

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

Judul Jurnal Ilmiah (Artikel) : Effect of Esterification on Cassava Starch: Physicochemical Properties and Expansion Ability
 Jumlah Penulis : 4 orang
 Status Pengusul : Penulis pertama/ penulis ke-3/ penulis korespondensi
 Identitas Jurnal Ilmiah :
 a. Nama Jurnal : Reaktor
 b. Nomor ISSN : 2407 – 5973
 c. Volume, nomor, bulan, tahun : Vol. 19, No. 1, Maret 2019
 d. Penerbit : Universitas Diponegoro
 e. DOI Artikel : 10.14710/reaktor.19.1.34-41
 f. Alamat web Jurnal : <https://ejournal.undip.ac.id/index.php/reaktor/article/view/23033>
 Alamat artikel : <https://ejournal.undip.ac.id/index.php/reaktor/article/view/23033/15124>
 g. Terindeks : SINTA 2 (2020), DOAJ

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

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☒	Jurnal Ilmiah Nasional Terakreditasi
☐	Jurnal Ilmiah Nasional Tidak Terakreditasi

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Komponen yang dinilai	Nilai Reviewer		Nilai Rata-rata
	Reviewer I	Reviewer II	
a. Kelengkapan unsur isi jurnal (10%)	2,50	2,50	2,50
b. Ruang lingkup dan kedalaman pembahasan (30%)	6,50	6,50	6,50
c. Kecukupan dan kemitakhiran data/ informasi dan metodologi (30%)	6,50	6,50	6,50
d. Kelengkapan unsur dan kualitas terbitan/ jurnal (30%)	6,50	7,00	6,75
Total = (100%)	22,00	22,50	22,25
Nilai Pengusul (60% x nilai total)	13,20	13,50	13,35

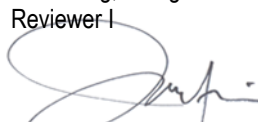
Reviewer II



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Semarang, 10 Agustus 2021

Reviewer I



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Hasil Penilaian Peer Review

Komponen yang dinilai	Nilai Maksimal Jurnal Ilmiah			Nilai Akhir yang diperoleh
	Internasional ☐	Nasional Terakreditasi 25	Nasional Tidak Terakreditasi ☐	
a. Kelengkapan unsur isi jurnal (10%)		2,50		2,50
b. Ruang lingkup dan kedalaman pembahasan (30%)		7,50		6,50
c. Kecukupan dan kemutakhiran data/ informasi dan metodologi (30%)		7,50		6,50
d. Kelengkapan unsur dan kualitas terbitan/ jurnal (30%)		7,50		6,50
Total = (100%)		25,00		22,00
Nilai pengusul = 60% x 22,00 = 13,20				

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 pH, waktu reaksi dan konsentrasi ester terhadap perubahan sifat psikokimia Tapioka dalam meningkatkan daya kembang pilus/coated peanut. Hasil dibahas dengan cukup detail dalam bentuk 6 grafik (termasuk data SEM produk) dan 1 tabel disertai referensi yang memadai dalam hasil dan pembahasan sebanyak 8 dari 25 referensi yang digunakan (32%). Meskipun demikian data-data sangat sederhana, kurang diolah dengan statistik yang lebih memadai.

3. Kecukupan dan kemutakhiran data/informasi dan metodologi:

Kemutakhiran data didukung referensi yaitu 10 (mulai tahun 2009) sebanyak 13 dari 25 artikel artikel yang disitasi, atau 52%. Metode penelitian dituliskan cukup komprehensif dan memenuhi standar penulisan yang dipersyaratkan dalam jurnal tersebut. Penyajian data cukup lengkap didukung oleh uji karakteristik produk dengan menggunakan instrument SEM dan FTIR.

4. Kelengkapan unsur dan kualitas terbitan:

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Semarang,
Reviewer I

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	Internasional ☐	Nasional Terakreditasi 25	Nasional Tidak Terakreditasi ☐	
a. Kelengkapan unsur isi jurnal (10%)		2,50		2,50
b. Ruang lingkup dan kedalaman pembahasan (30%)		7,50		6,50
c. Kecukupan dan kemutakhiran data/ informasi dan metodologi (30%)		7,50		6,50
d. Kelengkapan unsur dan kualitas terbitan/ jurnal (30%)		7,50		7,00
Total = (100%)		25,00		22,50
Nilai pengusul = 60% x 22,50 = 13,50				

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:

Artikel mengkaji pengaruh waktu reaksi, konsentrasi ester dan pH terhadap perubahan sifat psikokimia dan reologi pati ubi kayu untuk pemenuhan kebutuhan makanan ringan. Dalam pembahasan digunakan 8 referensi dari total 25 (32 %) dengan dilengkapi 1 tabel dan 6 grafik.

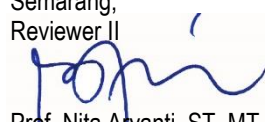
3. Kecukupan dan kemutakhiran data/infrmasi dan metodologi:

Penyajian metodologi dan data cukup lengkap dituliskan dalam beberapa sub bagian. Metodologi didukung oleh berbagai uji produk dengan instrument modern dan kemutakhiran artikel yang baik dibuktikan dalam 10 tahun terakhir (mulai tahun 2009) sebanyak 13 dari 25 artikel (52 %).

4. Kelengkapan unsur dan kualitas terbitan:

Jurnal ini merupakan Jurnal kategori SINTA 2 (2016-2021) yang diterbitkan oleh Universitas Diponegoro. Penulis dalam terbitan periode ini berasal dari berbagai Perguruan Tinggi seperti: Institut Teknologi Bandung, Universitas Riau, Universitas Trisakti, Universitas Diponegoro dan Universitas Pelita Harapan. Artikel ini memiliki similaritas turnitin 10 %.

Semarang,
Reviewer II



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REPUBLIK INDONESIA

30/E/KPT/2018

TENTANG

**PERINGKAT AKREDITASI JURNAL ILMIAH PERIODE II
TAHUN 2018**

DIREKTUR JENDERAL PENGUATAN RISET DAN PENGEMBANGAN
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- Menimbang : a. bahwa dalam rangka melaksanakan ketentuan Pasal 6 ayat (5) Peraturan Menteri Riset, Teknologi dan Pendidikan Tinggi Nomor 9 Tahun 2018 tentang Akreditasi Jurnal Ilmiah, perlu menetapkan Peringkat Akreditasi Jurnal Ilmiah;
- b. bahwa berdasarkan hasil akreditasi jurnal ilmiah yang ditetapkan oleh Tim Akreditasi Jurnal Ilmiah Kementerian Riset, Teknologi, dan Pendidikan Tinggi pada tanggal 27 September 2018 dan 12 Oktober 2018, perlu menetapkan Peringkat Akreditasi Jurnal Ilmiah Periode II Tahun 2018;
- c. bahwa berdasarkan pertimbangan sebagaimana dimaksud pada huruf a dan huruf b, perlu menetapkan Keputusan Direktur Jenderal Penguatan Riset dan Pengembangan Kementerian Riset, Teknologi, dan Pendidikan Tinggi tentang Peringkat Akreditasi Jurnal Ilmiah Periode II Tahun 2018;
- Mengingat : 1. Undang-Undang Nomor 12 Tahun 2012 tentang Pendidikan Tinggi (Lembaran Negara Republik Indonesia Tahun 2012 Nomor 158, tambahan Lembaran Negara Republik Indonesia Nomor 5336);
2. Peraturan Pemerintah Nomor 4 Tahun 2014 tentang Penyelenggaraan Pendidikan dan Pengelolaan Perguruan Tinggi (Lembaran Negara Republik Indonesia Tahun 2014, Nomor 16, tambahan Lembaran Negara Republik Indonesia Nomor 5500);
3. Peraturan Presiden Nomor 13 Tahun 2015 tentang Kementerian Riset, Teknologi, dan Pendidikan Tinggi (Lembaran Negara Republik Indonesia Tahun 2015 Nomor 14);
4. Keputusan Presiden Nomor 121/P Tahun 2014 tentang Pembentukan Kementerian dan Pengangkatan Menteri Kabinet Kerja Periode Tahun 2014-2019;
5. Keputusan Presiden Nomor 99/M Tahun 2015 tentang Pemberhentian dan Pengangkatan Dari dan Dalam Jabatan Pimpinan Tinggi Madya di Lingkungan Kementerian Riset, Teknologi, dan Pendidikan Tinggi;

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7. Peraturan Menteri Riset, Teknologi dan Pendidikan Tinggi Nomor 15 Tahun 2015 tentang Organisasi dan Tata Kerja Kementerian Riset, Teknologi dan Pendidikan Tinggi (Berita Negara Republik Indonesia Tahun 2015 Nomor 889);
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- KEDUA : Akreditasi Jurnal Ilmiah sebagaimana dimaksud dalam Diktum KESATU berlaku selama 5 (lima) tahun sejak dinilai baik oleh Tim Akreditasi Jurnal Ilmiah.
- KETIGA : Akreditasi Jurnal Ilmiah sebagaimana dimaksud dalam Diktum KESATU dapat mengajukan kembali kenaikan peringkat setelah menerbitkan minimal 1 (satu) nomor penerbitan.
- KEEMPAT : Setiap jurnal ilmiah wajib mencantumkan masa berlaku akreditasi dengan menuliskan tanggal penetapan dan tanggal akhir masa berlaku akreditasi.
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Ditetapkan di Jakarta
pada tanggal 24 Oktober 2018
DIREKTUR JENDERAL
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TTD.

MUHAMMAD DIMYATI
NIP 195912171984041001

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Kepala Bagian Hukum, Kerjasama, dan Layanan Informasi,

TTD.

Syarip Hidayat
NIP 197306101997031004

SALINAN
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PENGUATAN RISET DAN PENGEMBANGAN
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NOMOR 30/E/KPT/2018
TENTANG PERINGKAT AKREDITASI JURNAL
ILMIAH PERIODE II TAHUN 2018

PERINGKAT AKREDITASI JURNAL ILMIAH PERIODE II TAHUN 2018

Peringkat	No	Nama Jurnal	E-ISSN	Penerbit
Peringkat 1 (Satu)	1	Acta Medica Indonesiana	23382732	PB PAPDI (Perhimpunan Dokter Spesialis Penyakit Dalam Indonesia)
	2	AJAS (Agrivita Journal of agricultural science)	24778516	Fakultas Pertanian, Universitas Brawijaya
	3	Al-Jami'ah: Journal of Islamic Studies	2338557X	Universitas Islam Negeri Sunan Kalijaga
	4	Atom Indonesia	23565322	Badan Tenaga Nuklir Nasional
	5	Biodiversitas : Journal of Biolodical Diversity	20854722	Jurusan Biologi Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Sebelas Maret
	6	BIOTROPIA	1907770X	SEAMEO-BIOTROP
	7	Bulletin of Electrical Engineering and Informatics	23029285	Universitas Ahmad Dahlan
	8	Cakrawala Pendidikan	24428620	Lembaga Pengembangan dan Penjaminan Mutu Pendidikan UNY
	9	Electronic Journal of Graph Theory and Applications	23382287	Indonesian Combinatorial Society (InaCombS), Institut Teknologi Bandung (ITB) Indonesia dan GTA Research Centre, The University of Newcastle Australia
	10	<i>Gadjah Mada International Journal of Business</i>	23387238	Fakultas Ekonomika dan Bisnis Universitas Gadjah Mada
	11	HAYATI Journal of Biosciences	20864094	Perhimpunan Biologi Indonesia bekerja sama dengan Departemen Biologi Fakultas Matematika dan Ilmu Pengetahuan Alam Institut Pertanian Bogor
	12	<i>IJAIN (International Journal of Advances in Intelligent Informatics)</i>	25483161	Universitas Ahmad Dahlan
	13	<i>IJASEIT (International Journal on Advanced Science, Engineering and Information Technology)</i>	24606952	INSIGHT -Indonesian Society for Knowledge and Human Development

			Informatika, Kementerian Kominfo
223	Jurnal Penelitian Transportasi Darat	25798731	Puslitbang Transportasi Jalan dan Perkeretaapian
224	Jurnal Penelitian Transportasi Multimoda	25798529	Pusat Penelitian dan Pengembangan Transportasi Antarmoda
225	Jurnal Pengajaran MIPA	24433616	FMIPA Universitas Pendidikan Indonesia
226	Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan (Journal of Natural Resources and Environmental Management)	24605824	Sekolah Pascasarjana Institut Pertanian Bogor
227	Jurnal Pengembangan Energi Nuklir	25029479	Pusat Kajian Sistem Energi Nuklir (PKSEN) BATAN Jakarta
228	Jurnal Pengolahan Hasil Perikanan Indonesia	2354886x	Masyarakat Pengolahan Hasil Perikanan Indonesia
229	Jurnal Penyuluhan	24424110	Program Pascasarjana Ilmu Penyuluhan Pembangunan IPB bekerjasama dengan Perhimpunan Ahli Penyuluhan Pembangunan Indonesia
230	Jurnal Perbenihan Tanaman Hutan	25276565	Balai Penelitian Teknologi PerbenihanTanaman Hutan Bogor
231	Jurnal Perempuan	25412191	Yayasan Jurnal Perempuan
232	Jurnal Perikanan Universitas Gadjah Mada	25025066	Departemen Perikanan Universitas Gadjah Mada
233	Jurnal Perlindungan Tanaman Indonesia	25484788	Departemen Hama dan Penyakit Tumbuhan, Fakultas Pertanian, Universitas Gadjah Mada
234	Jurnal PIKOM (Penelitian Komunikasi dan Pembangunan)	25490176	Balai Pengkajian dan Pengembangan Komunikasi dan Informatika (BPPKI) Medan
235	Jurnal Psikologi	2460867X	Fakultas Psikologi Universitas Gadjah Mada
236	Jurnal Psikologi	23021098	Fakultas Psikologi Universitas Diponegoro
237	Jurnal Reaktor	24075973	Jurusan Teknik Kimia Fakultas Teknik, Universitas Diponegoro
238	Jurnal Rechts Vinding : Media Pembinaan Hukum Nasional	25802364	Pusat Penelitian dan Pengembangan Sistem Hukum Nasional Badan Pembinaan Hukum Nasional Kementerian Hukum dan HAM RI

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Growth Mechanism and Characterization of $\text{PbTe}_{0.5}\text{Se}_{0.5}$ Thin Films Used by Closed-Space Vapor Transport in a Vertical Reactor

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Abstract

A simple method for growing thin film of semiconductor material $\text{PbTe}_{0.5}\text{Se}_{0.5}$ has been designed using the vapor transport (CSVT) method in a vertical reactor. The objectivity of this method is to study thin film growth formation due to chemical reactions during the deposition process in the reactor. In this study will describe some formations the vapor transport mechanism of $\text{PbTe}_{0.5}\text{Se}_{0.5}$ semiconductor material using iodine gas (I_2) to accelerate the etching reaction on the substrate surface. Next, we will describe how the mechanism of the reaction in the reactor zone for growing thin films on the substrate. The thin films were characterized by structural, morphology properties and its composition. The film structure is a cubic structure with the maximum diffraction intensity at peak (222). The surface morphology of the thin film has a microcubes shape with a grain size~10 to 20 μm .

Keywords: etching reaction; micro-cube; $\text{PbTe}_{0.5}\text{Se}_{0.5}$; close-spaced vapor transport

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INTRODUCTION

The CSVT method using horizontal reactors was first used to grow semiconductor crystals in the 1980s. This model can grow semiconductor material for III-V GaAs elements that were published in 1983 (Chávez *et al.*, 1983), other researchers have examined the equilibrium and the growth rate of thin films of As_2

and As_4 , Ga_2O . (Cote *et al.*, 1986). Yanuar *et al.*, 2018 using the CSVT in a vertical reactor method have succeeded in growing thin layers of group I-III-VI2 elements $\text{CuIn}(\text{S},\text{Se})_2$. GaAs photovoltaic devices from group III-V elements have been fabricated using steam transportation methods in the form of GaAs

Investigating Mass Transfer Phenomena in Batch Solvent Extraction of Rice Bran Oil

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Abstract

In this study, we will point out the correlation of critical parameters in designing scale-up of process equipment for commercial rice bran oil extraction with different types of rice paddy, solvent, and physicochemical condition. Advantageously, this research was also intended to enhance the discoveries of novel sustainable production method for resilient agro-based food, energy, and chemical industries. In our experiment, the extraction of rice bran oil was organised in a batch agitated vessel and showed a profile of first order system. The most important factors which profoundly contributed towards the yield of rice bran oil from Saigon I and Padi Besar variety are temperature (T), impeller speed (N), ratio of bran to solvent (s/L), and ratio of impeller's height-off bottom to tank diameter (h/d). For the mass transfer constant and the rate of extraction as consequence, factors that significantly influenced the correlation were temperature (T), impeller speed (N), ratio of impeller diameter to tank diameter (d/D), and ratio of impeller's height-off bottom to tank diameter (h/d). For the dimensionless yield, generalised equation is provided with coefficient of determination 0.95, while that of the mass transfer equals to 0.63, reflecting the yield correlation to be more accurate in predicting further experimental results. These correlations are furthermore unique for different rice varieties, of which in this case belongs to Saigon I. Application for other rice species is relevant as by inserting additional correction factor which also exemplified in this research for Padi Besar.

Keywords: rice bran oil; batch extraction; storage time; mass transfer, rate, yield

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INTRODUCTION

Processed rice paddy will provide around 70% of endosperm (called white rice) and other by-products such as shell (20%), bran (8%), and germ (2%) (Gul *et al.*, 2015; Zúñiga-Díaz *et al.*, 2017). Significantly, as one of the highest consumed staples worldwide, rice production has been at the level of 480 million metric

tones annually (Muthayya *et al.*, 2014). In Indonesia itself, the production is targeted to increase by 5% per annum, with surplus was 10 million metric tones by 2015 (Panuju *et al.*, 2013; Mariyono, 2015). Even though such production scale does contribute to massive agrowastes, this also triggers ample opportunities for agriculture valorisation and supports

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Effect of Esterification on Cassava Starch: Physicochemical Properties and Expansion Ability

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Abstract

In this study, the characteristic of cassava starch has been developed through esterification using ethyl lactate. Commercial cassava starch was modified by using (0.5; 0.75; 1.00; 1.25; 1.50 % v/v) ethyl lactate solution with pH 6, 7, 8, 9 for 15, 25, 35, 45, 55 minutes and the cassava starch was dried with sun drying. The cassava starch has been esterified with 1.5% ethyl lactate for 15 minutes pH 6 gave highest volume expansion of 2,438.9 %. For swelling power, the highest value was 19.32 swelling power at variable concentrations of 1.5% ester, esterification period of 15 minutes, and pH 6. The lowest amylose content was 15.68 % in ester concentration of 1.5 %. From the scanning electron micrograph, shows that the cassava starch after and before modification has not changed since the modifications performed under the gelatinization temperature. FTIR spectra of native cassava starch and ester cassava starch has shown shift of the carboxyl group of starch from 1,072.37 to 1,087.80 cm^{-1} and a decrease in the OH group is from 3,452.53 to 3,417.81 cm^{-1} . Bond formed indicated that the esterification reaction occurs between cassava starch with ethyl lactate ester.

Keywords: expansion, cassava starch, ester starch, ethyl lactate, modified starch

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INTRODUCTION

Starch is an important natural resources which can be obtained from may renewable sources such as corn, potato, rice, wheat, peas or cassava. It's field of application is very broad from food, paper, and pharmaceutical to plastic industries (Barrios *et al.*,

2013). The main reason starch is chemically treated before commercially use is to split the long glucose chains of the polymer molecule to increase and obtain the maximum possible amounts of starch in technical applications (Dias *et al.*, 2011). Food grade starches are chemically modified mainly to increase paste

consistency, smoothness, and clarity, and to impart freeze-thaw and cold storage stabilities (Jane, 1997; Liu *et al.*, 1999a, 1999b; Perera *et al.*, 1997; Shi & Bemiller, 2000; Woo and Seib, 1997).

Modification of cassava starch has been carried out, among others, chemical, physical, enzymatic, and genetic (Kaur *et al.*, 2012). According Demiate *et al.* (2000) modification of cassava with natural fermentation followed by drying in the sun can improve expansion ability of cassava flour. Modified cassava starch by addition of lactic acid has been developed to speed up the fermentation process (Vatanasuchart *et al.*, 2005). Cassava starch modification history begins with sun dried and fermented cassava starch, known as *Polvilho azedo* or sour cassava starch. *Polvilho azedo* is a traditional product originating from Brazil and known in some countries in South America. Cassava starch extracted from cassava and soaked in a tank for natural fermentation for 30 days with an excess of water 5 cm above the surface of cassava starch. The process was dominated by lactic fermentation (Cereda, 1994). Wet starch is dried in the sun for 1-2 days depending on the weather and season (Cardenas and Buckle, 1980).

The treatment of starch by UV light, with or without a photosensitizer (Bertolini 2001), induces changes in its functional properties; it increase water buding capacity and solubility (Gholap *et al.*, 1993) and decrease hot paste viscosity (Fiedorowicz *et al.*, 1999). UV photodegradation of starch produced glycosidic bond cleavages, with a shortening oh amylose chain and debranching of amylopectin chain, through free radical formation (Bertolini *et al.*, 2001; Sumardiono *et al.*, 2018). Starch shows various changes in characteristics after modifying such as solubility, gelatinization temperature, viscosity, and stability of the paste, moisture, water retention, and film property (Rajan *et al.*, 2006).

Many research groups have tried to understand what kind of modification is responsible for the baking properties of cassava sour starch, but until now there is no conclusive answer. Esterification is one of modifications, which can impart hydrophobicity to

starch products by substitution of free hydroxyl group (Hujibrechts *et al.*, 2008) and has been carried out by a variety pathway (Barrios *et al.*, 2013). Esterification of starch using long-chain fatty acids is going to produce thermoplastic starch, so it can be used further to the needs of the pharmaceutical and plastics industries (Rajan *et al.*, 2006). This research will develop a modified starch using esters in the field of food.

Cassava starch (*Manihot esculenta* Crantz) is very important for the food industry, but the utilization is still limited. Cassava starch has no expansion ability compared with wheat flour. Wheat formed viscoelastic dough, caused by of gluten and gliadin proteins, capable of retaining gas during fermentation and at the early stage of the cooking process (He and Hoseney, 1991). This present study was undertaken to examine effects of esterification cassava starch using ethyl lactate on changes in molecular properties responsible for volume expansion behavior.

MATERIALS AND METHODS

Materials: Commercial cassava starch was purchased from Margoyoso, Pati (Indonesia). Other chemical agents were analytical grade from Merck (Germany).

Preparation of ethyl lactate: In this study, ester was obtained by mixing lactic acid and ethanol with various concentrations (0.5, 0.75, 1.0, 1.25, 1.5% v/v). Ratio of lactic acid and ethanol is 1:1. The mixture was allowed to stand for 24 hours. After 24 hours ester solution was diluted in 1000 ml of distilled water.

Experimental prosedure: 500 g of cassava starch was dissolved in ester solution. pH was measured on variable 6, 7, 8, 9. The solution was stirred using a magnetic stirrer with a stirring speed of 8 scales for variations in prescribed time 15, 25, 35, 45, 55 minutes. The product was filtered with a filter cloth, then placed on a portable solar dryer and dried for 9 hours. The scheme of experimental can be seen in Figure 1.

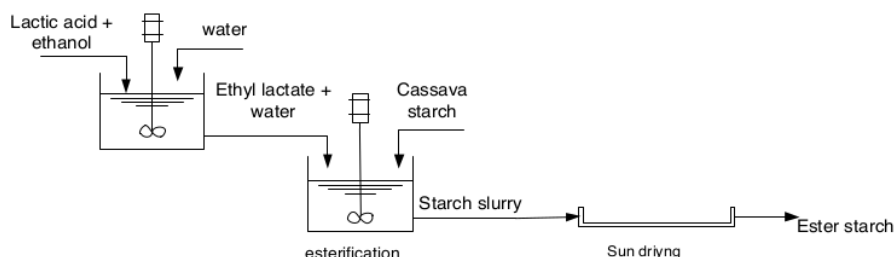


Figure 1. Esterification process of cassava starch

Swelling Property: Starch (0.1 g) was mixed with 10 ml distilled water in centrifuge tube and heated using a water bath with a temperature of 60°C for 30 minutes. The supernatant was separated using a centrifuge at a speed of 2500 rpm for 15 minutes. Swelling power is calculated by Eqs 1.

$$\text{Swelling Power (gr/gr)} = \frac{\text{supernatant weight}}{\text{dry starch weight}} \quad (1)$$

Determination of amylose content: Colorimetric method was used for determining the changes in amylose contents of starch samples after treatments (AACC, 2000).

FTIR Analysis: Results of esterification can be demonstrated using FTIR analysis (Fourier Transform Infra-Red). FTIR analysis is used to determine the change of carbonyl and carboxyl groups with starch ester carbonyl groups. Samples in the form of granules mixed with dry KBr. The mixture was made into a movie that will be analyzed by the light beam FT-IR spectrophotometer.

SEM Analysis: Scanning electron microscopy (SEM) was used to determine the surface starch esterified photography, cracks, and surface starch films. Starch samples mounted on aluminum specimen stubs with double-sided tape, and then coated with a 20 nm gold.

Frying Properties: Volume expansion is calculated by measuring the volume of dough before and after frying. Dough was made 20 times in order to obtain diverse and representative data of the sample. Dough diameter was measured with ruler, before frying (D1) and after frying (D2), the calculated each volume. Dough volume is calculated as the assumption that product perfectly spherical. Volume expansion level measured by Eqs 2.

$$\text{Volume expansion (\%)} = \frac{V_1}{V_2} \times 100\% \quad (2)$$

RESULTS AND DISCUSSION

Swelling Power Analysis

Swelling power of all variables on the study of modified cassava starch is shown in Table 1 and Figure 2. Esterification of starch is one of chemically method of modified starches. Modified starch using an esterification reaction aims to change the functional groups, hydroxyl groups of starch with carbonyl groups of esters (Jerachaimongkol *et al.*, 2006). Esterification process was carried out by reacting ethyl lactate esters with cassava starch, and then dried in the sun. From the results, the highest value was 19.32 swelling power at variable concentrations of 1.5% ester, esterification period of 15 minutes, and pH 6. In Figure 2 (a) shows increasing swelling power values due to increased concentrations of esters. Swelling power is strongly influenced by the network bonds between starch molecules. With addition of ester molecules into starch molecules, the bonds between starch molecules will weaken thus increasing the value of swelling power. The higher ester concentration will replace more hydroxyl groups in starch.

Cassava starch esterification process using ethyle lactate is strongly influenced by concentration variables of esters. In Fig 2 (b) shows that increasing period of esterification will decrease swelling power up to 35 min. This is because of long esterification period caused starch granule swollen. When the swelling process prolonged, the starch wall will begin to split, and damaging the granule, thereby reducing the swelling power. In the processing time 45 min, the swelling power increased, as the prolong esterification process lead to the amylose content reduction and amylopectin content in reverse.

Table 1. Experimental data of ester cassava starch in esterification variable

Esterification variabls			Volume expansion (%)	Swelling Power (gr/gr)	Amylose content (%)
Time (min.)	Ester Con. (%)	pH			
15	0.50	6	1,757.60	13.82	19.80
15	0.75	6	2,057.08	17.48	18.33
15	1.00	6	2,148.49	18.35	18.04
15	1.25	6	2,339.37	18.65	17.40
15	1.50	6	2,438.90	19.32	15.68
15	1.50	6	2,438.90	19.32	15.68
25	1.50	6	2,290.63	15.27	16.57
35	1.50	6	2,195.20	10.29	17.30
45	1.50	6	2,148.49	12.28	16.78
55	1.50	6	2,012.36	13.53	16.10
15	1.50	6	2,438.90	19.32	15.68
15	1.50	7	2,242.58	11.01	15.90
15	1.50	8	2,242.58	9.36	16.40
15	1.50	9	1,717.35	8.66	17.39

Amylopectin was insoluble in water. If the content of amylopectin increased, the paste will be increased and also swelling power value will increase. Starch degradation will occurs easier at acidic pH. Esterification at neutral or alkaline pH reduces expansion of cassava starch and inhibits depolymerization process. In Figure 2 (c) shows that the higher the pH esterification the swelling power decreased.

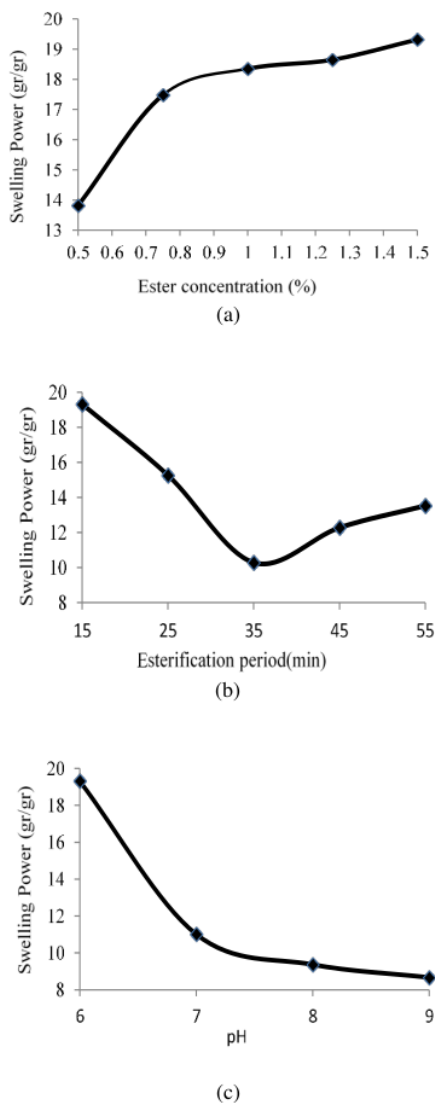


Figure 2. Swelling power of ester starch as function of ester concentration (a), esterification period (b), and pH (c).

Amylose Content Analysis

In the results showed that the amylose content in starch modified starch decreased as compared with native starch. Amylose content measurement can be seen in Table 1. Figure 3 shows the relationship between addition of ester concentration (a), time of esterification (b), and pH (c). On concentrations variable of esters showed a decrease in amylose content. The higher concentration of esters has lower amylose content. Lowest amylose content was 15.68 in ester concentration of 1.5 %. At the period esterification variables showed an increase up to 35 minutes and then decreased until 55 minutes.

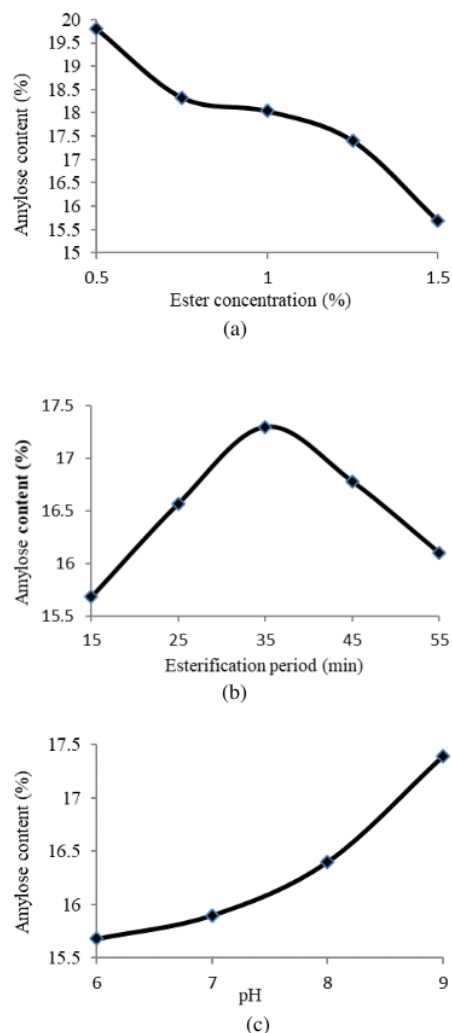


Figure 3. Amylose content of ester starch as function of ester concentration (a), esterification period (b), and pH (c).

Amylose content in native starches decreased after modified using ethyl lactate esterification methods. Reduced amylose was caused by partial depolymerization of amylose by ester and sunlight irradiation. Depolymerization of amylose led to the formation network structure of starch that affects the expansion ability. Lower amylose content caused better starch expansion properties. In a previous study were also explained that the amylose and amylopectin simultaneously degraded by acid hydrolysis with or without UV radiation (Sumardiono *et al.*, 2018; Bertolini *et al.*, 2000).

In addition, pH variable can be seen that the amylose content increased with increasing pH Fig 3 (c). At pH 6 amylose content in starch was 15.68, whereas at pH 9 amylose content of starch was 17.39. Amylose depolymerization occurs optimally under acidic conditions than under alkaline conditions, at neutral or alkaline pH may inhibit the depolymerization of starch thereby reducing the development of cassava starch.

SEM Analysis

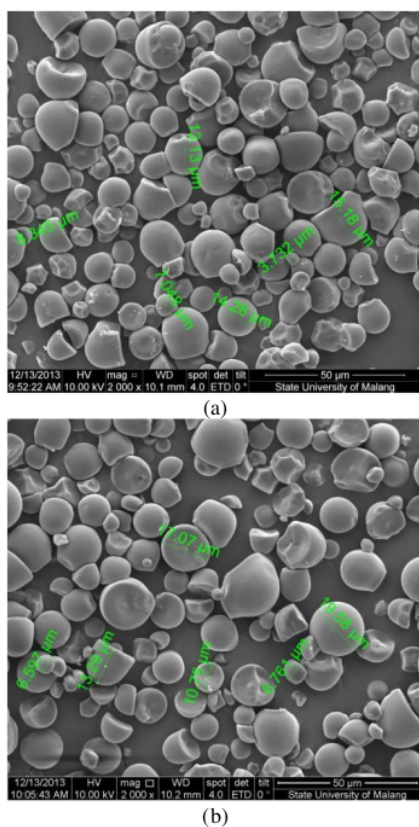


Figure 4. SEM micrograph of starch granule of native starch (a) and ester starch (b)

Surface morphology of cassava starch was observed using SEM (Scanning Electron Micrograph) with a magnification of 2000 times. The sample used in the SEM analysis is unmodified cassava starch (native starch) and starch esters with variable optimum concentration of 1.5% ester, esterification period of 25 minutes, and pH 6. Figure 4 shows the surface structure of native starch (a) and starch esters (b).

In Figure 4 shows that the cassava starch after and before modification has not changed since the modifications performed under the gelatinization temperature. Both have a structure that is round and have irregular pieces at the ends. The size of both types of particles varies. Native starch has a particle size averaging between 3.73 to 15.18 μm , while the starch ester having an average particle size of the larger of between 6.59 to 19.58 μm .

FTIR Analysis

FTIR spectra of native starch and esters starch are shown in Fig 5. In both spectra can be seen a few peaks of functional groups that are characteristics of starch include CO stretch with a wavelength of 1000-1,260 cm^{-1} , CH bend between 1,290-1,430 cm^{-1} , C=C between 1,630-1,690 cm^{-1} , CH stretch between 2,800-2,950 cm^{-1} , and OH stretch 3,300-3,400 cm^{-1} .

In Figure 5, it can be seen that the spectrum of native starch showed a CO stretch spectrum at a wavelength of 1,072.37 cm^{-1} , CH bend at a wavelength of 1,419.63 cm^{-1} , C=C at a wavelength of 1,643.30 cm^{-1} , CH stretch between 2,933.68 cm^{-1} , OH stretch 3,452.81 cm^{-1} . In ester starch showed CO stretch spectrum at a wavelength of 1,087.8 cm^{-1} , CH bend at a wavelength of 1,417.63 cm^{-1} , C=C at a wavelength of 1,643.30 cm^{-1} , CH stretch between 2,933.68 cm^{-1} , OH stretch 3,417.81 cm^{-1} . These results indicate a shift in the carbonyl group (CO) and hydroxyl group (OH).

From the results of the absorption peaks seen by the shift of the carboxyl group of starch from 1,072.37 to 1,087.8 cm^{-1} and a decrease in the OH group is from 3,452.53 to 3,417.81 cm^{-1} . Decreasing of OH group showed a substitution of hydroxyl groups of starch molecules with the ester carbonyl group. Increased carbonyl group due to the addition of starch on starch esters, carbonyl group substituting OH groups of starch will lead to changes in the structure of the modified starch (Perera *et al.*, 1997). Bond formed indicates that the esterification reaction occurs between tapioca starch with ethyl lactate ester.

Frying Properties

Modified cassava starch will be applied to process of coated peanut. Coated peanut processing was carried out by mixing 5 g of cassava starch and 3 ml of warm water temperature of 60 $^{\circ}\text{C}$. The dough is formed and measured initially at D1 diameter. The spheres are fried in hot oil with temperature 160 $^{\circ}\text{C}$ for 1 minute. Fried coated peanuts were measured the diameter of D2, then calculated the volume expansion.

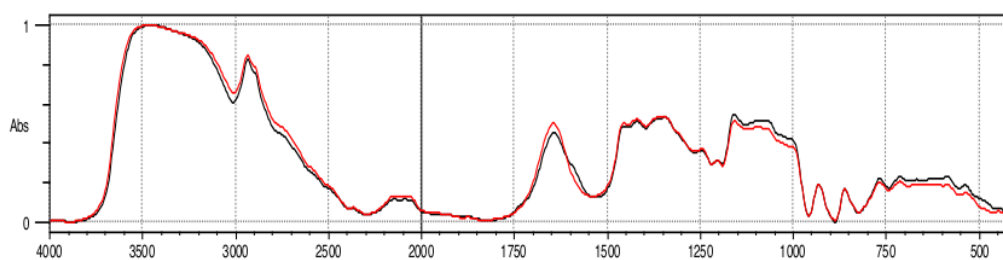
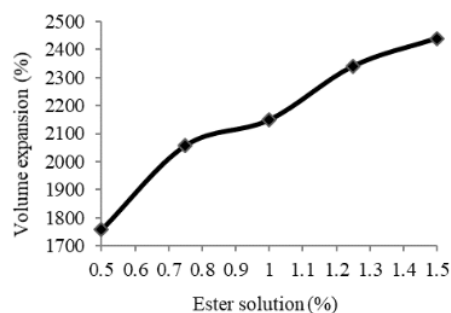
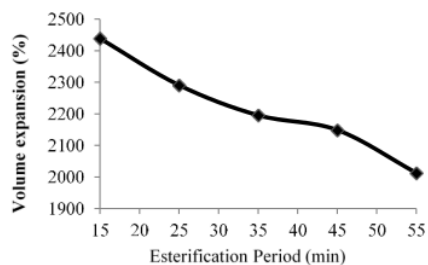


Figure 5. FTIR spectrum of native starch (red) and ester starch (black)

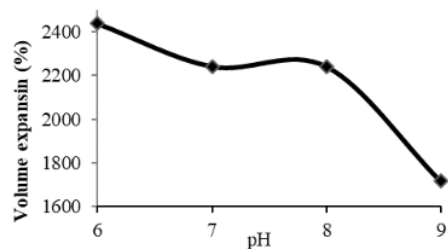
Volume expansion level data on each variable can be seen in Table 1 and Figure 6 (a), (b), (c).



(a)



(b)



(c)

Figure 6. Volume expansion of pilus as function of ester concentration (a), ester period (b), and pH (c).

Figure 6 (a) shows that the higher ester concentrations will increase volume expansion level. The largest volume expansion level is 2,438.9 % shown in ester concentration of 1.5 %. Most influential variable in esterification is starch concentration. While in the time variable esterification and pH levels decreased volume expansion level. Increasing ester concentration because the pH solution decreases. pH on starch effect on the amylose degradation process. Figure 7 shows the significant difference in volume expansion level between native starch with starch esters. The decrease in amylose content causes dough expansion ability (Vatanasuchart *et al.*, 2000).

Sufficient reaction with UV light causes partial depolymerization of amylose molecules and form hydrogen-bonded network structure. The network structure can absorb and store water during gelatinization process. UV drying enough energy help to improve starch properties development. Increasing the specific volume caused of increased amount of water lost during the frying process. At starch gelatinization due to heating, the water absorbed evaporated because of the high pressure caused by the expansion of the current driving force (Sumardiono *et al.*, 2017; Bertolini *et al.*, 2001). The process of water evaporation during frying process causes volume expansion increasing.



Figure 7. (1) coated peanut before frying, (2) fried product of native cassava starch, and (3) fried product of ester cassava starch

CONCLUSION

Cassava starch was modified to prepare starch-based rheological properties by esterification with ethyl lactate. Addition of ester molecules into starch molecules caused the bonds between starches molecules weaken thus increasing the value of swelling power. The higher ester concentration will replace more hydroxyl groups in starch. Structure of cassava starch after and before modification has not changed since the modifications performed under the gelatinization temperature. Both have a structure that is round and have irregular pieces at the ends. From the results of the absorption peaks seen by the shift of the carboxyl group of starch from 1,072.37 to 1,087.80 cm^{-1} and a decrease in the OH group is from 3,452.53 to 3,417.81 cm^{-1} . Decreasing of OH group showed a substitution of hydroxyl groups of starch molecules with the ester carbonyl group, its indicates that the esterification reaction occurs between tapioca starch with ethyl lactate esters.

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NOTATION

v_1 : volume of coated peanut before frying process

v_2 : volume of coated peanut after frying process

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