FORMULASI NANOEMULSI PICKERING BRAZILIN (*Caesalpinia sappan* L.) MENGGUNAKAN *BOX-BEHNKEN DESIGN*

SKRIPSI

YESHA AURA
A221031

SEKOLAH TINGGI FARMASI INDONESIA
YAYASAN HAZANAH
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Sebagai salah satu syarat untuk memperoleh gelar Sarjana Farmasi

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JUNI 2026
Disetujui oleh:

Pembimbing	**Pembimbing**
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Skripsi ini kupersembahkan untuk kedua orang tuaku, "Ya allah sayangilah dan hadiahkanlah surgamu yang paling indah untuk ayah dan mama" Yang tanpa lelah senantiasa berjuang, mengorbankan segalanya, dan melangitkan doa untuk kesuksesan dan kebahagiaan hidupku.

ABSTRAK

Brazilin merupakan senyawa dari kayu secang (*Caesalpinia sappan* L.) memiliki aktivitas antioksidan dan antiinflamasi, namun stabilitasnya perlu ditingkatkan melalui sistem penghantaran yang sesuai. Penelitian ini bertujuan mengoptimasi formula dan mengkarakterisasi nanoemulsi Pickering brazilin yang distabilkan oleh partikel kitosan-tripolifosfat (TPP) pada antarmuka minyak dan air. Optimasi dilakukan menggunakan metode *Box–Behnken Design* (BBD) dengan respon nilai transmitan. Model BBD menunjukkan hubungan signifikan antara faktor formulasi dan nilai transmitan serta menghasilkan nilai *desirability* yang mendekati 1, menunjukkan kesesuaian yang tinggi antara prediksi dan target optimasi. Faktor yang dioptimasi meliputi konsentrasi kitosan-TPP 25%, tween 80 2%, dan VCO 0,5%. Formula optimum kemudian dikarakterisasi meliputi organoleptik, pH, viskositas, sentrifugasi, ukuran droplet, indeks polidispersitas (PDI), dan zeta potensial. Hasil menunjukkan nanoemulsi Pickering berupa cairan coklat jernih beraroma khas secang dengan pH 4,22 ± 0,005, viskositas 1,1571 ± 0,002 cP, serta tidak mengalami pemisahan fase, maupun pengendapan pada uji sentrifugasi. Ukuran droplet, PDI, dan zeta potensial berturut-turut sebesar 36,17 ± 1,125 nm, 0,59 ± 0,016, dan −9,434 mV. Nanoemulsi Pickering brazilin hasil optimasi BBD berpotensi dikembangkan sebagai sistem penghantaran topikal yang stabil dengan aktivitas antioksidan dan antiinflamasi.

Kata kunci: nanoemulsi Pickering, brazilin, desain Box-Behnken, kitosan-TPP, transmitan.

ABSTRACT

Brazilin is a compound from sappan wood (Caesalpinia sappan L.) that has antioxidant and anti-inflammatory activities, but its stability needs to be improved through an appropriate delivery system. This study aims to optimize the formula and characterize Pickering brazilin nanoemulsion stabilized by chitosan-tripolyphosphate (TPP) particles at the oil-water interface. Optimization was carried out using the Box–Behnken Design (BBD) method with a transmittance value response. The BBD model showed a significant relationship between formulation factors and transmittance values and produced a desirability value close to 1, indicating a high agreement between predictions and optimization targets. Optimized factors included chitosan-TPP concentration of 25%, tween 80 2%, and VCO 0.5%. The optimum formula was then characterized including organoleptic, pH, viscosity, centrifugation, droplet size, polydispersity index (PDI), and zeta potential. The results showed that Pickering nanoemulsion was a clear brown liquid with a distinctive aroma of sappanwood with a pH of 4.22 ± 0.005, a viscosity of 1.1571 ± 0.002 cP, and did not experience phase separation or precipitation in the centrifugation test. The droplet size, PDI, and zeta potential were 36.17 ± 1.125 nm, 0.59 ± 0.016, and −9.434 mV, respectively. The Pickering brazilin nanoemulsion resulting from BBD optimization has the potential to be developed as a stable topical delivery system with antioxidant and anti-inflammatory activities.

***Keywords*:** *Pickering nanoemulsion, brazilin, Box-Behnken Design, TPP chitosan, transmitan.*

KATA PENGANTAR

Bismillahirrahmanirrahim,

Puji dan Syukur penulis panjatkan kehadirat Allat SWT atas segala berkah Rahmat dan ridho-nya penulis dapat menyelesaikan penelitian dan penulisan skripsi yang berjudul **"Formulasi Nanoemulsi Pickering Brazilin (*Caesalpinia sappan* L.) Menggunakan *Box-Behnken Design*"**

Penelitian dan penulisan skripsi ini dilakukan untuk memenuhi salah satu syarat untuk mendapatkan gelar sarjana pada Progam Studi Sarjana Farmasi Sekolah Tinggi Farmasi Indonesia.

Penulis mengucapkan terima kasih kepada dosen pembimbing dan apt. Yola Desnera Putri, M.Farm dan Prof. Dr. apt. Sukmadjaja Asyarie. atas bimbingan, nasihat, dukungan, serta pengorbanan yang diberikan. Pada kesempatan ini, penulis juga mengucapkan terima kasih kepada :

1. Dr. apt. Adang Firmansyah, M.Si., selaku Ketua Sekolah Tinggi Farmasi Indonesia,
2. Dr. apt. Diki Prayugo, M.Si., selaku Wakil Ketua I Bidang Akademik,
3. Dr. apt. Hesti Riasari, M.Si., selaku Ketua Program Studi Sarjana Farmasi,
4. Prof. Dr. apt. Aang Hanafiah Wangsaatmadja,. selaku Dosen Wali yang telah banyak memberikan bimbingan dan arahan kepada penulis,
5. Seluruh dosen, staf administrasi, serta seluruh karyawan Sekolah Tinggi Farmasi Indonesia atas ilmu, pengalaman dan bantuan kepada penulis selama penelitian.
6. Kepada teman-teman STFI angkatan 2022 yang selalu membersamai penulis dalam pelaksanaan akademik.
7. Seluruh pihak yang tidak disebutkan satu persatu yang telah membantu selama penelitian dan penyusunan skripsi.

Skripsi ini disusun sebagai salah satu bentuk kontribusi dalam pengembangan ilmu pengetahuan, khususnya pada bidang formulasi. Penulis menyadari bahwa masih terdapat aspek yang dapat dikembangkan lebih lanjut. Oleh karena itu, kritik dan saran yang konstruktif sangat diharapkan guna mendukung penyempurnaan penelitian selanjutnya. Besar harapan penulis agar skripsi ini dapat memberikan manfaat bagi dunia akademik.

Bandung, Juni 2026

Penulis

DAFTAR ISI

DAFTAR TABEL

DAFTAR GAMBAR

DAFTAR LAMPIRAN

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LAMPIRAN 1
HASIL OPTIMASI *BOX-BEHNKEN DESIGN*

1. Hasil Optimasi Nanoemulsi Pickering Brazilin

Formula	Kitosan -TPP %	Tween 80 %	VCO %	% Transmittan	SD
F1	50	2	0,5	94,679	±0,133
F2	25	0,5	1,25	93,378	±0,277
F3	25	2	1,25	95,285	±0,215
F4	25	1,25	0,5	95,779	±0,042
F5	75	2	1,25	95,196	±0,590
F6	50	1,25	1,25	94,712	±0,050
F7	75	1,25	2	90,569	±0,473
F8	75	1,25	0,5	95,328	±0,216
F9	50	1,25	1,25	95,046	±0,277
F10	25	1,25	2	89,686	±1,154
F11	50	0,5	2	78,365	±0,847
F12	50	0,5	0,5	95,206	±0,525
F13	50	2	2	81,924	±0,459
F14	75	0,5	1,25	91,967	±0,204
F15	50	1,25	1,25	92,59	±0,280

2. Data Perbandingan Hasil Aktual dan Prediksi BBD 15 Formula

Run	Actual Value	Predicted Value	Residual
1	94,68	98,06	-3,38
2	93,38	91,09	2,28
3	95,28	93,14	2,15
4	95,78	97,17	-1,39
5	95,20	92,87	2,33
6	94,71	91,98	2,73
7	90,57	86,79	3,78
8	95,33	96,90	-1,58
9	95,05	91,98	3,07
10	89,69	87,06	2,63
11	78,36	85,90	-7,54
12	95,21	96,02	-0,8097
13	81,92	87,95	-6,02
14	91,97	90,83	1,14

15	92,59	91,98	0,067

3. Rekomendasi Formula Persentase Transmitan Terbaik BBD

Number	P Mix	Tween 80	VCO	Transmittan	Desirability
1	25,003	2,000	0,500	98,191	0,910
2	25,359	2,000	0,500	98,189	0,909
3	26,114	2,000	0,500	98,185	0,909
4	25,006	1,993	0,500	98,182	0,909
5	27,178	2,000	0,500	98,179	0,909
6	27,431	2,000	0,500	98,178	0,909
7	27,961	2,000	0,500	98,175	0,909
8	25,773	1,991	0,500	98,175	0,909
9	28,244	2,000	0,500	98,174	0,909
10	28,920	2,000	0,500	98,170	0,909
11	29,599	2,000	0,500	98,167	0,908
12	25,000	1,984	0,501	98,164	0,908
13	30,353	2,000	0,500	98,163	0,908
14	32,413	2,000	0,500	98,152	0,908
15	25,000	2,000	0,506	98,151	0,908
16	25,000	1,968	0,500	98,148	0,907
17	33,189	2,000	0,500	98,147	0,907
18	33,865	2,000	0,500	98,144	0,907
19	34,647	2,000	0,500	98,140	0,907
20	34,961	2,000	0,500	98,138	0,907
21	35,884	2,000	0,500	98,133	0,907
22	36,470	2,000	0,500	98,130	0,906
23	36,819	2,000	0,500	98,128	0,906
24	37,298	2,000	0,500	98,125	0,906
25	38,731	2,000	0,500	98,118	0,906
26	39,856	2,000	0,500	98,111	0,906
27	40,478	2,000	0,500	98,108	0,905
28	41,431	2,000	0,500	98,103	0,905
29	43,487	2,000	0,500	98,092	0,905
30	43,698	2,000	0,500	98,091	0,905
31	44,376	2,000	0,500	98,088	0,904
32	44,819	2,000	0,500	98,085	0,904
33	29,708	2,000	0,512	98,085	0,904
34	47,082	2,000	0,500	98,073	0,904
35	48,363	2,000	0,500	98,066	0,903
36	48,552	2,000	0,500	98,065	0,903

37	48,874	2,000	0,500	98,064	0,903
38	50,046	2,000	0,500	98,057	0,903
39	53,480	2,000	0,500	98,039	0,902
40	25,001	1,888	0,500	98,039	0,902
41	28,858	1,901	0,500	98,036	0,902
42	54,946	2,000	0,500	98,031	0,902
43	25,000	2,000	0,525	98,020	0,901
44	57,934	2,000	0,500	98,015	0,901
45	59,216	2,000	0,500	98,008	0,900
46	60,018	2,000	0,500	98,004	0,900
47	60,914	2,000	0,500	97,999	0,900
48	61,314	2,000	0,500	97,997	0,900
49	62,084	2,000	0,500	97,993	0,900
50	62,505	2,000	0,500	97,991	0,900
51	25,000	1,849	0,500	97,986	0,899
52	65,499	2,000	0,500	97,975	0,899
53	67,019	2,000	0,500	97,967	0,898
54	67,473	2,000	0,500	97,964	0,898
55	67,759	2,000	0,500	97,963	0,898
56	69,049	2,000	0,500	97,956	0,898
57	69,396	2,000	0,500	97,954	0,898
58	71,259	2,000	0,500	97,944	0,897
59	71,839	2,000	0,500	97,941	0,897
60	72,629	2,000	0,500	97,937	0,897
61	73,303	2,000	0,500	97,933	0,897
62	25,000	1,806	0,500	97,927	0,896
63	74,732	2,000	0,500	97,925	0,896
64	75,000	2,000	0,507	97,878	0,894
65	25,005	1,751	0,500	97,852	0,893
66	74,985	1,926	0,500	97,823	0,891
67	25,001	1,726	0,500	97,818	0,891
68	25,003	1,671	0,500	97,743	0,887
69	75,000	1,849	0,500	97,719	0,886
70	74,995	1,829	0,500	97,691	0,885
71	25,000	1,553	0,500	97,582	0,879
72	25,001	1,521	0,500	97,540	0,877
73	25,000	1,468	0,500	97,467	0,873
74	25,074	1,434	0,500	97,420	0,871
75	25,002	1,337	0,500	97,288	0,864
76	25,000	1,326	0,500	97,273	0,864
77	75,000	1,512	0,500	97,260	0,863
78	25,000	1,299	0,500	97,237	0,862

79	75,000	1,473	0,500	97,207	0,860
80	25,004	1,120	0,500	96,992	0,850
81	25,000	1,094	0,500	96,957	0,848
82	74,999	1,231	0,500	96,877	0,844
83	25,001	0,867	0,500	96,649	0,832
84	75,000	0,858	0,500	96,370	0,818
85	74,999	1,029	0,543	96,313	0,816
86	25,001	0,606	0,500	96,294	0,815

4. Hasil Validasi Formula Terpilih Nanoemulsi Pickering Brazilin Berdasarkan Respon Transmitan

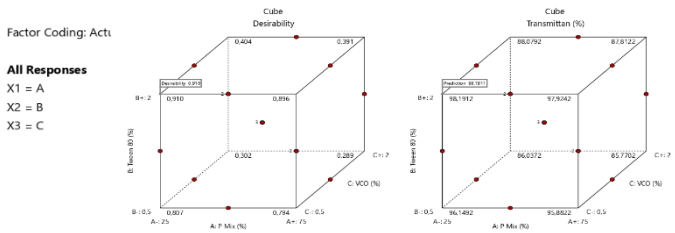
Data Respon Persen Transmitan

Faktor			Respon
Kitosan-TPP %	Tween 80 %	VCO %	Persentase transmitan
25	2	0,5	97,021
			97,486
			97,689
Rata-rata			97,399 ±0,280

Data Perbandingan Respon Prediksi dan Aktual Persen Transmitan

Respon	Hasil Prediksi	*n*	95% *PI low*	Hasil Aktual	95% *PI High*
Persentase Transmitan	98,0577 ±3,86767	3	91,1945	97,399 ±0,280	104,921

5. *Cube Plot* Hubungan Faktor Kitosan-TPP, Tween 80, Dan VCO, Terhadap Respon Persentase Transmitan



LAMPIRAN 2
HASIL KARAKTERISASI NANOEMULSI PICKERING

1. Hasil karakterisasi formula terpilih nanoemulsi Pickering Brazilin Berdasarkan Respon Transmitan

Karakterisasi	Hasil	Syarat	Pustaka
Uji Organoleptik	coklat jernih dan berbau asam yang tidak menyengat, tidak terjadi pemisahan fase	jernih, warna coklat dan tidak terjadi pemisahan fase	Ngamwonglumlert *et al* . (2020)
Viskositas (cP)	1,1571 $\pm$0,002	1-100	Perrin *et al* , (2023)
pH	4,22 $\pm$0,005	3,5-6,5	Zhai *et al* . (2026); Su *et al* . (2024)
Uji Sentrifugasi	Tidak terjadi *creaming*, pemisahan fase, dan pengendapan	Tidak terjadi *creaming*, pemisahan fase, dan pengendapan	Low *et al* . (2020)
Ukuran Droplet (nm)	36,17 $\pm$1,125	20-200 nm	Rosdianto *et al* . (2023); McClements (2020)
Polydisperisty Index (PDI)	0,59 $\pm$0,016	0,3-0,5	Danaei *et al* . (2018)
Zeta Potensial	-9,434	< -30 mV atau > +30 mV	Low *et al* . (2020) Mardhiani *et al* . (2022)

2. Hasil Uji Viskositas

F1. $BJ = \frac{25,3823-15,6105}{10mL} = \frac{9,778}{10} = 0,9771$

F2. $BJ = \frac{25,3806-15,6105}{10mL} = \frac{9,770}{10} = 0,9770$

F3. $BJ = \frac{25,3653-15,6105}{10mL} = \frac{9,754}{10} = 0,9754$

F1. $\frac{0,8}{n_2} = \frac{0,89}{0,9771} \times \frac{2,43}{3,20} =$

$\frac{0,8}{n_2} = \frac{2,1627}{3,1269} =$

$n_2 = \frac{0,8 \times 3,1269}{2,1627} =$

$n_2 = \frac{2,50152}{2,1627} = 1,1566\ cps$

F2. $\frac{0,8}{n_2} = \frac{0,89}{0,9770} \times \frac{2,43}{3,21} =$

$\frac{0,8}{n_2} = \frac{2,1627}{3,1362} =$

$n_2 = \frac{0,8 \times 3,1262}{2,1627} =$

$n_2 = \frac{2,5089}{2,1627} = 1,1601 cps$

F3. $\frac{0,8}{n_2} = \frac{0,89}{0,9754} \times \frac{2,43}{3,21} =$

$\frac{0,8}{n_2} = \frac{2,1627}{3,1215} =$

$n_2 = \frac{0,8 \times 3,1215}{2,1627} =$

$n_2 = \frac{2,4972}{2,1627} = 1,1571 cps$

3. Hasil Uji Sentrifugasi

Sebelum **Sesudah**

4. Hasil Karakterisasi Particle Size Analyzer & PDI

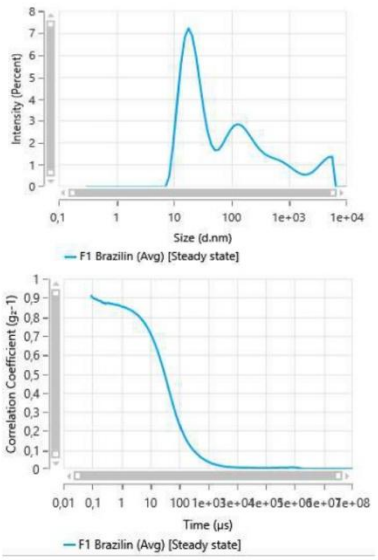
Technology

DKSH

HASIL ANALISIS
PARTICLE SIZE ANALYZER

Nama Mitra	: STFI Bandung
Nama Sampel	: Nanoemulsi Pickering Brazilin
Jenis Sampel	: Cairan
Penanggung Jawab	: Wiji Rahayu, S.Si.
Periode Pengerjaan	: 12 Juni 2026
Tempat Pengerjaan	: PT DKSH Market Expansion Services Indonesia

SIZE DISTRIBUTION



PT DKSH Market Expansion Services Indonesia
AIA Central 39th floor
Jalan Jenderal Sudirman Kav. 48A, Jakarta Pusat 12930. Indonesia
Phone +62 21 2988 8557

Delivering Growth – in Asia and Beyond.

Name	Mean	Standard Deviation	RSD	Minimum	Maximum
Z-Average (nm)	36,17	-	-	36,17	36,17
Polydispersity Index (PI)	0,5949	-	-	0,5949	0,5949
Peak 1 Mean by Intensity ordered by area (nm)	21,94	-	-	21,94	21,94
Peak 1 Area by Intensity ordered by area (%)	51,79	-	-	51,79	51,79
Peak 2 Mean by Intensity ordered by area (nm)	338,5	-	-	338,5	338,5
Peak 2 Area by Intensity ordered by area (%)	40,69	-	-	40,69	40,69

Penanggung Jawab Pengujian

Wiji Rahayu, S.Si.
Supervisor Field Application Services - SCS TEC

PT DKSH Market Expansion Services Indonesia
AIA Central 39th floor
Jalan Jenderal Sudirman Kav. 48A, Jakarta Pusat 12930. Indonesia
Phone +62 21 2988 8557

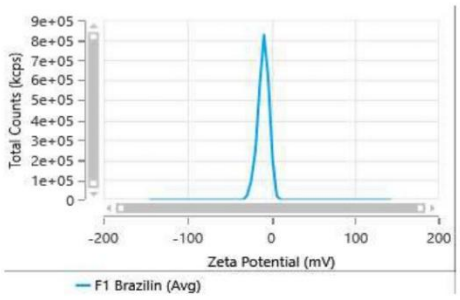
5. Hasil Karakterisasi Zeta Potensial

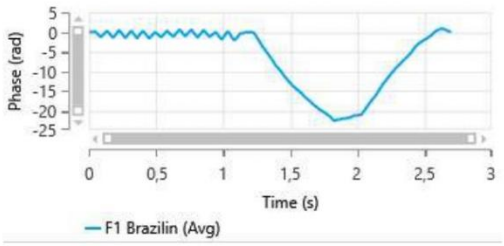
Technology

DKSH

HASIL ANALISIS
ZETA POTENSIAL

Nama Mitra	: STFI Bandung
Nama Sampel	: Nanoemulsi Pickering Brazilin
Jenis Sampel	: Cairan
Penanggung Jawab	: Wiji Rahayu, S.Si.
Periode Pengerjaan	: 12 Juni 2026
Tempat Pengerjaan	: PT DKSH Market Expansion Services Indonesia





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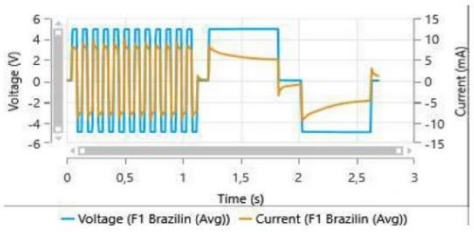
Delivering Growth – in Asia and Beyond.



Name	Mean	Standard Deviation	RSD	Minimum	Maximum
Zeta Potential (mV)	-9,434	-	-	-9,434	-9,434
Conductivity (mS/cm)	1,854	-	-	1,854	1,854
Wall Zeta Potential (mV)	0	-	-	0	0
Quality Factor	2,033	-	-	2,033	2,033
Zeta Peak 1 Mean (mV)	-9,434	-	-	-9,434	-9,434

Penanggung Jawab Pengujian

Wiji Rahayu, S.Si.
Supervisor Field Application Services - SCS TEC

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AIA Central 39th floor
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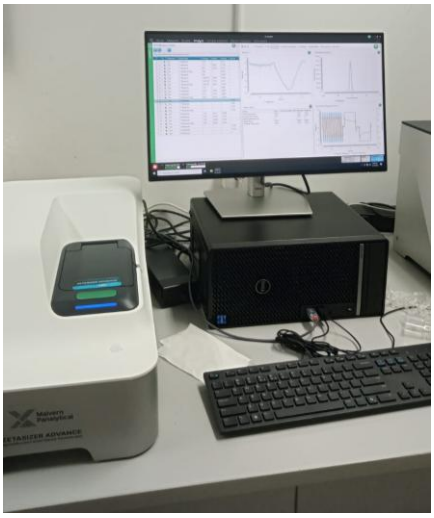
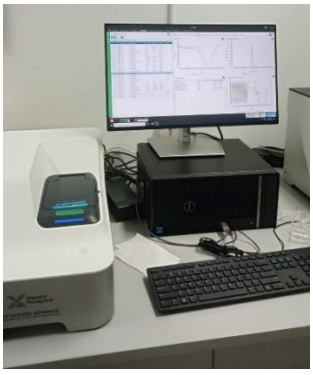
LAMPIRAN 3
PROSEDUR KERJA

	
Optimasi Formula Nanoemulsi Pickering Brazilin	Uji Persen Transmitan
	
Pembuatan Kitosan-TPP	Pembuatan Nanoemulsi Pickering Brazilin
	
Pembuatan Nanoemulsi Pickering Brazilin	Pembuatan Nanoemulsi Pickering Brazilin

	
Uji Organoleptik	Uji Viskositas
	
Uji pH	Uji Ukuran Droplet dan Indeks Polidisperistas
	
Uji Zeta Potensial	Uji Sentrifugasi

LAMPIRAN 4

CERTIFICATE OF ANALYSIS BRAZILIN

CERTIFICATE OF ANALYSIS

Product Name	: Zuiver Braz-45
Product ID	: PISBCS001
Batch Number	: ISB101025
Manufacture Date	: 10 10 2025
Re – Test Date	: 10 10 2028
Date of Release	: 30 10 2025

	RESULT
Organoleptic :	
Colour	Deep reddish brown
Form	Powder
Scent	Faint characteristic
Bioactive Content :	
Brazilin	45.00 % (HPLC)
Physcochemistry Characteristics :	
Absorbance UV/Vis	328 - 515 nm
Melting point	N/A
Loss on drying	N/A
pH	N/A
Solubility :	
Water	N/A
Ethanol	N/A
Methanol	N/A
Chlorofom	N/A
N - Hexan	N/A
Mikrobiology :	
Total Plate Count	N/A
Yeast Mold Count	N/A
E. Coli	N/A
S. Aureus	N/A
Salmonella sp.	N/A
P. Aerogenosa	N/A
Heavy Metal Residue :	
Cd	N/A
As	N/A
Hg	N/A
Pb	N/A
Solvent Residue :	
Ethanol	N/A
Methanol	N/A
N - Hexan	N/A
Etyl acetate	N/A

Quality Control

Betty Handayani, S.Farm

CERTIFICATE OF ANALYSIS MINYAK *VIRGIN COCONUT OIL*

CERTIFICATE OF ANALYSIS

"MINYAK KELAPA / VCO "

ANALYTICAL CHARACTERISTICS	METHODS	NORMS	RESULTS
Organoleptic characteristics	Internal	Unctuous mass, typical smell and taste	conform
Color		white	conform
Melting point [C]	AOCS Cc3b-93	20-28	25
Acid value [mg KOH/g]	PE 2.5.1	0,00-2,00	0,06
Peroxide value [meq O2/kg]	PE 2.5.5	0,00-10,0	0,2
FATTY ACID COMPOSITION(%)	**METHOD**	**NORMS**	**RESULTS**
C 6:0 Caproic Acid	PE 2.4.22	0,00 - 1,50	0,60
C 8:0 Caprilic Acid		5,00 - 14,50	7,60
C 10:0 Capric Acid		4,00 - 9,00	6,10
C 12:0 Lauric Acid		40,00 - 55,00	49,20
C 14:0 Myristic Acid		15,00 - 20,00	19,20
C 16:0 Palmitic Acid		3,50 - 12,00	8,40
C 18:0 Stearic Acid		1,500 - 5,00	3,20
C 18:1 Oleic Acid		2,00 - 10,00	4,70
C 18:2 Linoleic Acid		0,00 - 3,00	0,80
C 18:3 Linolenic Acid		0,00 - 0,20	0,00
C 20:0 Arachidic Acid		0,00 – 0,20	0,20
C 20:1 Eicosenoic Acid		0,00 – 0,20	0,10

CERTIFICATE OF ANALYSIS ASAM ASETAT

CERTIFICATE OF ANALYSIS

No : 0818/OQA/IA/03/25
Commercial Name : ACETIC ACID
Product Name : ACETIC ACID
Date Received : 05 – 03 – 2025
Date of Testing : 05 – 03 – 2025
Tested For : FULL ANALYSIS
Description of Sample : 1 BOTTLE 500ml
LOT. No : 05032505C04 MANUF. 04.03.2025 EXP. 05.03.2031

This Sample was analysed in our QA Analytical Laboratory and the Following result were obtained

No	PARAMETER	DIMENTION	TEST METHOD	RESULT	SPECIFICATION
1	Water Content	ppm	ASTM E – 1064	940	Max. 1500
2	Colour	APHA	ASTM D – 1209	3	Max. 10
3	Acid Content	wt %	ASTM E – 302	99.88	Min. 99.85
4	Appearance	-	VISUAL	clear	Clear
5	Formic Acid	wt %	ASTM D – 3546	0.005	Max. 0.05
6	Acetaldehyde	wt %	ASTM D – 2191	0.005	Max. 0.05
7	Sulphate	ppm	SGS RSP0088	< 1	Max. 1
8	Iron	ppm	ASTM E – 394	0.02	Max. 0.4
9	Chloride	ppm	SGS RSP0055	< 1	Max. 1
10	Residu After Evaporation	ppm	ASTM D – 1353	< 1	Max. 20
11	Specific Grafity at 20/20 °C	-	ASTM D – 4052	1.0513	1.0505-1.052
12	Freezing Point	°C	ASTM E – 302	16.4	Min. 16.35

keep container tightly closed, keep away from heat/sparks, store in well – ventilated place.

Approved by
(ANIK SULISTIYOWATI)
Head of Laboratory

Surakarta, 05 Maret 2025
QA – analyst
(Ari Widodo)

***CERTIFICATE OF ANALYSIS* KITOSAN**

Result Of Analysis

pharma

Source : SHRIMPSHELL extract

Batch : chs_0424

Production Date : April, 2024

Qty : 1Kg

Exp Date : April, 2027

Parameter	Result
Colour / Appearance	White
Particle Size	powder
Moisture Regaint	9.88%
Residue Of Ignition	0.89%
Degree Of Deacetylation	98.03%
Viscosity	198.21mPas
Molecular Weight	75.02KDa
Proteint Content	< 0.2 %
Heavy Metals	< 3ppm
Micro Organism	Negative

Indramayu, June 03rd, 2024

Kitosan Udang
Phy Edumedia

QC & QA

CERTIFICATE OF ANALYSIS NATRIUM TRIPOLIFOSFAT

PETROCENTRAL

Date : April 24, 2026
No. : 017/ROA/PCG/IV/2026

REPORT OF ANALYSIS

MATERIAL	: SODIUM TRIPOLYPHOSPHATE TECHNICAL GRADE
APPEARANCE	: WHITE, FREE-FLOWING FINE POWDER
PACKING	: NETTO 25 KG IN POLYPROPYLENE WOVEN BAG WITH POLYETHYLENE INNER
BATCH NO.	: 2004861
DATED OF MANUFACTURE	: APRIL 8, 2026
EXPIRY DATE	: APRIL 8, 2028
FOSFINDO'S DELIVERY NOTE NO.	: 000056 & 000057

Parameter	*Unit*	*Specification*	*Result*
Bulk Density	kg/L	0.6 - 1.0	0.781
Sodium Tripolyphosphate ($Na_5P_3O_{10}$)	% m/m	min. 92	99.1
pH 1 % solution	-	9.0 - 10.2	9.9
P_2O_5	% m/m	min. 56.0	56.58
Phase I	% m/m	10 - 45	19
Moisture	% m/m	max. 1.0	0.03
Iron (Fe)	mg/kg	max. 100	89.1
Water insolubles	% m/m	max. 0.1	0.03
Particle size cumulative			
- Retained on USS mesh 20	% m/m	max. 0.5	0.0
- Retained on USS mesh 100	% m/m	max. 15	2.4

PT. PETROCENTRAL

PETROCENTRAL

Quality Control

CERTIFICATE OF ANALYSIS TWEEN 80

3050 Spruce Street, Saint Louis, MO 63103, USA
Website: www.sigmaaldrich.com
Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Product Specification

Product Name:
TWEEN® 80 - for synthesis

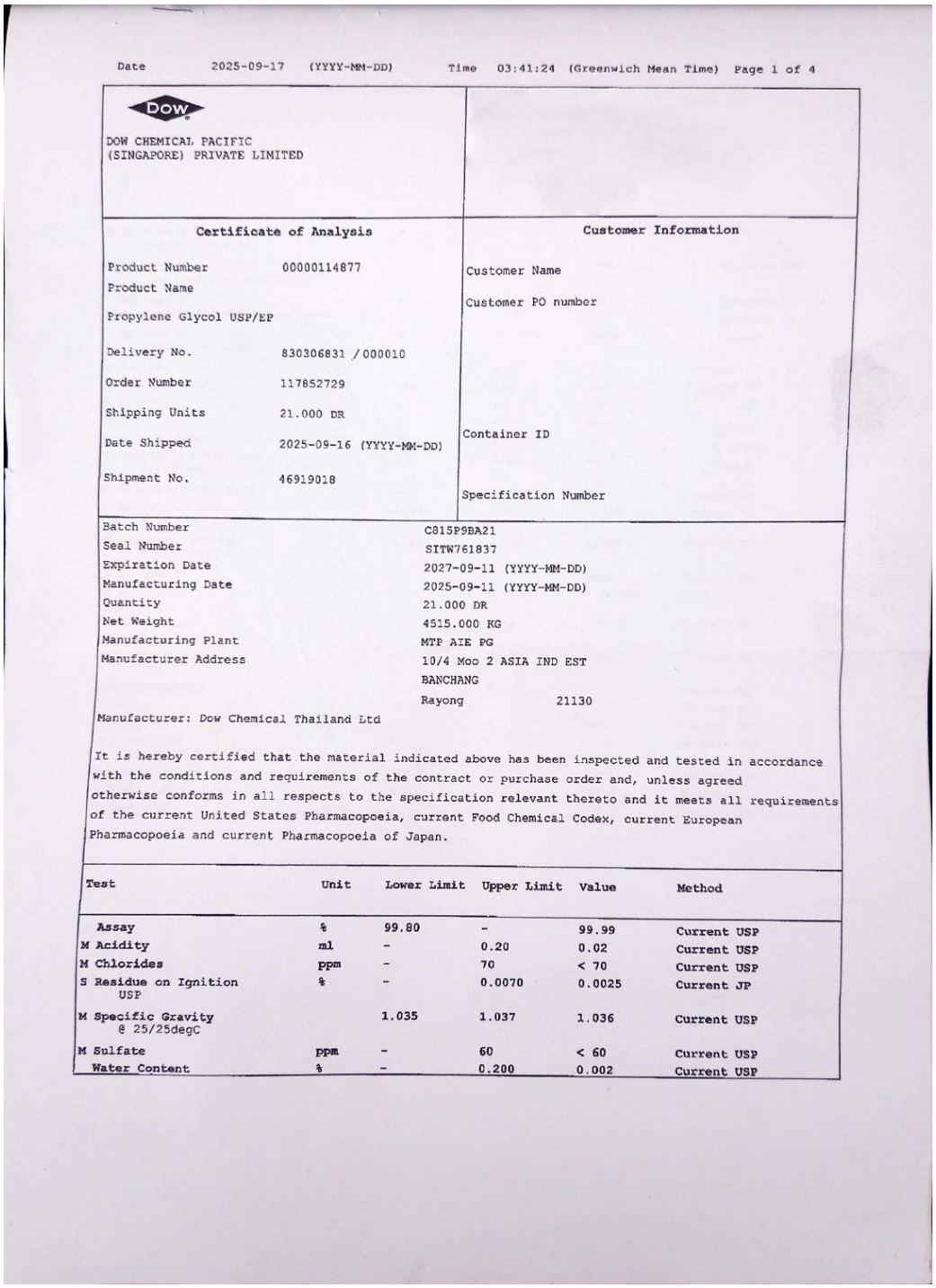
Product Number: **8.22187**
CAS Number: 9005-65-6

TEST	Specification
Density (D20/4)	1.060 - 1.090
Infrared Spectrum	Passes Test
Hydroxyl value	65 - 80
Saponification Value	45 - 55

Remarks:
Due to its specific melting range the product may be solid, liquid, a solidified melt or a supercooled melt.

Specification: PRE.0.ZQ5.10000025541

CERTIFICATE OF ANALYSIS PROPILEN GLIKOL



Date 2025-09-17 (YYYY-MM-DD) Time 03:41:24 (Greenwich Mean Time) Page 1 of 4

DOW CHEMICAL PACIFIC
(SINGAPORE) PRIVATE LIMITED

Certificate of Analysis

Product Number	00000114877
Product Name	Propylene Glycol USP/EP
Delivery No.	830306831 / 000010
Order Number	117852729
Shipping Units	21.000 DR
Date Shipped	2025-09-16 (YYYY-MM-DD)
Shipment No.	46919018

Customer Information

Customer Name

Customer PO number

Container ID

Specification Number

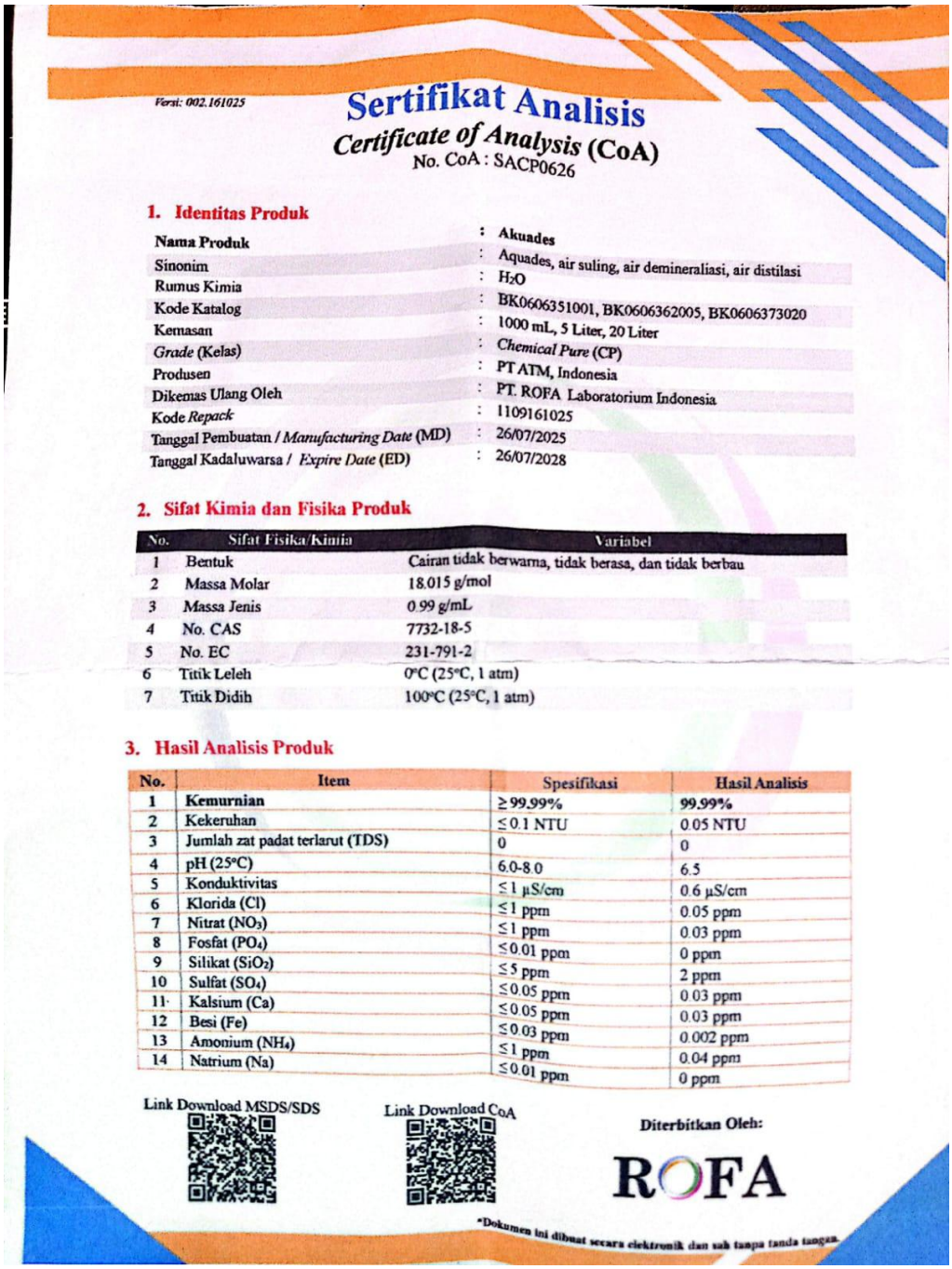
Batch Number	C815P9BA21
Seal Number	SITW761837
Expiration Date	2027-09-11 (YYYY-MM-DD)
Manufacturing Date	2025-09-11 (YYYY-MM-DD)
Quantity	21.000 DR
Net Weight	4515.000 KG
Manufacturing Plant	MTP AIE PG
Manufacturer Address	10/4 Moo 2 ASIA IND EST BANCHANG Rayong 21130

Manufacturer: Dow Chemical Thailand Ltd

It is hereby certified that the material indicated above has been inspected and tested in accordance with the conditions and requirements of the contract or purchase order and, unless agreed otherwise conforms in all respects to the specification relevant thereto and it meets all requirements of the current United States Pharmacopoeia, current Food Chemical Codex, current European Pharmacopoeia and current Pharmacopoeia of Japan.

Test	Unit	Lower Limit	Upper Limit	Value	Method
Assay	%	99.80	-	99.99	Current USP
M Acidity	ml	-	0.20	0.02	Current USP
M Chlorides	ppm	-	70	< 70	Current USP
S Residue on Ignition USP	%	-	0.0070	0.0025	Current JP
M Specific Gravity @ 25/25degC		1.035	1.037	1.036	Current USP
M Sulfate	ppm	-	60	< 60	Current USP
Water Content	%	-	0.200	0.002	Current USP

***CERTIFICATE OF ANALYSIS* AQUADEST**



Versi: 002.161025

Sertifikat Analisis

Certificate of Analysis (CoA)

No. CoA : SACP0626

1. Identitas Produk

Nama Produk	:	**Akuades**
Sinonim	:	Aquades, air suling, air demineraliasi, air distilasi
Rumus Kimia	:	H_2O
Kode Katalog	:	BK0606351001, BK0606362005, BK0606373020
Kemasan	:	1000 mL, 5 Liter, 20 Liter
Grade (Kelas)	:	*Chemical Pure* (CP)
Produsen	:	PT ATM, Indonesia
Dikemas Ulang Oleh	:	PT. ROFA Laboratorium Indonesia
Kode *Repack*	:	1109161025
Tanggal Pembuatan / *Manufacturing Date* (MD)	:	26/07/2025
Tanggal Kadaluwarsa / *Expire Date* (ED)	:	26/07/2028

2. Sifat Kimia dan Fisika Produk

No.	Sifat Fisika/Kimia	Variabel
1	Bentuk	Cairan tidak berwarna, tidak berasa, dan tidak berbau
2	Massa Molar	18.015 g/mol
3	Massa Jenis	0.99 g/mL
4	No. CAS	7732-18-5
5	No. EC	231-791-2
6	Titik Leleh	0°C (25°C, 1 atm)
7	Titik Didih	100°C (25°C, 1 atm)

3. Hasil Analisis Produk

No.	Item	Spesifikasi	Hasil Analisis
1	**Kemurnian**	≥ 99.99%	**99.99%**
2	Kekeruhan	≤ 0.1 NTU	0.05 NTU
3	Jumlah zat padat terlarut (TDS)	0	0
4	pH (25°C)	6.0-8.0	6.5
5	Konduktivitas	≤ 1 µS/cm	0.6 µS/cm
6	Klorida (Cl)	≤ 1 ppm	0.05 ppm
7	Nitrat (NO_3)	≤ 1 ppm	0.03 ppm
8	Fosfat (PO_4)	≤ 0.01 ppm	0 ppm
9	Silikat (SiO_2)	≤ 5 ppm	2 ppm
10	Sulfat (SO_4)	≤ 0.05 ppm	0.03 ppm
11	Kalsium (Ca)	≤ 0.05 ppm	0.03 ppm
12	Besi (Fe)	≤ 0.03 ppm	0.002 ppm
13	Amonium (NH_4)	≤ 1 ppm	0.04 ppm
14	Natrium (Na)	≤ 0.01 ppm	0 ppm

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Diterbitkan Oleh:

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*Dokumen ini dibuat secara elektronik dan sah tanpa tanda tangan.