7°C and 77.1°C, by heating below the solvent boiling point, so that the compounds in

the solvent are not affected at high temperatures.<sup>17</sup> The high polarity and volatility of methanol and ethyl acetate was used as solvent to enhance yield and concentrate the desired compounds.<sup>21</sup> Methanol and ethyl acetate were dissolved into the sea urchin.<sup>22</sup> The solvent will evaporate perfectly when the evaporation process on the rotary evaporator until obtained the solvent that has not dripped again on the round base flask and can also be seen with the more potent substances present in the sample round base flask So that the bubbles are formed on the surface of substances.<sup>23</sup> The yield of sea urchin (%) is the ratio of the resulting sea urchin (g) compared to the sample weight used in the process (g). The formula calculates the calculation of the yield:

$$\text{Yield (\%)} = \frac{\text{Weight of sea urchin (g)}}{\text{Weight of starting material (g)}} \times 100\%$$

**Table 1: Ultrasonic Assisted Extraction with Variations of Solvents and Time Extraction**

| Ingredients                | Sea urchin (Shell) |                     | Sea urchin (gonad) |                     |
|----------------------------|--------------------|---------------------|--------------------|---------------------|
|                            | Methanol (min)     | Ethyl acetate (min) | Methanol (min)     | Ethyl acetate (min) |
| Sea urchin                 | 30                 | 30                  | 30                 | 30                  |
| ( <i>Diadema setosum</i> ) | 60                 | 60                  | 60                 | 60                  |

### The Steps of Ultrasonic-Assisted Extraction (UAE)

Elmasonic Instrument P30 is paired with a cooling coil operated heating system (Fisher Scientific Inc St Louis, USA); and a cooling system for chillers; and water pumps (HJ-111 versions, 250 L/h submersible pumps, Sunshine Inc., Zhejiang, China). Ultrasonic waves are produced locally from micro cavitations around the material to be extracted so that the material is heated and the extract compounds are released. Double effects are generated, i.e. the cell wall screed to release the compound content in and the local heating in liquids and to increase the diffusion of the extracts. Variables selected temperatures of 30°C, 40°C, and 50°C; power settings of 30%, 50%, and 70 %; and high durations of 10 min, 20 min, and 30 min. Cinetic energy is transferred to all parts of the fluid, followed by the formation of cavitation bubbles on the wall or surface, thereby increasing the mass transfer

between the solid-liquid surfaces. The mechanical effect is to increase the penetration of the fluid into the cell membrane wall, support the release of the cell components and increase the transfer of mass.<sup>24</sup> Research<sup>25</sup> states that ultrasonic cavitation generates broken power that breaks the cell wall mechanically and improves material transfer. The variety of solvents used for extraction in Table 1.

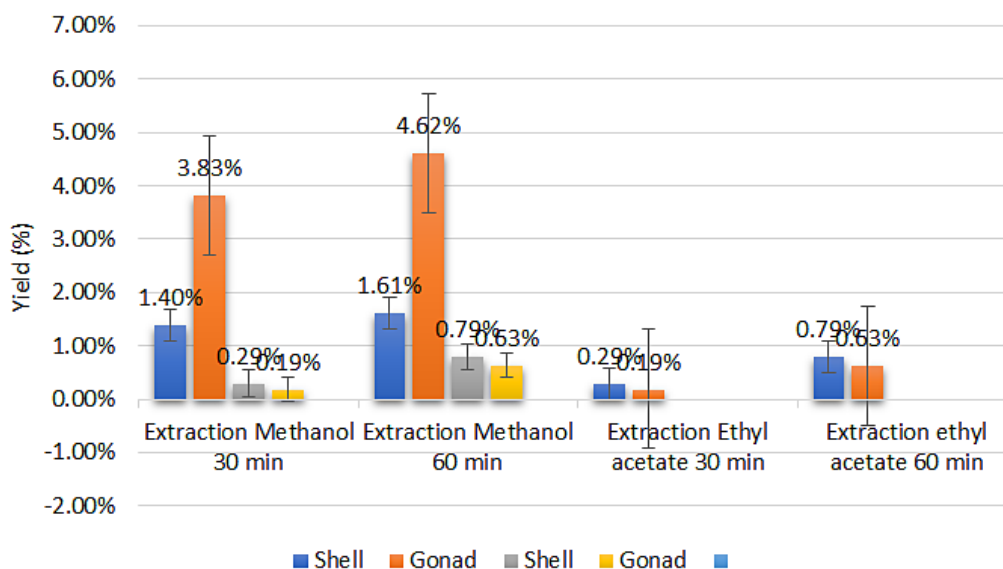
### Analysis of Bioactive Compounds (Gas Chromatography-Mass Spectrometry)

In a Shimadzu GCMS-QP 2010 Plus SHIMADZU instrument under computer control at 70 eV, the bioactive compound was determined using GC-MS analysis.<sup>26</sup> About 1 µl of the methanol extract injected into the GC-MS using a microsyringe, and complete scanning in 45 min. Starting from the phase selection of the motion or commonly called the gas carrier specified according to the analysis of the sample to be performed. In this research, gas



carrier He (Helium) with Principal level is 99.99%, and temperature maintained at 70-280°C or UHP (Ultra High Purity) type. Then the gas carrier is channelled through Stainless Steel tubing, and the pressure value of the gas carrier entered in Gas Chromatography is controlled by the AFC (Advanced Flow Controller) through the analysis software used

by GC-Solution. The column used Elite 1 (100% dimethyl polysiloxane) to isolate components<sup>27,28</sup>. The Advanced Flow Controller (AFC) controls the flow going into the column. Compounds were then identified by comparing their spectra of the spectral mass libraries of the Wiley and NIST/EPA/NIH.



**Fig. 2: The yield of sea urchin: a) Total yield per solvent; b) Values were presented as mean + SD (n=12)**

## Results

### Extraction Yield of Sea Urchin

The yield of each sample was recorded on the dry basis of sample weight from 0.18 to 4.61% using ultrasonic-assisted extraction method and methanol or ethyl acetate solvents, as shown in Fig. 2. Maximum extraction yields of 1.61% and 4.61% were obtained from shell and gonad sea urchin, respectively, with methanol solvents at 60 min.

Unlike the above, the minimum yield is achieved by using ethyl acetate solvent at 30 min was 0.29% and 0.18% for shell and gonad sea urchin (*Diadema setosum*), respectively. Methanol solvents are capable of extracting components derived from alkaloids, phenolic, rubberonoid, tannin, amino acids, sugars, and glycosides. Besides, that methanol can destroy cell walls, so that components

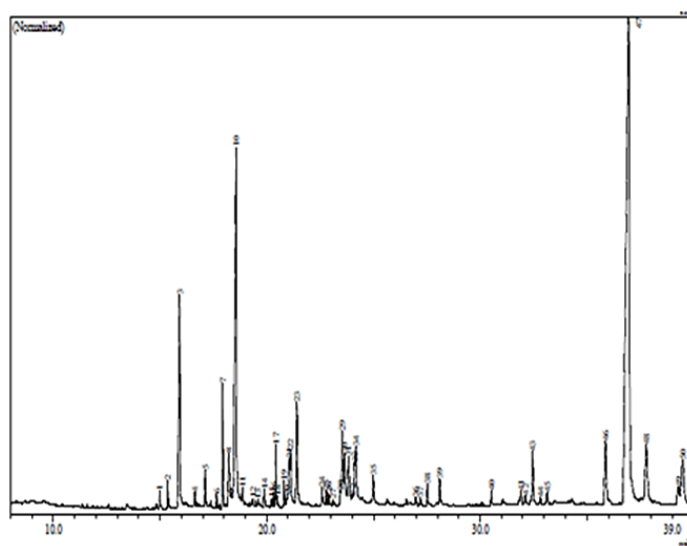
to break down and dissolve in methanol solvents.<sup>29,30</sup> Standard deviation (SD) test results indicate that SD value is smaller than the mean value, so data is not significant ( $P < 0.05$ ), mean the yield amount does not affect the number of bioactive compounds produced by each solvent in a sample of a sea urchin gonads and shell.

### The Bioactive Compound of Sea Urchin Shell with Methanol Solvent ExtractiSon

GC-MS test has performed showing the presence of 50 idealized compound components in methanol extract of sea urchin shell (Fig. 3), and 20 compounds identified in methanol extract of sea urchin gonads (Fig. 4). Some of the compounds detected at methanol extract of sea urchin shell, and gonad contains antibacterial substances. These antibacterial compounds include pentadecanoat acid, palmitic acid, stearic acid, ethyl cyclohexane, Tetradecanoic

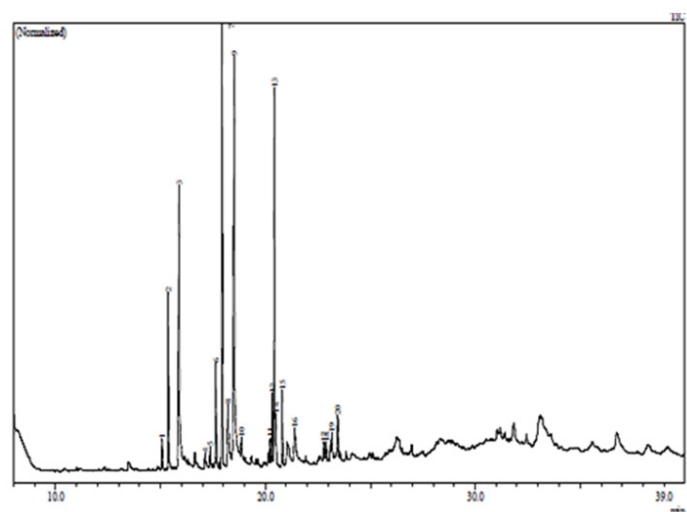
acid (Stearic acid), Phthalic Acid, 1-Eicosanol, and Ergosterol. Another study done by<sup>31</sup> informed that the white Oyster mushroom alcohol extract contains palmitic acid, 9,12-octadecadienoic acid, methyl ester (E, E)-18.55, 14.17-acid Oktadekadenoat, cholestatic-3, 7, 1, 25-tetraacetic extracts, methyl ester (E, E)-5.59, ethyl ester-3.84, (3a, 5a, 7a, 12a)-55.20 is potentially an antibacterial agent. The analysis of the chemical components of the sea urchin shell and gonad methanol extract using GC-

MS showed several active compounds that serve as antioxidant, antitumor, anticancer, analgesic agent and anti-inflammatory drugs. These active compounds include arachidonic acid, batilol, methyl ester, methyl ester, 9-octadecenoic acid (Z) -, tetradecanoic acid, and oleic acid. Analysis results also show that antibacterial components and anti-inflammatory drugs have the highest content, among other compounds. The antibacterial part detected is Cholest-5-EN-3-OL (3. Beta.) containing 39.51%.



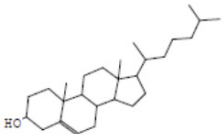
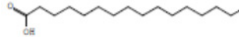
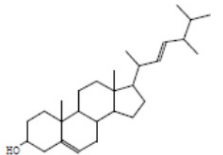
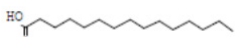
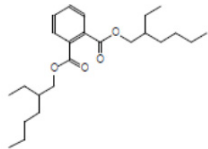
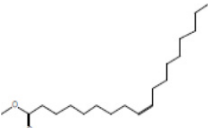
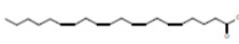
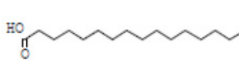
**Fig. 3: Sea urchin shell chromatogram of methanol extract**

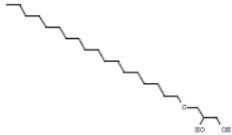
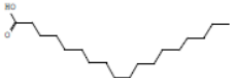
#### A Bioactive compound of sea urchin gonad with methanol solvent extraction



**Fig. 4: Sea urchin gonad chromatogram of methanol extract**

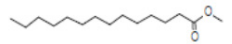
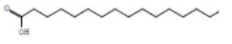
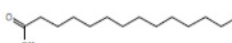
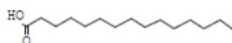

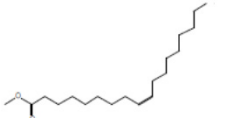
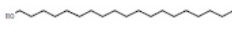
**Table 1: Major phytochemicals identified by a sea urchin shell methanol extract**

| No. | Phytochemical component                               | Area (%) | Formula           | Molecular weight (g/Mol) | Structure of the chemical  | Pharmacological measures   |
|-----|---|----------|-------------------|--------------------------|--|--|
| 1.  | CHOLEST-5-EN-3-OL (3. BETA.)                          | 39.51    | $C_{27}H_{46}O$   | 386                      |    | Antibacterial activity and anti-inflammatory   |
| 2.  | n-Hexadecanoic acid (Palmitic acid)                   | 14.87    | $C_{16}H_{32}O_2$ | 256                      |    | Anti-carcinogenic effects, Antioxidant, nematisida <sup>32</sup><br>Antibacterial activity <sup>33</sup> |
| 3.  | Ergosta-5,22-dien-3-ol                                | 3.14     | $C_{28}H_{46}O$   | 398                      |    | Anticyanobacteria <sup>34</sup> ,<br>Antibacterial activity <sup>35</sup>                                |
| 4.  | Pentadecanoic Acid                                    | 0.31     | $C_{15}H_{30}O_2$ | 242                      |  | Antibacterial activity <sup>36</sup>   |
| 5.  | 1,2-BENZENE DICARBOXYLIC ACID (Phthalic Acid)         | 0.10     | $C_{24}H_{38}O_4$ | 390                      |  | Antibacterial activity <sup>31</sup> ,<br>Antioxidant, nematocides                                       |
| 6.  | 9-Octadecenoic acid (Z) -, methyl ester <sup>37</sup> | 1.15     | $C_{19}H_{36}O_2$ | 296                      |  | Antioxidant, anti-tumor, anti-cancer agents <sup>38</sup>  |
| 7.  | Arachidonic acid                                      | 2.29     | $C_{20}H_{32}O_2$ | 304                      |  | Antioxidant, anti-tumor, anti-cancer agents, Analgesic effects   |
| 8.  | Palmitic Acid   | 0.19     | $C_{16}H_{32}O_2$ | 256                      |  | Anti-carcinogenic effects, Anti-oxidative, nematisida, Antibacterial activity <sup>33</sup>              |

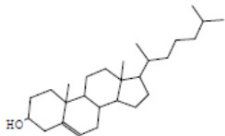
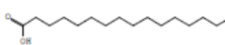
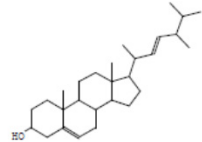

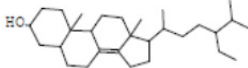
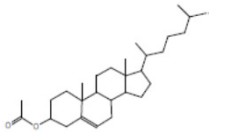
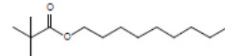

|     |            |      |                   |     |  |   |
|-----|------------|------|-------------------|-----|--|---|
| 9.  | Batilol    | 0.64 | $C_{21}H_{44}O_3$ | 344 |  | Antioxidant, anti-tumour, anti-cancer agents, Analgesic effects |
| 10. | Oleic Acid | 0.97 | $C_{18}H_{34}O_2$ | 282 |  | Antioxidant, anti-tumour, anti-cancer agents                    |

### A Bioactive compound of sea urchin gonad with methanol solvent extraction

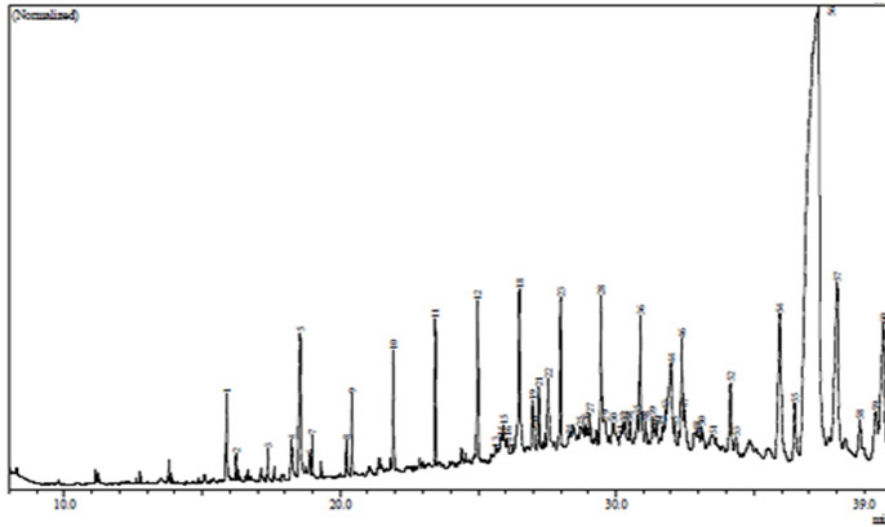
**Table 2: Major phytochemicals identified by a sea urchin gonad methanol extract**

| No. | Phytochemical component                  | Area (%) | Formula           | Molecular weight (g/Mol) | Structure of the chemical  | Pharmacological measures   |
|-----|--|----------|-------------------|--------------------------|--|--|
| 1.  | Tetradecanoic Acid, Methyl Ester         | 5.38     | $C_{15}H_{30}O_2$ | 242                      |    | Anti-carcinogenic effects, Antioxidant, nematisida<br>Antibacterial activity |
| 2.  | n-Hexadecanoic acid (Palmitic acid)      | 23.26    | $C_{16}H_{32}O_2$ | 256                      |  | Anti-carcinogenic effects, Antioxidant, nematisida<br>Antibacterial activity |
| 3.  | Tetradecanoic acid (Stearic acid)        | 15.63    | $C_{14}H_{28}O_2$ | 228                      |  | Antibacterial activity   |
| 4.  | Pentadecanoic                            | 0.90     | $C_{15}H_{30}O_2$ | 242                      |  | Antibacterial activity   |
| 5.  | 5,8,11-Eicosatrienoic acid, methyl ester | 0.78     | $C_{21}H_{36}O_2$ | 320                      |  | Antioxidant, Anti-Inflammatory   |
| 6.  | 9-Octadecenoic acid (Z) -,               | 14.31    | $C_{19}H_{36}O_2$ | 296                      |  | Antioxidant, anti-tumor, anti-cancer agents                                  |
| 7.  | 1-Eicosanol                              | 0.62     | $C_{20}H_{42}O$   | 298                      |  | Antibacterial activity   |

**Table 3: Major phytochemicals identified by a sea urchin shell ethyl acetate extract**

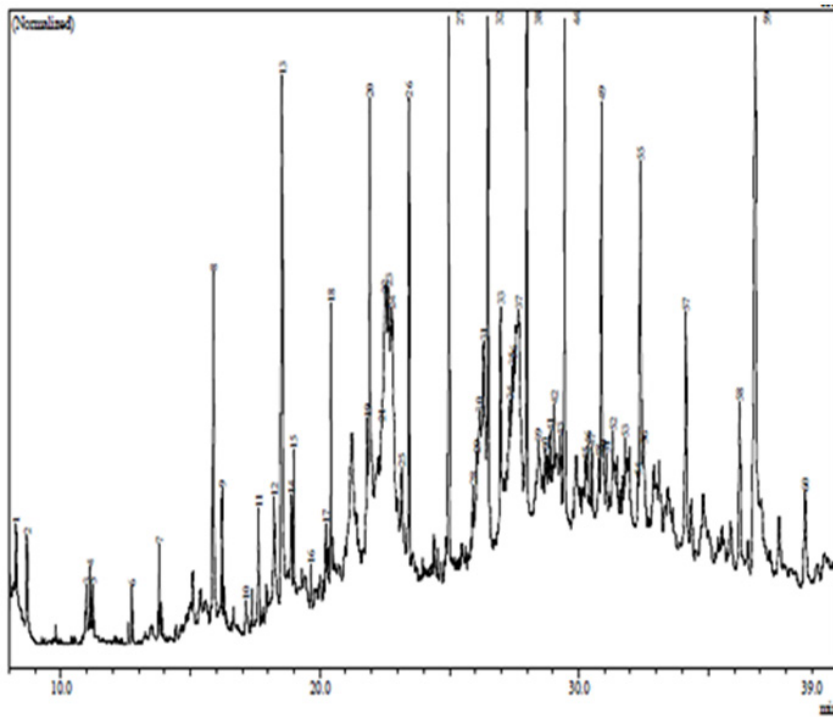
| No. | Phytochemical component                     | Area (%) | Formula  | Molecular weight (g/Mol) | Structure of the chemical  | Pharmacological measures   |
|-----|---|----------|--|--------------------------|--|--|
| 1.  | Cholest-5-EN-3-OL (3. beta.)                | 46.24    | C <sub>27</sub> H <sub>46</sub> O              | 386                      |    | Antibacterial activity and anti-inflammatory                               |
| 2.  | n-Hexadecanoic acid (Palmitic acid)         | 2.66     | C <sub>16</sub> H <sub>32</sub> O <sub>2</sub> | 256                      |    | Anti-carcinogenic effects, Antioxidant, nematisida, Antibacterial activity |
| 3.  | Ergosta-5,22-dien-3-ol                      | 5.30     | C <sub>28</sub> H <sub>46</sub> O              | 398                      |   | Anticyanobacteria, Antibacterial activity                                  |
| 4.  | Pentacosane                                 | 25.83    | C <sub>25</sub> H <sub>52</sub>                | 352                      |  | Antioxidant, anti-tumor, anti-cancer agents, anti-virus                    |
| 5.  | Stigmast-8 (14)-EN-3.beta.-OL <sup>39</sup> | 0.65     | C <sub>29</sub> H <sub>50</sub> O              | 414                      |  | Anti-bacterial, anti-fungi, Antibacterial activity and anti-inflammatory   |
| 6.  | Cholest-5-EN-3-YL acetate                   | 0.84     | C <sub>29</sub> H <sub>48</sub> O <sub>2</sub> | 428                      |  | Antibacterial activity and anti-inflammatory                               |
| 7.  | 2,2-Dimethylpropanoic acid, nonyl ester     | 0.18     | C <sub>14</sub> H <sub>28</sub> O <sub>2</sub> | 228                      |  | Antioxidant  |
| 8.  | Pentatriacontane                            | 0.60     | C <sub>35</sub> H <sub>72</sub>                | 492                      |  | Antioxidant,   |

**The bioactive compound of sea urchin shell with ethyl acetate solvent extraction**



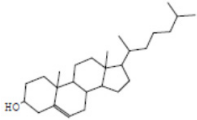
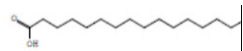
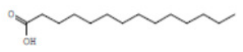

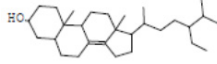
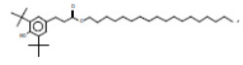
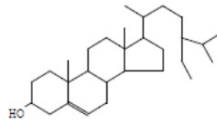
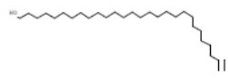
**Fig. 5: Sea urchin shell chromatogram of ethyl acetate extract**

**A Bioactive compound of sea urchin gonad with ethyl acetate solvent extraction**



**Fig. 6: Sea urchin gonad chromatogram of ethyl acetate extract**

**Table 4: Major phytochemicals identified by a sea urchin gonad methanol extract**

| No. | Phytochemical component   | Area (%) | Formula  | Molecular weight (g/Mol) | Structure of the chemical  | Pharmacological measures   |
|-----|---|----------|--|--------------------------|--|--|
| 1.  | Cholest-5-EN-3-OL (3. beta.)  | 9.17     | C <sub>27</sub> H <sub>46</sub> O              | 386                      |    | Antibacterial activity and anti-inflammatory                               |
| 2.  | n-Hexadecanoic acid (Palmitic acid)   | 6.05     | C <sub>16</sub> H <sub>32</sub> O <sub>2</sub> | 256                      |    | Anti-carcinogenic effects, Antioxidant, nematisida, Antibacterial activity |
| 3.  | Tetradecanoic acid  | 3.30     | C <sub>14</sub> H <sub>28</sub> O <sub>2</sub> | 228                      |    | Antibacterial, antifungi40   |
| 4.  | Pentacosane   | 15.48    | C <sub>25</sub> H <sub>52</sub>                | 352                      |    | Antioxidant, anti-tumor, anti-cancer agents, anti-virus                    |
| 5.  | STIGMAST-8 (14) -EN-3. BETA.-OL   | 3.10     | C <sub>29</sub> H <sub>50</sub> O              | 414                      |  | Anti-bacterial, anti-fungi, Antibacterial activity and anti-inflammatory   |
| 6.  | Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, octadecyl ester | 5.19     | C <sub>35</sub> H <sub>62</sub> O <sub>3</sub> | 530                      |  | Antioxidant  |
| 7.  | Gamma. -Sitosterol  | 2.81     | C <sub>29</sub> H <sub>50</sub> O              | 414                      |  | Anti-hypoglycemic,   |
| 8.  | Octacosanol   | 0.35     | C <sub>28</sub> H <sub>58</sub> O              | 410                      |  | Anti-fatigue, Anti-Parkinson effect, anticancer, anti-tumour               |

The GC-MS test showed the presence of 60 idealized compound components in the sea urchin extract of ethyl acetate (Fig. 5), and 60 compounds identified in the extract of ethyl acetate from sea urchin

gonades (Fig. 6). Some compounds found in ethyl acetate extract of sea urchin shell and gonad contain antibacterial and anti-fungal substances. These antibacterial compounds include pentadecanoat

acid, Cholest-5-EN-3-OL (3. BETA.), Stigmast-8 (14) -EN-3.BETA.-OL, palmitic acid, stearic acid, ethyl cyclohexane, tetradecanoic acid (stearic acid), phthalic acid, pentacosane, and ergosterol. The analysis of the chemical components of the sea urchin shell and gonad ethyl acetate extract using GC-MS showed several active compounds that serve as an antioxidant, antitumour, anticancer, analgesic agent and anti-inflammatory drugs. These active compounds include 9-octadecenoic acid (Z) -, methyl ester, pentacosane, 2,2-Dimethylpropanoic acid, p-Anisic acid, benzenepropanoic acid, 3,5-bi's (1,1-dimethyl ethyl) -4-hydroxy-, pentatriacontane, n-hexadecanoic acid or palmitic acid, Cholest-5-EN-3-YL acetate, and octadecyl ester. Some of the octacosanol compounds amounting to 0.81% (total amount) function as Anti-fatigue and Anti-Parkinson's effects. As well as a small fraction of 2.81% of the gamma.-sitosterol A compound can function as an antihyperglycemic. Analysis results also show that antibacterial components and anti-inflammatory drugs have the highest content, among other compounds. The most significant content is Cholest-5-EN-3-OL (3. beta.) or 46.24% steroid as an antibacterial agent.

### Conclusion

This study resulted in data types of bioactive compounds, quantities, benefits and phytochemical

characteristics of sea urchin gonads and shells. Sea urchin (*Diadema setosum*) was obtained by trawling off the coast Barrang Lompo Island in Makassar, South Sulawesi, Indonesia. Contains chemical constitutions that are useful for different herbal formulations as anti-tumour, anti-cancer, anti-inflammatory, analgesic, anti-fatigue, anti-Parkinson effect, and anti-hypoglycemic. And potentially as a preservative in food and beverages because it is as antibacterial and antifungal.

### Suggestions

Need to do further research to uses ultrasonic microwave-assisted extraction in extracting the sea urchin

### Acknowledgement

The authors are thankful to the Research Institute of Politeknik Negeri Ujung Pandang, which facilitated and funded this research.

### Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

### Conflict of Interest

The authors do not have any conflict of interest.

### References

1. Kuwahara R, Hatate H, Chikami A, Murata H, Kijidani Y. Quantitative separation of antioxidant pigments in purple sea urchin shells using a reversed-phase high performance liquid chromatography. *LWT - Food Sci Technol.* 2010. doi:10.1016/j.lwt.2010.03.005.
2. Amarowicz R, Synowiecki J, Shahidi F. Chemical composition of shells from red (*Strongylocentrotus franciscanus*) and green (*Strongylocentrotus droebachiensis*) sea urchin. *Food Chem.* 2012;133(3):822-826. doi:10.1016/j.foodchem.2012.01.099.
3. Anderson HA, Mathieson JW, Thomson RH. Distribution of spinochrome pigments in echinoids. *Comp Biochem Physiol.* 1969. doi:10.1016/0010-406X(69)91347-4.
4. Lebedev A V., Levitskaya EL, Tikhonova E V., Ivanova M V. Antioxidant properties, autooxidation, and mutagenic activity of echinochrome as compared with its etherified derivative. *Biokhimiya.* 2001.
5. Hou Y, Vasileva EA, Mishchenko NP, Carne A, McConnell M, Bekhit AEDA. Extraction, structural characterization and stability of polyhydroxylated naphthoquinones from shell and spine of New Zealand sea urchin (*Evechinus chloroticus*). *Food Chem.* 2019. doi:10.1016/j.foodchem.2018.08.046.
6. Soleimani S, Yousefzadi M, moein S, Rezadoost H, Bioki NA. Identification and antioxidant of polyhydroxylated naphthoquinone pigments from sea urchin pigments of *Echinometra mathaei*. *Med Chem*



- Res. 2016. doi:10.1007/s00044-016-1586-y
7. Koffi, Dodehe T, 4 SS. Effect of solvent type on extraction of polyphenols from twenty three Ivorian plants. *J Anim Plant Sci.* 2010.
  8. García-Márquez E, Román-Guerrero A, Cruz-Sosa F, Pérez-Alonso C, Jiménez-Alvarado R, Vernon-Carter EJ. Effect of solvent-temperature extraction conditions on the initial antioxidant activity and total phenolic content of muiltle extracts and their decay upon storage at different pH. *Rev Mex Ing Qum.* 2012.
  9. Guneidy RA, Shahein YE, Aboueillela AMK, Zaki ER, Hamed RR. Inhibition of the recombinant cattle tick *Rhipicephalus (Boophilus) annulatus* glutathione S-transferase. *Ticks Tick Borne Dis.* 2014. doi:10.1016/j.ttbdis.2014.03.009.
  10. Akhbari M, Hamedi S, Aghamiri Z sadat. Optimization of total phenol and anthocyanin extraction from the peels of eggplant (*Solanum melongena* L.) and biological activity of the extracts. *J Food Meas Charact.* 2019. doi:10.1007/s11694-019-00241-1.
  11. Liu CT, Wu CY, Weng YM, Tseng CY. Ultrasound-assisted extraction methodology as a tool to improve the antioxidant properties of herbal drug Xiao-chia-hu-tang. *J Ethnopharmacol.* 2005. doi:10.1016/j.jep.2005.02.018.
  12. Piccolella S, Crescente G, Nocera P, Pacifico F, Manti L, Pacifico S. Ultrasound-assisted aqueous extraction, LC-MS/MS analysis and radiomodulating capability of autochthonous Italian sweet cherry fruits. *Food Funct.* 2018. doi:10.1039/c7fo01977g.
  13. Chemat F, Rombaut N, Sicaire AG, Meullemiestre A, Fabiano-Tixier AS, Abert-Vian M. Ultrasound assisted extraction of food and natural products. Mechanisms, techniques, combinations, protocols and applications. A review. *Ultrason Sonochem.* 2017. doi:10.1016/j.ultsonch.2016.06.035.
  14. Zhou P, Wang X, Liu P, *et al.*, Enhanced phenolic compounds extraction from *Morus alba* L. leaves by deep eutectic solvents combined with ultrasonic-assisted extraction. *Ind Crops Prod.* 2018. doi:10.1016/j.indcrop.2018.04.071.
  15. Adeel S, Rehman F ur, Iqbal MU, *et al.*, Ultrasonic assisted sustainable dyeing of mordanted silk fabric using arjun (*Terminalia arjuna*) bark extracts. *Environ Prog Sustain Energy.* 2019. doi:10.1002/ep.13048.
  16. Pan Z, Qu W, Ma H, Atungulu GG, McHugh TH. Continuous and pulsed ultrasound-assisted extractions of antioxidants from pomegranate peel. *Ultrason Sonochem.* 2012. doi:10.1016/j.ultsonch.2011.05.015.
  17. Wang L, Weller CL. Recent advances in extraction of nutraceuticals from plants. *Trends Food Sci Technol.* 2006. doi:10.1016/j.tifs.2005.12.004.
  18. Khan MK, Abert-Vian M, Fabiano-Tixier AS, Dangles O, Chemat F. Ultrasound-assisted extraction of polyphenols (flavonone glycosides) from orange (*Citrus sinensis* L.) peel. *Food Chem.* 2010. doi:10.1016/j.foodchem.2009.08.046.
  19. Jacques RA, dos Santos Freitas L, Pérez VF, *et al.*, The use of ultrasound in the extraction of *Ilex paraguariensis* leaves: A comparison with maceration. *Ultrason Sonochem.* 2007. doi:10.1016/j.ultsonch.2005.11.007.
  20. Haug T, Kjuul AK, Styrvold OB, Sandsdalen E, Olsen ØM, Stensvåg K. Antibacterial activity in *Strongylocentrotus droebachiensis* (Echinoidea), *Cucumaria frondosa* (Holothuroidea), and *Asterias rubens* (Asteroidea). *J Invertebr Pathol.* 2002;81(2):94-102. doi:10.1016/S0022-2011(02)00153-2.
  21. Yusuf M, Indriati S, Attahmid Nfu. Karakterisasi Antosianin Kubis Merah Sebagai Indikator Pada Kemasan Cerdas Characterization Antosianin of Red Cabbage as a Indicator in Smart Packaging. *J Galung Trop.* 2018;7(April):46-55.
  22. Altemimi A, Watson DG, Choudhary R, Dasari MR, Lightfoot DA. Ultrasound assisted extraction of phenolic compounds from peaches and pumpkins. *PLoS One.* 2016. doi:10.1371/journal.pone.0148758.
  23. Teng H, Choi YH. Optimization of ultrasonic-assisted extraction of bioactive alkaloid compounds from rhizoma coptidis (*coptis chinensis franch.*) using response surface methodology. *Food Chem.* 2014. doi:10.1016/j.foodchem.2013.06.136.
  24. Keil FJ. Modeling of Process Intensification.;

2007. doi:10.1002/9783527610600
25. Liu QM, Yang XM, Zhang L, Majetich G. Optimization of ultrasonic-assisted extraction of chlorogenic acid from *Folium eucommiae* and evaluation of its antioxidant activity. *J Med Plants Res.* 2010.
26. Mohammad A, Imad H. Autosomal STR: From locus information to next generation sequencing technology. *Res J Biotechnol.* 2013.
27. Hameed IH, Jebor MA, Ommer AJ, Abdulzahra AI, Yoke C. Haplotype data of mitochondrial DNA coding region encompassing nucleotide positions 11,719–12,184 and evaluate the importance of these positions for forensic genetic purposes in Iraq. *Mitochondrial DNA.* 2016. doi:10.3109/19401736.2014.945576
28. Kareem MA, Abdulzahra AI, Hameed IH, Jebor MA. A new polymorphic positions discovered in mitochondrial DNA hypervariable region HVIII from central and north-central of Iraq. *Mitochondrial DNA.* 2016. doi:10.3109/19401736.2015.1007369.
29. Anwar F, Przybylski R. Effect of solvents extraction on total phenolics and antioxidant activity of extracts from flaxseed (*Linum usitatissimum* L.). *Acta Sci Pol Technol Aliment.* 2012.
30. Anwar F, Kalsoom U, Sultana B, Mushtaq M, Mehmood T, Arshad HA. Effect of drying method and extraction solvent on the total phenolics and antioxidant activity of cauliflower (*Brassica oleracea* L.) Extracts. *Int Food Res J.* 2013.
31. Jananie R, Priya V, Vijayalakshmi K. Determination of bioactive components of *Cynodon dactylon* by GC-MS analysis. *New York Sci J.* 2011.
32. Vijisara Elizabeth D, Arumugam S. GC-MS analysis of bioactive constituents of *indigofera suffruticosa* leaves. *J Chem Pharm Res.* 2014.
33. Graikou K, Kapeta S, Aligiannis N, *et al.*, Chemical analysis of Greek pollen - Antioxidant, antimicrobial and proteasome activation properties. *Chem Cent J.* 2011. doi:10.1186/1752-153X-5-33.
34. Cantrell CL, Rajab MS, Franzblau SG, Fronczek FR, Fischer NH. Antimycobacterial ergosterol-5,8-endoperoxide from *Ajuga remota*. *Planta Med.* 1999. doi:10.1055/s-1999-14053.
35. Zhao J, Mou Y, Shan T, *et al.*, Antimicrobial metabolites from the endophytic fungus *pichia guilliermondii* Isolated from *Paris polyphylla* var. *yunnanensis*. *Molecules.* 2010. doi:10.3390/molecules15117961.
36. Mujeeb F, Bajpai P, Pathak N. Phytochemical evaluation, antimicrobial activity, and determination of bioactive components from leaves of *aegle marmelos*. *Biomed Res Int.* 2014. doi:10.1155/2014/497606.
37. Park N, Kwon B, Kim SD, Cho J. Characterizations of the colloidal and microbial organic matters with respect to membrane foulants. *J Memb Sci.* 2006. doi:10.1016/j.memsci.2005.08.020.
38. Rajeswari G, Murugan M, Mohan VR. GC-MS analysis of bioactive components of *Hugonia mystax* L. (Linaceae). *Res J Pharm Biol Chem Sci.* 2012.
39. Nedeltcheva-Antonova D, Ivanova D, Antonov L, Abe I. Insight into the aroma profile of Bulgarian tobacco absolute oil. *Ind Crops Prod.* 2016. doi:10.1016/j.indcrop.2016.08.047.
40. Agoramoorthy G, Chandrasekaran M, Venkatesalu V, Hsu MJ. Antibacterial and antifungal activities of fatty acid methyl esters of the blind-your-eye mangrove from India. *Brazilian J Microbiol.* 2007. doi:10.1590/S1517-83822007000400028.