

LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU PEER REVIEW
KARYA ILMIAH: JURNAL ILMIAH

Judul Jurnal Ilmiah (Artikel) : Physicochemical Properties of Sago Ozone Oxidation: The Effect of Reaction Time, Acidity, and Concentration of Starch

Jumlah Penulis : 6 orang

Status Pengusul : Penulis pertama/penulis ke-3/ penulis korespondensi

Identitas Jurnal Ilmiah :

- a. Nama Jurnal : Foods
- b. Nomor ISSN : 2304-8158
- c. Volume, nomor, bulan, tahun : Vol. 10, No. 6, Juni 2021
- d. Penerbit : Multidisciplinary Digital Publishing Institute (MDPI)
- e. DOI Artikel : 10.3390/foods10061309
- f. Alamat web Jurnal : <https://www.mdpi.com/journal/foods>
- Alamat artikel : <https://www.mdpi.com/2304-8158/10/6/1309>
- g. Terindeks : SCOPUS (Q1: Food Science), SJR=0,77 (2020)

Kategori Publikasi Jurnal Ilmiah (Beri ✓ pada kategori yang tepat)

☒	Jurnal Ilmiah Internasional
☐	Jurnal Ilmiah Nasional Terakreditasi
☐	Jurnal Ilmiah Nasional Tidak Terakreditasi

Hasil Penilaian *Peer Review*

Komponen yang dinilai	Nilai Reviewer		Nilai Rata-rata
	Reviewer I	Reviewer II	
a. Kelengkapan unsur isi jurnal (10%)	4,00	4,00	4,00
b. Ruang lingkup dan kedalaman pembahasan (30%)	12,00	11,00	11,50
c. Kecukupan dan kemitakhiran data/ informasi dan metodologi (30%)	11,00	11,00	11,00
d. Kelengkapan unsur dan kualitas terbitan/ jurnal (30%)	9,00	9,00	9,00
Total = (100%)	36,00	35,00	35,50
Nilai Pengusul (60% x nilai total)	21,60	21,00	21,30

Reviewer II



Prof. Nita Aryanti, ST, MT, PhD
 NIP. 197501172000032001
 Unit Kerja : Departemen Teknik Kimia FT Undip

Semarang, 10 Agustus 2021

Reviewer I



Prof. Dr. Mohamad Djaeni, ST, M,Eng
 NIP. 197102071995121001
 Unit Kerja : Departemen Teknik Kimia FT Undip

LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU PEER REVIEW
KARYA ILMIAH: JURNAL ILMIAH

Judul Jurnal Ilmiah (Artikel) : Physicochemical Properties of Sago Ozone Oxidation: The Effect of Reaction Time, Acidity, and Concentration of Starch

Jumlah Penulis : 6 orang

Status Pengusul : Penulis pertama/penulis ke-3/ penulis korespondensi

Identitas Jurnal Ilmiah :

- a. Nama Jurnal : Foods
- b. Nomor ISSN : 2304-8158
- c. Volume, nomor, bulan, tahun : Vol. 10, No. 6, Juni 2021
- d. Penerbit : Multidisciplinary Digital Publishing Institute (MDPI)
- e. DOI Artikel : 10.3390/foods10061309
- f. Alamat web Jurnal : <https://www.mdpi.com/journal/foods>
- Alamat artikel : <https://www.mdpi.com/2304-8158/10/6/1309>
- g. Terindeks : SCOPUS (Q1: Food Science), SJR=0,77 (2020)

Kategori Publikasi Jurnal Ilmiah (Beri ✓ pada kategori yang tepat)

☒	Jurnal Ilmiah Internasional
☐	Jurnal Ilmiah Nasional Terakreditasi
☐	Jurnal Ilmiah Nasional Tidak Terakreditasi

Hasil Penilaian Peer Review

Komponen yang dinilai	Nilai Maksimal Jurnal Ilmiah			Nilai Akhir yang diperoleh
	Internasional 40	Nasional Terakreditasi	Nasional Tidak Terakreditasi	
a. Kelengkapan unsur isi Jurnal (10%)	4,00			4,00
b. Ruang lingkup dan kedalaman pembahasan (30%)	12,00			12,00
c. Kecukupan dan kemutakhiran data/informasi dan metodologi (30%)	12,00			11,00
d. Kelengkapan unsur dan kualitas terbitan/ jurnal (30%)	12,00			9,00
Total = (100%)	40,00			36,00
Nilai pengusul = 60% x 36,00 = 21,60				

Catatan penilaian artikel oleh Reviewer:

1. Kesesuaian dan kelengkapan unsur isi jurnal:

Artikel ini dipublikasikan lengkap dengan bagian terdiri dari: Judul, Abstrak, Pendahuluan, Bahan dan Metode, Hasil, Pembahasan, Kesimpulan, Ucapan Terima Kasih, dan Daftar Pustaka. Artikel ditulis sesuai dengan petunjuk penulisan Jurnal. Substansi artikel sesuai dengan bidang ilmu Teknik Kimia.

2. Ruang lingkup dan kedalaman pembahasan:

Substansi artikel sesuai dengan bidang ilmu pengusul, yaitu Teknik Kimia. Kebaruan artikel ini membahas secara komprehensif mengenai pengaruh waktu reaksi, pH, dan konsentrasi pati terhadap perubahan sifat psikokimia pati sago. Hasil dibahas dengan cukup detail dalam bentuk 15 grafik dan 1 tabel disertai referensi yang memadai dalam hasil dan pembahasan sebanyak 44 dari 66 referensi yang digunakan (66,67%). Data-data juga cukup detail dari morfologi sampai molecular. Kesimpulan yang dihasilkan sangat signifikan untuk pengembangan bidang terkait.

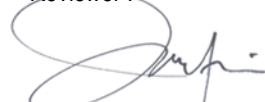
3. Kecukupan dan kemutakhiran data/informasi dan metodologi:

Kemutakhiran data didukung referensi yaitu 10 tahun terakhir sebanyak 46 artikel dari 66 artikel yang disitasi, atau 71 %. Metode penelitian dituliskan cukup komprehensif dan memenuhi standar penulisan yang dipersyaratkan dalam jurnal tersebut. Penyajian data cukup lengkap didukung oleh uji karakteristik produk (SEM, FTIR, XRD).

4. Kelengkapan unsur dan kualitas terbitan:

Artikel ini dipublikasikan dalam Foods terbitan Multidisciplinary Digital Publishing Institute (MDPI), termasuk dalam jurnal terindeks SCOPUS Q1, SJR = 0,77 (2020), H index=38, dan Impact Factor 4,350 (2020), namun kualitas penerbit cukup baik dengan 12 issue tiap tahun dan 287 artikel tiap issue. Artikel memiliki similaritas turnitin 15 %. Jurnal terindeks di Scopus (Elsevier), Scimagojr/SCIE-Science Citation Index Expanded (Clarivate Analytics/ Thomson Reuters).

Semarang,
 Reviewer I



Prof. Dr. Mohamad Djaeni, ST, M,Eng
 NIP. 197102071995121001
 Unit Kerja : Departemen Teknik Kimia FT Undip

LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU PEER REVIEW
KARYA ILMIAH: JURNAL ILMIAH

Judul Jurnal Ilmiah (Artikel) : Physicochemical Properties of Sago Ozone Oxidation: The Effect of Reaction Time, Acidity, and Concentration of Starch

Jumlah Penulis : 6 orang

Status Pengusul : Penulis pertama/penulis ke-3/ penulis korespondensi

Identitas Jurnal Ilmiah :

- a. Nama Jurnal : Foods
- b. Nomor ISSN : 2304-8158
- c. Volume, nomor, bulan, tahun : Vol. 10, No. 6, Juni 2021
- d. Penerbit : Multidisciplinary Digital Publishing Institute (MDPI)
- e. DOI Artikel : 10.3390/foods10061309
- f. Alamat web Jurnal : <https://www.mdpi.com/journal/foods>
- Alamat artikel : <https://www.mdpi.com/2304-8158/10/6/1309>
- g. Terindeks : SCOPUS (Q1: Food Science), SJR=0,77 (2020)

Kategori Publikasi Jurnal Ilmiah (Beri ✓ pada kategori yang tepat)

☒	Jurnal Ilmiah Internasional
☐	Jurnal Ilmiah Nasional Terakreditasi
☐	Jurnal Ilmiah Nasional Tidak Terakreditasi

Hasil Penilaian Peer Review

Komponen yang dinilai	Nilai Maksimal Jurnal Ilmiah			Nilai Akhir yang diperoleh
	Internasional	Nasional Terakreditasi	Nasional Tidak Terakreditasi	
	40			
a. Kelengkapan unsur isi Jurnal (10%)	4,00			4,00
b. Ruang lingkup dan kedalaman pembahasan (30%)	12,00			11,00
c. Kecukupan dan kemutakhiran data/informasi dan metodologi (30%)	12,00			11,00
d. Kelengkapan unsur dan kualitas terbitan/ jurnal (30%)	12,00			9,00
Total = (100%)	40,00			35,00
Nilai pengusul = 60% x 35,00 = 21,00				

Catatan penilaian artikel oleh Reviewer:

1. Kesesuaian dan kelengkapan unsur isi jurnal:

Kesesuaian dan unsur isi artikel lengkap sesuai dengan bidang ilmu Teknik Kimia. Artikel ditulis sesuai dengan panduan penulisan jurnal yang tersaji dengan baik, terdiri dari judul, abstrak, pendahuluan, bahan dan metode, hasil, pembahasan, kesimpulan, ucapan terima kasih serta daftar pustaka.

2. Ruang lingkup dan kedalaman pembahasan:

Ruang lingkup artikel mengkaji secara komprehensif pengaruh waktu reaksi, pH, dan konsentrasi pati terhadap perubahan sifat psikokimia pati sagu. Pati sagu termodifikasi menunjukkan hasil psikokimia yang lebih baik dibandingkan bentuk tepung aslinya. Dalam pembahasan digunakan 44 referensi dari total 66 (73,68%) dengan dilengkapi 15 grafik dan 1 tabel sehingga menunjukkan kedalaman pembahasan yang baik.

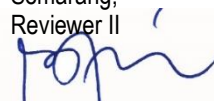
3. Kecukupan dan kemutakhiran data/infrmasi dan metodologi:

Penyajian metodologi dan data cukup lengkap dituliskan dalam beberapa sub bagian. Metodologi didukung oleh berbagai uji produk yang memadai (XRD, SEM, FTIR) dengan kemutakhiran artikel yang baik dibuktikan 47 referensi dalam 10 tahun terakhir dari 66 referensi yang digunakan atau (71%).

4. Kelengkapan unsur dan kualitas terbitan:

Jurnal Foods diterbitkan oleh Multidisciplinary Digital Publishing Institute (MDPI) dengan Impact Factor 4,350 (2020), termasuk dalam jurnal terindeks SCOPUS Q1 dengan SJR = 0,77 (2020), H index=38, kualitas terbitan cukup baik dengan 12 issue tiap tahun. Artikel memiliki similaritas turnitin 15 %. Pada vol. 10(6), 2021, penulis berasal dari banyak negara dengan distribusi : Spanyol, Cina, Itali, Amerika, Jerman, Korea, Inggris, Indonesia. Australia, dll.

Semarang,
Reviewer II



Prof. Nita Aryanti, ST, MT, PhD

NIP. 197501172000032001

Unit Kerja : Departemen Teknik Kimia FT Undip



1 of 1

[Export](#) [Download](#) [Print](#) [E-mail](#) [Save to PDF](#) [Save to list](#) [More... >](#)[View at Publisher](#)**Document type**

Article

Source type

Journal

ISSN

23048158

DOI

10.3390/foods10061309

[View more](#) [Foods](#) • [Open Access](#) • Volume 10, Issue 6 • June 2021 • Article number 1309

Physicochemical properties of sago ozone oxidation: The effect of reaction time, acidity, and concentration of starch

[Sumardiono S.^a](#) , [Cahyono H.^a](#) , [Jos B.^a](#) , [Pudjihastuti I.^b](#) , [Yafiz A.M.^a](#) ,[Rachmasari M.^a](#) [Save all to author list](#)^a Department of Chemical Engineering, Faculty of Engineering, Universitas Diponegoro, Semarang, 50239, Indonesia^b Department of Industrial Chemical Engineering, Vocational School, Universitas Diponegoro, Semarang, 50239, Indonesia[Abstract](#)[Author keywords](#)[Reaxys Chemistry database information](#)[SciVal Topics](#)[Metrics](#)[Funding details](#)

Cited by 0 documents

Inform me when this document is cited in Scopus:

[Set citation alert >](#)**Related documents**[Gaseous Ozonation at Low Concentration Modifies Functional, Pasting, and Thermal Properties of Arrowroot Starch \(Maranta arundinaceae\)](#)Handarini, K. , Hamdani, J.S. , Cahyana, Y.
(2020) *Starch/Staerke*[Hydrogels based on ozonated cassava starch: Effect of ozone processing and gelatinization conditions on enhancing 3D-printing applications](#)Maniglia, B.C. , Lima, D.C. , Matta Junior, M.D.
(2019) *International Journal of Biological Macromolecules*[Functional, thermal, and molecular properties of ozonated starches](#)Handarini, K. , Hamdani, J.S. , Cahyana, Y.
(2020) *IOP Conference Series: Earth and Environmental Science*[View all related documents based on references](#)[Find more related documents in Scopus based on:](#)[Authors >](#) [Keywords >](#)**Abstract**

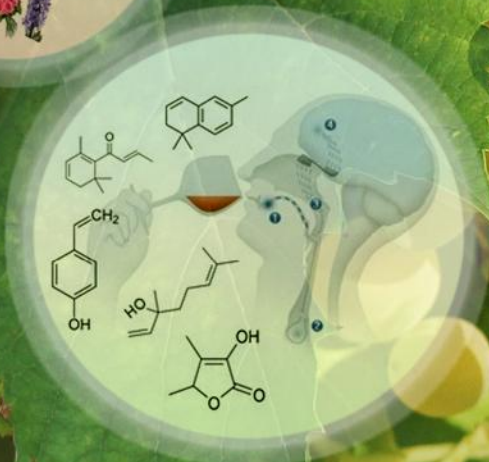
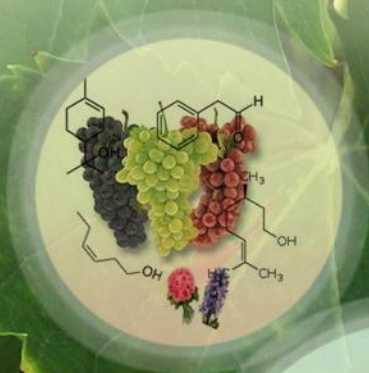
The disadvantageous properties of sago starch has limited its application in food and industrial processes. The properties of sago starch can be improved by changing its physicochemical and rheological characteristics. This study examined the influence of reaction time, acidity, and starch concentration on the oxidation of sago starch with ozone, a strong oxidant. Swelling, solubility, carbonyl, carboxyl, granule morphology, thermal profile, and functional groups are comprehensively observed parameters. With starch concentrations of 10–30% (v/w) and more prolonged oxidation, sago starch was most soluble at pH 10. The swelling power decreased with a longer reaction time, reaching the lowest pH 10. In contrast, the carbonyl and carboxyl content exhibited the same pattern as solubility. A more alkaline environment tended to create modified starch with more favorable properties. Over time, oxidation shows more significant characteristics, indicating a superb product of



foods

IMPACT
FACTOR
4.092

Indexed in:
PubMed



The Flavor Chemistry of Fortified Wines—A Comprehensive Approach

Volume 10 · Issue 6 | June 2021



mdpi.com/journal/foods
ISSN 2304-8158

25th Anniversary
Journals
Information
Author Services
Initiatives
About

Sign In / Sign Up
Submit

Search for Articles:

Title / Keyword
Author / Affiliation
Foods
All Article Types

Search
Advanced

Journals / Foods / Editorial Board

Submit to Foods
Review for Foods

Journal Menu

- Foods Home
- Aims & Scope
- Editorial Board
- Reviewer Board
- Topics Board
- Instructions for Authors
- Special Issues
- Sections & Collections
- Article Processing Charge
- Indexing & Archiving
- Editor's Choice Articles
- Most Cited & Viewed
- Journal Statistics
- Journal History
- Journal Awards
- Society Collaborations
- Conferences
- Editorial Office

Journal Browser

volumes
issues

Go

Forthcoming issue
Current issue

Vol. 10 (2021)
Vol. 5 (2016)
Vol. 9 (2020)
Vol. 4 (2015)
Vol. 8 (2019)
Vol. 3 (2014)
Vol. 7 (2018)
Vol. 2 (2013)
Vol. 6 (2017)
Vol. 1 (2012)

Editorial Board

- Editorial Board
- Food Physics and (Bio)Chemistry Section
- Food Engineering and Technology Section
- Food Quality and Safety Section
- Food Analytical Methods Section
- Food Microbiology Section
- Food Nutrition Section
- Nutraceuticals and Functional Foods Section
- Food Security and Sustainability Section
- Food Packaging and Preservation Section
- Sensory and Consumer Sciences Section
- Foodomics Section
- Food Toxicology Section
- Food Systems Section
- Food Biotechnology Section
- Meat Section
- Foods of Marine Origin Section
- Plant Foods Section
- Grain Section
- Dairy Section
- Beverages/Drinks Section

Editors (15)

Prof. Dr. Christopher John Smith
Editor-in-Chief
Visiting Professor, Faculty of Clinical Sciences and Nutrition, University of Chester, Chester, UK
Interests: immunoassays for food analysis; rheology; allergy; functional foods
Special Issues and Collections in MDPI journals

Prof. Dr. Katrina Campbell * Website SciProfiles
Section Editor-in-Chief
Institute for Global Food Security, Queen's University, Belfast, 19 Chlorine Gardens, Belfast BT9 5DL, UK
Interests: food safety; food security and sustainability; aquaculture; feed and food; natural toxins; drug residues; antibiotics; chemical contaminants; climate change; (bio) analytical chemistry; biosensors; diagnostics; immunoassays; mass spectrometry
* Section: Food Systems
Special Issues and Collections in MDPI journals

Prof. Dr. José Antonio Beltrán Gracia * Website SciProfiles
Section Editor-in-Chief
Department of Animal Production and Food Sciences, University of Zaragoza, Zaragoza, Spain
Interests: seafood; meat and fish; animal origin
* Section: Foods of Marine Origin

Prof. Dr. Juana Fernández-López * Website SciProfiles
Section Editor-in-Chief
AgroFood Technology Department, Escuela Politécnica Superior de Orihuela, Miguel Hernández University, Orihuela, Spain
Interests: functional foods; dietary fiber; natural inhibitors; antioxidants; healthier meat products; essential oils; in vitro digestion
* Section: Meat
Special Issues and Collections in MDPI journals

Prof. Dr. Theodoros Varzakas * Website SciProfiles
Section Editor-in-Chief
Department of Food Science and Technology, University of Peloponnese, Antikalamos 24100, Kalamata, Greece
Interests: food technology; food engineering; food safety; food quality; extra virgin olive oil; mycotoxins
* Section: Food Security and Sustainability
Special Issues and Collections in MDPI journals

Prof. Dr. Susana Casal * Website SciProfiles
Section Editor-in-Chief
REQUIMTE, Laboratory of Bromatology and Hydrology, Faculty of Pharmacy, University of Porto, Rua de Jorge Viterbo Ferreira, 228, 4050-313 Porto, Portugal
Interests: analytical methods; food lipids; food technology; food authenticity; food safety; food waste
* Section: Food Quality and Safety
Special Issues and Collections in MDPI journals

READ THE NEW BLOG POST
25 Ways to Improve Your Research Paper

<https://www.mdpi.com/2304-8158/10/6?listby=date&view=compact>

Foods, Volume 10, Issue 6 (June 2021) – 287 articles

Article

Physicochemical Properties of Sago Ozone Oxidation: The Effect of Reaction Time, Acidity, and Concentration of Starch

Siswo Sumardiono ^{1,*} , Bakti Jos ¹, Isti Pudjihastuti ², Arvin M. Yafiz ¹, Megaria Rachmasari ¹ and Heri Cahyono ¹ 

¹ Department of Chemical Engineering, Faculty of Engineering, Universitas Diponegoro, Semarang 50239, Indonesia; bakti.jos@che.undip.ac.id (B.J.); arvinmuhammadyafiz@gmail.com (A.M.Y.); rachmasarimegaria@gmail.com (M.R.); hericahyono@che.undip.ac.id (H.C.)

² Department of Industrial Chemical Engineering, Vocational School, Universitas Diponegoro, Semarang 50239, Indonesia; istipudjihastuti@gmail.com

* Correspondence: siswo.sumardiono@che.undip.ac.id; Tel.: +62-24-746-0058; Fax: +62-24-7648-0675

Abstract: The disadvantageous properties of sago starch has limited its application in food and industrial processes. The properties of sago starch can be improved by changing its physicochemical and rheological characteristics. This study examined the influence of reaction time, acidity, and starch concentration on the oxidation of sago starch with ozone, a strong oxidant. Swelling, solubility, carbonyl, carboxyl, granule morphology, thermal profile, and functional groups are comprehensively observed parameters. With starch concentrations of 10–30% (*v/w*) and more prolonged oxidation, sago starch was most soluble at pH 10. The swelling power decreased with a longer reaction time, reaching the lowest pH 10. In contrast, the carbonyl and carboxyl content exhibited the same pattern as solubility. A more alkaline environment tended to create modified starch with more favorable properties. Over time, oxidation shows more significant characteristics, indicating a superb product of this reaction. At the starch concentration of 20%, modified sago starch with the most favorable properties was created. When compared to modified starch, native starch is generally shaped in a more oval and irregular manner. Additionally, native starch and modified starch had similar spectral patterns and identical X-ray diffraction patterns. Meanwhile, oxidized starch had different gelatinization and retrogradation temperatures to those of the native starch.

Keywords: starch; oxidation; physicochemical properties



Citation: Sumardiono, S.; Jos, B.; Pudjihastuti, I.; Yafiz, A.M.; Rachmasari, M.; Cahyono, H. Physicochemical Properties of Sago Ozone Oxidation: The Effect of Reaction Time, Acidity, and Concentration of Starch. *Foods* **2021**, *10*, 1309. <https://doi.org/10.3390/foods10061309>

Academic Editor: Ramón F. Moreira

Received: 26 April 2021

Accepted: 4 June 2021

Published: 7 June 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Starch, which is mainly composed of carbohydrates, is an essential daily nutrient source. Starch can be produced from various plant parts, such as the seeds of corn, rice, wheat, tubers of cassava, yams, and potato, and the stem of sago palm [1]. Starch plays an essential role in the food industry, such as in the production of candy, glucose, dextrose, and fructose. Besides, it is widely used in other industries, such as textile, paper, glue, and sludge drilling [2–6]. There are two kinds of starch that are produced in agriculture: native and modified [7]. Various starch modifications have been carried out using various starch sources, one of which can be developed from sago.

The sago palm (*Metroxylone sagu* Rottb) grows well in Southeast Asia's tropical rain forests between 100 northern and southern latitudes [8,9]. Sago starch contains 73% amylopectin as the branched polymer and 27% amylose (the linear polymer) [10,11]. While native sago starch can be a valuable source of foodstuffs and industrial raw materials, its use of native sago starch is still limited due to the disadvantageous properties of the raw sago paste [11]. For example, raw sago paste becomes a chewy paste when heated, is difficult to dissolve in cold water, opaque, spoils quickly during storage, and it lacks emulsifying properties. Consequently, industrial applications of sago starch are limited [12,13], and most have not been sufficiently utilized. Native sago starch is also reactive, because it

Article

Effects of Hydrothermal Processing Duration on the Texture, Starch and Protein In Vitro Digestibility of Cowpeas, Chickpeas and Kidney Beans

Prit Khrisanapant ^{1,2}, Sze Ying Leong ^{1,2} , Biniam Kebede ¹  and Indrawati Oey ^{1,2,*} 

¹ Department of Food Science, Division of Sciences, University of Otago, P.O. Box 56, Dunedin 9054, New Zealand; prit.khrisanapant@outlook.com (P.K.); sze.leong@otago.ac.nz (S.Y.L.); biniam.kebede@otago.ac.nz (B.K.)

² Riddet Institute, Private Bag 11 222, Palmerston North 4442, New Zealand

* Correspondence: indrawati.oey@otago.ac.nz; Tel.: +64-3-479-8735

Abstract: Legumes are a vital candidate in the fight for food security as a sustainable and nutritious food source. The current study systematically investigated the effects of hydrothermal processing of varying durations (15–120 min) on the texture, starch and protein digestibility of cowpeas (*Vigna unguiculata*), chickpeas (*Cicer arietinum*) and kidney beans (*Phaseolus vulgaris*). Texture analysis and in vitro oral-gastro-intestinal digestion of each legume was combined with kinetic modelling to explore the rate and extent of their changes observed during hydrothermal processing. All three legumes showed rapid initial texture decay in the first 30 min of processing. Chickpeas showed the fastest rate of texture degradation with processing duration, whereas texture degradation of kidney bean was slower but reached the lowest hardness value among all beans when processed up to 120 min. The rate of starch and protein digestion increased with prolonged processing duration, whilst showing an inverse relationship with texture values. The extent of starch digestion continually increased with processing duration for all three legumes, whereas the extent of protein digestion decreased after 60 min in cowpeas. This study systematically demonstrated how choosing different processing times can modulate the rate of texture degradation, starch and protein digestion in legumes. The findings of this study can aid consumers and manufacturers on optimal processing to achieve the desired texture or modulate starch and protein digestibility.

Keywords: legumes; hydrothermal processing; texture; starch digestion; protein digestion; simulated digestion; kinetic modelling



Citation: Khrisanapant, P.; Leong, S.Y.; Kebede, B.; Oey, I. Effects of Hydrothermal Processing Duration on the Texture, Starch and Protein In Vitro Digestibility of Cowpeas, Chickpeas and Kidney Beans. *Foods* **2021**, *10*, 1415. <https://doi.org/10.3390/foods10061415>

Academic Editors: Raquel Olías and Alfonso Clemente

Received: 3 May 2021

Accepted: 14 June 2021

Published: 18 June 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Legumes are a sustainable source of (plant-based) protein, carbohydrate, fibre and minerals. Legumes are consumed as a staple food in developing countries due to their economical cost and long (i.e., years) shelf life [1]. Legume consumption has been associated with lower risk of non-communicable diseases, such as diabetes [2]. Furthermore, legumes may be cultivated in poor soil and/or arid regions [3]; hence, legumes are a robust candidate to contribute to the world's food security. Some examples of well-known legumes include cowpeas (*Vigna unguiculata*), chickpeas (*Cicer arietinum*) and kidney beans (*Phaseolus vulgaris*).

Despite the health and sustainability benefits, legumes are not as widely consumed in developed countries. This is due to a combination of factors, such as the involved process in their cooking, the potential of gastrointestinal discomfort from gas, undesirable odour [4] and generally lower protein digestibility (compared to animal sources) [5]. Complicating their utilisation is the presence of antinutrients which needs to be inactivated before consumption. Antinutrients include lectins, which can potentially cause food poisoning [6], α-galactosides which may be metabolised by gut bacteria to cause gastrointestinal discomfort.

Article

Effect of Freeze Drying and Simulated Gastrointestinal Digestion on Phenolic Metabolites and Antioxidant Property of the Natal Plum (*Carissa macrocarpa*)

Faith Seke ¹, Vimbainashe E. Manhivi ² , Tinotenda Shoko ², Retha M. Slabbert ¹, Yasmina Sultanbawa ³  and Dharini Sivakumar ^{2,3,*} 

¹ Department of Horticulture, Tshwane University of Technology, Pretoria West 0001, South Africa; fayeesk@gmail.com (F.S.); SlabbertMM@tut.ac.za (R.M.S.)

² Phytochemical Food Network Group, Department of Crop Sciences, Tshwane University of Technology, Pretoria West 0001, South Africa; ManhiviVE@tut.ac.za (V.E.M.); ShokoT@tut.ac.za (T.S.)

³ Australian Research Council Industrial Transformation Training Centre for Uniquely Australian Foods, Queensland Alliance for Agriculture and Food Innovation, Center for Food Science and Nutrition, The University of Queensland, St Lucia, QLD 4069, Australia; y.sultanbawa@uq.edu.au

* Correspondence: SivakumarD@tut.ac.za



Citation: Seke, F.; Manhivi, V.E.; Shoko, T.; Slabbert, R.M.; Sultanbawa, Y.; Sivakumar, D. Effect of Freeze Drying and Simulated Gastrointestinal Digestion on Phenolic Metabolites and Antioxidant Property of the Natal Plum (*Carissa macrocarpa*). *Foods* **2021**, *10*, 1420. <https://doi.org/10.3390/foods10061420>

Academic Editors: José Manuel Moreno-Rojas, Gema Pereira Caro and Raquel Rodríguez Solana

Received: 7 May 2021
Accepted: 14 June 2021
Published: 18 June 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: Natal plums (*Carissa macrocarpa*) are a natural source of bioactive compounds, particularly anthocyanins, and can be consumed as a snack. This study characterized the impact of freeze drying and *in vitro* gastrointestinal digestion on the phenolic profile, antioxidant capacity, and α -glucosidase activity of the Natal plum (*Carissa macrocarpa*). The phenolic compounds were quantified using high performance liquid chromatography coupled to a diode-array detector HPLC-DAD and an ultra-performance liquid chromatograph (UPLC) with a Waters Acquity photodiode array detector (PDA) coupled to a Synapt G2 quadrupole time-of-flight (QTOF) mass spectrometer. Cyanidin-3-O- β -sambubioside (Cy-3-Sa) and cyanidin-3-O-glucoside (Cy-3-G) were the dominant anthocyanins in the fresh and freeze-dried Natal plum powder. Freeze drying did not affect the concentrations of both cyanidin compounds compared to the fresh fruit. Both cyanidin compounds, ellagic acid, catechin, epicatechin syringic acid, caffeic acid, luteolin, and quercetin O-glycoside from the ingested freeze-dried Natal plum powder was quite stable in the gastric phase compared to the small intestinal phase. Cyanidin-3-O- β -sambubioside from the ingested Natal plum powder showed bioaccessibility of 32.2% compared to cyanidin-3-O-glucoside (16.3%). The degradation of anthocyanins increased the bioaccessibility of gallic acid, protocatechuic acid, coumaric acid, and ferulic acid significantly, in the small intestinal digesta. The ferric reducing antioxidant power (FRAP), 2,2'-azino-bis-3-ethylbenzthiazoline-6-sulphonic acid (ABTS) activities, and inhibitory effect of α -glucosidase activity decreased in the small intestinal phase. Indigenous fruits or freeze-dried powders with Cy-3-Sa can be a better source of anthocyanin than Cy-3-G due to higher bioaccessibility in the small intestinal phase.

Keywords: functional powder; phytochemicals; antioxidants; bioaccessibility; cyanidin-3-O- β -sambubioside

1. Introduction

Market knowledge and interest in nutritional quality, particularly in healthier foods, is currently apparent in many communities. Food suppliers are striving to develop innovative food products with functional powders. The projection is that global functional foods' market size would increase in 2025 to US \$275.77 billion, predominantly due to the increasing consumer demand for nutritional and fortifying food additives [1]. Furthermore, the market growth of global functional powdered drink concentrates increased by 7% during the period 2017–2021 [2]. Fruits with bright red, or pink to dark blue colours predominantly contain anthocyanins belonging to the phenolic group and show numerous health benefits due to their potent antioxidant properties [3].

Article

Synergistic Effects of the Jackfruit Seed Sourced Resistant Starch and *Bifidobacterium pseudolongum* subsp. *globosum* on Suppression of Hyperlipidemia in Mice

Zeng Zhang ¹, Yuanyuan Wang ¹, Yanjun Zhang ², Kaining Chen ³, Haibo Chang ¹, Chenchen Ma ¹, Shuaiming Jiang ¹, Dongxue Huo ¹, Wenjun Liu ⁴, Rajesh Jha ⁵  and Jiachao Zhang ^{1,5,*}

¹ Key Laboratory of Food Nutrition and Functional Food of Hainan Province, College of Food Science and Engineering, Hainan University, Haikou 570228, China; zzeng66@163.com (Z.Z.); wang2019yuanyuan@163.com (Y.W.); c15364690101@163.com (H.C.); mcc19970104@163.com (C.M.); jsm15501859060@163.com (S.J.); 17784625873@126.com (D.H.)

² Spice and Beverages Research Institute, Chinese Academy of Tropical Agricultural Science, Wanning 571533, China; zhangyanjun0305@163.com

³ Hainan Provincial People's Hospital, Haikou 570311, China; kainch@sina.com

⁴ Key Laboratory of Dairy Biotechnology and Engineering, Ministry of Education P.R.C., Key Laboratory of Dairy Products Processing, Ministry of Agriculture and Rural Affairs China, Inner Mongolia Agricultural University, Hohhot 010018, China; wjlui168@163.com

⁵ Department of Human Nutrition, Food and Animal Sciences, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, Honolulu, HI 96822, USA; rjha@hawaii.edu

* Correspondence: jiachao@hainanu.edu.cn



Citation: Zhang, Z.; Wang, Y.; Zhang, Y.; Chen, K.; Chang, H.; Ma, C.; Jiang, S.; Huo, D.; Liu, W.; Jha, R.; et al. Synergistic Effects of the Jackfruit Seed Sourced Resistant Starch and *Bifidobacterium pseudolongum* subsp. *globosum* on Suppression of Hyperlipidemia in Mice. *Foods* **2021**, *10*, 1431. <https://doi.org/10.3390/foods10061431>

Academic Editor: Robert G. Gilbert

Received: 25 April 2021

Accepted: 30 May 2021

Published: 21 June 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: Approximately 17 million people suffer from cardiovascular diseases caused by hyperlipidemia, making it a serious global health concern. Among others, resistant starch (RS) has been widely used as a prebiotic in managing hyperlipidemia conditions. However, some studies have reported limited effects of RS on body weight and blood lipid profile of the host, suggesting further investigation on the synergistic effects of RS in combination with probiotics as gut microbes plays a role in lipid metabolism. This study evaluated the effects of jackfruit seed sourced resistant starch (JSRS) as a novel RS on mice gut microbes and hyperlipidemia by performing 16s rRNA and shotgun metagenomic sequencing. The results showed that 10% JSRS had a limited preventive effect on bodyweight and serum lipid levels. However, the JSRS promoted the growth of *Bifidobacterium pseudolongum*, which indicated the ability of *B. pseudolongum* for JSRS utilization. In the validation experiment, *B. pseudolongum* interacted with JSRS to significantly reduce bodyweight and serum lipid levels and had a therapeutic effect on hepatic steatosis in mice. Collectively, this study revealed the improvements of hyperlipidemia in mice by the synergistic effects of JSRS and *B. pseudolongum*, which will help in the development of “synbiotics” for the treatment of hyperlipidemia in the future.

Keywords: hyperlipidemia; resistant starch; *Bifidobacterium pseudolongum*; gut microbes; synbiotics

1. Introduction

Hyperlipidemia is a chronic systemic metabolic disease with lower levels of high-density lipoprotein cholesterol (HDL-C) and higher levels of total cholesterol (TC), triglycerides (TG), and low-density lipoprotein cholesterol (LDL-C) due to abnormal fat transport or metabolism [1]. It is considered as one of the risk factors of cardiovascular diseases, including atherosclerosis [2], coronary heart disease [3], and diabetes [4]. Intestinal microbes, the “second genome” of the human body [5], are inextricably linked to these diseases, and the intestinal microbiota of such patients is significantly different from that of healthy people [6]. The gut microbiome in hyperlipidemic subjects is also characterized by low microbial diversity, such as a high abundance of some taxa from the phylum Actinobacteria and lower abundance of many taxa from phyla Proteobacteria and Bacteroidetes [7].