

## POTENTIAL OF ROSELLA *HIBISCUS SABDARIFFA L*) AS A HERBAL MEDICINE FOR HEALTH

Sri Muliana Putri Bakara<sup>1\*</sup>, Siti Nurmawan Sinaga<sup>2</sup>, Herna Rinayanti Manurung<sup>3</sup>, Oktavania Damanik<sup>4</sup>, Cristoboy Vasius Bakara<sup>5</sup>, Paslina Gulo<sup>6</sup>

Stikes Mitra Husada Medan<sup>1,2,3,4,5,6</sup>

Corresponding Author: Sri Muliana Putri Bakara

E-Mail: [Sriputribakara97@gmail.com](mailto:Sriputribakara97@gmail.com)

Received: 12-12-2024

Revised: 22-12-2024

Approved: 28-12-2024

### ABSTRACT

*Hibiscus Sabdariffa L* Usually Called The Rosella Plant, Is A Plant That Has Many Benefits Starting From The Petals, Leaves, Seeds, And Stems, Has Been Used As An Herbal Medicinal Plant Since Ancient Times With A Variety Of Substances That Are Good For The Human Body. *Hibiscus Sabdariffa L* Contains Antioxidants, Anti-Diabetes, As A Diuretic, Anti-Cholesterol, Anti-Cancer, Anti-Microbial, Anti-Inflammatory, Anti-Lipidemic, Anti-Hypertensive, And Immunomodulatory Agent. This Literature Summarises Some Of The Nutritional Benefits Of Rosella And Its Potential Use As A Herbal Medicine. This Literature Method Uses A Systematic Review. The Database Used Is PUBMED, Science Direct, And Google Scholar. Using Keywords That Correspond To The Potential Of The Hibiscus Sabdariffa Plant For Health, 15 Articles Were Obtained In Indonesian And English. There Have Been Various Studies Related To The Nutritional Content Of The *Hibiscus Sabdariffa L* Plant Which Has Great Potential To Be Used As An Herbal Medicinal Ingredient That Has Many Benefits And Is Safe For Consumption Every Day Which Is Discussed In This Review.

**Keywords:** *Hibiscus Sabdariffa L*, Herbal Medicine, Nutritional Potential.

### INTRODUCTION

*Hibiscus Sabdariffa* Also Called Rosella Is A Plant Belonging To The Malvaceae Family And Is Often Found In Africa And Southeast Asia Such As Indonesia, China, Thailand, And Malaysia. (1,2) This Plant Is Better Known As Rosella In Indonesia, China, Thailand And Jamaican In India. It Grows Widely In Tropical And Subtropical Climates (3), With Trees Reaching A Height Of 2.4 M With Red Cylindrical Trunks. The Leaves Are Green With A Width Of 7.5 To 12.5 Cm. The Roots That Support The Stem Are Taproots (1). The Flower Crown Is Funnel-Shaped And Is Composed Of 5 Corolla Leaves. The Roselle Flower That Emerges From The Leaf Axil Is A Single Flower, Meaning There Is Only One Flower On Each Stem. (4) This Flower Has 8 – 11 Hairy Petals, 1 Cm Long, The Bases Are Attached To Each Other And Are Red. These Flower Petals Are Often Considered Flowers By People. This Part Is Often Used As Food And Drink Ingredients. Since Ancient Times, It Has Been Known As A Herbal Plant Used As Traditional Herbal Medicine, Because It Is Believed To Contain Many Health Benefits, Most Often Consumed As A Tea With Its Sour Taste. (5)(6)

The Most Widely Used Rosella Plants Are The Flower Petals, Seeds, Leaves, And Stems Because They Contain Many Nutrients For Health. Has A Rich Content Of Vitamin C, Vitamin A, Vitamin B, Fibre, Calcium, Phosphorus, Magnesium, And Iron. (7,8) High In Bioactive Antioxidants Such As Carotenoids, Polyphenols, Ascorbic Acid, Flavonoids, And Tannins. (9,10)(11) Dried Rosella Petals, Often Used As A Tea Drink, Rosella Flower Flour In Food Mixtures, And Rosella Flower Extract. (12)(13) Rosella Flowers Are Believed To Have Quite High Health Benefits And Have A Unique Taste. In Various Studies, Rosella Flowers Can Cure Various Diseases And Prevent Various Disease

Transmissions And Can Be Used As A Natural Coloring And Preservative In Food Or Drinks. (14)

The Use Of Herbal Medicines Is Currently Used As A Complementary Therapy In Treating Health Problems. (15) One Way Is By Consuming Processed Rosella In Various Types Of Processing. The Content Of Rosella Is 260-280 Mg Of Vitamin C, Which Is Higher Than Oranges, Guava, Kiwi, And Manga, The Highest Among Several Types Of Fruit. (16,17) (18) The Antioxidants Contained In The Petals Of Rosella Flowers Consist Of Flavonoids, Gossypetine, Glucoside Hibiscin, And Sabdaretine. (19,20) These Antioxidant Levels Can Also Act As Anti-Free Radical Inhibitors For The Human Body. (21) Various Kinds Of Preparations Use The Rosella Plant Through Extraction, Making Herbal Teas, Flour, And Others. (22,23) Rosella Has Great Potential To Be Developed As A Raw Material For Food And Drinks. The Deeper The Red Color Of The Rosella Flower Petals, The More Sour The Resulting Taste And The Higher The Oxidant Content. (24,25)

In Indonesia, Many People Are Starting To Use Roselle. In Other Countries, Roselle Has Been Widely Used For A Long Time. However, Recently Drinks Made From Roselle Have Begun To Be Widely Known As Health Drinks. (26,27) Drinks Made From Roselle Which Are Packaged Like Tea Bags Can Now Be Found On The Market. Through Various Studies, It Has Been Shown That The Rosella Flower Is Able To Lower Blood Pressure, Creatinine, Uric Acid, Anti-Diabetes, And Anti-Cancer, So The Rosella Flower Has High Economic Value And Has The Potential To Become An Herbal Medicine Or Alternative For Health With Its Easy Processing And Adequate Cultivation Methods. Easy Too.(20,28)

The Following Is A Summary Of The Nutritional Potential In Hibiscus Sabdariffa Which Can Be Used As A Herbal Medicine In Several Clinical Trials.

## **MATERIALS AND METHODS**

The Method Used In This Review Is Systematic Literature. The Databases Used By PUBMED, Science Direct, And Google Scholar With The Inclusion Criteria For Articles To Be Reviewed Are Clinical Trial Articles, Available In English And Indonesian, In The Period 2019-2023, Open Access, Full Text. Meanwhile, The Exclusion Criteria Are Articles That Are The Result Of A Review, Are Not Relevant, Do Not Use *Hibiscus Sabdariffa L* As The Main Focus In Clinical Trials, And Research Methods And Research Results Are Unclear. An Article Search Was Carried Out Using Keywords Including "*Hibiscus Sabdariffa L*" OR "Rosella" AND "Herbal Medicine", "Potential Nutrition", Showing That There Were 333 Articles From The Database Then Screening 22 Duplicates, There Were 82 Articles With Clinical Trials. Then Another Screening Was Carried Out Based On The Criteria For Selecting Articles That Were Appropriate To The Content, Resulting In 13 Articles Selected For Review, Full Text, And Open Access. This Review Explains The Nutritional Potential Of The Rosella Plant And Its Use As An Herbal Medicine That Has Been Carried Out In Clinical Trials.

## **RESULTS**

### ***Hibiscus Sabdariffa L*. Plant Parts**

When Young, The Stems Are Green. And When They Grow Up And Flower, The Rosella Stems Are Reddish Brown. Attached To The Rosella Stem Are Arranged Leaves, Green In Colour, And Oval In Shape With Spines And Serrated Edges. The Tips Of The Rosella Leaves Are Tapered And The Veins Of The Leaves Are Red. (1,27,29) The Roots That Support The Stem Are Taproots. The Rosella Flower That Emerges From The Leaf

Axil Is A Single Flower. The Flower Crown Is Funnel-Shaped And Is Composed Of 5 Corolla Leaves. Rosella Flower Petals Contain Anthocyanin Pigments Which Form Flavonoids Which Act As Antioxidants. (4,30)(11) The Reddish-Purple Colour Of The Flower Petals Can Be Formed Through Anthocyanin Pigments. This Part Is Often Used As Food And Drink Ingredients. The Flower Petals Have Pectin Which Makes The Jelly Firm. The Young Leaves And Soft Stems Can Be Eaten Raw As A Salad Or Cooked As A Vegetable. Meanwhile, The Seeds Can Be Used As A Coffee Substitute. The Way To Make Coffee From Rosella Seeds Is To Roast The Seeds, And Then Make Flour. Rosella Seed Coffee Has Long Been Famous In Africa. (19) Leaves And Flower Petals Boiled In Water Are Recognized As Efficacious As A Urinary Laxative And Stimulate The Release Of Bile From The Liver (Choleretic). (16,31) Apart From That, It Can Also Lower Blood Pressure (Hypotensive). ), Reduces Blood Viscosity And Increases Intestinal Peristalsis. Other Known Benefits Of The Rosella Plant Include Antispasmodic, Treating Worms And As An Antibacterial. Rosella Leaves Can Also Treat Cracked Feet And Minor Burns. The Seeds Are Also Useful As A Diuretic And Tonic. Antioxidants In Roselle Such As Gossypetine, Anthocyanin, And Hibiscin Glucoside Provide Protection Against Various Degenerative Diseases Such As Coronary Heart Disease, Cancer, Diabetes Mellitus, And Cataracts. Apart From Containing Vitamin C, Rosella Flower Petals Also Contain Vitamin A And 18 Types Of Amino Acids That The Body Needs. (32,33)

### **Benefits Of *Hibiscus Sabdariffa L***

Rosella Is A Plant That Can Be Planted In Tropical And Subtropical Areas. There Are 300 Species Of Rosella Plants Spread Throughout The World, Including Indonesia, Malaysia, Thailand, The Philippines, China, India, Africa, Asia, Brazil, And Australia, With A Planting Period Of 5-6 Months. And Starts Flowering At The Age Of 2-3 Months. The Parts Of The Plant That Can Be Used Include Petals, Leaves, Roots, Seeds And Stems, Making It A Multi-Benefit Plant, Resulting In The Development Of The Rosella Processing Industry. From An Economic Perspective, Currently, Many People Are Using Rosella Flowers, Starting From Making Them Into Tea Drinks, And Syrups, Processing The Seeds Into Coffee, Jelly, And Extracting Them Into Additional Food Ingredients, Flour And Cosmetic Ingredients. The Many Benefits Of Rosella For Health Increase The Potential Of Processed Rosella, Making The Economic Value Of Rosella Increase In Cultivation Among The Community In Growing Rosella. (16,34,35)

### **Nutritional Content Of Rosella**

Other Ingredients In Rosella Flowers Are Protein, Vitamin A, And Other Elements Needed By The Body. Important Ingredients Such As Flavonoids Which Consist Of Flavanols And Anthocyanin Pigments Are Natural Coloring Substances From Plants. In 100 G Dried Herbal Rosella Flower Petals Contain: 9.2 G Water, 1.145 G Protein, 2.61 Fat, 12.0 G Fibre, 6.90 G Ash, 1.263 G Calcium, 273.2 Mg Phosphorus, 8.98 Mg Iron, 0.029 Mg Carotene, 0.12 Mg Thiamine, 6.7 Mg Ascorbic Acid. Rosella Is Rich In Anthocyanins And Protocatechuic Acid. (14,17,32) Dried Petals Contain Flavonoid *Gossypetine*, *Hibiscetine* And *sabdariffetine*. The Main Pigment, Previously Reported As Hibiscine Has Been Identified As Daphniphline. A Small Number *Myrtillin (Delphinidin 3-Monoglucoside)*, *Chrysanthenin (Cyanidin 3-Monoglucoside)* And *delphinidine*. (17,35,36) Roselle Seeds Are A Good Source Of Lipidolubricant Antioxidants, Especially Tocopherol. 100g Of Fresh Rosella Leaves Contain 3.3-3.5g/100g Of Protein, And Amino Acids In The Form Of Phenylalanine, Glutamic Acid, Lysine Leucine And Arginine.

Leaves With Red Petals Have A Higher Protein Content Than Leaves With Yellow Petals. (31,37).

Rosella Flower Seeds Contain Protein And Essential Amino Acids, Compared To Pea Seeds, Cowpeas, Black Seeds, Sunflower Seeds, Melon Seeds, Beans And Soybeans, Rosella Seeds Have A Higher Protein Content Of 32.8%-35. 4%. The Protein Content In Rosella Seeds Can Be Utilized By Fermentation Cooking. (25,38)(7) Rosella Petals Are The Part That Many People Use The Most. The Flower Petals That Are Ready To Be Harvested Are Red And When The Flowers Have Fallen Off They Can Be Harvested Within 10-15 Days So That The Petals Taste Sweet. Every 100g Of Rosella Flower Petals Contains 1.9g Of Protein, Vitamin C, Antioxidants, Vitamin B2, Calcium, And Iron. (7.39)

### **Antihypertensives And Diuretics**

This Rosella Plant Has Been Clinically Proven To Be Able To Reduce The Amount Of Plaque That Sticks To Blood Vessels, Not Only That, Rosella Also Has The Potential To Reduce Levels Of Bad Cholesterol Called LDL And Fat In The Body. This Shows That Rosella Is Also Useful For Reducing Blood Pressure In Sufferers (High Blood Pressure). Viewed From A Modern Medical Point Of View (Medicine), Consuming Processed Rosella Flower Petals Regularly Shows Equivalent Results To Modern (Pharmacological) Treatment For Several Diseases. Rosella Flower Petals Have Traditionally Been Used As An Antihypertensive Drug. (32,33) In Hypertensive Patients, It Was Concluded That In The Pre-Test And Post-Test Diastolic Blood Pressure, Namely "There Was A Difference In The Diastolic Pre-Test And Post-Test Of Administering Rosella Flower (*Hibiscus Sabdariffa*) Petal Extract To Reducing Blood Pressure Levels In Hypertensive Clients. (32)(40)

Complementary Therapy With Rosella Flower Extract Is An Alternative Therapy Related To Practices, Approaches, Knowledge And Beliefs That Combine Plants And Minerals As The Basis Of Treatment. The Properties Of Rosella *Hibiscus Sabdariffa* Flowers Are Rich In Vitamin C Which Functions As An Antioxidant To Ward Off Free Radicals. Free Radicals Trigger Degenerative Diseases. The Most Important Ingredients In Rosella Flowers (*Hibiscus Sabdariffa* Linn) Include Gassypetin, Anthocyanin, And Glucoside Hibiscin. (6) These Substances Are Believed To Be Diuretics, Reducing Blood Viscosity, Lowering Blood Pressure And Stimulating Bowel Movements, Providing The Antihypertensive Effect Of Anthocyanins Through Inhibition Of Angiotensin-Converting Enzyme II (ACE) And Therefore A Vasodilating Effect. The Mechanism Of Action Of Flavonoids As Vasodilators Is The Role Of Smooth Muscles And Blood Vessels.

Flavanoids Work Directly On Arterial Smooth Muscle By Stimulating Or Activating Endothelium-Derived Relaxing Factor (EDRF), Causing Vasodilation. (20,32,33) Anthocyanins Can Reduce Blood Pressure Through The Mechanism Of Maintaining Endothelial Function By Increasing Nitric Oxide Synthase (NOS) Because Anthocyanins Can Act As Antioxidants So They Can Overcome Oxidative Stress. This Substance Functions As A Diuretic, Reducing Blood Viscosity, Lowering Blood Pressure, And Stimulating Bowel Movements. So The Anthocyanin Compounds Found In Many Dried Rosella Flower Petals Have An Antihypertensive Effect.

### **Antioxidants And Anticancer**

Antioxidants Are Compounds That Have The Ability To React With Free Radicals To Produce Stable Free Radicals By Accepting Or Donating Electrons. Most Antioxidant Substances Are Found In Herbal Plants. Rosella Is A Source Of Vitamins, Minerals, And

Antioxidant Components Such As Organic Acids, Phytosterols, Polyphenols Found In Flower Petals, And Anthocyanin Pigments Belonging To The Flavonoid Group. The Antioxidant Test Carried Out Showed That Extraction Of *Hibiscus Sabdariffa L* Within 40 Minutes And 60 Minutes Resulted In An Overall Antioxidant Content Of 74.58%. (20) (22,41) The Antioxidant Content In Each Species Of This Plant Varies Depending On The Planting Method, Soil, And The Length Of The Extraction Process Carried Out. Phenolics Are Most Abundant In Flower Petals And Are Highest In Dark Red Rosella Types Compared To White Petals.

Polyphenols	13.019 Mg GAE/G
Flavonoids	4,981 CE/G Dw
Anthocyanins	1.855 Mg Cya3GE/G Dw
Tannins	0.745 CE/G Dw

High Levels Of Antioxidants Such As Polyphenols, Flavonoids, And Anthocyanins (Delphinidin 3-O-Sambubioside And Cyanidin 3-O-Sambubioside) Increase Performance As Anti-Free Radicals In The Body, Increase Body Metabolism, With A Total Rosella Antioxidant Content Of 51%. In Mouse Tests, Hibiscus Extraction Was Able To Protect DNA Cells, By Detecting Damaged DNA Cells And Reducing Cytotoxicity Induced By Tertbutyl Hydroperoxide, And Damage To Liver Cells. Further Research Regarding The Benefits Of Hibiscus Sabdariffa Has Been Carried Out Previously. (42)(2,3)

Giving *Hibiscus Sabdariffa L* Extraction Was Able To Inhibit The Viability Of Breast Cancer Cells, As An Antitumor Using The Ethylacetate Fraction Of Hibiscus Sabdariffa (Hsef) On Both Breast Cancer Cells: MCF-7 And MDA-MB-231 Cells. It Is Found That MCF-7 Cells As Estrogen And Progesterone Receptors Are Positive And Less Aggressive. Meanwhile, MDA-MB-231 Cells Are Triple-Negative And Show Highly Aggressive Properties, Which Significantly Shows That Hibiscus Sabdariffa Extraction Can Inhibit Cancer Cell Duplication And Slow Tumour Cell Proliferation So That Tumour Cell Development Is Reduced. (21,28)

### **Anti Diabetes**

The Niacin Content In Rosella Flower Petals Can Increase HDL Levels By Suppressing Hepatic Changes In Apo-A1 And Suppressing The Removal Of Apo-A1 By The Liver. This Will Increase The Level Of Apo-A1 As A Precursor For Forming HDL. As Is Known, Apo-A1 Is An Apolipoprotein Compound That Participates In Forming Pre-B HDL Which Is Then Converted Into A-HDL Through The Esterification Process Of Free Cholesterol Into Cholesterol Ester With The Help Of The Enzyme Lecithin-Cholesterol Acyltransferase. This Fact Proves That The Increase In HDL Levels From The Ethanolic Extract Of Rosella Flower Petals At A Dose Of 75.6 Mg/Kg BW Equals The Effect Of Gemfibrozil In Increasing HDL Levels Which Has Been Clinically Proven. (22,23,33)

The Optimum (Most Effective) Dose Of Administering Ethanolic Extract Of Rosella Flower Petals Which Can Increase HDL Levels Is A Dose Of 75.6 Mg/Kgbw With A Percentage Increase In HDL Levels Of 29.87%. Consuming Foods Rich In Polyphenols Found In Rosella Shows That There Is A Significant Reduction In LDL Levels, Total Cholesterol Fat, And Triglycerides, And Increases HDL Cholesterol. Reducing LDL/HDL Cholesterol Levels And The Atherogenic Index When Administering Rosella Extract Can Reduce The Risk Of Cardiovascular Disease. (23.31)

### **Anti-Anemia**

High Mineral Content In The Form Of Fe And Vitamin C Compared To Several Other Plants Such As Oranges, Kiwi And Apples. It Turns Out That 100 Grams Of Petals Contain 8.98 Mg Of Iron And 244.4 Mg Of Vitamin C. Vitamin C, Which Plays A Role In The Iron Absorption Process, Helps The Absorption Of Non-Heme Iron By Reducing Ferric Iron To Ferrous Iron In The Small Intestine So That It Is Easily Absorbed. (16,41). The Process Of Absorbing Ferric Iron (Fe<sup>3+</sup>) Into Ferro (Fe<sup>2+</sup>) Increases Iron Absorption By Up To 30%. Vitamin C Also Plays A Role In The Transfer Of Iron From Transferrin In Plasma To Liver Ferritin. (43)

Research Conducted On Groups Of Women And Children Showed An Increase In Iron By Providing Food Fortification Made From Hibiscus Sabdariffa Flour, As Well As An Increase In Nutritional Status, Especially In The Case Of Stunting. In Ghana. This Study Concluded That There Was An Increase In Haemoglobin Levels And Nutritional Status By 5.1% In The Intervention Group Of Women And Children By Administering Hibiscus Sabdariffa, Which Shows The Potential Benefits Of The Rosella Plant In Treating Anaemia. (44,45) Other Clinical Trials Were Also Carried Out By Administering It. Rosella Tea In The Group Of Pregnant Women, It Was Found That There Was An Increase In Haemoglobin Levels Of 1.11 Gr/Dl In The Intervention Group Given Rosella Tea And Fe Tablets. (46,47)

### **CONCLUSION**

*Hibiscus Sabdariffa L* Also Called Rosella Has Many Benefits That Have Been Widely Researched Long Ago, And Its Use As A Herbal Medicine Is Well Known To The Public Through Traditional Processing, In The Form Of Tea, Syrup, Wine, Juice, Jelly, Flour, Extraction, Food Colouring, Cosmetic Ingredients. With This Very Potential Nutritional Content, It Is Used As A Therapy As An Antioxidant, Anti-Hypertension, Anti-Cancerous, Anti-Tumor, Anti-Inflammatory, Anti-Diabetic, Anti-Microbial, Anti-Anemic, And Others. The Main Content Of Antioxidants Such As Flavonoids, Vitamin C And Organic Amino Acids Makes The Potential For Developing Medicines Made From Hibiscus Sabdariffa Increasingly Attractive To The Industrial World In All Countries Through The Development Of Research And Production Of Rosella, Thus Increasing The Potential Economic Value Of Rosella.

### **REFERENCES**

- Mariod Adam Abdalbasit, Tahir Elrasheid Haroon, Mahunu Komla Gustav. Roselle (Hibiscus Sabdariffa) [Internet]. 1st Ed. Zahir Mona, Editor. Vol. 1. United Kingdom: Mikki Levy; 2021 [Cited 2023 Aug 13]. 1-274 P. Available From: <https://www.elsevier.com/books-and-journals/publisher:nikki-levy/acquisitions> Editor:Megan Balleeditorial Project Manager:Mona Zahirproduction Project Manager:Kumar Anbazhagancover Designer:Christian J. Bilbowtypeset By MPS Limited, Chennai, India
- Riaz G, Chopra R. A Review On Phytochemistry And Therapeutic Uses Of *Hibiscus Sabdariffa L*. Vol. 102, Biomedicine And Pharmacotherapy. Elsevier Masson SAS; 2018. P. 575-86.
- Aumeeruddy MZ, Mahomoodally MF. Traditional Herbal Medicines Used In Obesity Management: A Systematic Review Of Ethnomedicinal Surveys. J Herb Med. 2021 Aug 1;28.
- Yusni Y, Meutia F. Action Mechanism Of Rosella (*Hibiscus Sabdariffa L*.) Used To Treat

- Metabolic Syndrome In Elderly Women. Evidence-Based Complement Altern Med. 2020;2020.
- Jabeur I, Pereira E, Barros L, Calhelha RC, Soković M, Oliveira MBPP, Et Al. *Hibiscus Sabdariffa L.* As A Source Of Nutrients, Bioactive Compounds And Colouring Agents. Food Res Int. 2017 Oct 1;100:717–23.
- Ali BH, Al Wabel N, Blunden G. Phytochemical, Pharmacological And Toxicological Aspects Of *Hibiscus Sabdariffa L.*: A Review. Vol. 19, Phytotherapy Research. 2005. P. 369–75.
- Salami SO, Afolayan AJ. Evaluation Of Nutritional And Elemental Compositions Of Green And Red Cultivars Of Roselle: *Hibiscus Sabdariffa L.* Sci Rep. 2021 Dec 1;11(1).
- Falade OS, Otemuyiwa IO, Oladipo A, Oyedapo OO, Akinpelu BA, Adewusi SRA. The Chemical Composition And Membrane Stability Activity Of Some Herbs Used In Local Therapy For Anemia. J Ethnopharmacol. 2005 Oct 31;102(1):15–22.
- Aryati Luwih Devy, Rohadi, Pratiwi Ery. Aktivitas Antioksidan Ekstrak Kelompok Bunga Rosella (*H.Sabdariffa L.*) Merah Pada Berbagai Suhu Pemanasan. Hurnal Teknol Pangan Dan Has Pertan [Internet]. 2020;1–9. Available From: [Http://journals.usm.ac.id/index.php/jtphp](http://journals.usm.ac.id/index.php/jtphp)
- Beltrán-Debón R, Alonso-Villaverde C, Aragonès G, Rodríguez-Medina I, Rull A, Micol V, Et Al. The Aqueous Extract Of *Hibiscus Sabdariffa* Calices Modulates The Production Of Monocyte Chemoattractant Protein-1 In Humans. Phytomedicine. 2010;17(3–4):186–91.
- Efosa JO, Omega K, Azeke MA. *Hibiscus Sabdariffa* Calyx Protects Against Oxidative Stress And Aluminium Chloride-Induced Neurotoxicity In The Brain Of Experimental Rats. Toxicol Reports [Internet]. 2023;10(January):469–80. Available From: <https://doi.org/10.1016/j.toxrep.2023.04.008>
- Fahroji, Linda Eka Oni. Aneka Olahsan Rosella. Balai Penelit Dan Pengemb Pertan Dep Pertan. 2009;
- Herrera-Arellano A, Miranda-Sánchez J, Vila-Castro P, Herrera-Lvarez S, Enrique Jimenez-Ferrer J, Zamilpa A, Et Al. Clinical Effects Produced By A Standardized Herbal Medicinal Product Of *Hibiscus Sabdariffa* On Patients With Hypertension. A Randomized, Double-Blind, Lisinopril-Controlled Clinical Trial. J Plantamedica [Internet]. 2007;6–12. Available From: [Http://www.thieme-connect.de/ejournals/toc/plantamedica](http://www.thieme-connect.de/ejournals/toc/plantamedica)
- Debelo H, Fiecke C, Terekhov A, Reuhs B, Hamaker B, Ferruzzi MG. Compositional Analysis Of Phytochemicals And Polysaccharides From Senegalese Plant Ingredients: *Adansonia Digitata* (Baobab), *Moringa Oleifera* (Moringa) And *Hibiscus Sabdariffa* (*Hibiscus*). NFS J. 2023;32(March):100144.
- Kruger J, Taylor JRN, Ferruzzi MG, Debelo H. What Is Food-To-Food Fortification? A Working Definition And Framework For Evaluation Of Efficiency And Implementation Of Best Practices. Compr Rev Food Sci Food Saf. 2020;19(6):3618–58.
- Onyeukwu OB, Dibia DC, Njideaka OT. *Hibiscus Sabdariffa* - Uses, Nutritional And Therapeutic Benefits - A Review. J Biosci Biotechnol Discov. 2023;8(2):18–23.
- Pheumphong S, Roschat W, Namwongsa K, Wonam A, Kaisri T, Duangpakdee P, Et Al. Evaluation Of The Nutritional, Minerals, And Antioxidant Potential Of Roselle (*Hibiscus Sabdariffa* Linn.) Seeds From Roi Et Province In The Northeastern Region Of Thailand. Trends Sci. 2023;20(6).

- Sari DM, Asngad A. KANDUNGAN VITAMIN C DAN SIFAT ORGANOLEPTIK PADA SELAI KULIT PISANG AMBON DENGAN PENAMBAHAN BUAH KERSEN DAN BUNGA ROSELLA. *Progr Stud Pendidik Biol.* 2015;
- Agunbiade HO, Fagbemi TN, Aderinola TA. Antioxidant Properties Of Beverages From Graded Mixture Of Green/Roasted Coffee And Hibiscus Sabdariffa Calyx Flours. *Appl Food Res* [Internet]. 2022;2(2):100163. Available From: <https://doi.org/10.1016/j.afres.2022.100163>
- Wang C, Karmakar B, Awwad NS, Ibrahim HA, El-Kott AF, Abdel-Daim MM, Et Al. Bio-Supported Of Cu Nanoparticles On The Surface Of Fe<sub>3</sub>O<sub>4</sub> Magnetic Nanoparticles Mediated By Hibiscus Sabdariffa Extract: Evaluation Of Its Catalytic Activity For Synthesis Of Pyrano[3,2-C]Chromenes And Study Of Its Anti-Colon Cancer Properties. *Arab J Chem* [Internet]. 2022;15(6):103809. Available From: <https://doi.org/10.1016/j.arabjc.2022.103809>
- Ajiboye BO, Akinnusi PA, Fatoki TH, Adigun DK, Adewole ZO, Efekemo EO, Et Al. In Silico Assessment Of Hibiscus Sabdariffa As A Possible Therapeutic Agent For Breast Cancer Management. *Informatics Med Unlocked* [Internet]. 2023;41:101330. Available From: <https://doi.org/10.1016/j.imu.2023.101330>
- Sayed Mostafa H. Production Of Low-Tannin Hibiscus Sabdariffa Tea Through D-Optimal Design Optimization Of The Preparation Conditions And The Catalytic Action Of New Tannase. *Food Chem X* [Internet]. 2023;17(June 2022):100562. Available From: <https://doi.org/10.1016/j.fochx.2023.100562>
- Najafpour Boushehri S, Karimbeiki R, Ghasempour S, Ghalishourani SS, Pourmasoumi M, Hadi A, Et Al. The Efficacy Of Sour Tea (*Hibiscus Sabdariffa L.*) On Selected Cardiovascular Disease Risk Factors: A Systematic Review And Meta-Analysis Of Randomized Clinical Trials. *Phyther Res.* 2020;34(2):329–39.
- Ngoc Nhon HT, Diem My NT, Tuong Vi VN, Kim Lien PT, Thao Minh NT, Doan Duy LN, Et Al. Enhancement Of Extraction Effectiveness And Stability Of Anthocyanin From *Hibiscus Sabdariffa L.* *J Agric Food Res* [Internet]. 2022;10(October):100408. Available From: <https://doi.org/10.1016/j.jafr.2022.100408>
- Bankole DT, Oluyori AP, Inyinbor AA. Acid-Activated Hibiscus Sabdariffa Seed Pods Biochar For The Adsorption Of Chloroquine Phosphate: Prediction Of Adsorption Efficiency Via Machine Learning Approach. *South African J Chem Eng* [Internet]. 2022;42(June):162–75. Available From: <https://doi.org/10.1016/j.sajce.2022.08.012>
- Kristianingsih Ida, Marhenta Bhakti Yogi. Pemanfaatan Rosela Merah Untuk Minuman Tradisional Teh Yang Bermanfaat Untuk Kesehatan. In: *Prosiding Seminar Pengabdian Masyarakat 2017*. Kediri: Institut Ilmu Kesehatan Bhakti Wiyata Kediri; 2017. P. 1–4.
- Ellis LR, Zulfiqar S, Holmes M, Marshall L, Dye L, Boesch C. A Systematic Review And Meta-Analysis Of The Effects Of Hibiscus Sabdariffa On Blood Pressure And Cardiometabolic Markers. Vol. 80, *Nutrition Reviews*. Oxford University Press; 2022. P. 1723–37.
- Malacrida A, Erriquez J, Hashemi M, Rodriguez-Menendez V, Casseti A, Cavaletti G, Et Al. Evaluation Of Antitumoral Effect Of Hibiscus Sabdariffa Extract On Human Breast Cancer Cells. *Biochem Biophys Reports* [Internet]. 2022;32(April):101353. Available From: <https://doi.org/10.1016/j.bbrep.2022.101353>
- Dwiki, Nur Y, Fadraersada J. Profil Stabilitas Ekstrak Bunga Rosella (*Hibiscus*

- Sabdariffa) Sebagai Kandidat Pewarna Lipstik. Proceeding Mulawarman Pharm Conf. 2018 Dec 31;8:200–6.
- Da-Costa-Rocha I, Bonnlaender B, Sievers H, Pischel I, Heinrich M. *Hibiscus Sabdariffa L.* - A Phytochemical And Pharmacological Review. Vol. 165, Food Chemistry. Elsevier Ltd; 2014. P. 424–43.
- Raghu K, Naidoo Y, Dewir YH. Secretory Structures In The Leaves Of *Hibiscus Sabdariffa L.* South African J Bot [Internet]. 2019;121:16–25. Available From: <https://doi.org/10.1016/j.sajb.2018.08.018>
- Sapian S, Ibrahim Mze AA, Jubaidi FF, Mohd Nor NA, Taib IS, Abd Hamid Z, Et Al. Therapeutic Potential Of *Hibiscus Sabdariffa Linn.* In Attenuating Cardiovascular Risk Factors. Pharmaceuticals [Internet]. 2023;16(6):807. Available From: <https://www.mdpi.com/1424-8247/16/6/807>
- Da-Costa-Rocha I, Bonnlaender B, Sievers H, Pischel I, Heinrich M. *Hibiscus Sabdariffa L.* - A Phytochemical And Pharmacological Review. Food Chem [Internet]. 2014;165:424–43. Available From: <http://dx.doi.org/10.1016/j.foodchem.2014.05.002>
- Gómez-Aldapa CA, Rangel-Vargas E, Refugio Torres-Vitela MA, Villarruel-López A, Acevedo-Sandoval OA, Gordillo-Martínez AJ, Et Al. Antibacterial Activities Of *Hibiscus Sabdariffa* Extracts And Chemical Sanitizers Directly On Green Leaves Contaminated With Foodborne Pathogens. J Food Prot. 2018;81(2):209–17.
- Rangel-Vargas E, Luna-Rojo AM, Cadena-Ramírez A, Torres-Vitela MR, Gómez-Aldapa CA, Villarruel-López A, Et Al. Behavior Of 11 Foodborne Bacteria On Whole And Cut Mangoes Var. Ataulfo And Kent And Antibacterial Activities Of *Hibiscus Sabdariffa* Extracts And Chemical Sanitizers Directly Onto Mangoes Contaminated With Foodborne Bacteria. J Food Prot. 2018;81(5):743–53.
- Abdou NM, El-Saadony FMA, Roby MHH, Mahdy HAA, El-Shehawi AM, Elseehy MM, Et Al. Foliar Spray Of Potassium Silicate, Aloe Extract Composite And Their Effect On Growth And Yielding Capacity Of Roselle (*Hibiscus Sabdariffa L.*) Under Water Deficit Stress Conditions. Saudi J Biol Sci [Internet]. 2022;(Xxxx). Available From: <https://doi.org/10.1016/j.sjbs.2022.02.033>
- Carla Guimarães Sobrinho A, Silva Corpes R, Isabel Portilho Dos Santos K, Maria Menezes Barra I, Kiyoshi Miyagawa H, Silva Santos A. Untargeted GC-MS Metabolomics Applied To Wild Leaves And Callus Produced By Plant Tissue Culture Of *Hibiscus Sabdariffa L.* Arab J Chem. 2022;15(9).
- Ghosh P, Priyadarshini S, Munshi M, Beula P, Atthoti L, Kruthi GS, Et Al. Physicochemical Characterization And Mass Modelling Of Roselle (*Hibiscus Sabdariffa L.*) Calyx And Seeds. Food Chem Adv [Internet]. 2023;3(February):100400. Available From: <https://doi.org/10.1016/j.focha.2023.100400>
- Pozos GIP, Ruiz-López MA, Nátera JFZ, Moya CÁ, Ramírez LB, Silva MR, Et Al. Antioxidant Capacity And Antigenotoxic Effect Of *Hibiscus Sabdariffa L.* Extracts Obtained With Ultrasound-Assisted Extraction Process. Appl Sci. 2020 Jan 1;10(2).
- Mckay DL, Chen CYO, Saltzman E, Blumberg JB. *Hibiscus Sabdariffa L.* Tea (Tisane) Lowers Blood Pressure In Prehypertensive And Mildly Hypertensive Adults. J Nutr. 2010;140(2):298–303.
- Oladejo AO, Nkem OM, Alonge AF, Akpan MG, Etti CJ, Okoko JU, Et Al. Influence Of Ultrasound-Pretreated Convective Drying Of Roselle (*Hibiscus Sabdariffa L.*)

- Leaves On Its Drying Kinetics And Nutritional Quality. *Sci African*. 2023;20:1–11.
- Sawyer SM, Azzopardi PS, Wickremarathne D, Patton GC. *The Age Of Adolescence*. Vol. 2, *The Lancet Child And Adolescent Health*. Elsevier B.V.; 2018. P. 223–8.
- Lestari EDP, Widyarti S, Sumitro SB. Determination Of Herbal Combinations Based On Mucoadhesive Properties. *IOP Conf Ser Earth Environ Sci*. 2022;1097(1).
- Kubuga CK, Hong HG, Song WO. Hibiscus Sabdariffa Meal Improves Iron Status Of Childbearing Age Women And Prevents Stunting In Their Toddlers In Northern Ghana. *Nutrients*. 2019 Jan 1;11(1).
- Doom JR, Gahagan S, Caballero G, Encina P, Lozoff B. Infant Iron Deficiency, Iron Supplementation, And Psychosocial Stress As Predictors Of Neurocognitive Development In Chilean Adolescents. *Nutr Neurosci*. 2021;24(7):520–9.
- Darma Sari S, Soleha M, Rahmadaniah I, Abdurahman Palembang S. Efektivitas Seduhan Teh Rosella Kering Terhadap Peningkatan Kadar Hemoglobin Pada Ibu Hamil. 2021; Available From: <https://journal.budimulia.ac.id/>
- Wulandari R. Meningkatkan Hemoglobin Pada Ibu Hamil Trimester III Dengan Rebusan Bunga Rosella. *J Bidan Cerdas*. 2020 Sep 5;2(3):163–9.