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## LAMPIRAN

Lampiran 1. Data hasil pengujian derajat putih Selulosa Mikrokrystalin.

Ulangan	Derajat Putih	
	Selulosa Mikrokrystalin Hasil Penelitian	Selulosa Mikrokrystalin Komersial (Avicel PH 102)
Ulangan 1	82	86
Ulangan 2	88	86
Ulangan 3	96	86
Rata-Rata	88,667	86

Sumber : Data primer Profil Bioplastik Berpenyerap Oksigen Terintegrasi Selulosa Mikrokrystalin dari *Acetobacter xylinum* dan Butylated Hydroxytoluene (BHT) sebagai Kemasan Aktif, 2024.

Lampiran 2. Uji normalitas derajat putih Selulosa Mikrokrystalin

Tests of Normality						
	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
derajat putih	.204	3	.	.993	3	.843
a. Lilliefors Significance Correction						

Keterangan : Jika Nilai Sig. > 0,05 maka nilai residual standard berdistribusi normal.

Lampiran 3. Hasil uji Independent Sample t Test derajat putih Selulosa Mikrokrystalin hasil penelitian dibandingkan Selulosa Mikrokrystalin komersial merek Avicel PH 102.

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
derajat putih	Equal variances assumed	5.319	.082	.658	4	.547	2.66667	4.05518
	Equal variances not assumed			.658	2.000	.578	2.66667	4.05518

keterangan : jika Sig. (2-tailed) < 0,05. maka perbedaan bermakna secara statistik atau signifikan pada probabilitas 0,05.

Lampiran 4. Data hasil pengujian kadar air Selulosa Mikrokrystalin.

Ulangan	Kadar Air	
	Selulosa Mikrokrystalin Hasil Penelitian	Selulosa Mikrokrystalin Komersial (Avicel PH 102)
1	3,51	4
2	4,21	4
3	3,65	4
Rata-rata	3,79	4

Sumber : Data primer Profil Bioplastik Berpenyerap Oksigen Terintegrasi Selulosa Mikrokrystalin dari *Acetobacter xylinum* dan Butylated Hydroxytoluene (BHT) sebagai Kemasan Aktif, 2024.

Lampiran 5. Hasil uji Independent Sample t Test kadar air Selulosa Mikrokrystalin hasil penelitian dibandingkan Selulosa Mikrokrystalin komersial merek Avicel PH 102.

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
kadar air	Equal variances assumed	12.029	.026	-.975	4	.385	-.20800	.21331
	Equal variances not assumed			-.975	2.000	.432	-.20800	.21331

keterangan : jika Sig. (2-tailed) < 0,05. maka perbedaan bermakna secara statistik atau signifikan pada probabilitas 0,05.

Lampiran 6. Data hasil pengujian pH Selulosa Mikrokrystalin.

Ulangan	pH	
	Selulosa Mikrokrystalin Hasil Penelitian	Selulosa Mikrokrystalin Komersial (Avicel PH 102)
Ulangan 1	82	86
Ulangan 2	88	86
Ulangan 3	96	86
Rata-Rata	88,667	86

Lampiran 7. Hasil uji Independent Sample t Test pH Selulosa Mikrokrystalin hasil penelitian dibandingkan Selulosa Mikrokrystalin komersial merek Avicel PH 102.

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
ph	Equal variances assumed	11.325	.028	-5.717	4	.005	-.72500	.12681
	Equal variances not assumed			-5.717	2.000	.029	-.72500	.12681

keterangan : jika Sig. (2-tailed) < 0,05. maka perbedaan bermakna secara statistik atau signifikan pada probabilitas 0,05.

Lampiran 8. Hasil uji biodegradabilitas bioplastik berbasis PLA terintegrasi SM dan BHT.

Kode Sampel	Ulangan	Berat sebelum inkubasi(B0)	Berat setelah inkubasi (Bf)	Kehilangan berat (B0-Bf)/B0 X100%	Rata-Rata (%)
0%SM+0%BHT	U1	0,1931	0,189	2,123	2,274
	U2	0,2481	0,243	2,056	
	U3	0,1664	0,162	2,644	
10%SM+0%BHT	U1	0,3012	0,282	6,375	6,591
	U2	0,1789	0,167	6,652	
	U3	0,2016	0,188	6,746	
20%SM+0%BHT	U1	0,2260	0,191	15,487	14,577
	U2	0,2758	0,237	14,068	
	U3	0,1806	0,155	14,175	
30%SM+0%BHT	U1	0,1825	0,154	15,616	15,092
	U2	0,2142	0,184	14,099	
	U3	0,2712	0,229	15,560	
0%SM+5%BHT	U1	0,2125	0,207	2,588	3,186
	U2	0,2272	0,219	3,609	
	U3	0,2411	0,233	3,360	
10%SM+5%BHT	U1	0,2994	0,274	8,484	8,314
	U2	0,2621	0,242	7,669	
	U3	0,2105	0,192	8,789	



Kode Sampel	Ulangan	Berat sebelum inkubasi(B0)	Berat setelah inkubasi (Bf)	Kehilangan berat (B0-Bf)/B0 X100%	Rata-Rata (%)
20%SM+5%BHT	U1	0,2686	0,223	16,977	16,584
	U2	0,2048	0,172	16,016	
	U3	0,2715	0,226	16,759	
30%SM+5%BHT	U1	0,2084	0,172	17,466	18,195
	U2	0,1837	0,149	18,889	
	U3	0,2666	0,218	18,230	
0%SM+10%BHT	U1	0,1652	0,157	4,964	5,246
	U2	0,2467	0,233	5,553	
	U3	0,1456	0,138	5,220	
10%SM+10%BHT	U1	0,2164	0,184	14,972	14,820
	U2	0,2164	0,186	14,048	
	U3	0,2850	0,241	15,439	
20%SM+10%BHT	U1	0,2019	0,161	20,258	20,966
	U2	0,1378	0,109	20,900	
	U3	0,2990	0,234	21,739	
30%SM+10%BHT	U1	0,1895	0,153	19,261	19,514
	U2	0,3164	0,255	19,406	
	U3	0,2234	0,179	19,875	
LDPE	U1	0,0239	0,0238	0,418	0,139
	U2	0,0237	0,0237	0,000	
	U3	0,0230	0,0230	0,000	
HDPE	U1	0,0516	0,0516	0,000	0,057
	U2	0,0584	0,0584	0,000	
	U3	0,0581	0,0580	0,172	

Sumber : Data primer Profil Bioplastik Berpenyerap Oksigen Terintegrasi Selulosa Mikrokristalin dari *Acetobacter xylinum* dan Butylated Hydroxytoluene (BHT) sebagai Kemasan Aktif, 2024.

#### Lampiran 9. Hasil uji ANOVA nilai biodegradabilitas bioplastik berbasis PLA terintegrasi SM dan BHT.

Tests of Between-Subjects Effects						
Dependent Variable: biodegradability_Percentage						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2185.332 <sup>a</sup>	13	168.102	560.911	.000	.996

Intercept	2434.747	1	2434.747	8124.079	.000	.997
CM	1221.044	3	407.015	1358.095	.000	.993
BHT	187.003	2	93.502	311.989	.000	.957
CM * BHT	34.878	6	5.813	19.397	.000	.806
Error	8.391	28	.300			
Total	6733.573	42				
Corrected Total	2193.723	41				

a. R Squared = .996 (Adjusted R Squared = .994)

Keterangan : Jika Sig. < 0,05. maka perbedaan bermakna secara statistik atau signifikan pada probabilitas 0,05.

### Lampiran 10. Uji lanjut tuckey nilai biodegradabilitas bioplastik berbasis PLA terintegrasi SM dan BHT.

biodegradability_Percentage										
Tukey HSD <sup>a,b</sup>										
interaction	N	Subset								
		1	2	3	4	5	6	7	8	9
CM*BHT										
Control_HDP E	3	.0573 3								
Control_PE	3	.1393 3								
0%SM+0%B HT	3		2.2743 3							
0%SM+5%B HT	3		3.1856 7							
0%SM+10%B HT	3			5.245 67						
10%SM+0%B HT	3			6.591 00						
10%SM+5%B HT	3				8.31400					
20%SM+0%B HT	3					14.57667				
10%SM+10% BHT	3					14.81967				
30%SM+0%B HT	3					15.09167	15.09167			
20%SM+5%B HT	3						16.58400	16.58 400		
30%SM+5%B HT	3							18.19 500	18.1950 0	
30%SM+10% BHT	3								19.5140 0	19.514 00
20%SM+10% BHT	3									20.965 67
Sig.		1.000	.732	.193	1.000	.995	.101	.057	.215	.122

Means for groups in homogeneous subsets are displayed.  
Based on observed means.  
The error term is Mean Square(Error) = .300.  
a. Uses Harmonic Mean Sample Size = 3.000.  
b. Alpha = .05.

Lampiran 11. Rata-rata nilai biodegradabilitas dan subset hasil uji lanjut interaksi pengaruh konsentrasi Selulosa Mikrokristalin dari selulosa bakteri *Acetobacter xylinum* sebagai filler dan BHT sebagai bahan aktif berpenyerap oksigen pada pembuatan bioplastik berbahan dasar PLA.

Perlakuan		Persentase biodegradabilitas
%SM	%BHT	
0%SM	0%BHT	2,274 ± 0,321 b
	5%BHT	3,186 ± 0,532 b
	10%BHT	5,246 ± 0,295 c
10%SM	0%BHT	6,591 ± 0,192 c
	5%BHT	8,314 ± 0,579 d
	10%BHT	14,820 ± 0,707 e
20%SM	0%BHT	14,577 ± 0,790 e
	5%BHT	16,584 ± 0,503 fg
	10%BHT	20,966 ± 0,742 i
30%SM	0%BHT	15,092 ± 0,860 ef
	5%BHT	18,195 ± 0,712 gh
	10%BHT	19,514 ± 0,320 hi
Kontrol	LDPE	0,139 ± 0,24 a
	HDPE	0,057 ± 0,099 a

Keterangan : Angka yang diikuti huruf yang sama menunjukkan tidak berbeda nyata menurut uji Tuckey pada taraf 5%.

Lampiran 12. Hasil uji ANOVA nilai Kemampuan Retensi Kelembaban bioplastik berbasis PLA terintegrasi SM dan BHT.

Tests of Between-Subjects Effects					
Dependent Variable: moisture retention capability (MRC) (%)					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1068.073 <sup>a</sup>	13	82.159	154.230	.000
Intercept	306005.224	1	306005.224	574435.681	.000
CM	566.583	3	188.861	354.531	.000
BHT	180.792	2	90.396	169.692	.000
CM * BHT	56.232	6	9.372	17.593	.000
Error	14.916	28	.533		
Total	365697.449	42			
Corrected Total	1082.989	41			

a. R Squared = .986 (Adjusted R Squared = .980)

Keterangan : Jika Sig. < 0,05. maka perbedaan bermakna secara statistik atau signifikan pada probabilitas 0,05.

Lampiran 13. Uji lanjut tuckey nilai Kemampuan Retensi Kelembaban bioplastik berbasis PLA terintegrasi SM dan BHT.

moisture retention capability (MRC) (%)								
	interaction CM*BHT	N	Subset					
			1	2	3	4	5	6
Tukey HSD <sup>a,b</sup>	0%SM+0 %BHT	3	85.79433					
	0%SM+5 %BHT	3	86.30767					
	0%SM+10 %BHT	3	87.47867	87.47867				
	10%SM+0 %BHT	3	87.96667	87.96667				
	10%SM+5 %BHT	3		88.90900	88.90900			
	20%SM+0 %BHT	3			90.17367			
	20%SM+5 %BHT	3				93.50300		
	10%SM+1 0%BHT	3				95.22733	95.22733	
	30%SM+0 %BHT	3				95.63267	95.63267	
	30%SM+5 %BHT	3					96.70400	
	Control_P E	3						98.88867
	20%SM+1 0%BHT	3						99.04233
	30%SM+1 0%BHT	3						99.07367
	Control_H DPE	3						99.72700
	Sig.			.052	.504	.682	.061	.455

Means for groups in homogeneous subsets are displayed.  
Based on observed means.  
The error term is Mean Square(Error) = .533.

a. Uses Harmonic Mean Sample Size = 3.000.  
b. Alpha = .05.

Lampiran 14. Rata-rata Kemampuan Retensi Kelembaban dan subset hasil uji lanjut interaksi pengaruh konsentrasi Selulosa Mikrokristalin dari selulosa bakteri *Acetobacter xylinum* sebagai penguat dan BHT sebagai bahan aktif berpenyerap oksigen pada pembuatan bioplastik berbahan dasar PLA.

Perlakuan		Kemampuan Retensi Kelembaban
%SM	%BHT	
0%SM	0%BHT	85,794 ± 0,157a
	5%BHT	86,308 ± 0,321a
	10%BHT	87,479 ± 0,421ab
10%SM	0%BHT	87,967 ± 0,656b
	5%BHT	88,909 ± 0,597bc
	10%BHT	95,227 ± 0,570de
20%SM	0%BHT	90,174 ± 0,469c
	5%BHT	93,503 ± 1,242d
	10%BHT	99,042 ± 0,654f
30%SM	0%BHT	95,633 ± 1,224de
	5%BHT	96,704 ± 0,739e
	10%BHT	99,074 ± 1,326f
Control	LDPE	98,889 ± 0,147f
	HDPE	99,727 ± 0,132f

Keterangan : Angka yang diikuti huruf yang sama menunjukkan tidak berbeda nyata menurut uji Tuckey pada taraf 5%.

Lampiran 15. Hasil uji *swelling* bioplastik berbasis PLA terintegrasi SM dan BHT.

Kode Sampel	Ulangan	berat awal (wd) g	berat akhir (ws) g	Nilai ST (%)
0%SM+0%BHT	U1	0,1111	0,1651	48,605
	U2	0,2177	0,3243	48,966
	U3	0,1874	0,2758	47,172
10%SM+0%BHT	U1	0,1923	0,2743	42,642
	U2	0,2011	0,2872	42,815
	U3	0,2922	0,4173	42,813
20%SM+0%BHT	U1	0,1693	0,2288	35,145
	U2	0,1376	0,1871	35,974
	U3	0,2413	0,3234	34,024
30%SM+0%BHT	U1	0,2045	0,2651	29,633
	U2	0,1864	0,2423	29,989
	U3	0,2327	0,3031	30,254

Kode Sampel	Ulangan	berat awal (wd) g	berat akhir (ws) g	Nilai ST (%)
0%SM+5%BHT	U1	0,2515	0,3677	46,203
	U2	0,1564	0,2276	45,524
	U3	0,2121	0,3103	46,299
10%SM+5%BHT	U1	0,2317	0,3265	40,915
	U2	0,2024	0,2821	39,377
	U3	0,2498	0,3519	40,873
20%SM+5%BHT	U1	0,2849	0,3776	32,538
	U2	0,1419	0,1881	32,558
	U3	0,2191	0,2891	31,949
30%SM+5%BHT	U1	0,2715	0,3497	28,803
	U2	0,1564	0,2025	29,476
	U3	0,3166	0,4079	28,838
0%SM+10%BHT	U1	0,1469	0,2128	44,860
	U2	0,2397	0,3484	45,348
	U3	0,2401	0,3501	45,814
10%SM+10%BHT	U1	0,245	0,3413	39,306
	U2	0,1967	0,2716	38,078
	U3	0,1262	0,1748	38,510
20%SM+10%BHT	U1	0,1811	0,2371	30,922
	U2	0,1001	0,1316	31,469
	U3	0,2343	0,3051	30,218
30%SM+10%BHT	U1	0,1915	0,2448	27,833
	U2	0,2442	0,3131	28,215
	U3	0,1808	0,2316	28,097
LDPE	U1	0,0256	0,0257	0,391
	U2	0,0224	0,0225	0,446
	U3	0,0243	0,0249	2,469
HDPE	U1	0,0625	0,0626	0,160
	U2	0,0638	0,064	0,313
	U3	0,0586	0,059	0,683

Lampiran 16. Hasil uji ANOVA nilai *swelling* bioplastik berbasis PLA terintegrasi SM dan BHT.

Tests of Between-Subjects Effects					
Dependent Variable: <i>Swelling_Test</i>					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8584.969 <sup>a</sup>	13	660.382	1623.112	.000
Intercept	23234.475	1	23234.475	57106.546	.000
CM	1668.073	3	556.024	1366.617	.000
BHT	65.945	2	32.972	81.041	.000
CM * BHT	6.085	6	1.014	2.493	.057
Error	11.392	28	.407		
Total	51637.455	42			
Corrected Total	8596.361	41			

a. R Squared = .999 (Adjusted R Squared = .998)

Lampiran 17. Uji lanjut tuckey nilai *swelling* bioplastik berbasis PLA terintegrasi SM dan BHT.

<i>Swelling_Test</i>						
Tukey HSD <sup>a,b,c</sup>						
Percentage Cellulose Microcrystalline	N	Subset				
		1	2	3	4	5
Control_HDPE	3	.38533				
Control_PE	3	1.10200				
30%	9		29.01533			
20%	9			32.75522		
10%	9				40.59211	
0%	9					46.53233
Sig.		.454	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.  
Based on observed means.  
The error term is Mean Square(Error) = .407.

a. Uses Harmonic Mean Sample Size = 5.400.  
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.  
c. Alpha = .05.

<i>Swelling_Test</i>					
Tukey HSD <sup>a,b,c</sup>					
Percentage Butylated Hydroxytoluene	N	Subset			
		1	2	3	4
Control_HDPE	3	.38533			
Control_LDPE	3	1.10200			

10%	12		35.72250		
5%	12			36.94608	
0%	12				39.00267
Sig.		.364	1.000	1.000	1.000
Means for groups in homogeneous subsets are displayed.					
Based on observed means.					
The error term is Mean Square(Error) = .407.					
a. Uses Harmonic Mean Sample Size = 5.455.					
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.					
c. Alpha = .05.					

Lampiran 18. Rata-rata *swelling* dan subset hasil uji lanjut interaksi pengaruh konsentrasi Selulosa Mikrokristalin dari selulosa bakteri *Acetobacter xylinum* sebagai penguat dan BHT sebagai bahan aktif berpenyerap oksigen pada pembuatan bioplastik berbahan dasar PLA.

Perlakuan		Persentase <i>swelling</i>
%SM	%BHT	
0%SM	0%BHT	48,24767 ± 0,948 eD
	5%BHT	42,75667 ± 0,422 eC
	10%BHT	35,04767 ± 0,477eB
10%SM	0%BHT	29,95867 ± 0,099 dD
	5%BHT	46,00867 ± 0,876 dC
	10%BHT	40,38833 ± 0,622 dB
20%SM	0%BHT	32,34833 ± 0,978 cD
	5%BHT	29,0388 ± 0,345 cC
	10%BHT	45,34067 ± 0,627 cB
30%SM	0%BHT	38,63133 ± 0,311 bD
	5%BHT	30,86967 ± 0,378 bC
	10%BHT	28,04833 ± 0,195 bB
Kontrol	HDPE	1,102 ± 1,184 aA
	HDPE	0,38533 ± 0,268 aA

Keterangan : Angka yang diikuti huruf yang sama menunjukkan tidak berbeda nyata menurut uji Tuckey pada taraf 5%. Huruf kapital mewakili pengaruh BHT dan huruf kecil mewakili CM terhadap uji *swelling* bioplastik.



Lampiran 19. Hasil uji kuat tarik bioplastik berbasis PLA terintegrasi SM dan BHT.

Kode Sampel	Ulangan	N/mm <sup>2</sup>
0%SM+0%BHT	U1	4,2902
	U2	4,2308
10%SM+0%BHT	U1	3,3054
	U2	2,8864
20%SM+0%BHT	U1	1,9287
	U2	1,5864
30%SM+0%BHT	U1	2,3480
	U2	2,3845
0%SM+5%BHT	U1	2,6336
	U2	2,6256
10%SM+5%BHT	U1	3,0341
	U2	2,8762
20%SM+5%BHT	U1	2,0658
	U2	2,3398
30%SM+5%BHT	U1	2,3454
	U2	2,2977
0%SM+10%BHT	U1	3,0033
	U2	3,3159
10%SM+10%BHT	U1	1,5592
	U2	1,6832
20%SM+10%BHT	U1	1,9272
	U2	1,864
30%SM+10%BHT	U1	2,71
	U2	2,26
HDPE	U1	4,3933
	U2	4,0915



0%SM+0%BHT	2							4.26050
Sig.		.051	.117	.139	.486	.094	.065	1.000
Means for groups in homogeneous subsets are displayed. Based on observed means. The error term is Mean Square(Error) = .031.								
a. Uses Harmonic Mean Sample Size = 2.000.								
b. Alpha = .05.								

Lampiran 22. Rata-rata kuat tarik dan subset hasil uji lanjut interaksi pengaruh konsentrasi Selulosa Mikrokristalin dari selulosa bakteri *Acetobacter xylinum* sebagai penguat dan BHT sebagai bahan aktif berpenyerap oksigen pada pembuatan bioplastik berbahan dasar PLA.

Perlakuan		Kuat Tarik
%SM	%BHT	
0%SM	0%BHT	4,2605 ± 0,042g
	5%BHT	3,0959 ± 0,005def
	10%BHT	1,75755 ± 0,221f
10%SM	0%BHT	2,36625 ± 0,29f
	5%BHT	2,6296 ± 0,111ef
	10%BHT	2,95515 ± 0,087a
20%SM	0%BHT	2,2028 ± 0,242ab
	5%BHT	2,32155 ± 0,193abcd
	10%BHT	3,1596 ± 0,044abc
30%SM	0%BHT	1,6212 ± 0,025bcde
	5%BHT	1,8956 ± 0,033abcde
	10%BHT	2,485 ± 0,318cdef
Kontrol	HDPE	4,2424 ± 0,213g

Lampiran 23. Hasil uji kuat mulur bioplastik berbasis PLA terintegrasi SM dan BHT.

Kode Sampel	Ulangan	Kuat mulur (%)
0%SM+0%BHT	U1	3,1
	U2	3,63
10%SM+0%BHT	U1	2,43
	U2	2,08
20%SM+0%BHT	U1	2,09
	U2	2,24
30%SM+0%BHT	U1	2,32

Kode Sampel	Ulangan	Kaut mulur (%)
		U2
0%SM+5%BHT	U1	12,18
	U2	5,59
10%SM+5%BHT	U1	15,02
	U2	7,65
20%SM+5%BHT	U1	3,14
	U2	1,73
30%SM+5%BHT	U1	2,66
	U2	2,25
0%SM+10%BHT	U1	17,91
	U2	33,58
10%SM+10%BHT	U1	1,75
	U2	2,35
20%SM+10%BHT	U1	2,67
	U2	3,82
30%SM+10%BHT	U1	2,71
	U2	2,26
HDPE	U1	329,67
	U2	265,08

Lampiran 24. Hasil uji ANOVA kuat mulur bioplastik berbasis PLA terintegrasi SM dan BHT.

Tests of Between-Subjects Effects					
Dependent Variable: elongation (Kuat Mulur)_percentage					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	158072.559 <sup>a</sup>	12	13172.713	75.773	.000
Intercept	77764.027	1	77764.027	447.321	.000
CM	410.457	3	136.819	.787	.522
BHT	137.183	2	68.591	.395	.682
CM * BHT	520.300	6	86.717	.499	.798
Error	2259.971	13	173.844		
Total	180985.653	26			
Corrected Total	160332.530	25			

a. R Squared = .986 (Adjusted R Squared = .973)

Lampiran 25. Rata-rata kuat mulur bioplastik berbasis PLA terintegrasi SM dan BHT.

Perlakuan		Kuat Mulur
%SM	%BHT	
0%SM	0%BHT	3,365 ± 0,374
	5%BHT	8,885 ± 4,659
	10%BHT	25,745 ± 11,080
10%SM	0%BHT	2,255 ± 0,247
	5%BHT	11,335 ± 5,211
	10%BHT	2,05 ± 0, 424
20%SM	0%BHT	2,165 ± 0,106
	5%BHT	2,435 ± 0,997
	10%BHT	3,245 ± 0,813
30%SM	0%BHT	2,6 ± 0,395
	5%BHT	2,455 ± 0,289
	10%BHT	2,485 ± 0,318
Control	HDPE	297,375± 45,672

Lampiran 26. Laporan pengujian kuat tarik dan kuat mulur HDPE oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM



**BADAN STANDARDISASI DAN KEBIJAKAN JASA INDUSTRI  
LABORATORIUM PENGUJI BBSPJIHPMM**

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**LAPORAN PENGUJIAN**

Nomor : 2.4123/LU-BBIHP/VII/2022

Nomor Analisis : P. 3927  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.2, Keadaan Contoh Baik, Sampel Kode HDPE, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	4,3933	IK-MT-28.01
		4,0915	
Kuat Mulur	%	329,67	IK-MT-28.01
		265,08	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi



MAMANG

Lampiran 27. Laporan pengujian kuat tarik dan kuat mulur bioplastik 0%SM+0%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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Telp: (0411) 441207 Fax: (0411) 441135 Website: www.bbhip.kemenperin.go.id E-mail.: bbhip@kemenperin.go.id

**LAPORAN PENGUJIAN**

Nomor : 2.4127/LU-BBIHP/VII/2022

Nomor Analisis : P. 3931  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.6, Keadaan Contoh Baik, Sampel Kode DD, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	4,2902	IK-MT-28.01
		4,2308	
Kuat Mulur	%	3,10	IK-MT-28.01
		3,63	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi



Lampiran 28. Laporan pengujian kuat tarik dan kuat mulur bioplastik 0%SM+5%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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Telp: (0411) 441207 Fax: (0411) 441135 Website: www.bbhp.kemenperin.go.id E-mail.: bbhp@kemenperin.go.id

**LAPORAN PENGUJIAN**

Nomor : 2.4132/LU-BBIHP/VII/2022

Nomor Analisis : P. 3936  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.11, Keadaan Contoh Baik, Sampel Kode GG, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	2,6336	IK-MT-28.01
		2,6256	
Kuat Mulur	%	12,18	IK-MT-28.01
		5,59	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi





Lampiran 29. Laporan pengujian kuat tarik dan kuat mulur bioplastik 0%SM+10%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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Telp: (0411) 441207 Fax: (0411) 441135 Website: www.bbhp.kemenperin.go.id E-mail: bbhp@kemenperin.go.id

**LAPORAN PENGUJIAN**

Nomor : 2.4134/LU-BBIHP/VII/2022

Nomor Analisis : P. 3938  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.13, Keadaan Contoh Baik, Sampel Kode II, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	3,0033	IK-MT-28.01
		3,3159	
Kuat Mulur	%	17,91	IK-MT-28.01
		33,58	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi



Lampiran 30. Laporan pengujian kuat tarik dan kuat mulur bioplastik 10%SM+0%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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Telp: (0411) 441207 Fax: (0411) 441135 Website: www.bbhip.kemenperin.go.id E-mail: bbhip@kemenperin.go.id

**LAPORAN PENGUJIAN**

Nomor : 2.4128/LU-BBIHP/VII/2022

Nomor Analisis : P. 3932  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.7, Keadaan Contoh Baik, Sampel Kode EE, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	3,3054	IK-MT-28.01
		2,8864	
Kuat Mulur	%	2,43	IK-MT-28.01
		2,08	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi



Lampiran 31. Laporan pengujian kuat tarik dan kuat mulur bioplastik 10%SM+5%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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**LAPORAN PENGUJIAN**  
Nomor : 2.4124/LU-BBIHP/VII/2022

Nomor Analisis : P. 3928  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.3, Keadaan Contoh Baik, Sampel Kode AA, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	3,0341	IK-MT-28.01
		2,8762	
Kuat Mulur	%	15,02	IK-MT-28.01
		7,65	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi




**MAMANG**

Lampiran 32. Laporan pengujian kuat tarik dan kuat mulur bioplastik 10%SM+10%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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**LAPORAN PENGUJIAN**

Nomor : 2.4129/LU-BBHP/VI/2022

Nomor Analisis : P. 3933  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.8, Keadaan Contoh Baik, Sampel Kode HH, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	1,5592	IK-MT-28.01
		1,6832	
Kuat Mulur	%	1,75	IK-MT-28.01
		2,35	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi



Lampiran 33. Laporan pengujian kuat tarik dan kuat mulur bioplastik 20%SM+0%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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**LAPORAN PENGUJIAN**

Nomor : 2.4131/LU-BBIHP/VII/2022

Nomor Analisis : P. 3935  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.10, Keadaan Contoh Baik, Sampel Kode KK, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	1,9287	IK-MT-28.01
		1,5864	
Kuat Mulur	%	2,09	IK-MT-28.01
		2,24	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi



Lampiran 34. Laporan pengujian kuat tarik dan kuat mulur bioplastik 20%SM+5%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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**LAPORAN PENGUJIAN**

Nomor : 2.4130/LU-BBIHP/VII/2022

Nomor Analisis : P. 3934  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.9, Keadaan Contoh Baik, Sampel Kode JJ, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	2,0658	IK-MT-28.01
		2,3398	
Kuat Mulur	%	3,14	IK-MT-28.01
		1,73	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi



Lampiran 35. Laporan pengujian kuat tarik dan kuat mulur bioplastik 20%SM+10%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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**LAPORAN PENGUJIAN**

Nomor : 2.4133/LU-BBIHP/VII/2022

Nomor Analisis : P. 3937  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.12, Keadaan Contoh Baik, Sampel Kode FF, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	1,9272	IK-MT-28.01
		1,8640	
Kuat Mulur	%	2,67	IK-MT-28.01
		3,82	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi



Lampiran 36. Laporan pengujian kuat tarik dan kuat mulur bioplastik 30%SM+0%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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**LAPORAN PENGUJIAN**

Nomor : 2.4125/LU-BBIHP/VII/2022

Nomor Analisis : P. 3929  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.4, Keadaan Contoh Baik, Sampel Kode BB, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	2,3480	IK-MT-28.01
		2,3845	
Kuat Mulur	%	2,32	IK-MT-28.01
		2,88	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi



MAMANG



Lampiran 37. Laporan pengujian kuat tarik dan kuat mulur bioplastik 30%SM+5%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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**LAPORAN PENGUJIAN**

Nomor : 2.4126/LU-BBIHP/VII/2022

Nomor Analisis : P. 3930  
Tanggal Penerimaan : 24 Juni 2022  
Nama Pelanggan : Irma Kamaruddin  
Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
Nama Contoh : Bioplastik  
Keterangan Contoh : Kode 798.1077.5, Keadaan Contoh Baik, Sampel Kode CC, Untuk Analisis Fisika  
Pengambilan Contoh : -  
Berita Acara : -  
Tanggal Analisis : 27 Juni 2022  
Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	2,3454	IK-MT-28.01
		2,2977	
Kuat Mulur	%	2,66	IK-MT-28.01
		2,25	

Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi



MAMANG

Lampiran 38. Laporan pengujian kuat tarik dan kuat mulur bioplastik 30%SM+5%BHT oleh Badan Standardisasi dan Kebijakan Jasa Industri, Laboratorium Pengujian BBSPJIHPMM.



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**LAPORAN PENGUJIAN**  
Nomor : 2.4122/LU-BBIHP/VII/2022

Nomor Analisis : P. 3926  
 Tanggal Penerimaan : 24 Juni 2022  
 Nama Pelanggan : Irma Kamaruddin  
 Alamat : Ilmu dan Teknologi Pangan, Universitas Hasanuddin  
 Nama Contoh : Bioplastik  
 Keterangan Contoh : Kode 798.1077.1, Keadaan Contoh Baik, Sampel Kode LL, Untuk Analisis Fisika  
 Pengambilan Contoh : -  
 Berita Acara : -  
 Tanggal Analisis : 27 Juni 2022  
 Tanggal Penerbitan : 13 Juli 2022



Setelah dilakukan pengujian, diperoleh hasil sebagai berikut :

Parameter	Satuan	Hasil	Metode Uji
Kuat Tarik	N/mm <sup>2</sup>	2,71	IK-MT-28.01
		2,26	
Kuat Mulur	%	2,71	IK-MT-28.01
		2,26	

↳ Koordinator Inspeksi Teknis, Pengujian dan Kalibrasi



**MAMANG**

Lampiran 39. Hasil uji densitas bioplastik berbasis PLA terintegrasi SM dan BHT.

Kode Sampel	berat sampel (gr)	Ketebalan (cm)	Volume (cm <sup>3</sup> )	p (Densitas/Rapat massa) g/cm <sup>3</sup>
0%SM+0%BHT	1,8208	0,144	3,848698	0,473
	1,8354	0,142	3,784642	0,485
	1,8291	0,143	3,822008	0,479
10%SM+0%BHT	1,9632	0,141	3,76329	0,522
	1,9809	0,141	3,76329	0,526
	1,9541	0,141	3,76329	0,519
20%SM+0%BHT	2,6615	0,143	3,81667	0,697
	2,5899	0,141	3,76329	0,688
	2,5052	0,141	3,76329	0,666
30%SM+0%BHT	2,9998	0,142	3,78998	0,792
	2,9919	0,141	3,76329	0,795
	2,9569	0,141	3,76329	0,786
0%SM+5%BHT	1,8348	0,140	3,7366	0,491
	1,9295	0,149	3,9701375	0,486
	1,8549	0,148	3,95012	0,470
10%SM+5%BHT	1,9829	0,147	3,92343	0,505
	1,9913	0,148	3,95012	0,504
	2,0471	0,147	3,92343	0,522
20%SM+5%BHT	2,8639	0,148	3,936775	0,727
	2,7872	0,146	3,89674	0,715
	2,8926	0,145	3,87005	0,747
30%SM+5%BHT	3,1943	0,142	3,78998	0,843
	3,1989	0,142	3,78998	0,844
	3,1952	0,142	3,78998	0,843
0%SM+10%BHT	1,9197	0,1415	3,776635	0,508
	1,9164	0,1412	3,768628	0,509
	1,8982	0,142	3,78998	0,501
10%SM+10%BHT	1,9902	0,147	3,92343	0,507
	2,0938	0,141	3,76329	0,556
	2,0502	0,148	3,95012	0,519
20%SM+10%BHT	3,1887	0,142	3,78998	0,841
	3,1857	0,142	3,78998	0,841
	3,1970	0,142	3,78998	0,844

Kode Sampel	berat sampel (gr)	Ketebalan (cm)	Volume (cm <sup>3</sup> )	p (Densitas/Rapat massa) g/cm <sup>3</sup>
30%SM+10%BHT	3,1998	0,142	3,78998	0,844
	3,1987	0,142	3,78998	0,844
	3,1979	0,142	3,78998	0,844
LDPE	1,5064	0,0669	1,785561	0,844
	1,5131	0,0671	1,790899	0,845
	1,5124	0,0663	1,769547	0,855
HDPE	1,7521	0,0697	1,860293	0,942
	1,7249	0,0692	1,846948	0,934
	1,7845	0,0715	1,908335	0,935

Lampiran 40. Hasil uji ANOVA densiitas bioplastik berbasis PLA terintegrasi SM dan BHT.

Tests of Between-Subjects Effects					
Dependent Variable: Sweeling_Test					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.126 <sup>a</sup>	13	.087	780,055	.000
Intercept	17.934	1	17.934	161506.890	.000
CM * BHT	.024	6	.004	36.434	.000
CM	.757	3	.252	2272.224	.000
BHT	.023	2	.011	102.333	.000
Error	.003	28	.000		
Total	20.656	42			
Corrected Total	1.129	41			

a. R Squared = .997 (Adjusted R Squared = .996)

Lampiran 41. Uji lanjut tuckey densitas bioplastik berbasis PLA terintegrasi SM dan BHT.

Density_Test									
Tukey HSD <sup>a,b</sup>									
interaction CM*BHT	N	Subset							
		1	2	3	4	5	6	7	8
0%SM+0% BHT	3	.47890							
0%SM+5% BHT	3	.48220	.482 20						
0%SM+10 %BHT	3	.50587	.505 87	.50587					
10%SM+5 %BHT	3		.510 43	.51043					
10%SM+0 %BHT	3			.52247					
10%SM+1 0%BHT	3			.52757					
20%SM+0 %BHT	3				.6837 3				
20%SM+5 %BHT	3					.73007			
30%SM+0 %BHT	3						.79073		
20%SM+1 0%BHT	3							.8418 3	
30%SM+5 %BHT	3							.8433 0	
30%SM+1 0%BHT	3							.8440 3	
Control_P E	3							.8477 7	
Control_H DPE	3								.93693
Sig.		.152	.113	.429	1.000	1.000	1.000	1.000	1.000
Means for groups in homogeneous subsets are displayed. Based on observed means. The error term is Mean Square(Error) = .000.									
a. Uses Harmonic Mean Sample Size = 3.000.									
b. Alpha = .05.									

Lampiran 42. Rata-rata densitas bioplastik berbasis PLA terintegrasi SM dan BHT.

Perlakuan		Densitas
%SM	%BHT	
0%SM	0%BHT	0,47890 ± 0,005956a
	5%BHT	0,48220 ± 0,011195ab
	10%BHT	0,50587 ± 0,004389abc
10%SM	0%BHT	0,52247 ± 0,003612c
	5%BHT	0,51043 ± 0,009865bc
	10%BHT	0,52757 ± 0,025647c
20%SM	0%BHT	0,68373 ± 0,016267d
	5%BHT	0,73007 ± 0,016203e
	10%BHT	0,84183 ± 0,001498g
30%SM	0%BHT	0,79073 ± 0,004697f
	5%BHT	0,84330 ± 0,000624g
	10%BHT	0,84403 ± 0,000252g
Control	HDPE	0,93693 ± 0,004257h
	PE	0,84777 ± 0,006034g

Lampiran 43. Hasil uji permeabilitas oksigen bioplastik berbasis PLA terintegrasi SM dan BHT.

%SM	%BHT	Oksigen permeabilitas
0%SM	0%BHT	11,9532
0%SM	0%BHT	11,9249
0%SM	0%BHT	12,0247
10%SM	0%BHT	8,7214
10%SM	0%BHT	8,6732
10%SM	0%BHT	8,6982
20%SM	0%BHT	7,7968
20%SM	0%BHT	7,8793
20%SM	0%BHT	7,8492
30%SM	0%BHT	6,2154
30%SM	0%BHT	6,1635
30%SM	0%BHT	6,2452
0%SM	5%BHT	3,9427

%SM	%BHT	Oksigen permeabilitas
0%SM	5%BHT	3,8956
0%SM	5%BHT	3,9313
10%SM	5%BHT	3,2293
10%SM	5%BHT	3,1473
10%SM	5%BHT	3,1239
20%SM	5%BHT	2,1698
20%SM	5%BHT	2,2689
20%SM	5%BHT	2,2584
30%SM	5%BHT	1,9381
30%SM	5%BHT	1,9173
30%SM	5%BHT	1,9321
0%SM	10%BHT	0,9281
0%SM	10%BHT	0,9138
0%SM	10%BHT	0,9013
10%SM	10%BHT	0,9134
10%SM	10%BHT	0,9337
10%SM	10%BHT	0,9211
20%SM	10%BHT	0,8799
20%SM	10%BHT	0,8653
20%SM	10%BHT	0,8728
30%SM	10%BHT	0,8121
30%SM	10%BHT	0,8238
30%SM	10%BHT	0,8132
Control	PE	0,7915
Control	PE	0,7964
Control	PE	0,8048
Control	HDPE	0,5134
Control	HDPE	0,5291
Control	HDPE	0,5217

Lampiran 44. Hasil uji ANOVA permeabilitas oksigen bioplastik berbasis PLA terintegrasi SM dan BHT.

Tests of Between-Subjects Effects						
Dependent Variable: oxygen_permeability						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	517.912 <sup>a</sup>	13	39.839	40093.552	.000	1.000
Intercept	321.490	1	321.490	323540.674	.000	1.000
CM	33.543	3	11.181	11252.165	.000	.999
BHT	395.739	2	197.870	199132.084	.000	1.000
CM * BHT	26.773	6	4.462	4490.557	.000	.999
Error	.028	28	.001			
Total	1071.189	42				
Corrected Total	517.940	41				

a. R Squared = 1.000 (Adjusted R Squared = 1.000)





Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .001.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

Lampiran 46. Rata-rata permeabilitas oksigen bioplastik berbasis PLA terintegrasi SM dan BHT.

Perlakuan		Permeabilitas Oksigen
%SM	%BHT	
0%SM	0%BHT	11,96760 ± 0,051435 <sup>k</sup>
	5%BHT	3,92320 ± 0,024573 <sup>g</sup>
	10%BHT	0,91440 ± 0,013410 <sup>c</sup>
10%SM	0%BHT	8,69760 ± 0,024106 <sup>j</sup>
	5%BHT	3,16683 ± 0,055348 <sup>f</sup>
	10%BHT	0,92273 ± 0,010248 <sup>c</sup>
20%SM	0%BHT	7,84177 ± 0,041749 <sup>i</sup>
	5%BHT	2,23237 ± 0,054438 <sup>e</sup>
	10%BHT	0,87267 ± 0,007301 <sup>bc</sup>
30%SM	0%BHT	6,20803 ± 0,041345 <sup>h</sup>
	5%BHT	1,92917 ± 0,010706 <sup>d</sup>
	10%BHT	0,81637 ± 0,006461 <sup>b</sup>
Control	HDPE	0,52140 ± 0,007854 <sup>a</sup>
	LDPE	0,79757 ± 0,006726 <sup>b</sup>

Lampiran 47. Hasil uji kadar vitamin C buah apel potong segar yang dikemas dengan bioplastik berbasis PLA terintegrasi 30%SM dan 10%BHT, plastik HDPE, dan tanpa kemasan.

Perlakuan	Ulangan	Lama Penyimpanan				
		Jam Ke-0	Jam Ke-2	Jam Ke-4	Jam Ke-6	Jam Ke-8
Tanpa Kemasan	U1	2,12	1,05	1,75	1,51	2,24
	U2	2,09	1,02	1,8	1,89	2,15
	U3	2,12	1,05	1,83	1,83	2,21
Kemasan HDPE	U1	1,17	1,49	1,43	2,21	2,04
	U2	1,2	1,49	1,4	2,3	2,04
	U3	1,2	1,51	1,4	2,53	2,06
Bioplastik	U1	2,27	2,24	2,04	1,83	1,54
	U2	2,32	2,15	1,89	1,92	1,57
	U3	2,56	2,18	1,92	1,66	1,54

Lampiran 48. Hasil uji ANOVA kadar vitamin C buah apel potong segar yang dikemas dengan bioplastik berbasis PLA terintegrasi 30%SM dan 10%BHT, plastik HDPE, dan tanpa kemasan.

Tests of Between-Subjects Effects					
Dependent Variable: kadar vitamin c					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.158 <sup>a</sup>	14	.511	61.682	.000
Intercept	148.549	1	148.549	17921.441	.000
jenis_kemasan	.612	2	.306	36.920	.000
lama_penyimpanan	.982	4	.246	29.630	.000
jenis_kemasan * lama_penyimpanan	5.563	8	.695	83.899	.000
Error	.249	30	.008		
Total	155.955	45			
Corrected Total	7.407	44			
a. R Squared = .966 (Adjusted R Squared = .951)					

Lampiran 49. Uji lanjut tuckey kadar vitamin C buah apel potong segar yang dikemas dengan bioplastik berbasis PLA terintegrasi 30%SM dan 10%BHT, plastik HDPE, dan tanpa kemasan.

kadar vitamin c							
Tukey HSD <sup>a,b,c</sup>							
interaksi jenis kemasan dan lama penyimpanan	N	Subset					
		1	2	3	4	5	6
tanpa kemasan 2 jam	3	1.0400					
HDPE 0 jam	3	1.1900	1.1900				
HDPE 4 jam	3	1.4100	1.4100	1.4100			
HDPE 2 jam	3		1.4967	1.4967	1.4967		
tanpa kemasan 6 jam	6			1.7733	1.7733	1.7733	
tanpa kemasan 4 jam	6				1.8717	1.8717	
tanpa kemasan 8 jam	6				1.8750	1.8750	
HDPE 8 jam	3					2.0467	2.0467
tanpa kemasan 0 jam	3					2.1100	2.1100
bioplastik 2 jam	3					2.1900	2.1900
HDPE 6 jam	3						2.3467
bioplastik 0 jam	3						2.3833
Sig.		.189	.434	.209	.167	.089	.302
Means for groups in homogeneous subsets are displayed.							
Based on observed means.							
The error term is Mean Square(Error) = .028.							
a. Uses Harmonic Mean Sample Size = 3.429.							
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.							
c. Alpha = .05.							

Lampiran 50. Hasil kuantifikasi pencoklatan enzimatis buah apel potong segar yang dikemas dengan bioplastik berbasis PLA terintegrasi 30%SM dan 10%BHT, plastik HDPE, dan tanpa kemasan.

Perlakuan	Ulangan	Lama Penyimpanan				
		Jam Ke-0	Jam Ke-2	Jam Ke-4	Jam Ke-6	Jam Ke-8
Tanpa Kemasan	U1	23669,38	25302,64	27199,59	27371,51	27984,62
	U2	25315,6	26263,08	25645,67	28735,24	27278,55
	U3	24492,49	25782,86	26422,63	28053,375	27631,585
Rata-rata		24492,49	25782,86	26422,63	28053,375	27631,585
Kemasan HDPE	U1	22599,04	25531,3	24249,6	27874,52	30515,71
	U2	23352,68	25483,3	24324,565	26759,865	28200,9
	U3	24106,32	25435,3	24399,53	25645,21	25886,09
Rata-rata		23352,68	25483,3	24324,565	26759,865	28200,9
Bioplastik	U1	23447,405	25775,155	26212,12	28304,04	27065,17
	U2	22939,45	25166,6	25846,1	26667,27	28864,63
	U3	23955,36	26383,71	26578,14	29940,81	25265,71
Rata-rata		23447,405	25775,155	26212,12	28304,04	27065,17

Lampiran 51. Hasil uji ANOVA kuantifikasi pencoklatan enzimatis buah apel potong segar yang dikemas dengan bioplastik berbasis PLA terintegrasi 30%SM dan 10%BHT, plastik HDPE, dan tanpa kemasan.

Tests of Between-Subjects Effects					
Dependent Variable: Indeks pencoklatan					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	113462663.325 <sup>a</sup>	14	8104475.952	7.618	.000
Intercept	30624412086.052	1	30624412086.052	28786.923	.000
jenis_kemasan	5570224.923	2	2785112.462	2.618	.090
lama_penyimpanan	96822985.375	4	24205746.344	22.753	.000
jenis_kemasan * lama_penyimpanan	11069453.027	8	1383681.628	1.301	.281
Error	31914920.585	30	1063830.686		
Total	30769789669.962	45			
Corrected Total	145377583.910	44			

a. R Squared = .780 (Adjusted R Squared = .678)

Lampiran 52. Hasil uji Tucky lama penyimpanan terhadap kuantifikasi pencoklatan enzimatis buah apel potong segar yang dikemas dengan bioplastik berbasis PLA terintegrasi 30%SM dan 10%BHT, plastik HDPE, dan tanpa kemasan.

Indeks pencoklatan				
Tukey HSD <sup>a,b</sup>				
lama penyimpanan	N	Subset		
		1	2	3
0 jam	9	23764.1917		
4 jam	9		25653.1050	
2 jam	9		25680.4383	
8 jam	9			27632.5517
6 jam	9			27705.7600
Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.  
Based on observed means.  
The error term is Mean Square(Error) = 1063830.686.

a. Uses Harmonic Mean Sample Size = 9.000.  
b. Alpha = .05.

Lampiran 53. Hasil uji total fenol buah apel potong segar yang dikemas dengan bioplastik berbasis PLA terintegrasi 30%SM dan 10%BHT, plastik HDPE, dan tanpa kemasan.

Perlakuan	Ulangan	Lama Penyimpanan				
		Jam Ke-0	Jam Ke-2	Jam Ke-4	Jam Ke-6	Jam Ke-8
Tanpa Kemasan	U1	3,33	3,12	3,36	3,1	3,02
	U2	3,35	3,13	3,37	3,1	3,02
	U3	3,34	3,125	3,365	3,1	3,02
Rata-Rata		3,34	3,125	3,365	3,1	3,02
Kemasan HDPE	U1	3,4	3,15	3,41	2,88	2,91
	U2	3,39	3,165	3,415	2,895	2,91
	U3	3,38	3,18	3,42	2,91	2,91
Rata-Rata		3,39	3,165	3,415	2,895	2,91
Bioplastik	U1	3,44	3,965	3,865	3,915	4,025
	U2	3,43	3,96	3,85	3,91	4,02
	U3	3,45	3,97	3,88	3,92	4,03
Rata-Rata		3,44	3,965	3,865	3,915	4,025

Lampiran 54. Hasil uji ANOVA total fenol buah apel potong segar yang dikemas dengan bioplastik berbasis PLA terintegrasi 30%SM dan 10%BHT, plastik HDPE, dan tanpa kemasan.

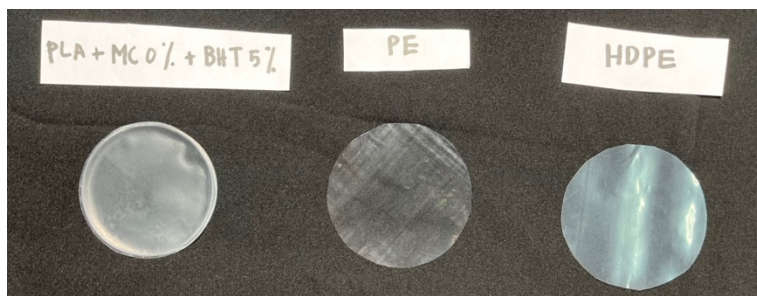
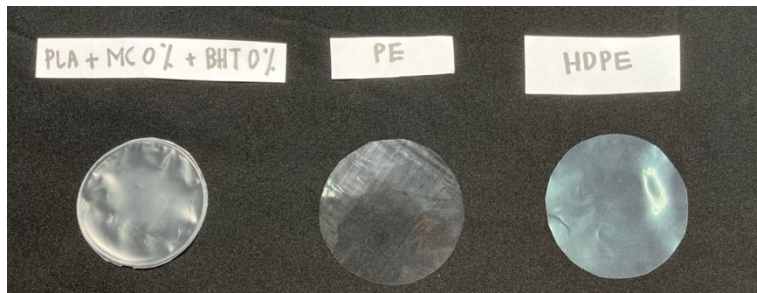
<b>Tests of Between-Subjects Effects</b>					
Dependent Variable: total fenol					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6.174 <sup>a</sup>	14	.441	5880.410	.000
Intercept	518.875	1	518.875	6918331.267	.000
lama_penyimpanan	.345	4	.086	1150.767	.000
jenis_kemasan	4.491	2	2.246	29943.267	.000
lama_penyimpanan * jenis_kemasan	1.338	8	.167	2229.517	.000
Error	.002	30	7.500E-5		
Total	525.052	45			
Corrected Total	6.177	44			
a. R Squared = 1.000 (Adjusted R Squared = .999)					

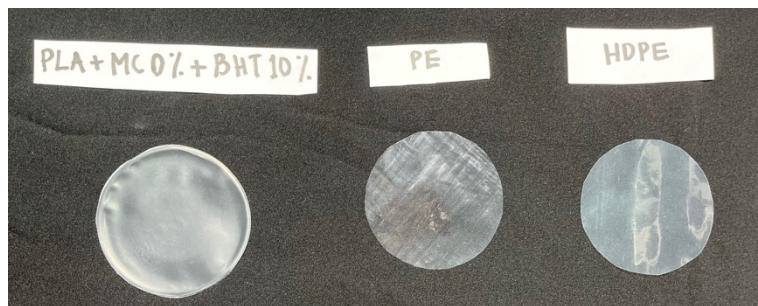
Lampiran 55. Uji lanjut tuckey total fenol buah apel potong segar yang dikemas dengan bioplastik berbasis PLA terintegrasi 30%SM dan 10%BHT, plastik HDPE, dan tanpa kemasan.

total fenol														
Tukey HSD <sup>a,b</sup>														
interaksi jenis kemasan dan lama penyimpanan	N	Subset												
		1	2	3	4	5	6	7	8	9	10	11	12	
HDPE 6 jam	3	2.8950												
HDPE 8 jam	3	2.9100												
tanpa kemasan 8 jam	3		3.0200											
tanpa kemasan 6 jam	3			3.1000										
tanpa kemasan 2 jam	3			3.1250										
HDPE 2 jam	3				3.1650									
tanpa kemasan 0 jam	3					3.3400								
tanpa kemasan 4 jam	3					3.3650	3.3650							
HDPE 0 jam	3						3.3900	3.3900						
HDPE 4 jam	3							3.4150	3.4150					
bioplastik 0 jam	3								3.4400					
bioplastik 4 jam	3									3.8650				
bioplastik 6 jam	3										3.9150			
bioplastik 2 jam	3											3.9650		
bioplastik 8 jam	3												4.0250	
Sig.		.712	1.000	.070	1.000	.070	.070	.070	.070	.070	1.000	1.000	1.000	1.000
Means for groups in homogeneous subsets are displayed.														
Based on observed means.														
The error term is Mean Square(Error) = 7.50E-005.														
a. Uses Harmonic Mean Sample Size = 3.000.														
b. Alpha = .05.														

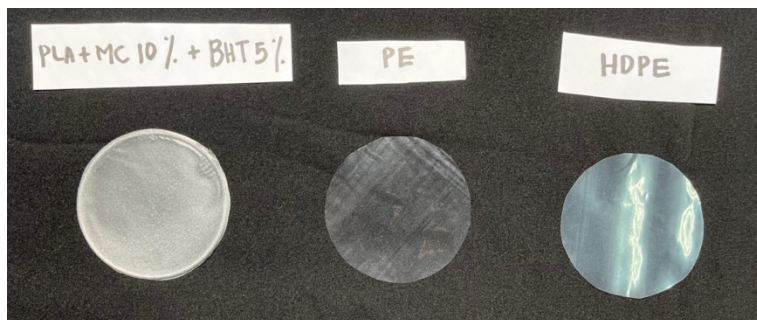
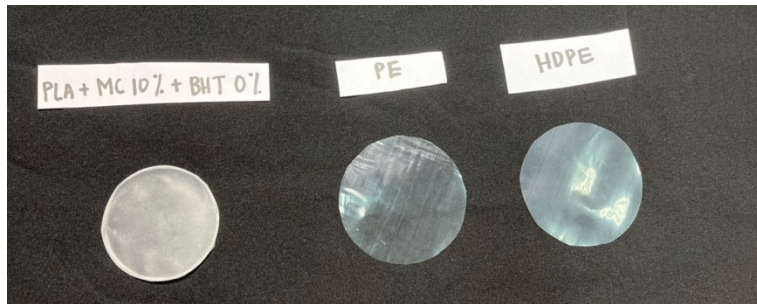


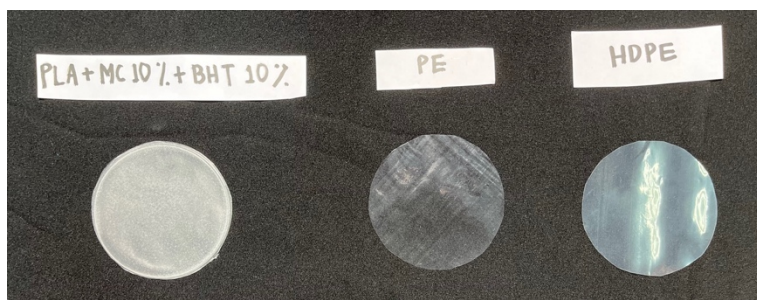
Lampiran 56. Dokumentasi bioplastik berbasis PLA terintegrasi 0% Selulosa Mikrokrystalin (SM) dan 0%; 5%; 10% Butylated Hydroxytoluene (BHT)



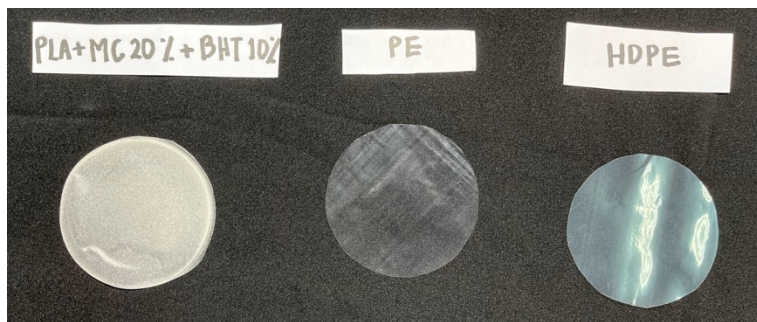
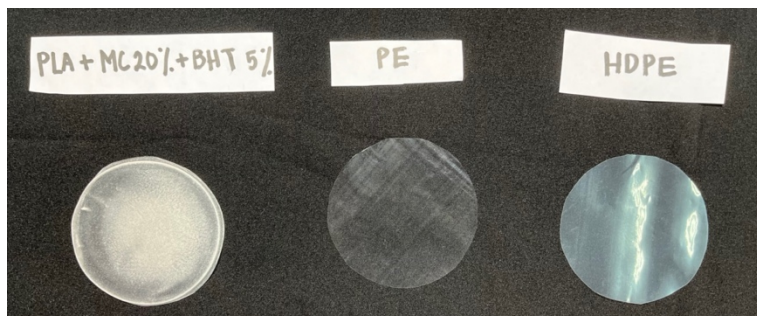
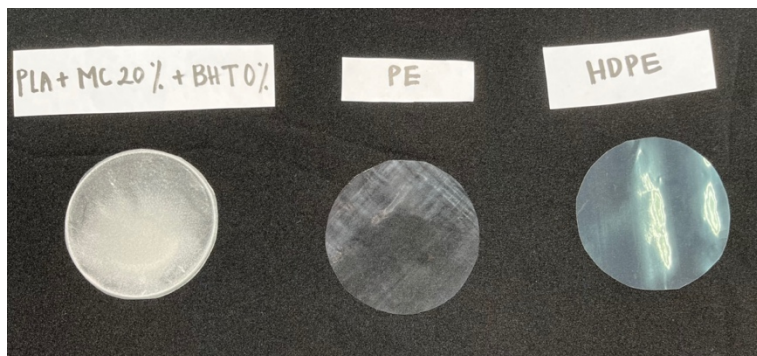


Lampiran 57. Dokumentasi bioplastik berbasis PLA terintegrasi 10% Selulosa Mikrokrystalin (SM) dan 0%; 5%; 10% Butylated Hydroxytoluene (BHT)



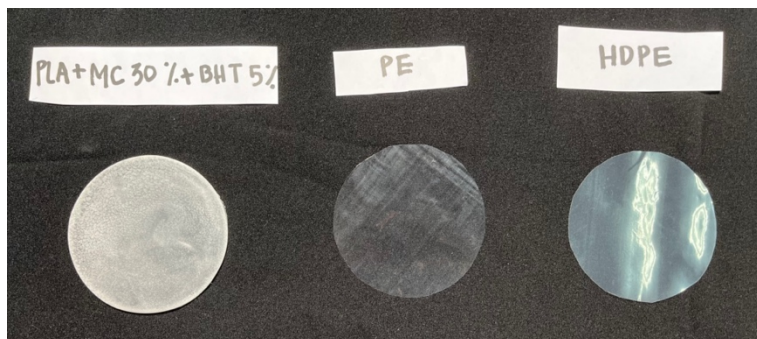
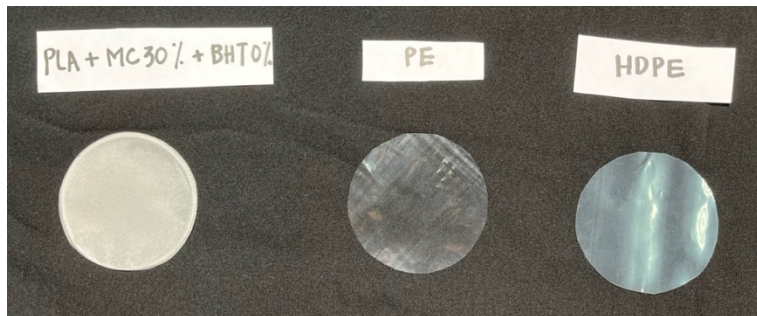


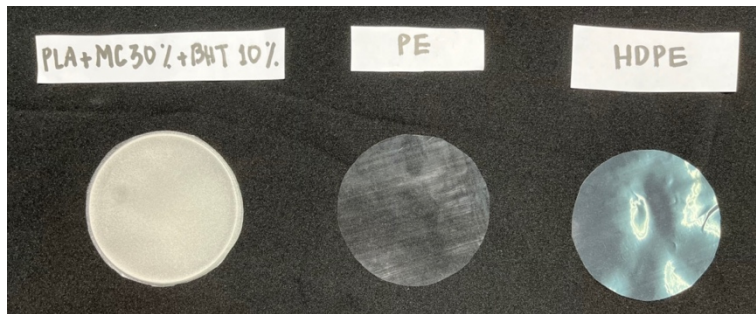
Lampiran 58. Dokumentasi bioplastik berbasis PLA terintegrasi 20% Selulosa Mikrokrystalin (SM) dan 0%; 5%; 10% Butylated Hydroxytoluene (BHT)





Lampiran 59. Dokumentasi bioplastik berbasis PLA terintegrasi 30% Selulosa Mikrokrystalin (SM) dan 0%; 5%; 10% Butylated Hydroxytoluene (BHT)





Lampiran 60. Dokumentasi penelitian



(a)

(b)

(c)

Penundaan air kelapa tua selama 5 hari untuk menurunkan pH (a) dan penyaringan air kelapa untuk menghilangkan kotoran (b) pemasakan media air kelapa (c)





Fermentasi selulosa bakteri



Purifikasi selulosa



Selulosa bakteri setelah purifikasi



Mengempa selulosa bakteri *Acetobacter xylinum*



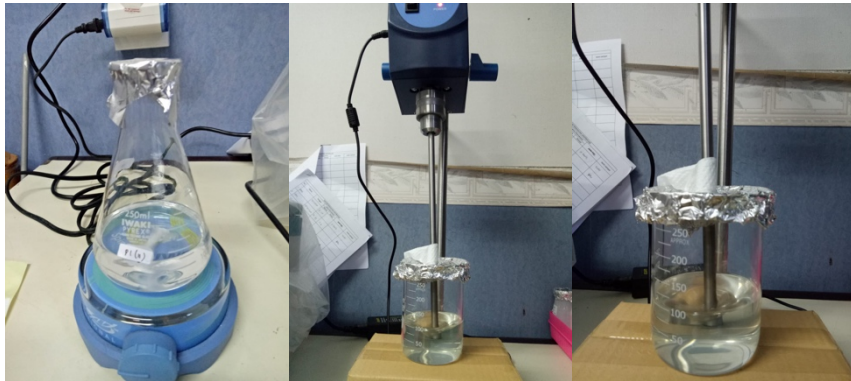
Pengeringan selulosa bakteri *Acetobacter xylinum*



Selulosa bakteri *Acetobacter xylinum* kering



Selulosa Mikrokrystalin



Pembuatan larutan bioplastik



Pencetakan bioplastik



Uji biodegradabilitas

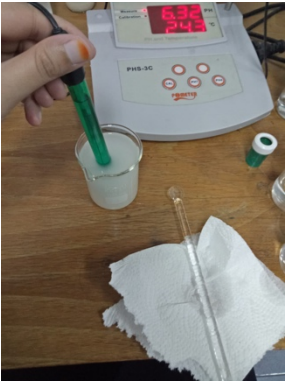




Bioplastik setelah terdegradasi



Uji warna



Uji pH



Uji Swelling



Uji Vitamin C