V. SIMPULAN DAN SARAN

A. Simpulan

Berdasarkan penelitian yang dilakukan, dapat disimpulkan:

1. Ekstrak etanol dan heksana daun bangle mengandung alkaloid, flavonoid, terpenoid, dan steroid. Ekstrak etanol mengandung saponin, sedangkan ekstrak heksana tidak mengandung saponin.
2. Daun bangle yang diekstrak menggunakan etanol dan heksana memiliki aktivitas antibakteri yang tidak berbeda nyata dari kontrol negatif berupa larutan *Dimethyl Sulfoxide* (DMSO), pelarut etanol, dan heksana.
3. Konsentrasi hambat minimum ekstrak daun bangle terhadap *Escherichia coli* yaitu 95 mg/ml dan konsentrasi hambat minimum terhadap *Staphylococcus aureus* yaitu 0,3 mg/ml.

B. Saran

1. Zona hambat yang dihasilkan ekstrak daun bangle tidak berbeda nyata dengan kontrol negatif, sehingga perlu dilakukan penelitian lebih lanjut untuk meningkatkan potensi antibakteri daun bangle. Hal ini dapat dilakukan dengan:
   a) Meningkatkan konsentrasi ekstrak yang digunakan dalam uji aktivitas antibakteri: konsentrasi ekstrak yang digunakan sebesar 100 mg/ml sehingga perlu dilakukan penelitian lanjutan untuk mengetahui potensi antibakteri ekstrak daun bangle pada konsentrasi >100mg/ml.

b) Mengubah metode ekstraksi: kandungan fitokimia dalam daun bangle lebih sedikit daripada rimpang, sehingga metode ekstraksi remaserasi disarankan untuk mengoptimalkan ekstraksi keseluruhanfitokimia dalam daun bangle.

c) Penggunaan pelarut non-polar: senyawa aktifantibakteri bangle diketahui berasal dari golongan terpenoid yang bersifat non-polar, sehingga penggunaan pelarut non-polarlebih disarankan.

2. Sejumlah senyawa terpenoid bersifat volatil. Aroma khas yang kuat dalam daun bangle menunjukkan keberadaan senyawa volatil yang diketahui memiliki aktivitas antibakteri.Ekstraksi senyawa terpenoid menggunakan destilator juga disarankan untuk mengekstrak keseluruhan terpenoid (volatil dan non-volatil) yang terlarut dalam minyak esensial.
3. Isolasi kandungan fitokimia spesifik dengan pemisahan dan pemurnian menggunakan pelarut bertingkat atau menggunakan kromatografi kolom dapat meningkatkan penggunaan daun bangle sebagai sumber senyawa antibakteri. Sejumlah senyawa antibakteri spesifik yang telah diisolasi dapat menghasilkan aktivitas antibakteri yang lebih baik.
4. Rimpang dan daun bangle dari tanaman berumur kurang dari 1 tahun dimungkinkan mengandung sejumlah fitokimia dalam konsentrasi lebih tinggi sehingga penggunaan rimpang dan daun dari tanaman berumur kurang dari 1 tahunlebih disarankan untuk memperoleh daya antibakteri yang lebih baik.

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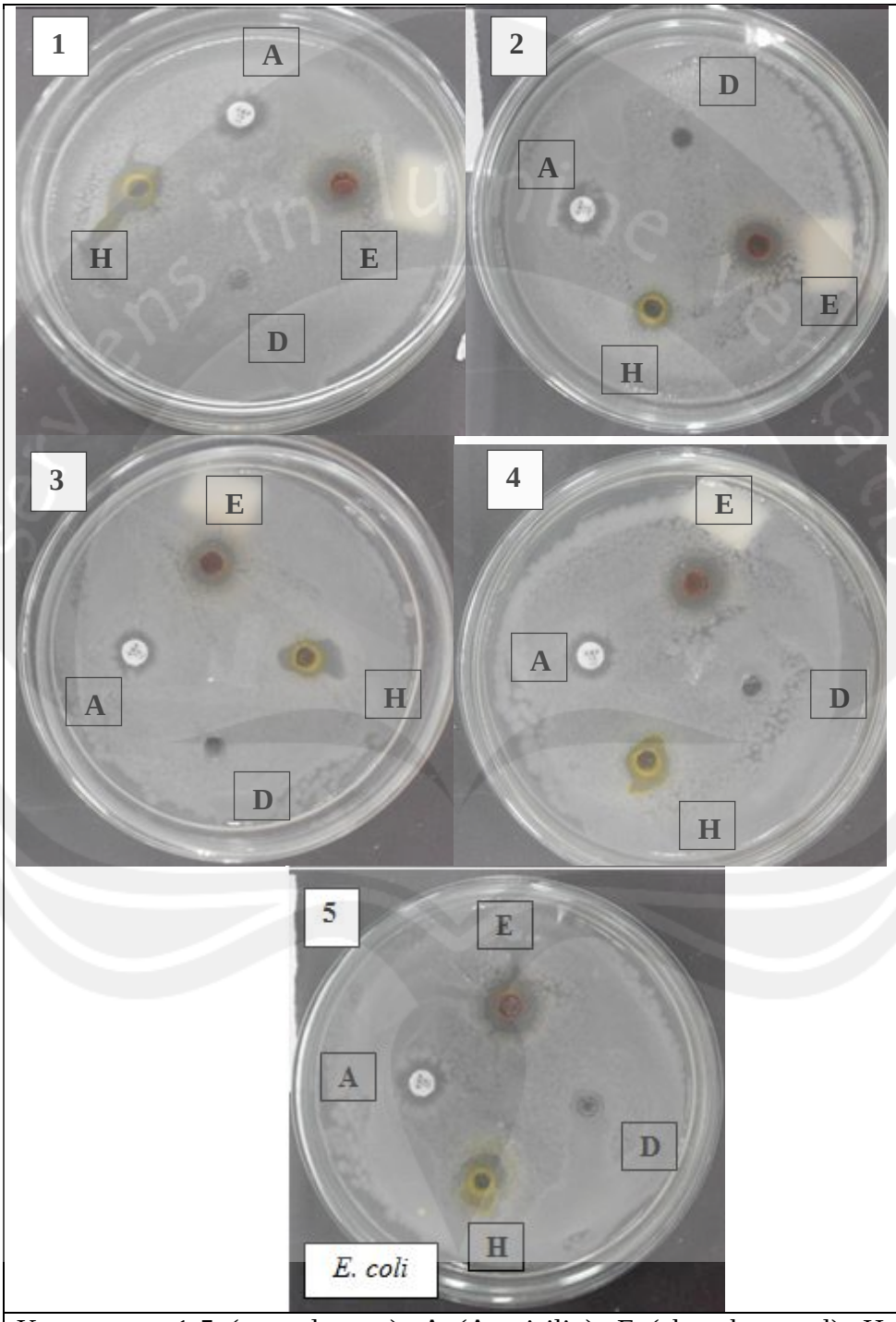
LAMPIRAN

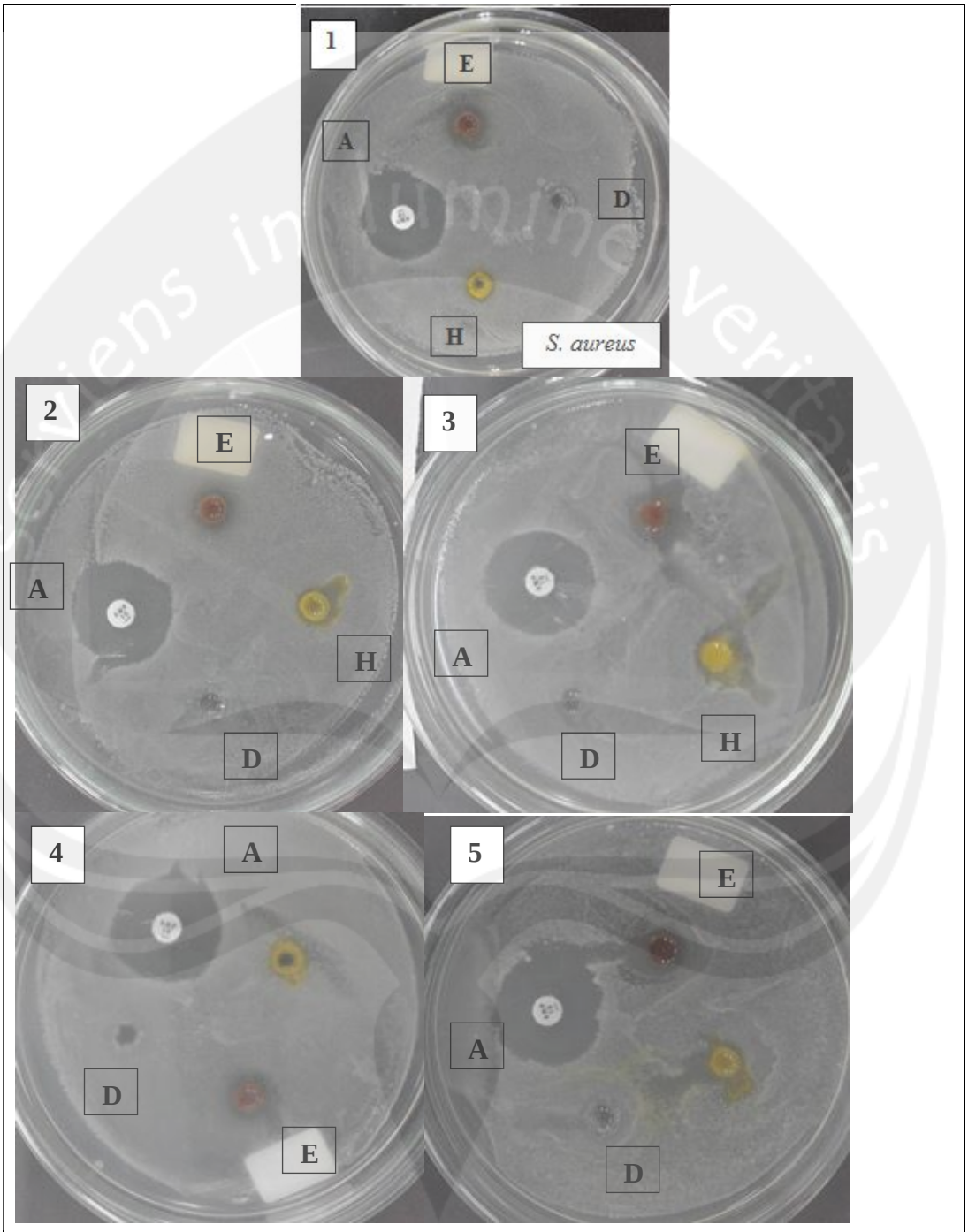
Lampiran 4. Zona hambat ekstrak daun bangle dan kontrol



Keterangan: 1-5 (pengulangan), A (Ampisilin), E (ekstrak etanol), H (ekstrak heksana), D (larutan DMSO).

Gambar 32. Hasil uji aktivitas antibakeri ekstrak etanol dan heksana daun bangle terhadap *E. coli* (Sumber: dokumentasi pribadi).

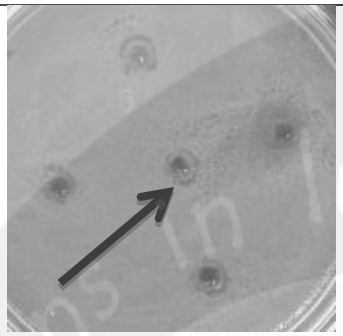
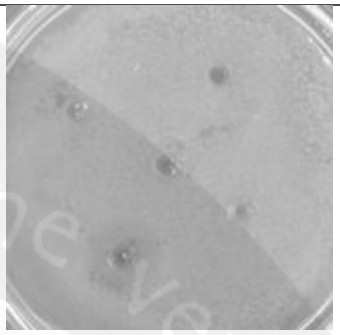
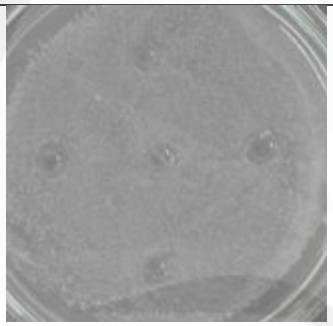
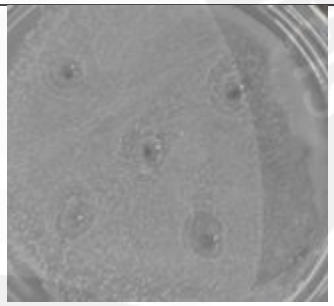
Lampiran 1



Keterangan: 1-5 (pengulangan), A (Ampisilin), E (ekstrak etanol), H (ekstrak heksana), D (larutan DMSO)

Gambar 33. Hasil uji aktivitas antibakeri ekstrak etanol dan heksana daun bangle terhadap *S. aureus* (Sumber: dokumentasi pribadi)

Lampiran 1

Etanol	Heksana
Escherichia coli	
	
Keterangan: pelarut etanol menghasilkan zona hambat terhadap *E. coli* (bagian yang ditunjuk	Keterangan: tidak terdapat zona hambat
S. aureus	
	
Keterangan: tidak terdapat zona hambat	

Gambar 34. Hasil uji aktivitas antibakteri kontrol negatif pelarut etanol dan heksana (Sumber: dokumentasi pribadi)

Lampiran 1

Tabel 13. Luas Zona Hambat Ekstrak dan Kontrol

Escherichia coli							
Etanol							
Ulangan	d	r	LZH 1	LZH 2	LZH ekstrak		
1	1,2	0,6	1,130	0,292	0,839		
2	1,2	0,6	1,130	0,292	0,839		
3	1,1	0,55	0,950	0,292	0,658		
4	1,2	0,6	1,130	0,292	0,839		
5	1,2	0,6	1,130	0,292	0,839		
Rata-rata					0,803		
Heksana							
Ulangan	d1	d2	rata2 d	r	LZH 1	LZH 2	LZH ekstrak
1	1,1	1,2	1,150	0,575	1,038	0,292	0,747
2	1	1	1,000	0,500	0,785	0,292	0,493
3	0,9	1,1	1,000	0,500	0,785	0,292	0,493
4	0,9	1,5	1,200	0,600	1,130	0,292	0,839
5	1	1,4	1,200	0,600	1,130	0,292	0,839
Rata-rata							0,682
Kontrol Positif Ampisilin							
ulangan	d1	d2	rata2 d	r	LZH kontrol		
1	1,1	1,1	1,100	0,550	0,950		
2	1	1	1,000	0,500	0,785		
3	1	1	1,000	0,500	0,785		
4	1	1	1,000	0,500	0,785		
5	1	1,1	1,050	0,525	0,865		
Rata-rata					0,834		
Kontrol Negatif: pelarut etanol							
ulangan	r	LZH 1	LZH 2	LZH kontrol			
1	0,4	0,502	0,292	0,211			
2	0,4	0,502	0,292	0,211			
3	0,4	0,502	0,292	0,211			
4	0,4	0,502	0,292	0,211			
5	0,4	0,502	0,292	0,211			
Rata-rata				0,211			

Keterangan

d : diameter (cm)
d1: diameter terpendek (cm)
d2: diameter terpanjang (cm)
r: jari-jari (cm)

LZH: Luas Zona Hambat (cm^2)
LZH 1: LZH ekstrak dan sumuran (cm^2)
LZH 2: LZH sumuran (cm^2)

Lampiran 1

Tabel 9 (Lanjutan)

Staphylococcus aureus							
Etanol							
Ulangan	d	r	LZH 1	LZH 2	LZH ekstrak		
1	1	0,5	0,785	0,292	0,493		
2	1	0,5	0,785	0,292	0,493		
3	1	0,5	0,785	0,292	0,493		
4	1	0,5	0,785	0,292	0,493		
5	1	0,5	0,785	0,292	0,493		
Rata-rata					0,493		
Heksana							
Ulangan	d1	d2	Rata-rata d	r	LZH 1	LZH 2	LZH ekstrak
1	0,9	0,9	0,900	0,450	0,636	0,292	0,344
2	0,9	0,9	0,900	0,450	0,636	0,292	0,344
3	0,9	1,2	1,050	0,525	0,865	0,292	0,574
4	0,9	1,2	1,050	0,525	0,865	0,292	0,574
5	0,9	0,9	0,900	0,450	0,636	0,292	0,344
Rata-rata							0,436
Kontrol Positif Ampisilin							
Ulangan	d1	d2	Rata-rata d	R	LZH kontrol		
1	2,3	2,5	2,400	1,200	4,522		
2	2,4	2,4	2,400	1,200	4,522		
3	2,4	2,5	2,450	1,225	4,712		
4	2,4	2,4	2,400	1,200	4,522		
5	2,5	2,5	2,500	1,250	4,906		

Keterangan
d : diameter (cm)
d1: diameter terpendek (cm)
d2: diameter terpanjang (cm)
r: jari-jari (cm)
LZH: Luas Zona Hambat (cm^2)
LZH 1: LZH ekstrak dan sumuran (cm^2)
LZH 2: LZH sumuran (cm^2)

Lampiran 5. Hasil uji ANAVA dan DMRT

ANALISIS VARIASI

Between-Subjects Factors

		Value Label	N
Bakteri	1	Escherichia coli	30
	2	Staphylococcus aureus	30
Perlakuan	1	Ekstrak_etanol	10
	2	Ekstrak_heksan	10
	3	Kontrol_Ampisilin	10
	4	Kontrol_DMSO	10
	5	Kontrol_etanol	10
	6	Kontrol_heksan	10

Uji Antarpengaruh Perlakuan

Dependent Variable:LZH

Source	Type II Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	58.790[a]	6	9.798	15.656	.000
Intercept	27.309	1	27.309	43.636	.000
Bakteri	3.840	1	3.840	6.136	.016
Perlakuan	54.950	5	10.990	17.560	.000
Error	33.170	53	.626		
Total	119.269	60			
Corrected Total	91.960	59			

a. R Squared = ,639 (Adjusted R Squared = ,598)

Perkiraan Marjinal

1. Bakteri

Dependent Variable:LZH

Bakteri	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Escherichia coli	.422	.144	.132	.711
Staphylococcus aureus	.928	.144	.638	1.217

2. Perlakuan

Dependent Variable:LZH

Perlakuan	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Ekstrak_etanol	.648	.250	.146	1.150
Ekstrak_heksan	.559	.250	.057	1.061
Kontrol_Ampisilin	2.735	.250	2.234	3.237
Kontrol_DMSO	-2.13E-16	.250	-.502	.502
Kontrol_etanol	.105	.250	-.396	.607
Kontrol_heksan	6.10E-16	.250	-.502	.502

Gambar 35. Hasil uji ANAVA(Sumber: dokumentasi pribadi)

Lampiran 2

LZH

Duncan

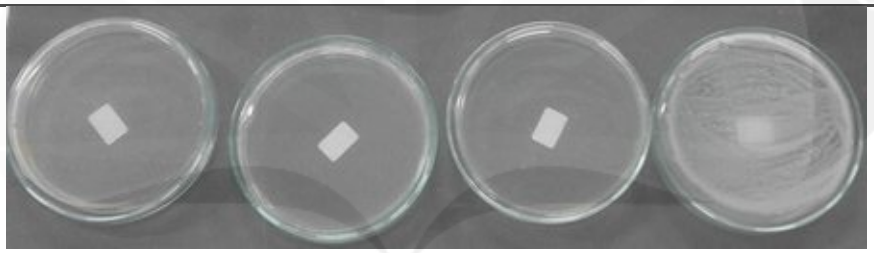
Perlakuan	N	Subset 1	Subset 2
Kontrol_DMSO	10	.00000	
Kontrol_heksan	10	.00000	
Kontrol_etanol	10	.10550	
Ekstrak_heksan	10	.55910	
Ekstrak_etanol	10	.64790	
Kontrol_Ampisilin	10		2.73540
Sig.		.108	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = ,626.

Gambar 36. Hasil uji DMRT (Sumber: dokumentasi pribadi)

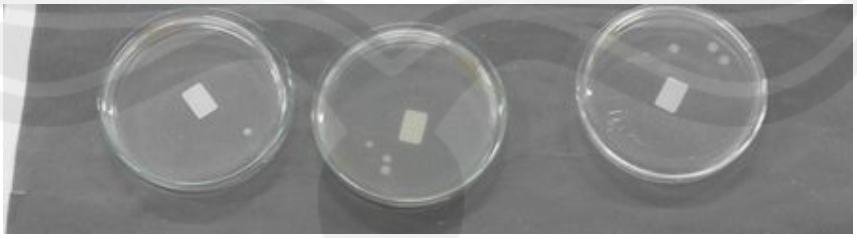
Lampiran 6. Pengujian konsentrasi hambat minimum (KHM)

A. *Escherichia coli*

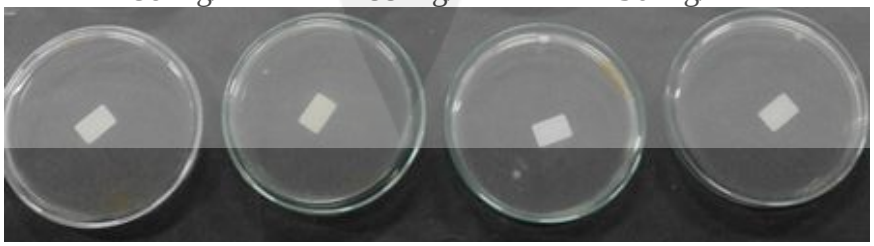


100 mg/ml, 95 mg/ml, 90 mg/ml, kontrol positif, kontrol negatif

Keterangan: konsentrasi 100 mg/ml, 95 mg/ml, dan kontrol positif tidak ada pertumbuhan bakteri

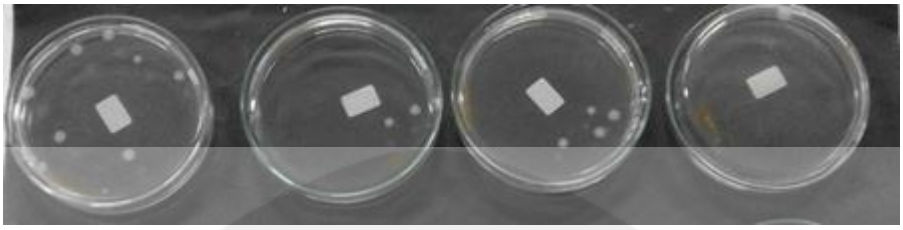


86 mg/ml 88 mg/ml 90 mg/ml

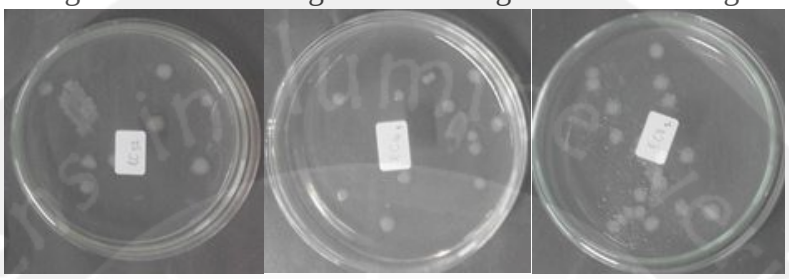


75 mg/ml 80 mg/ml 82 mg/ml 84 mg/ml

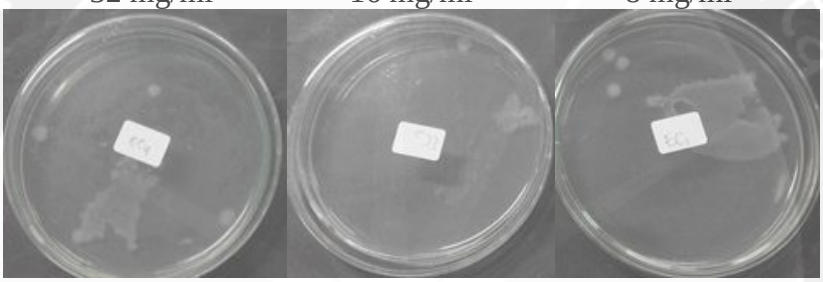
Gambar 37. Hasil uji KHM ekstrak etanol daun bangle (Sumber: dokumentasi pribadi)



64 mg/ml 66 mg/ml 68 mg/ml 70 mg/ml

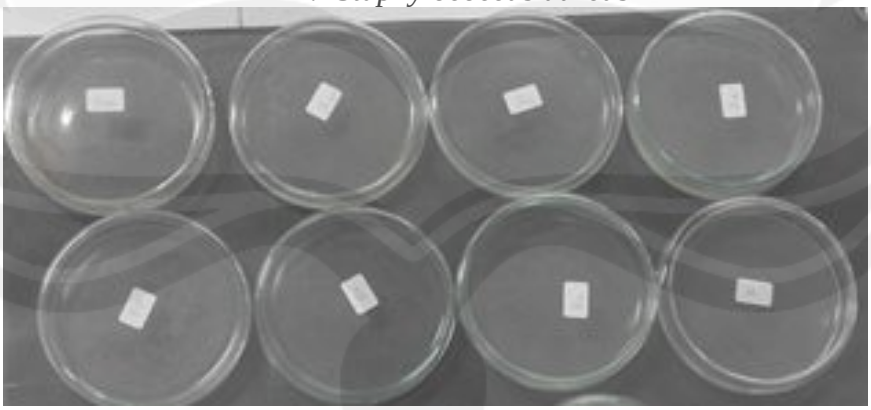


32 mg/ml 16 mg/ml 8 mg/ml



4 mg/ml 2 mg/ml 1 mg/ml

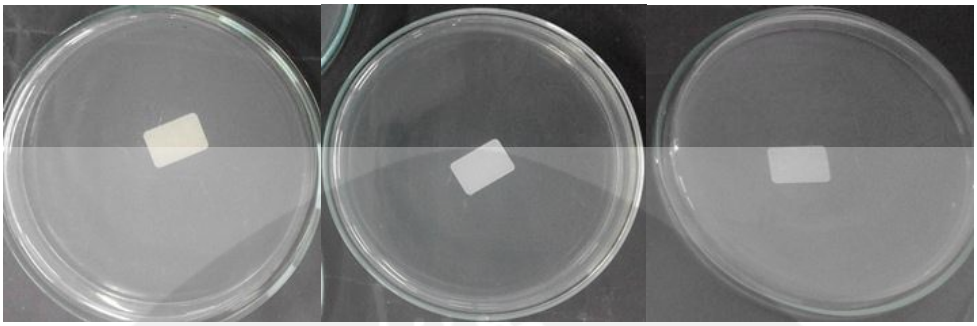
B. *Staphylococcus aureus*



1, 2, 4, 8, 16, 32, 64, 100 mg/ml

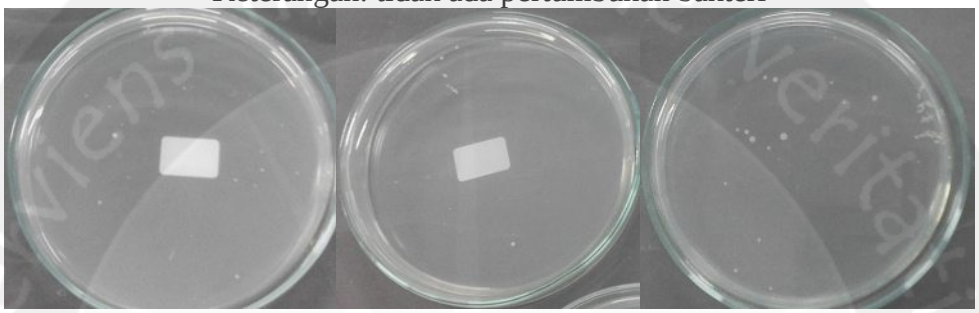
Keterangan: tidak ada pertumbuhan bakteri

Gambar 35 (lanjutan)



0,5 mg/ml 0,4 mg/ml 0,3 mg/ml

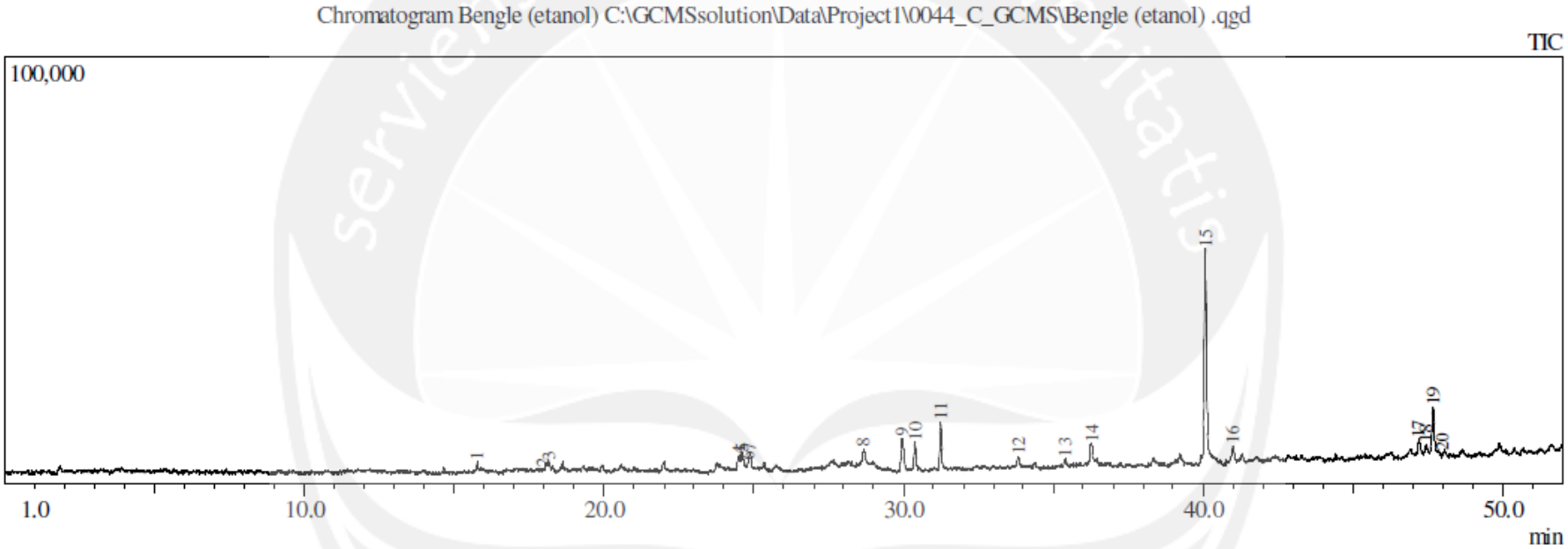
Keterangan: tidak ada pertumbuhan bakteri



0,2 mg/ml 0,1 mg/ml 0,05 mg/ml

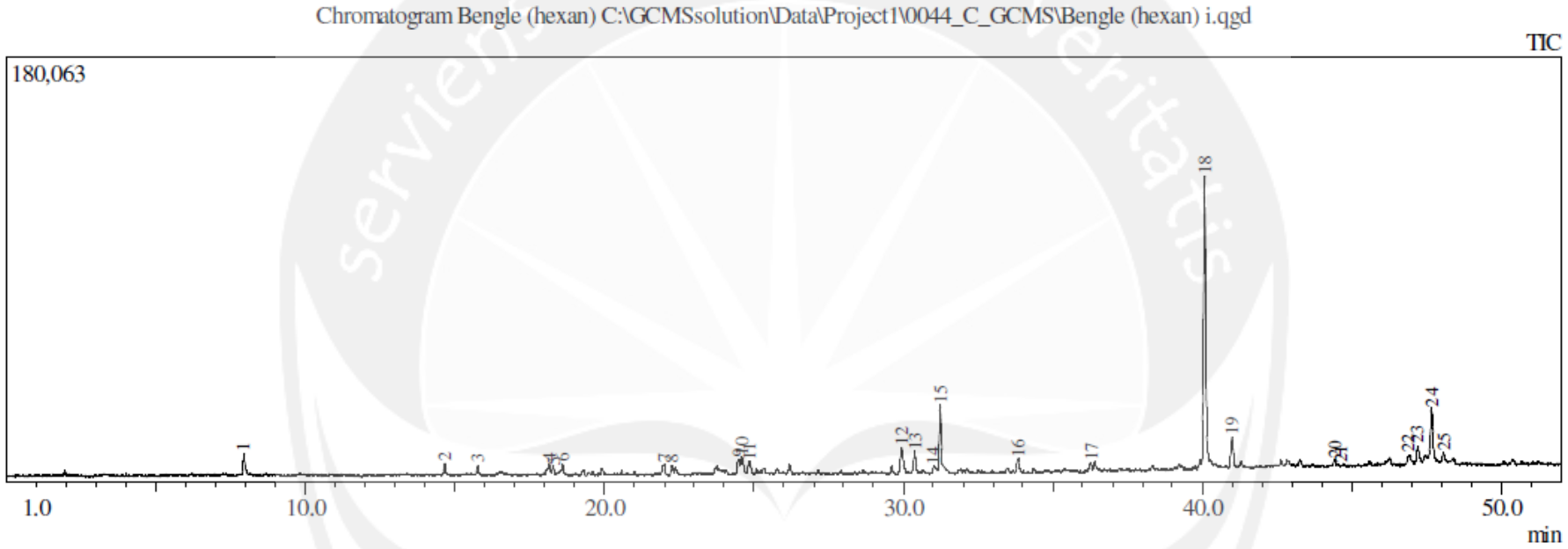
Gambar 35 (Lanjutan)

Lampiran 4. Hasil uji GC/MS



Gambar 36. Kromatogram ektrak etanol daun bangle (Sumber: dokumentasi pribadi).
Keterangan: terdapat 20 *peak* yang menunjukkan keberadaan senyawa volatil

Lampiran 4.



Gambar 37. Kromatogram ekstrak heksan daun bangle (Sumber: dokumentasi pribadi).
Keterangan: terdapat 25 *peak* yang menunjukkan keberadaan senyawa volatil

Lampiran 4

ETANOL

Peak Report TIC

Peak#	R.Time	I.Time	F.Time	Area	Area%	Height
1	15.783	15.733	15.842	5996	1.01	1952
2	17.958	17.942	18.025	1945	0.33	714
3	18.174	18.025	18.242	16071	2.70	2089
4	24.500	24.433	24.575	19040	3.20	3168
5	24.602	24.575	24.700	20921	3.51	3957
6	24.817	24.700	24.833	7968	1.34	1838
7	24.867	24.833	24.983	20526	3.45	3733
8	28.661	28.567	28.775	20775	3.49	3346
9	29.964	29.875	30.067	37942	6.37	7297
10	30.387	30.300	30.483	31511	5.29	6346
11	31.243	31.158	31.333	46174	7.75	10943
12	33.826	33.800	33.908	4794	0.80	1384
13	35.414	35.333	35.433	5404	0.91	1343
14	36.265	36.208	36.317	16663	2.80	4190
15	40.075	39.975	40.217	231640	38.90	48673
16	40.996	40.950	41.058	9321	1.57	2581
17	47.209	47.150	47.300	13993	2.35	3110
18	47.434	47.392	47.525	11108	1.87	2293
19	47.672	47.525	47.783	60656	10.19	10442
20	48.000	47.967	48.225	13089	2.20	1168
				595537	100.00	120567

HEKSAN

Peak Report TIC

Peak#	R.Time	I.Time	F.Time	Area	Area%	Height
1	7.959	7.892	8.058	35635	2.51	8755
2	14.667	14.617	14.733	15325	1.08	4439
3	15.783	15.717	15.858	14744	1.04	3971
4	18.166	18.117	18.225	17511	1.24	4543
5	18.300	18.225	18.383	14579	1.03	3440
6	18.615	18.550	18.683	13208	0.93	3350
7	21.997	21.917	22.058	15891	1.12	3628
8	22.272	22.200	22.317	13556	0.96	3635
9	24.499	24.408	24.533	28515	2.01	6001
10	24.605	24.533	24.725	48360	3.41	7152
11	24.868	24.725	24.950	33275	2.35	4732
12	29.946	29.825	30.083	66480	4.69	10494
13	30.378	30.283	30.483	48627	3.43	9283
14	31.017	30.958	31.167	14569	1.03	2133
15	31.239	31.167	31.350	114138	8.05	27035
16	33.841	33.750	33.933	28129	1.98	5725
17	36.266	36.192	36.333	14223	1.00	3307
18	40.076	39.975	40.275	574999	40.57	122152
19	40.997	40.917	41.117	56826	4.01	12251
20	44.440	44.208	44.492	22564	1.59	2974
21	44.633	44.492	44.842	13632	0.96	778
22	46.908	46.817	47.058	32638	2.30	3781
23	47.206	47.100	47.308	34369	2.43	6828
24	47.662	47.558	47.817	128901	9.10	21927
25	48.072	48.000	48.142	16470	1.16	3548
				1417164	100.00	285862

Gambar 38. *Peak report* kromatogram ekstrak daun bangle.

Lampiran 4

Tabel 10.Hasil interpretasi senyawa-senyawa volatil ekstrak daun bangle

Ekstrak Etanol				Ekstrak Heksan			
Peak	Waktu Retensi (menit ke-)	Senyawa	% Area	*Peak*	Waktu Retensi (menit ke-)	Senyawa	% Area
1	15.783	*β-Caryophyllene*	1,01	1	7.959	*Naphtalene*	2,51
2	17.958	-	0,33	2	14.667	*Thiofenchone*	1,08
3	18.174	*Tricyclo[4.3.0.0(7,9)]non-3-ene, 2,2,5,5,8,8-hexamethyl-, (1.alpha.,6.beta.,7.alpha.,9.alpha.)-*	2,70	3	15.783	*β-Caryophyllene*	1,04
4	24.500	*(-)-Sinularene*	3,20	4	18.166	*Tricyclo[4.3.0.0(7,9)]non-3-ene, 2,2,5,5,8,8-hexamethyl-, (1.alpha.,6.beta.,7.alpha.,9.alpha.)-*	1,24
5	24.602	*γ-Gurjunene*	3,51	5	18.300	*(-)-Dehydroaromadendrene*	1,03
6	24.817	-	1,34	6	18.615	*α-selinene*	0,93
7	24.867	*Androstan-17-one, 3-ethyl-3-hydroxy-, (5.alpha.)- (CAS) 3-ethyl-3-hydroxy-17-oxo-5.alpha.-androstane*	3,45	7	21.997	*β-sitosterol*	1,12
8	28.661	*Trispiro[4.2.4.2.4.2.]heneicosane*	3,49	8	22.272	*Octadecane (CAS) n-Octadecane*	0,96
9	29.964	2-methyl-4-(2,6,6-trimethyl-cyclohex-1-enyl)-but-2-en-1-ol	6,37	9	24.499	*(-)-Sinularene*	2,01
10	30.387	*β-elemene*	5,29	10	24.605	*γ-Gurjunene*	3,41
11	31.243	*2-Pentadecanone, 6,10,14-trimethyl- (CAS) 6,10,14-Trimethyl-2-pentadecanone*	7,75	11	24.868	*Androstan-17-one, 3-ethyl-3-hydroxy-, (5.alpha.)- (CAS) 3-ethyl-3-hydroxy-17-oxo-5.alpha.-androstane*	2,35

Keterangan: - tidak dideteksi adanya senyawa volatil

Lampiran 4

Tabel 10 (Lanjutan)

12	33.826	*(-)-Caryophyllene oxide*	0,80	12	29.946	2-methyl-4-(2,6,6-trimethyl-cyclohex-1-enyl)-but-2-en-1-ol	4,69
13	35.414	*Ergost-5-en-3-ol, 22,23-3dimethyl-, (3.beta.)-*	0,91	13	30.378	*β-elemene*	3,43
14	36.265	*2,2,6-trimethyl-1-(3-methyl-buta-1,3-dienyl)-7-oxa-bicyclo[4.1.0]heptan-3-ol*	2,80	14	31.017	*Cyclohexene-1-carboxaldehyde, 1,3,4-trimethyl- (CAS) 1,2,4-trimethyl-1-cyclohexene-4-carboxaldehyde*	1,03
15	40.075	*Neophytadiene*	38,90	15	31.239	*2-Pentadecanone, 6,10,14-trimethyl- (CAS) 6,10,14-Trimethyl-2-pentadecanone*	8,05
16	40.996	*2,5,5,8a-tetramethyl-4-methylene-6,7,8,8a-tetrahydro-4h,5h-chromen-4a-yl hydrope*	1,57	16	33.841	*Drimenol*	1,98
17	47.209	*14-.beta.-H-pregna*	2,35	17	36.266	*2,2,6-trimethyl-1-(3-methyl-buta-1,3-dienyl)-7-oxa-bicyclo[4.1.0]heptan-3-ol*	1,00
18	47.434	*(7R,8R)-cis-syn-trans-Tricyclo[7.3.0.0(2,6)]dodecan-7,8-diol*	1,87	18	40.076	*Neophytadiene*	40,57
19	47.672	*Ambrosin*	10,19	19	40.997	*2,5,5,8a-tetramethyl-4-methylene-6,7,8,8a-tetrahydro-4h,5h-chromen-4a-yl hydrope*	4,01
20	48.000	-	2,20	20	44.440	*Zonarone*	1,59
21		-		21	44.633	-	0,96
22		-		22	46.908	*Spiro[5.5]undecan-1-one*	2,3
23		-		23	47.206	*14-.beta.-H-pregna*	2,43
24		-		24	47.662	*Ambrosin*	9,1
25		-		25	48.072	*Hedycaryol*	1,16

Keterangan: - tidak dideteksi adanya senyawa volatil

Lampiran 4

Tabel 11.Aktivitas antibakteri senyawa-senyawa volatil

Senyawa	Formula	Berat Molekul (g/mol)	Kelompok senyawa	Kandungan dalam tanaman Zingiberaceae	Aktivitas antibakteri
β-Caryophyllene	$C_{15}H_{24}$	204	Seskuiterpen	Minyak esensial daun bangle mengandung *caryophyllene* sebesar 9,47% (Bhuiyan dkk., 2008b)	*β-caryophyllene* yang diisolasi dari minyak esensial *Helichrysum cymosum* (Asteraceae) dengan senyawa utama *β-Caryophyllene* (27,02%) memiliki aktivitas antibakteri terhadap *S. aureus, S. epididirmis, Pseudomonas aeruginosa, E. cloacae, Klebsiella pneumonia*,dan *E. coli* (Bougatsos dkk., 2014)
Tricyclo[4.3.0.0(7,9)]non-3-ene, 2,2,5,5,8,8-hexamethyl-, (1.alpha.,6.beta.,7.alpha.,9.alpha.)-	$C_{15}H_{24}$	204	Seskuiterpen	-	*Tricyclo[4.3.0.0(7,9)]non-3-ene, 2,2,5,5,8,8-hexamethyl-, (1.alpha.,6.beta.,7.alpha.,9.alpha.)-* yang diisolasi dari ekstrak metanol *Fulgensia fulgens* tidak memiliki aktivitas antibakteri terhadap *E. coli* dan *S. aureus* (Valadbeigi dan Rashki, 2015)
γ-Gurjunene	$C_{15}H_{24}$	204	Seskuiterpen	Minyak esensial rimpang *Zingiber officinale* mengandung γ-Gurjunene sebesar 0,96% (Buang dkk., 2014)	Minyak esensial *Anaphalis nubigena* var *monocephala* (Asteraceae) dengan kandungan *α-gurjunene* sebesar 6% memiliki aktivitas antibakteri terhadap *E. coli* (Joshi dkk., 2009). Minyak esensial bagian aerial *Salvia verticillata* (Lamiaceae)dengan kandungan γ-Gurjunene sebesar 0,8% memiliki aktivitas antibakteri terhadap *E. coli* dan *S. aureus* (Mahdavi dkk., 2015). α-gurjunene berperan sebagai agen antibakteri (EMBL-EBI, 2016).

Keterangan: - tidak diketahui

Lampiran 4

Tabel 11 (Lanjutan)

(-)-Sinularene	$C_{15}H_{24}$	204	Seskuiterpen	-	Minyak esensial *Artemisia scoparia* (Asteraceae)mengandung *sinularene* (0,26%), menunjukkan aktivitas antibakteri terhadap *Escherichia coli* dan *S. aureus* (Mahdavi, 2015)
Androstan-17-one, 3-ethyl-3-hydroxy-, (5.alpha.)- (CAS) 3-ethyl-3-hydroxy-17-oxo-5.alpha.-androstane	$C_{21}H_{34}O_2$	318	Steroid	Rimpang *Curcuma amada* mengandung Androstan-17-one, 3-ethyl-3-hydroxy-, (5.alpha.)- sebesar 93,67% (Jegajeevanram dkk., 2014)	Androstan-17-one, 3-ethyl-3-hydroxy-, (5.alpha.)- memiliki aktivitas antimikroba, antikanker, antiinflamasi, antiasma, diuretik, antiartritis, insektisida (Jegajeevanram dkk., 2014)
Trispiro[4.2.4.2.4.2.]heneicosane	$C_{21}H_{36}$	288			
2-methyl-4-(2,6,6-trimethyl-cyclohex-1-enyl)-but-2-en-1-ol	$C_{14}H_{24}O$	208	-	-	-
β-elemene	$C_{15}H_{24}$	204	Seskuiterpen	Minyak esensial daun bangle mengandung sebesar 0,17% (Bhuiyan dkk., 2008b) *β-elemene* terdapat juga pada rimpang *Zingiber officinale* Roscoe dan *Zingiberzerumbet* Smith (Sharafkhaneh dkk., 2008)	Minyak esensial *Alpinia galanga* dan *Kaempferia parviflora* (Zingiberaceae)mengandung *β-elemene* sebesar 2,39% dan 6,03%, menunjukkan aktivitas antibakteri terhadap *E. coli* dan *S. aureus* (Wungsintaweekul dkk., 2010) Kandungan *β-elemene* dalam minyak esensial *Curcuma wenyujin* (Zingiberaceae) memiliki aktivitas antimikroba (Zhu dkk., 2013)

Keterangan: - tidak diketahui

Lampiran 4

Tabel 11 (Lanjutan)

2-Pentadecanone, 6,10,14-trimethyl- (CAS) 6,10,14-Trimethyl-2-pentadecanone	$C_{18}H_{36}O$	268		Minyak esensial daun *Kaempferia galanga* (Zingiberaceae) mengandung *2-Pentadecanone, 6,10,14-trimethyl-* (0,43%) (Bhuiyan dkk., 2008a)	Minyak esensial daun *Gnetum africanum* dengan salah satu kandungan utama *6,10,14-Trimethyl-2-pentadecanone* (9,7%) menunjukkan aktivitas antibakteri kuat terhadap *E. coli* (Ogunwande dkk., 2007)
(-)-Caryophyllene oxide	$C_{15}H_{24}O$	220	Seskuiterpen	Minyak esensial daun bangle mengandung *caryophyllene oxide* sebesar 13,85% (Bhuiyan dkk., 2008b)	*Caryophyllene oxide* yang diisolasi dari minyak esensial *Helichrysum fulgidum* (Asteraceae) dengan senyawa utama *caryophyllene oxide* (12,45%) memiliki aktivitas antibakteri terhadap *S. aureus, S. epididirmis, Pseudomonas aeruginosa, E. cloacae, Klebsiella pneumonia*,dan *E. coli* (Bougatsos dkk., 2014)
Ergost-5-en-3-ol, 22,23-dimethyl-, (3.beta.)-	$C_{30}H_{52}O$	428	-	-	-
2,2,6-trimethyl-1-(3-methyl-buta-1,3-dienyl)-7-oxa-bicyclo[4.1.0]heptan-3-ol	$C_{14}H_{22}O_2$	222	-	-	-
Neophytadiene	$C_{20}H_{38}$	278	Diterpen	Daun *Alpinia galanga (*Zingiberaceae*)* mengandung neophytadiene sebesar (3,75%) (Lim, 2016)	*Neophytadiene* yang diisolasi dari daun *Erigeron sumatrensis* (Asteraceae)menunjukkan aktivitas antibakteri terhadap *E. coli* dan *Pseudomonas aeruginosa* (Ragasa dkk.,2009) *Neophytadiene* merupakan bakterisidal kuat, memiliki aktivitas antipiretik, analgesik, antiinflamasi, dan antioksidan (Dr. Duke's Phytochemical and Ethnobotanical Databases *diacu dalam* Raman dkk., 2012)

Keterangan: - tidak diketahui

Lampiran 4

Tabel 11 (Lanjutan)

2,5,5,8a-tetramethyl-4-methylene-6,7,8,8a-tetrahydro-4h,5h-chromen-4a-yl hydrope	$C_{14}H_{22}O_3$	238	-	-	-
14-.beta.-H-pregna	$C_{21}H_{36}$	288	Steroid	-	-
(7R,8R)-cis-syn-trans-Tricyclo[7.3.0.0(2,6)]dodecan-7,8-diol	$C_{12}H_{20}O_2$	196	-	-	-
Ambrosin	$C_{15}H_{18}O_3$	246	Seskuiterpen	-	Ekstrak metilen klorida *Artemisia maritima* (Asteraceae) dengan senyawa utama *ambrosin* (27,05%) memiliki aktivitas antibakteri terhadap *E. coli*, *Bacillus subtilis*, dan *Erwinia spp.* (Makkawi dkk., 2015)
Naphtalene	$C_{10}H_8$	128	Monoterpen	-	*Naphtalene* dan senyawa turunannya berpotensi sebagai agen antimikroba. *Azo-2 naphtol dan 2 naphtol* (turunan mono-hidroksi naphtalene) efektif dalam menghambat pertumbuhan *S. aureus*, *E. coli*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, dan *Streptococcus faecalis* (Rokade dan Sayyed, 2009)
Thiofenchone	$C_{10}H_{16}$	168	Monoterpen	-	-
(-)-Dehydroaromadendrene	$C_{15}H_{24}$	204	Seskuiterpen	Minyak esensial rimpang *Zingiber zerumbet* mengandung *dehydroaromadendrene* sebesar 0,2% (Dai dkk., 2013)	Miyak esensial *Hypericum rumeliacum subsp. apollinis* (Hypericaceae) dengan salah satu kandungan utama *dehydroaromadendrene* (6,81%) menunjukkan aktivitas antibakteri moderat terhadap 6 bakteri Gram negatif dan positif (*Couladis* dkk., 2003)

Keterangan: - tidak diketahui

Lampiran 4

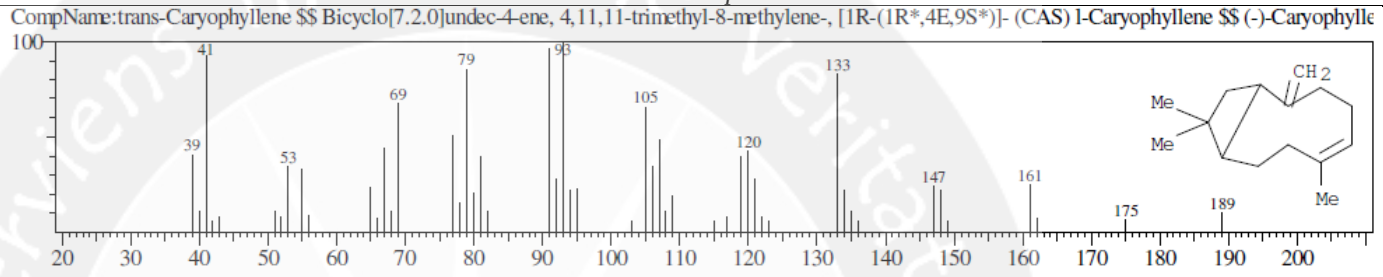
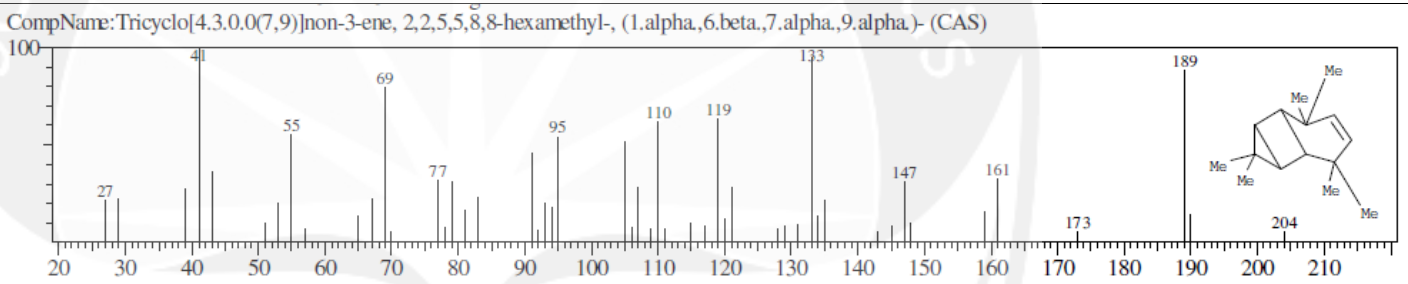
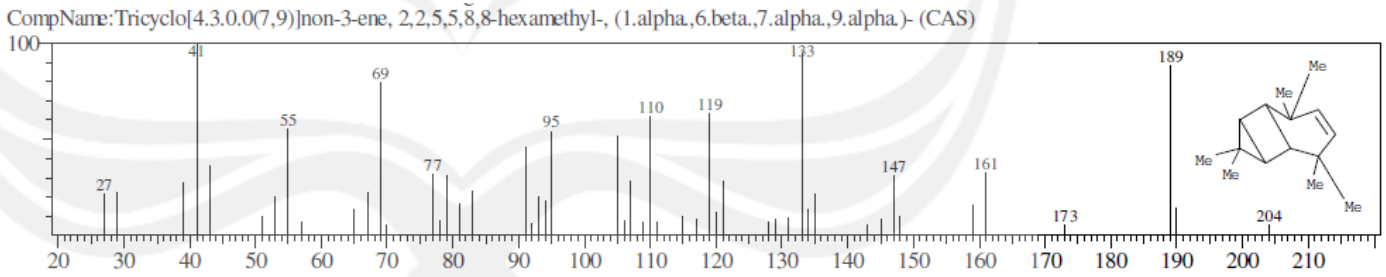
Tabel 11 (Lanjutan)

α-selinene	$C_{15}H_{24}$	204	Seskuiterpen	Minyak esensial rimpang bangle mengandung α-selinene sebesar 0,12% (Bhuiyan dkk., 2008b)	Minyak esensial daun *Solanun spirale* (Solanaceae)dengan salah satu senyawa utama α-selinene (2,71%) memiliki aktivitas antibakteri terhadap *E. coli* dan *S.aureus* (Keawsa dkk., 2015)
β-sitosterol	$C_{29}H_{50}O$	414	Steroid	β-sitosterol menjadi 1 dari 5 senyawa utama rimpang *Zingiber cassumunar* (Azid, 2012)	β-sitosterol yang diisolasi dari *Momordica charantia* memiliki aktivitas antibakteri terhadap *E. coli, S. aureus, Klebsiella pneumoniae*, dan *Pseudomonas aeruginosa* (Sen dkk., 2012)
3-Cyclohexene-1-carboxaldehyde, 1,3,4-trimethyl- (CAS) 1,2,4-trimethyl-1-cyclohexene-4-carboxaldehyde	$C_{10}H_{16}O$	152	Monoterpen	Rimpang *Curcuma armada* (Zingiberaceae) mengandung 3-*cyclohexene-1-carboxaldehyde, 1,3,4-trimethyl-* sebesar 0,59% (Jegajeevanram dkk., 2014)	*3-Cyclohexene-1-carboxaldehyde, 1,3,4-trimethyl-* memiliki aktivitas antitumor, analgesik, antibakteri, antiinflamasi, sedatif, dan fungisida. (Jegajeevanram dkk., 2014)
Drimenol	$C_{15}H_{23}O$	219	Seskuiterpen	-	Minyak esensial daun kering *Persicaria odorata* (Polygonaceae)dengan salah satu senyawa utama *drimenol* (4,34%) memiliki aktivitas antibakteri terhadap *E. coli* dan *S. aureus* (Sasongko dkk., 2011)
Hedycaryol	$C_{15}H_{26}O$	222	Seskuiterpen	Minyak esensial rimpang *Hedychium spicatum* Sm. (Zingiberaceae) mengandung *Hedycaryol* sebesar 2,6% (Tisseran dan Young, 2014)	Minyak esensial *Chamaecyparis obtusa* (Cupressaceae) dengan salah satu senyawa utama *Hedycaryol* (3,89%)memiliki aktivitas antibakteri terhadap *E. coli* dan *S. aureus* (Lee dkk., 2009)

Keterangan: - tidak diketahui

Lampiran 4

Tabel 12. *Mass spectrum* senyawa volatil ekstrak daun bangle

Senyawa	*Mass Spectrum*
β-Caryophyllene	
Tricyclo[4.3.0.0(7,9)]non-3-ene, 2,2,5,5,8,8-hexamethyl-, (1.alpha.,6.beta.,7.alpha.,9.alpha.)-	
(-)-Sinularene	

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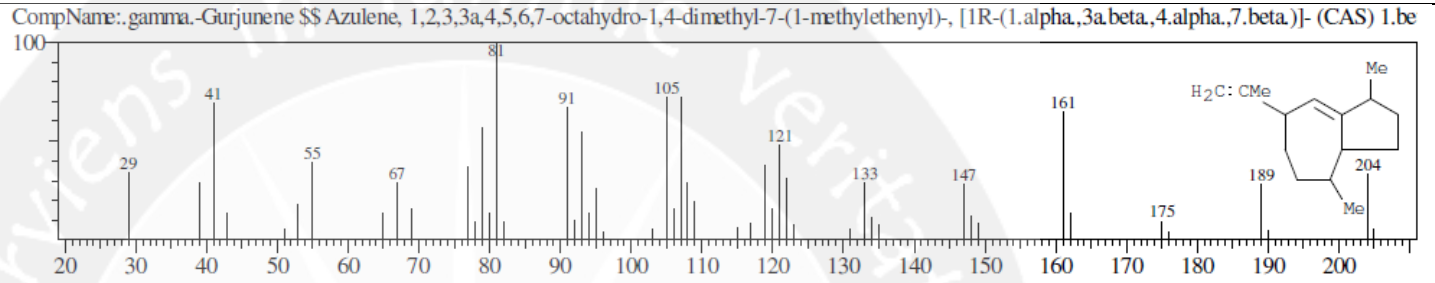
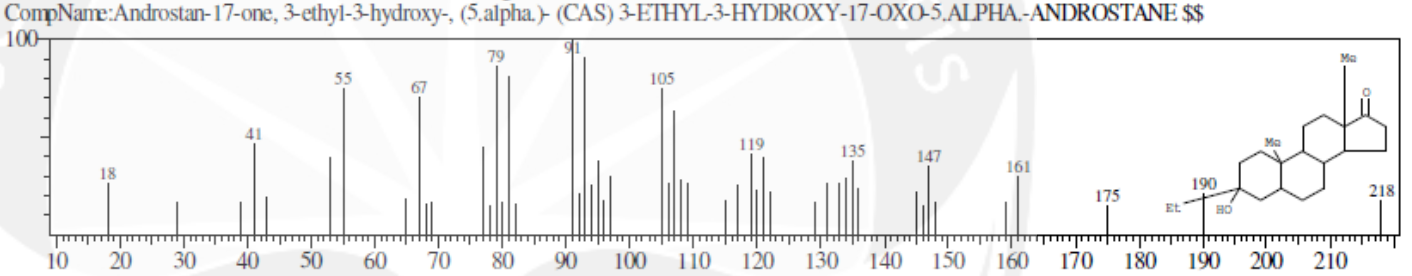
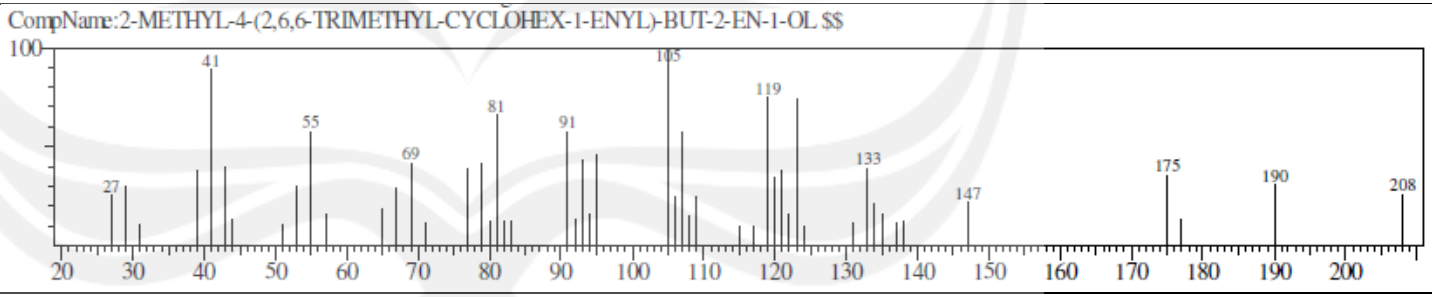
Tabel 12 (Lanjutan)

γ-Gurjunene	
Androstan-17-one, 3-ethyl-3-hydroxy-, (5.alpha.)- (CAS) 3-ethyl-3-hydroxy-17-oxo-5.alpha.-androstane	
2-methyl-4-(2,6,6-trimethyl-cyclohex-1-enyl)-but-2-en-1-ol	

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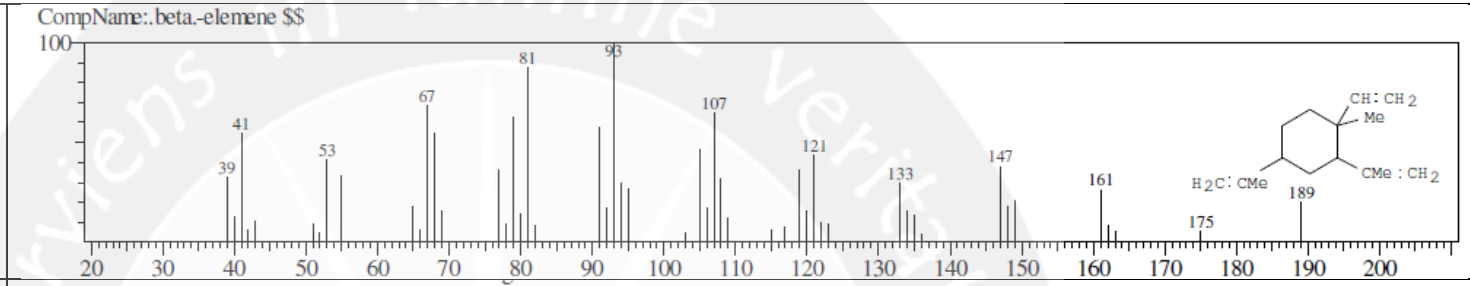
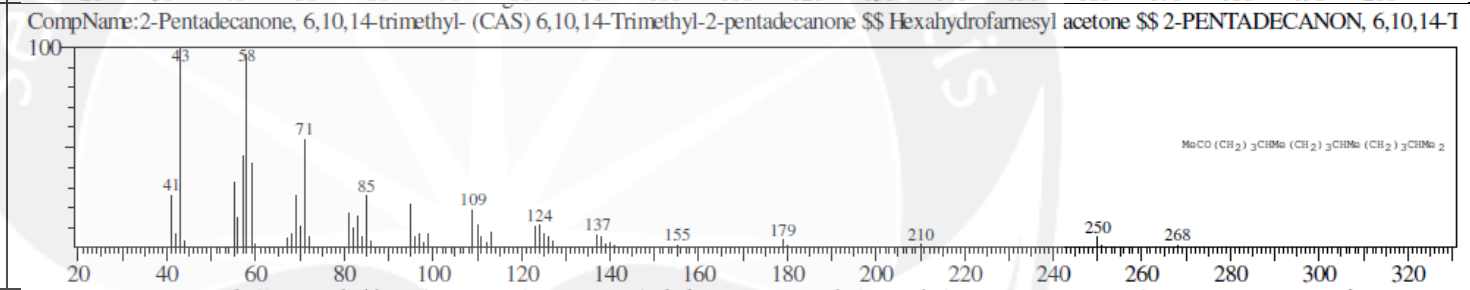
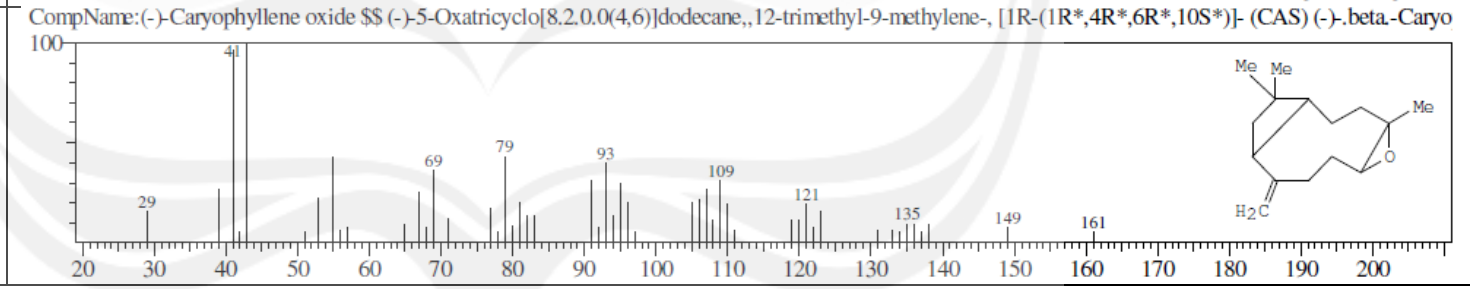
Tabel 12 (Lanjutan)

β-elemene	
2-Pentadecanone, 6,10,14-trimethyl- (CAS) 6,10,14-Trimethyl-2-pentadecanone	
(-)-Caryophyllene oxide	

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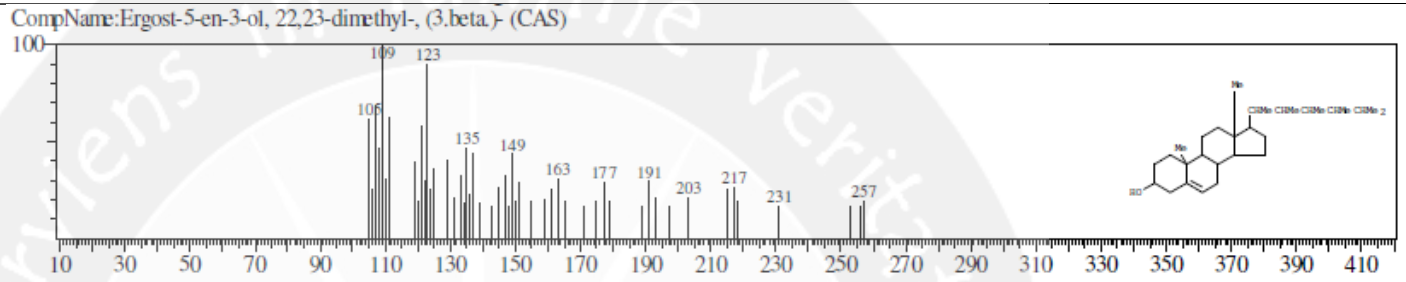
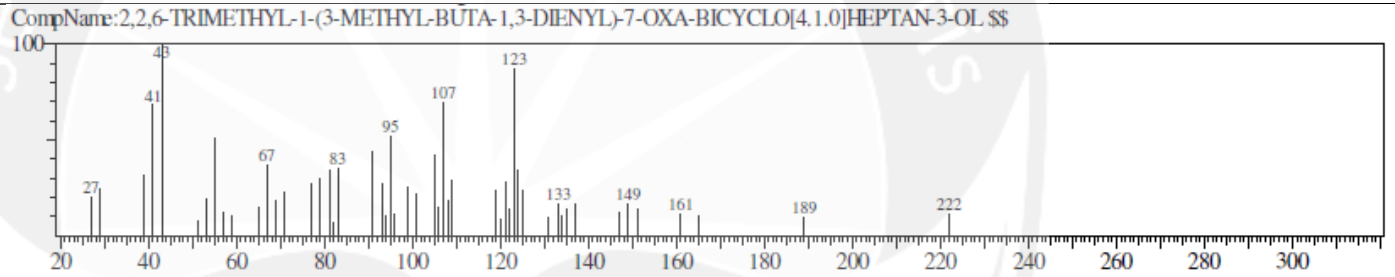
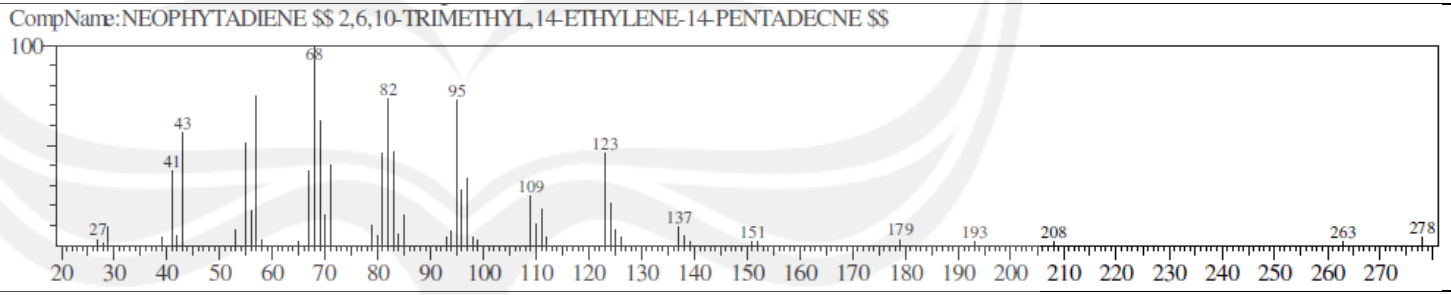
Tabel 12 (Lanjutan)

Ergost-5-en-3-ol, 22,23-dimethyl-, (3.beta.)-	
2,2,6-trimethyl-1-(3-methyl-buta-1,3-dienyl)-7-oxa-bicyclo[4.1.0]heptan-3-ol	
Neophytadiene	

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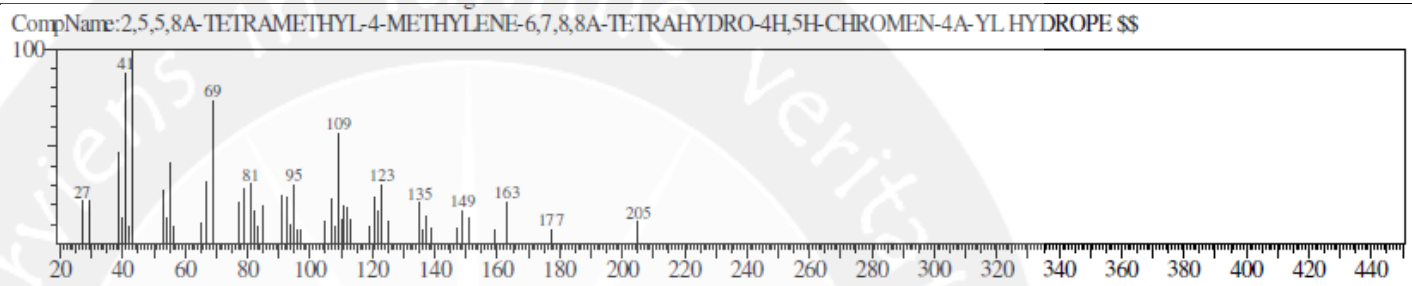
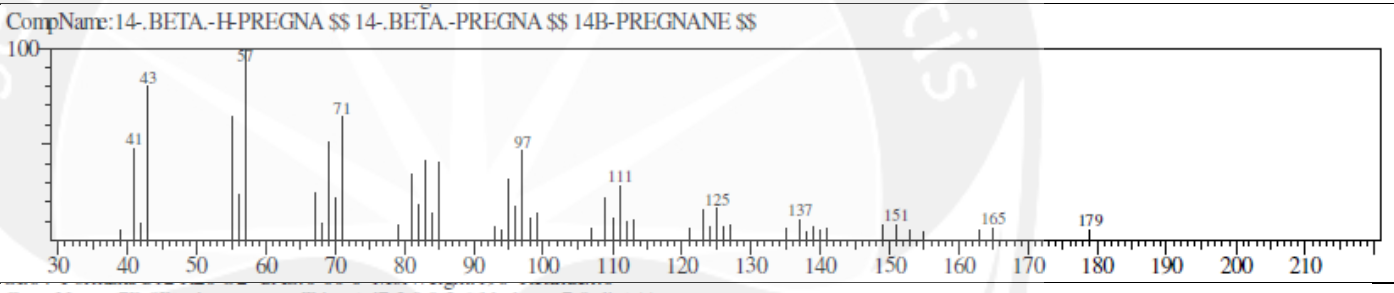
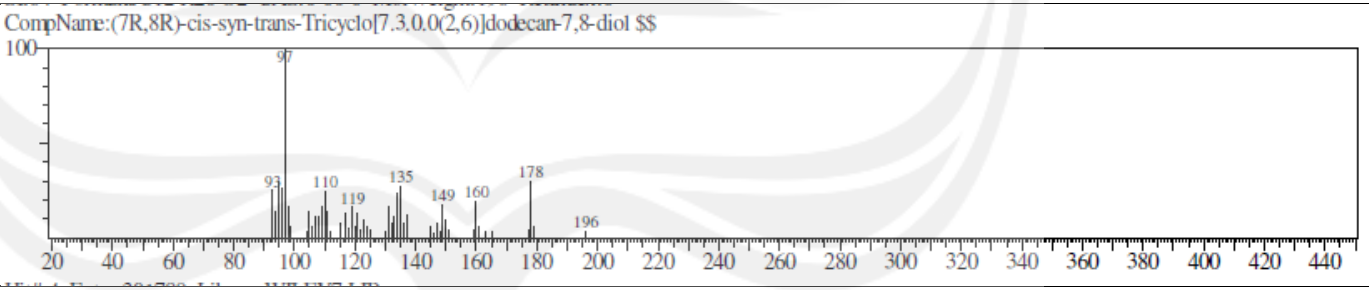
Tabel 12 (Lanjutan)

2,5,5,8a-tetramethyl-4-methylene-6,7,8,8a-tetrahydro-4H,5H-chromen-4a-yl hydrope	
14-.beta.-H-pregna	
(7R,8R)-cis-syn-trans-Tricyclo[7.3.0.0(2,6)]dodecan-7,8-diol	

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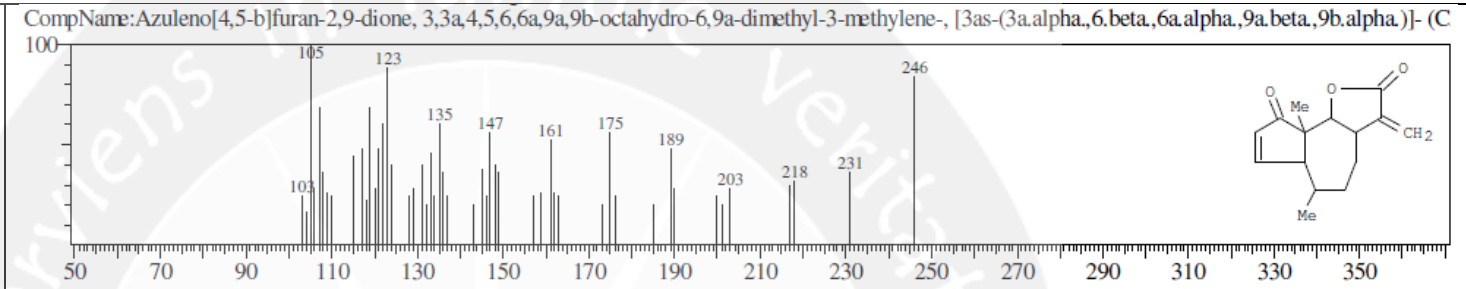
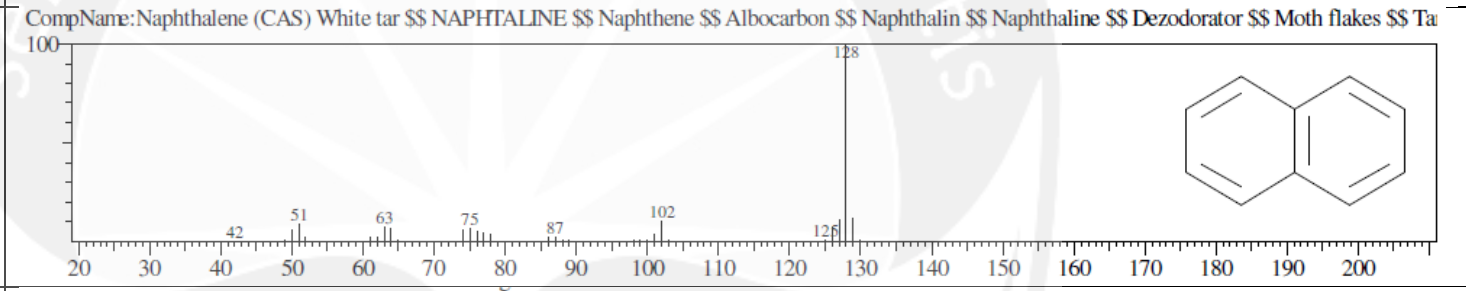
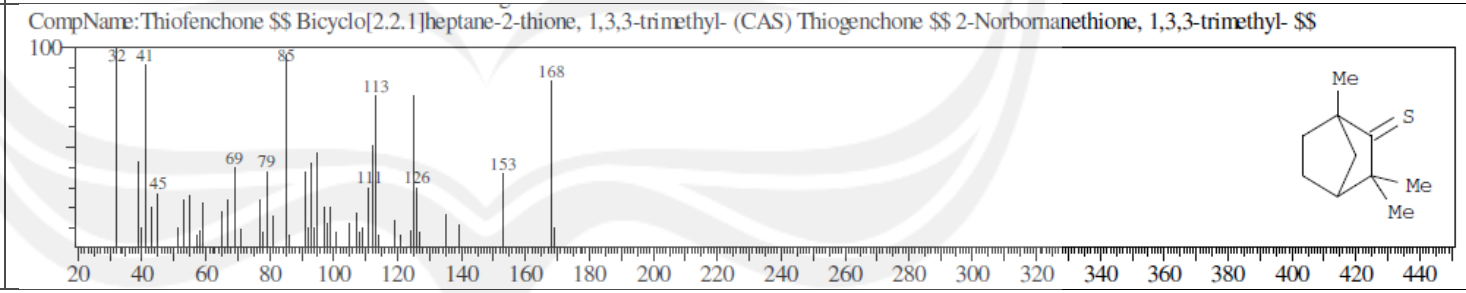
Tabel 12 (Lanjutan)

Ambrosin	
Naphtalene	
Thiofenchone	

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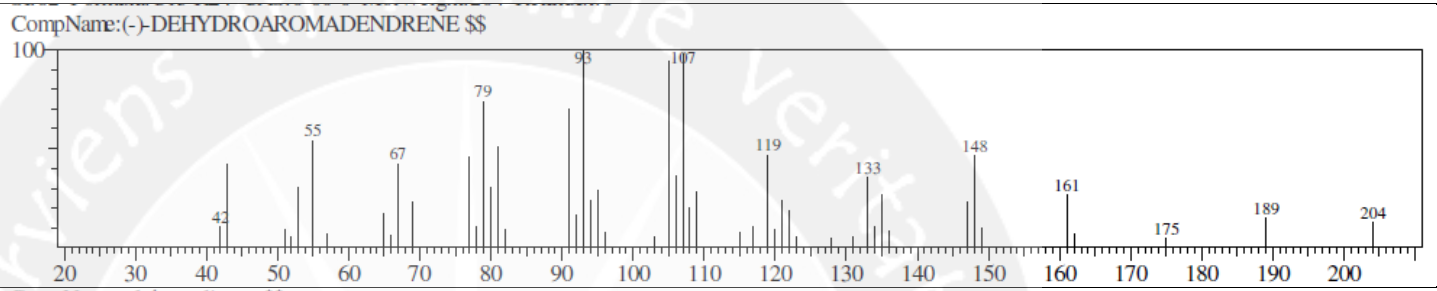
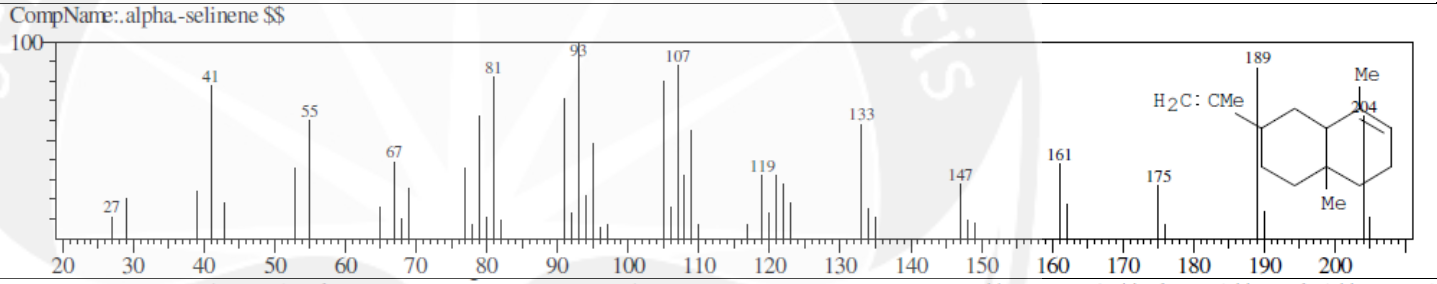
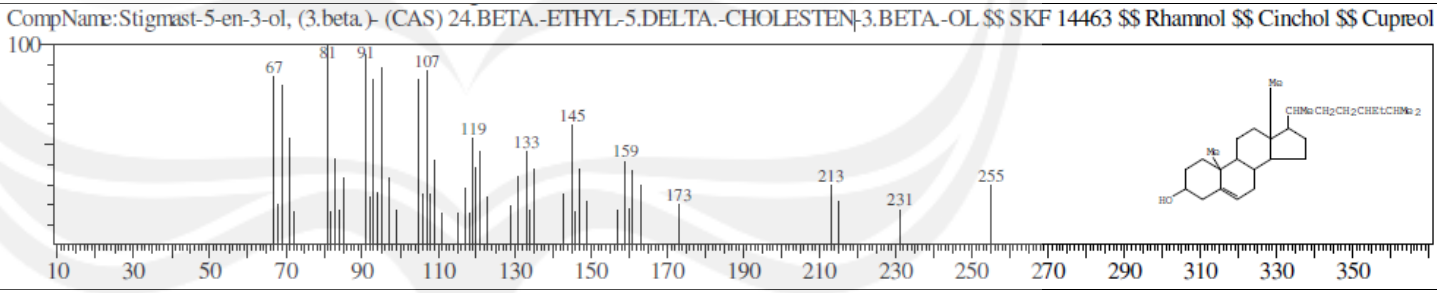
Tabel 12 (Lanjutan)

(-)-Dehydroaromadendrene	
α-Selinene	
β-Sitosterol	

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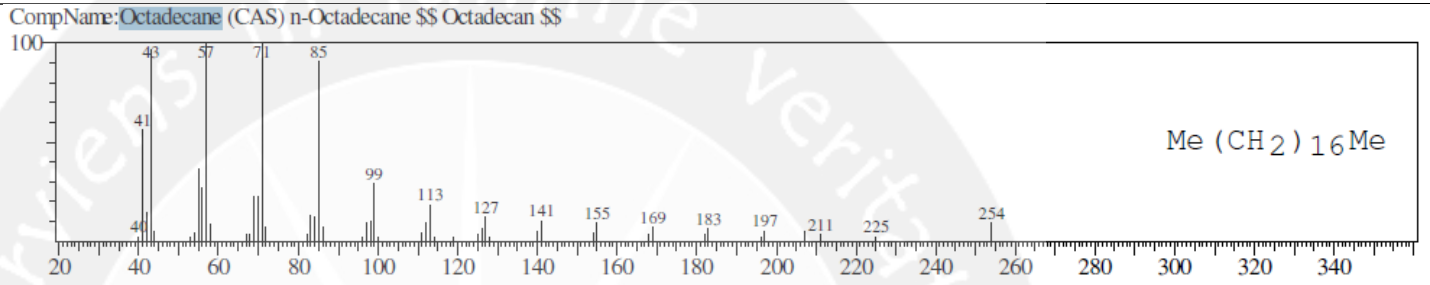
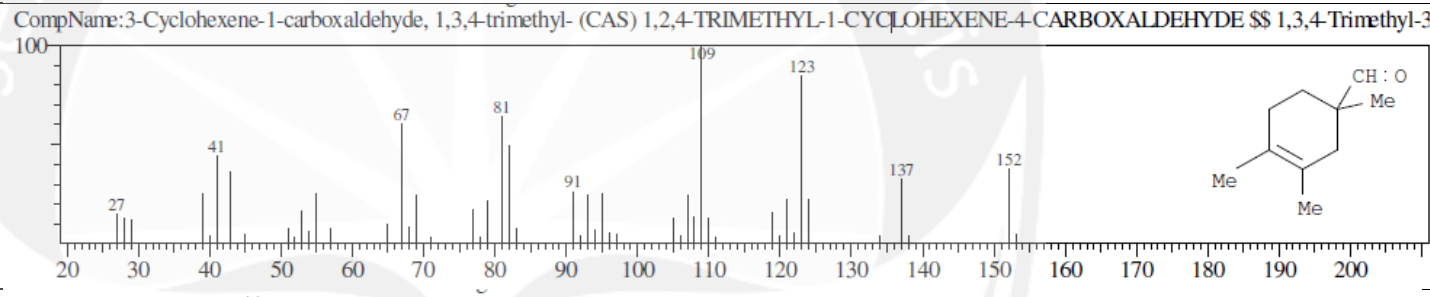
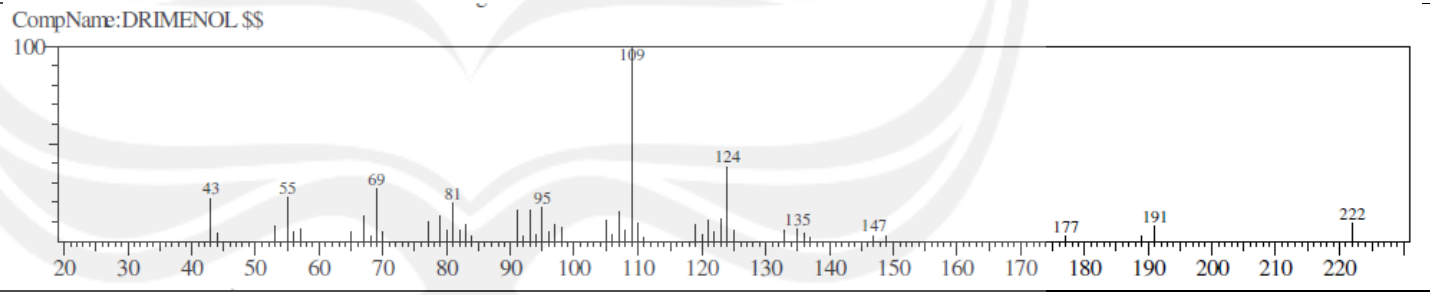
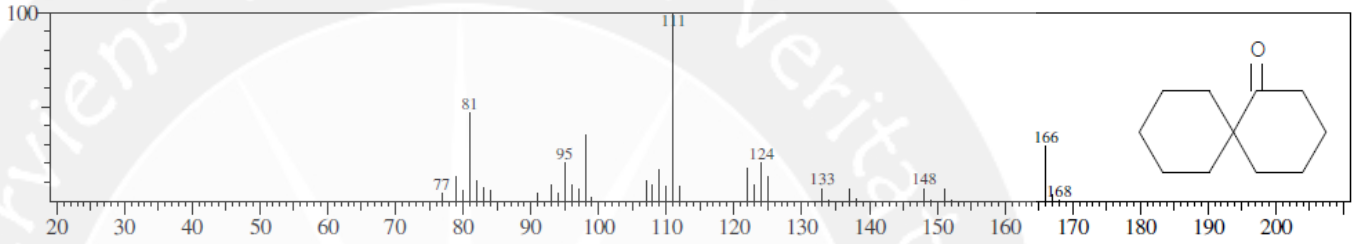
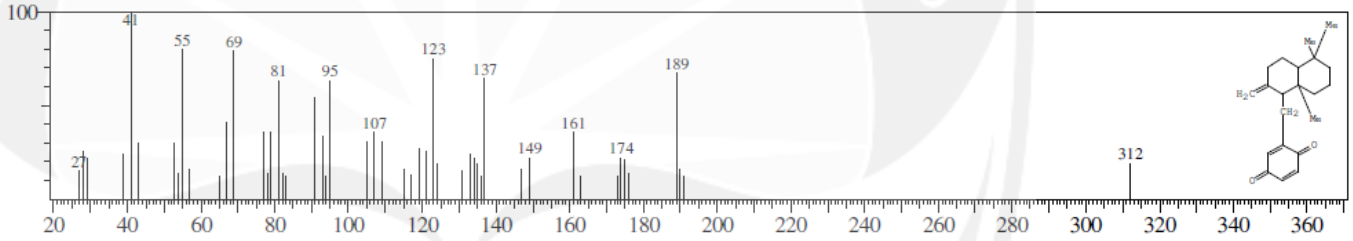
Tabel 12 (Lanjutan)

Octadecane (CAS) n-Octadecane	
3-Cyclohexene-1-carboxaldehyde, 1,3,4-trimethyl- (CAS) 1,2,4-trimethyl-1-cyclohexene-4-carboxaldehyde	
Drimenol	

Lampiran 4

Tabel 12 (Lanjutan)

Spiro[5.5]undecan-1-one	CompName:Spiro[5.5]undecan-1-one (CAS) SPIRO(5,5)-UNDECANE-1-ONE $$ 1-Oxospiro[5.5]undecane $$ spiro[5,5]undecan-1-one $$ 
Zonarone	Hit#:1 Entry:223069 Library:WILEY7.LIB SI:65 Formula:C21 H28 O2 CAS:39707-56-7 MolWeight:312 RetIndex:0 CompName:Zonarone $$ 2,5-Cyclohexadiene-1,4-dione, 2-[(decahydro-5,5,8a-trimethyl-2-methylene-1-naphthalenyl)methyl]-, [1S-(1.alpha.,4a.beta.,8a.alpha.)] 
Hedycaryol	Hit#:2 Entry:123957 Library:WILEY7.LIB SI:78 Formula:C15 H26 O CAS:21657-90-9 MolWeight:222 RetIndex:0 CompName:HEDYCARYOL $$