

DAFTAR PUSTAKA

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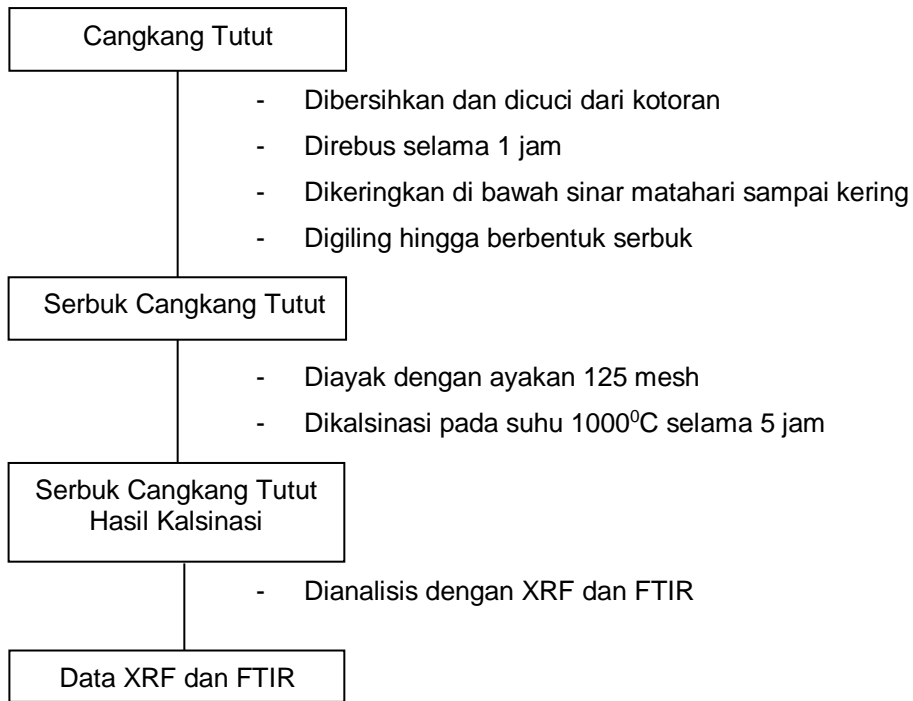
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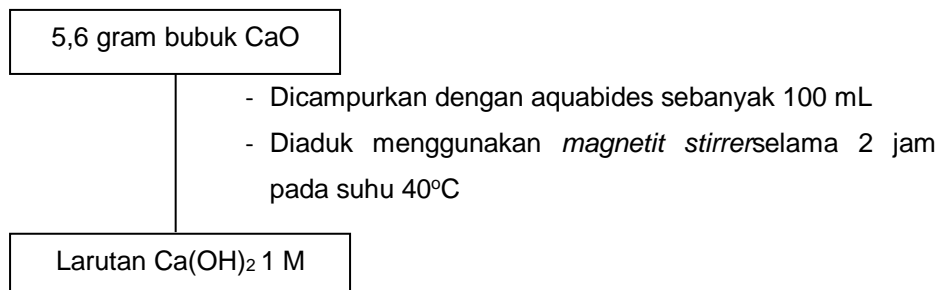
LAMPIRAN 1. Bagan Kerja Penelitian

1.1. Preparasi Cangkang Tutut

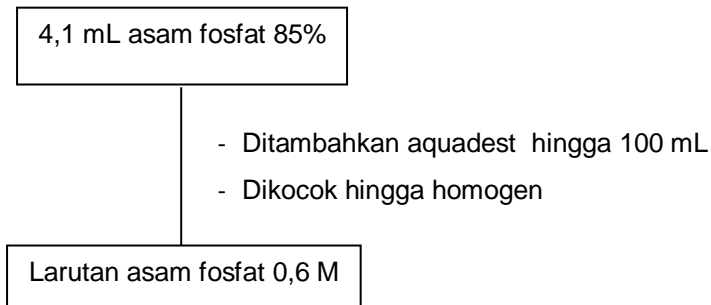


2.1. Preparasi Larutan Kalsium dan Larutan Fosfat

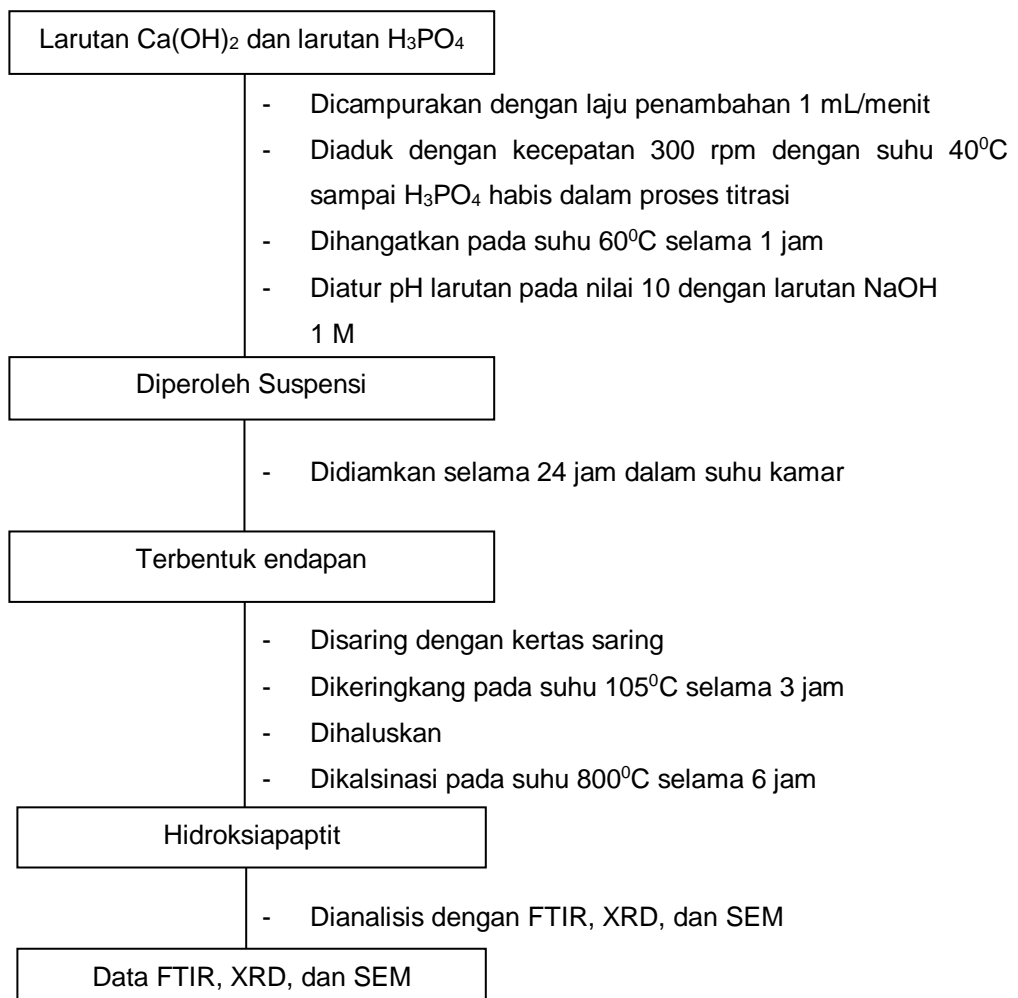
2.1.1. Pembuatan Larutan Kalsium



2.1.2. Pembuatan Larutan Fosfat

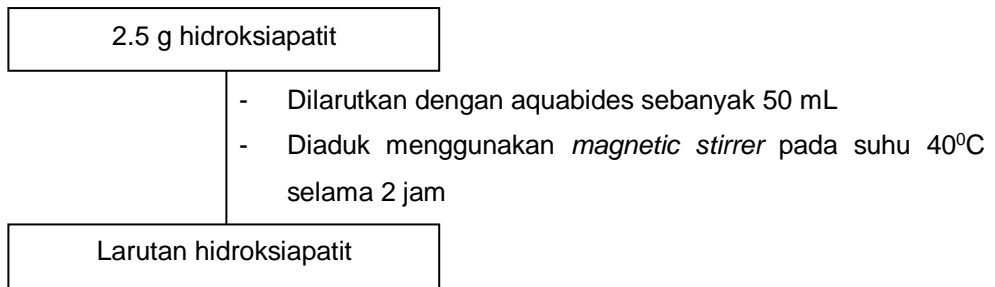


3.1. Sintesis Hidroksiapatit dengan Metode Presipitasi Basah

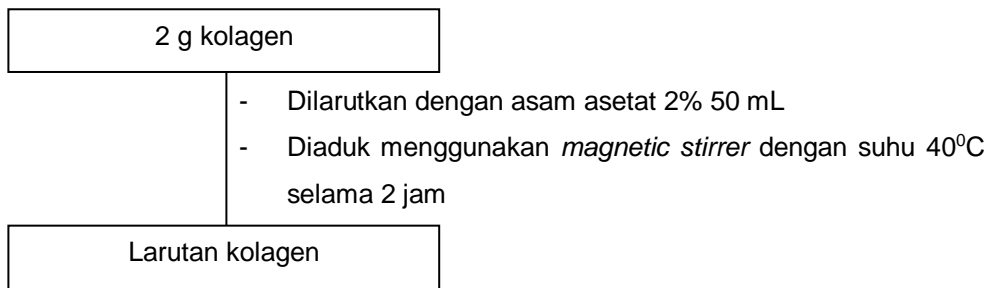


4.1. Sintesis Komposit Hidroksiapatit-Kolagen Doping Zinc

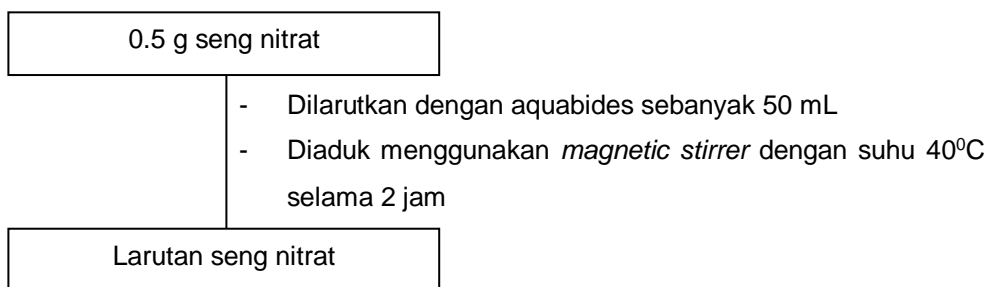
4.1.1. Pembuatan Larutan Hidroksiapatit



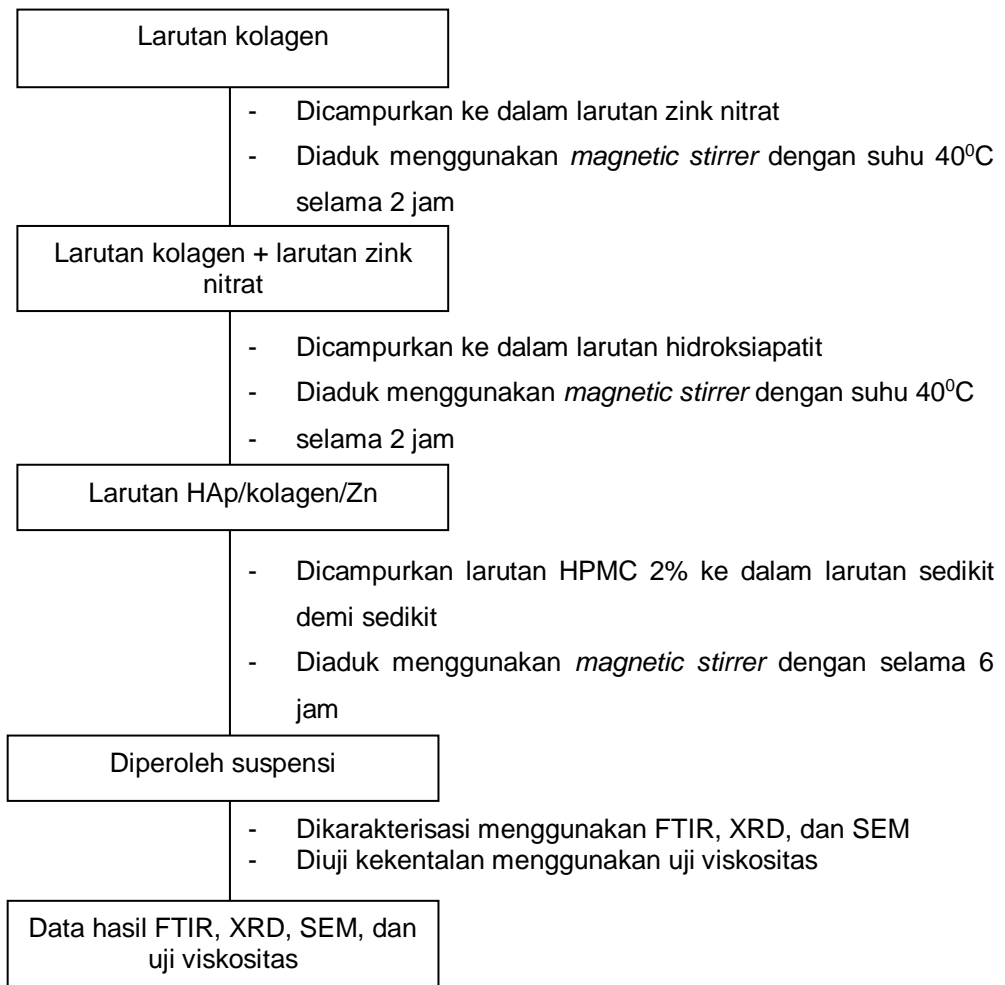
4.1.2. Pembuatan Larutan Kolagen



4.1.3. Pembuatan Larutan Seng (Zn)



5.1. Pembuatan Larutan Hidroksiapatit/Kolagen/Seng (Zn)



LAMPIRAN 2. Data Analisis dan Hasil Analisis

2.1. Data Analisis

2.1.1. Pembuatan Larutan Kalsium Hidroksida (Ca(OH)₂) 1 M dalam 100 mL

$$M = \frac{g \text{ CaO}}{Mr \text{ CaO}} + \frac{1000}{V}$$

$$g \text{ CaO} = \frac{M \times Mr \text{ CaO} \times V}{1000}$$

$$g \text{ CaO} = \frac{\frac{1 \text{ mol}}{L} \times 56 \frac{g}{\text{mol}} \times 100 \text{ mL}}{1000 \frac{\text{mL}}{L}}$$

$$\text{CaO} = 5,6 \text{ g}$$

2.1.2. Pembuatan Larutan Asam Fosfat (H₃PO₄) 0,6 M dalam 100 mL

$$M = \frac{\% \times BJ \times 1000}{Mr}$$

$$= \frac{85\% \times 1,6845 \frac{g}{\text{mL}} \times 1000 \frac{\text{mL}}{L}}{98 \frac{g}{\text{mol}}}$$

$$= 14,6 \text{ mol/L} = 14,6 \text{ M}$$

$$V_1 \times M_1 = V_2 \times M_2$$

$$V_1 \times 14,6 \text{ M} = 100 \text{ mL} \times 0,6 \text{ M}$$

$$V_1 = \frac{100 \text{ mL} \times 0,6 \text{ M}}{14,6 \text{ M}}$$

$$= 4,1 \text{ mL}$$

2.1.3. Pembuatan Larutan Natrium Hidroksida (NaOH) 1 M dalam 100 mL

$$M = \frac{g \text{ NaOH}}{Mr \text{ NaOH}} + \frac{1000}{V}$$

$$g \text{ NaOH} = \frac{M \times Mr \text{ NaOH} \times V}{1000}$$

$$= \frac{\frac{1 \text{ mol}}{L} \times 40 \frac{g}{\text{mol}} \times 100 \text{ mL}}{1000 \frac{\text{mL}}{L}}$$

$$= 4 \text{ g}$$

2.1.4. Pembuatan Larutan Asam Asetat (CH₃COOH) 2% dalam 50 mL

$$M = \frac{\text{Massa Jenis} \times 10 \times \%}{BM}$$

$$= \frac{1,05 \frac{g}{\text{mL}} \times 10 \times 2}{60,05 \frac{g}{\text{mol}}}$$

$$= 0,35 \text{ M}$$

$$V_1 \times M_1 = V_2 \times M_2$$

$$V_1 \times 17,5 \text{ M} = 50 \text{ mL} \times 0,35 \text{ M}$$

$$V_1 = \frac{100 \text{ mL} \times 0,35 \text{ M}}{17,5 \text{ M}}$$

$$= 1 \text{ mL}$$

2.1.5. Perhitungan Ukuran Kristal Menggunakan Persamaan Scherrer

2.1.5.1. Perhitungan Ukuran Kristal Hidroksiapatit

1.) $2\theta = 49,5875$

$$\beta = 0,39500 \times 3,14 / 180 = 0,00689 \text{ radians}$$

$$D = 0,9 \times 0,1541 / 0,00689 \times \text{Cos } 24,79375$$

$$D = 22,36 \text{ nm}$$

2.) $2\theta = 33,0558$

$$\beta = 0,41930 \times 3,14 / 180 = 0,00731 \text{ radians}$$

$$D = 0,9 \times 0,1541 / 0,00731 \times \text{Cos } 16,5279$$

$$D = 19,81 \text{ nm}$$

3.) $2\theta = 32,0624$

$$\beta = 0,70170 \times 3,14 / 180 = 0,01224 \text{ radians}$$

$$D = 0,9 \times 0,1541 / 0,01224 \times \text{Cos } 16,0312$$

$$D = 11,85 \text{ nm}$$

2.1.5.2. Perhitungan Ukuran Kristal Komposit Hidroksiapatit

1.) $2\theta = 46,4593$

$$\beta = 0,41470 \times 3,14 / 180 = 0,00723 \text{ radians}$$

$$D = 0,9 \times 0,1541 / 0,00723 \times \text{Cos } 23,22965$$

$$D = 21,06 \text{ nm}$$

2.) $2\theta = 32,6657$

$$\beta = 0,45140 \times 3,14 / 180 = 0,00787 \text{ radians}$$

$$D = 0,9 \times 0,1541 / 0,00787 \times \text{Cos } 16,33285$$

$$D = 18,49 \text{ nm}$$

3.) $2\theta = 31,6790$


$$\beta = 0,72200 \times 3,14 / 180 = 0,01259 \text{ radians}$$

$$D = 0,9 \times 0,1541 / 0,01259 \times \text{Cos } 15,8395$$


$$D = 11,46 \text{ nm}$$

2.2. Hasil Analisis

2.2.1. Hasil Karakterisasi XRF Cangkang Tutut



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UNIVERSITAS HASANUDDIN
Jl. Perintis Kemerdekaan Km. 10 Tamalene, Makassar 90245
Telp. 0411-586016 • Fax. 0411-588551 • Email : https://mpa.umbis@gmail.com



LAPORAN HASIL PENGUJIAN
CERTIFICATE OF ANALYSIS

Nomor Pekerjaan : L.PPS.XJ-2208-13/1
Job Number

Dipersiapkan Kepada
Presented To

Kepada Yth <i>Attention</i>	: Windasari	Jabatan <i>Job Title</i>	: Mahasiswa
Nama Pelanggan <i>Customer Name</i>	: Windasari	Tujuan Pengujian <i>Purpose of analysis</i>	: Analisis Unsur dan Oksida
Alamat/Universitas <i>Address/University</i>	: Universitas Hasanuddin	No. Faktur /No.	: -
Tanggal Sampel Diterima <i>Date of Sample Receipt</i>	: 11 Agustus 2022	No. Telp./ Phone No.	: 082549240413
Email <i>Email</i>	: -	Tanggal Sampel Dianalisis <i>Date of Sample Analyzed</i>	: 18 Agustus 2022
Nama Pengujian <i>Name of analysis</i>	: Analisis Unsur dan Oksida pada Cangkang Tutut dengan XRF	Total Halaman	: 2

Hasil hanya berhubungan dengan contoh yang diuji dan laporan ini tidak boleh digandakan kecuali sehubungan.
The result relate only to the samples tested and this report shall not be reproduced except in full

No. Dok: P90P-7.8-L.PPS-FMIPA/IF-01.1

No.Revisi/Terbit:1/1

Halaman 1 dari 2



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UNIVERSITAS HASANUDDIN
Jl. Perintis Kemerdekaan Km. 10 Tamalanrea, Makassar 90245
Telp. 0411-586016 • Fax. 0411-588551 • Email : lpps.fmipa.unhas@gmail.com

LAPORAN HASIL PENGUJIAN
CERTIFICATE OF ANALYSIS

Nomor Pekerjaan : LPPS.XJ-2208-13/1

I. Pelanggan / Principal

1.1 Nama / Name : Windasari
1.2 Alamat / Address : Daya
1.3 Telepon / Phone : 082349240413
1.4 Personil Penghubung / Contact Person : -
1.5 Email / Email : -

II. Contoh Uji / Sample

2.1 Kode Sampel / Sample Code : -
2.2 Kemasan / Packaging : Botol vial
2.3 Nama Sampel / Sample Name : Cangkang Tutut
2.4 Keterangan Lain / Other Information : -
2.5 Tanggal Sampling / Date of Sampling : -
2.6 Diterima / Date of Received : 11 Agustus 2022
2.7 Tanggal Uji / Date of Analysis : 18 Agustus 2022
2.8 Jenis Uji / Type of Analysis : Unsur dan Oksida

III. Hasil Uji / Result

Parameter	Satuan	Hasil
Ca	m/m%	96.78
Fe	m/m%	1.61
Sr	m/m%	0.805
Si	m/m%	0.51
Px	m/m%	0.117
Ti	m/m%	0.077
Zn	m/m%	0.029
Nb	m/m%	0.0201
Mo	m/m%	0.0155
Ru	m/m%	0.0069

Parameter	Satuan	Hasil
CaO	m/m%	96.67
Fe ₂ O ₃	m/m%	1.41
SiO ₂	m/m%	0.97
SrO	m/m%	0.586
P ₂ O ₅	m/m%	0.207
TiO ₂	m/m%	0.079
ZnO	m/m%	0.0223
Nb ₂ O ₅	m/m%	0.0176
MoO ₃	m/m%	0.0143
RuO ₄	m/m%	0.0056

Makassar, 19 Agustus 2022
Penanggung Jawab Mutu

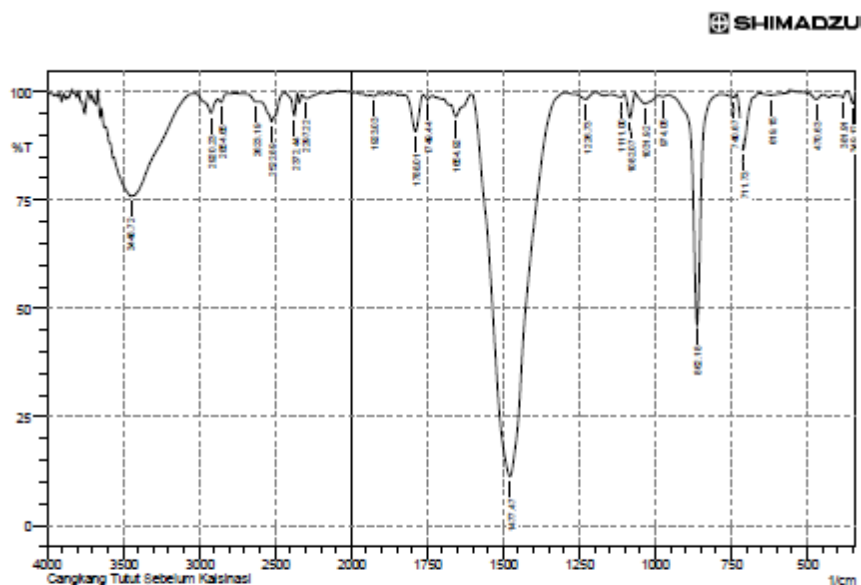
Prof. Dr. Nurul Hariani Soekanto, MS
NIP. 19661215 198702 2 001

Catatan:

- Hasil Uji hanya berlaku untuk contoh tersebut di atas
- Dilarang mengutip/meyalin sebagian isi hasil uji ini

2.2.2. Hasil Karakterisasi FTIR

2.2.2.1. Cangkang Tutut Sebelum Kalsinasi



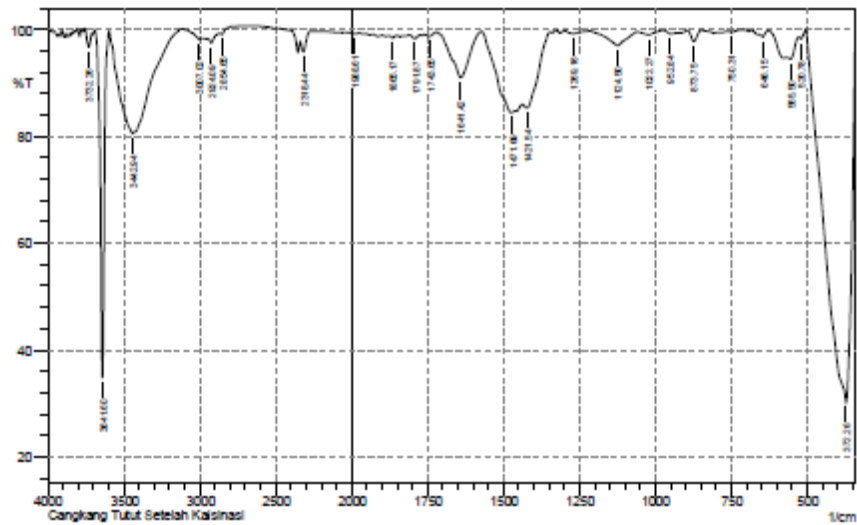
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	349.12	97.364	2.75	366.48	341.4	0.145	0.159
2	381.91	98.646	0.932	393.48	366.48	0.074	0.033
3	470.63	98.304	1.212	499.56	447.49	0.23	0.125
4	619.15	99.24	0.691	653.87	557.43	0.208	0.216
5	711.73	86.653	12.496	731.02	678.94	1.58	1.361
6	740.67	98.697	0.902	783.1	732.95	0.191	0.079
7	862.18	46.36	53.026	954.76	795.03	9.148	8.689
8	974.05	98.83	0.42	989.48	956.69	0.133	0.027
9	1031.92	97.278	2.195	1064.71	989.48	0.604	0.421
10	1082.07	93.989	5.63	1101.35	1064.71	0.482	0.42
11	1111	98.796	0.732	1147.65	1101.35	0.18	0.077
12	1226.73	98.247	1.498	1287.23	1195.87	0.29	0.201
13	1477.47	11.288	88.202	1598.99	1294.24	87.661	87.053
14	1654.92	94.266	2.586	1672.28	1631.78	0.777	0.21
15	1749.44	98.303	0.926	1762.94	1732.08	0.166	0.061
16	1788.01	90.873	8.41	1822.73	1764.87	1.156	0.976
17	1923.03	98.986	0.423	1938.46	1907.6	0.105	0.025
18	2297.22	98.551	0.855	2324.22	2175.7	0.514	0.253
19	2372.44	94.482	5.187	2434.17	2363.16	0.732	0.646
20	2622.89	93.174	5.588	2600.04	2436.09	2.602	1.765
21	2623.19	97.647	0.503	2696.48	2601.97	0.603	0.034
22	2854.65	97.556	1.077	2875.86	2804.5	0.417	0.077
23	2920.23	95.096	3.546	3024.38	2877.79	1.598	0.908
24	3448.72	75.884	1.009	3560.59	3437.15	12.664	0.88

Comment;
Cangkang Tutut Sebelum Kalsinasi

Date/Time; 10/27/2022 1:35:54 PM
No. of Scans;
Resolution;
Apodization;

2.2.2.2. Cangkang tutut Setelah Kalsinasi

SHIMADZU



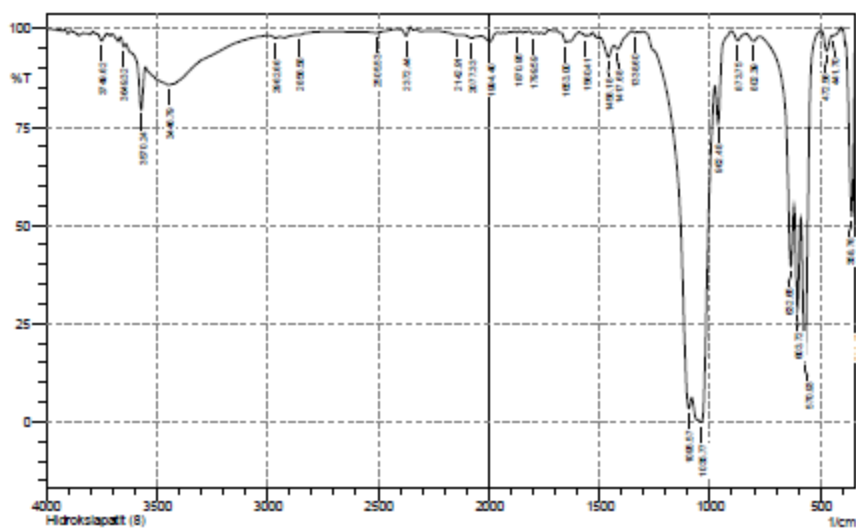
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	372.26	30.218	66.343	503.42	343.33	41.702	40.193
2	520.78	98.247	0.768	528.5	503.42	0.119	0.04
3	555.5	34.488	1.554	569	528.5	0.75	0.151
4	646.15	98.605	1.202	682.8	628.79	0.178	0.134
5	750.31	99.426	0.302	761.88	723.31	0.057	0.019
6	873.75	97.757	2.107	894.97	846.75	0.225	0.197
7	952.84	99.158	0.684	974.05	894.97	0.197	0.144
8	1022.27	99.017	0.684	1060.85	974.05	0.228	0.121
9	1124.5	96.998	2.638	1215.15	1060.85	1.035	0.796
10	1269.16	99.203	0.539	1298.09	1217.08	0.183	0.089
11	1421.54	85.34	2.953	1436.97	1346.31	3.572	0.639
12	1471.69	84.441	1.854	1570.06	1460.11	4.892	0.791
13	1541.42	90.986	8.608	1718.58	1571.99	2.803	2.541
14	1743.65	98.717	0.526	1751.01	1718.58	0.176	0.043
15	1791.87	98.278	0.694	1811.15	1774.51	0.216	0.051
16	1865.17	98.406	0.445	1878.67	1851.66	0.158	0.023
17	1988.61	99.14	0.262	2004.04	1975.11	0.089	0.014
18	2318.44	95.811	2.518	2339.65	2272.15	0.703	0.313
19	2854.65	99.042	0.415	2870.08	2769.78	-0.007	-0.043
20	2924.09	97.494	1.096	2947.23	2870.08	0.534	0.122
21	3007.02	98.163	0.589	3086.11	2980.02	0.48	0.078
22	3442.94	80.522	19.146	3597.24	3142.04	20.996	20.347
23	3641.6	34.771	64.938	3689.83	3599.17	10.982	10.869
24	3732.26	96.669	2.902	3753.48	3712.97	0.36	0.288

Comment;
Cangkang Tutut Setelah Kalsinasi

Date/Time; 8/30/2022 12:32:07 PM
No. of Scans;
Resolution;
Apodization;

2.2.2.3. Hidroksiapatit

SHIMADZU



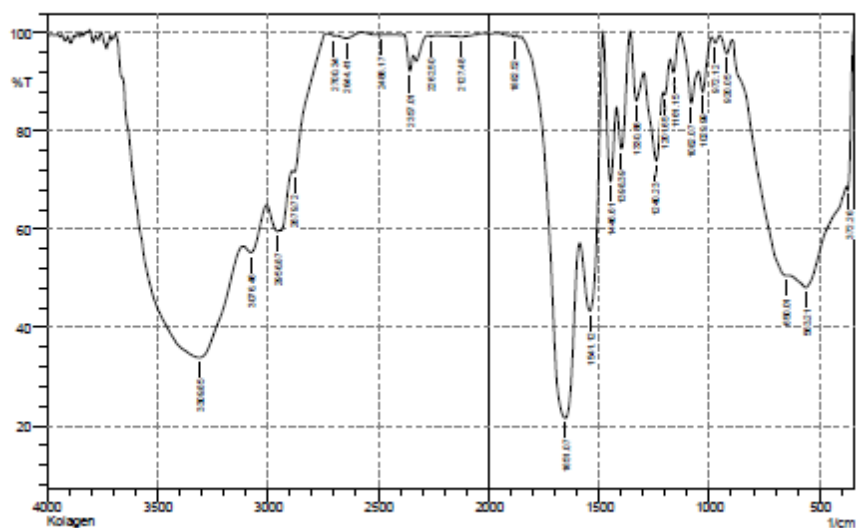
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	341.4	27.985	37.323	343.33	339.47	2.089	0.56
2	358.76	52.373	40.015	385.75	345.26	6.209	4.969
3	441.7	98.158	0.384	447.49	412.77	0.194	0.044
4	472.56	94.337	4.653	495.71	447.49	0.67	0.451
5	570.93	15.762	45.145	588.29	497.63	19.095	9.67
6	603.72	28.438	24.599	619.15	590.22	11.66	3.684
7	632.55	39.686	17.957	775.38	621.08	14.189	2.259
8	802.35	96.844	1.576	837.11	775.38	0.624	0.21
9	873.75	96.99	2.163	902.69	837.11	0.522	0.27
10	962.48	75.911	12.127	975.98	904.61	2.884	0.911
11	1035.77	0	0.296	1043.49	1033.85	1545.602	1516.513
12	1095.57	3.442	8.43	1301.95	1082.07	59.373	-74.091
13	1338.6	99.001	0.331	1354.03	1327.03	0.095	0.019
14	1417.68	94.828	1.627	1433.11	1354.03	1.033	0.214
15	1458.18	92.758	3.75	1494.83	1435.04	1.345	0.474
16	1560.41	98.125	0.371	1573.91	1554.63	0.139	0.017
17	1653	96.569	1.12	1672.28	1641.42	0.342	0.064
18	1799.59	98.756	0.477	1815.02	1788.01	0.119	0.031
19	1870.95	99.023	0.35	1884.45	1859.38	0.085	0.016
20	1994.4	96.769	1.901	2034.9	1961.61	0.718	0.277
21	2077.33	97.601	0.634	2123.63	2054.19	0.591	0.072
22	2142.91	98.404	0.205	2258.64	2123.63	0.58	-0.022
23	2372.44	98.206	2.01	2397.52	2353.15	0.141	0.175
24	2505.63	98.999	0.559	2584.61	2420.66	0.494	0.187
25	2856.58	98.394	0.134	2870.08	2746.63	0.552	-0.038
26	2962.66	97.605	0.494	2991.59	2943.37	0.44	0.043
27	3446.79	85.674	6.085	3550.95	3007.02	19.521	5.521
28	3570.24	79.483	11.887	3637.75	3552.88	3.935	1.27
29	3649.32	95.388	1.461	3664.75	3639.68	0.403	0.076
30	3748.62	96.902	1.864	3772.75	3728.4	0.407	0.168

Comment;
Hidroksiapatit (B)

Date/Time; 10/20/2023 12:18:31 PM
No. of Scans;
Resolution;
Apodization;

2.2.2.4. Kolagen

SHIMADZU



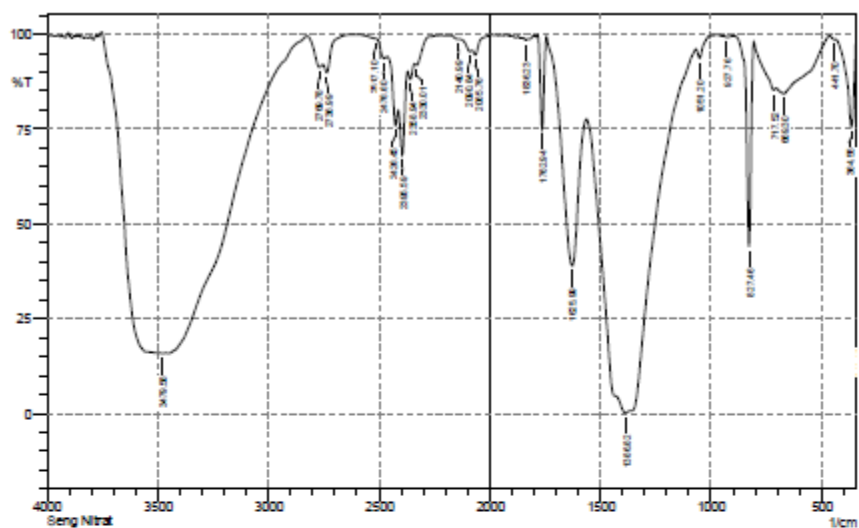
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	372.26	67.982	6.271	378.05	345.26	3.099	0.678
2	563.21	48.13	7.63	636.51	379.98	66.608	6.808
3	660.01	50.697	2.106	894.97	638.44	42.192	3.856
4	820.06	95.775	3.176	952.84	896.9	0.514	0.377
5	972.12	97.967	1.344	987.55	952.84	0.206	0.104
6	1029.99	87.991	6.4	1049.28	989.48	1.933	0.792
7	1082.07	86.67	9.339	1134.14	1051.2	2.855	1.33
8	1161.15	91.911	4.603	1176.58	1134.14	0.92	0.399
9	1201.65	87.413	1.721	1207.44	1178.51	1.29	0.153
10	1240.23	73.995	15.272	1296.16	1209.37	7.693	3.634
11	1330.88	86.187	10.32	1367.89	1298.09	2.619	1.526
12	1398.39	76.424	13.834	1419.61	1359.82	4.308	2.27
13	1446.61	69.786	21.24	1481.33	1421.54	5.864	3.613
14	1541.12	43.42	32.13	1586.48	1483.26	26.009	13.718
15	1651.07	21.556	45.801	1649.73	1587.42	74.624	43.277
16	1882.52	99.144	0.449	1897.96	1872.88	0.069	0.026
17	2127.48	99.28	0.446	2233.57	2021.4	0.496	0.243
18	2262.6	99.246	0.238	2276	2233.57	0.111	0.016
19	2367.01	92.199	4.778	2382.09	2341.58	0.838	0.389
20	2488.17	99.66	0.238	2574.97	2461.17	0.126	0.078
21	2644.41	98.91	0.808	2688.77	2574.97	0.299	0.196
22	2700.34	99.299	0.249	2733.13	2688.77	0.077	0.006
23	2879.72	71.642	1.731	2887.44	2742.76	8.961	0.191
24	2966.87	59.614	1.154	3006.1	2946.3	12.637	0.33
25	3076.46	55.296	4.049	3111.18	3007.02	24.341	1.746
26	3309.86	33.88	36.096	3667.04	3113.11	187.512	108.723

Comment;
Kolagen

Date/Time; 10/6/2023 1:31:04 PM
No. of Scans;
Resolution;
Apodization;

2.2.2.6. Seng Nitrat ($Zn(NO_3)_2$)

SHIMADZU



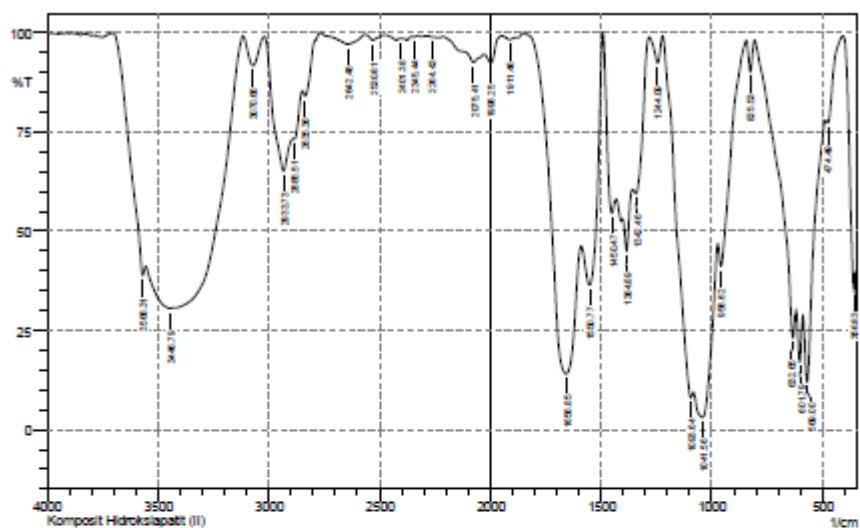
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	341.4	23.025	38.93	343.33	339.47	2.444	0.625
2	364.55	75.593	22.065	435.91	345.26	4.525	3.734
3	441.7	98.636	0.157	464.84	437.84	0.116	0.011
4	669.3	84.301	3.454	704.02	464.84	11.137	2.988
5	717.52	85.322	1.841	804.32	705.95	4.464	0.652
6	827.46	43.913	54.42	898.83	806.25	7.32	6.811
7	927.76	99.18	0.517	974.05	898.83	0.156	0.074
8	1051.2	93.695	3.355	1058.96	1002.98	0.921	0.313
9	1386.82	0.111	8.91	1560.41	1365.6	202.085	16.526
10	1625.99	38.97	46.319	1741.72	1562.34	33.43	23.16
11	1762.94	75.088	24.432	1782.23	1743.65	2.192	2.11
12	1836.23	98.465	0.35	1847.81	1828.52	0.111	0.013
13	2065.76	94.539	1.972	2081.19	1992.47	0.843	0.013
14	2090.84	95.454	0.822	2137.13	2081.19	0.69	0.004
15	2140.99	98.678	0.098	2177.63	2137.13	0.156	0.013
16	2330.01	91.834	0.816	2337.72	2220.07	1.305	0.051
17	2358.94	88.128	2.783	2370.51	2339.65	1.434	0.203
18	2395.59	68.16	16.08	2412.95	2372.44	4.602	1.755
19	2426.45	75.928	7.223	2463.1	2414.88	3.453	0.588
20	2476.6	93.65	0.881	2609.69	2465.03	1.158	0.068
21	2517.1	98.884	0.023	2609.69	2515.18	0.191	-0.042
22	2736.99	89.917	3.025	2754.35	2611.62	1.73	0.252
23	2769.78	91.289	2.149	2823.79	2756.28	1.552	0.267
24	3479.58	15.846	0.074	3495.01	3456.08	23.118	0.029

Comment;
Seng Nitrat

Date/Time; 10/6/2023 1:45:27 PM
No. of Scans;
Resolution;
Apodization;

2.2.2.7. Komposit Hidroksiapatit/Kolagen/Seng Nitrat

SHIMADZU



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	356.83	35.176	8.567	405.05	352.97	10.381	1.036
2	474.49	77.26	3.289	484.13	405.05	3.673	0.272
3	569	12.092	24.866	586.36	486.06	35.545	9.255
4	601.79	17.065	12.101	617.22	588.29	18.8	3.316
5	632.65	23.239	11.804	804.32	619.15	40.19	2.41
6	825.53	90.16	7.935	844.82	806.25	0.959	0.637
7	958.62	41.198	11.012	972.12	844.82	21.058	2.481
8	1041.56	3.084	20.246	1082.07	974.05	110.16	37.452
9	1093.64	8.036	7.608	1220.94	1083.99	59.476	2.305
10	1244.09	92.387	6.701	1280.73	1222.87	1.094	0.855
11	1342.46	59.485	8.085	1355.96	1282.66	9.802	2.082
12	1384.89	45.095	10.872	1402.25	1357.89	12.541	1.663
13	1450.47	54.567	15.995	1490.97	1433.11	10.373	3.32
14	1550.77	36.426	30.296	1587.42	1492.9	28.503	13.188
15	1656.85	14.048	45.963	1851.66	1589.34	91.498	50.638
16	1911.46	98.275	0.733	1948.1	1884.45	0.368	0.1
17	1998.25	92.492	3.772	2027.19	1950.03	1.599	0.559
18	2075.41	92.568	3.096	2210.42	2029.11	3.725	1.106
19	2264.43	98.897	0.076	2287.58	2258.64	0.118	-0.001
20	2345.44	98.922	0.249	2355.08	2328.08	0.108	0.013
21	2401.38	98.538	0.002	2403.3	2395.59	0.049	0
22	2530.61	98.162	1.347	2565.33	2472.74	0.442	0.239
23	2642.48	97.146	1.917	2702.27	2565.33	1.198	0.674
24	2835.36	84.088	4.239	2848.86	2791	2.82	0.671
25	2885.51	73.236	1.23	2889.37	2850.79	4.146	0.287
26	2933.73	65.188	16.663	3018.6	2891.3	15.428	6.447
27	3070.68	91.757	7.376	3116.97	3020.53	2.03	1.664
28	3446.79	30.568	1.565	3554.81	3429.43	59.656	3.237
29	3568.31	38.834	7.014	3703.33	3556.74	25.56	1.018

Comment;

Komposit Hidroksiapatit (II)

Date/Time; 11/23/2023 10:39:35 AM

No. of Scans;

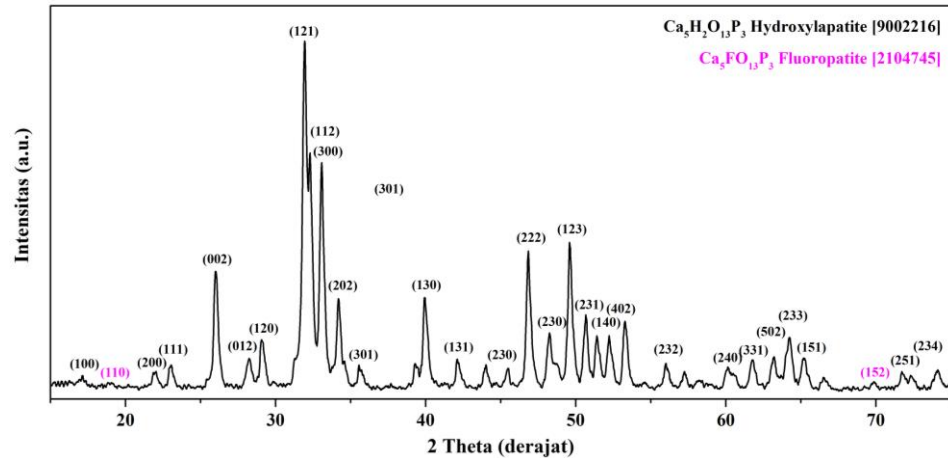
Resolution;

Apodization;

2.2.3. Hasil Karakterisasi XRD

2.2.3.1. Hidroksiapati

XRD Pattern



References

Formula sum	Ca5 H2 O13 P3
Entry number	96-900-2217
Figure-of-Merit (FoM)	0.867074
Total number of peaks	134
Peaks in range	73
Peaks matched	63
Intensity scale factor	1.00
Space group	P 63/m
Crystal system	hexagonal
Unit cell	a= 9.4232 Å c= 6.8833 Å
Uvol	1.59
Calc. density	3.157 g/cm ³
Reference	Wilson R. M., Elliot J. C., Dowker S. E. P., "Rietveld refinement of the crystallographic structure of human dental enamel apatites Sample: Prep.63b, synthetic", <i>American Mineralogist</i> 84 , 1406-1414 (1999)
Formula sum	Ca4.852 FO.89 O12 P3 Sr0.148
Entry number	96-900-1389
Figure-of-Merit (FoM)	0.783678
Total number of peaks	133
Peaks in range	72
Peaks matched	59
Intensity scale factor	1.35
Space group	P 63/m
Crystal system	hexagonal
Unit cell	a= 9.3786 Å c= 6.8922 Å
Uvol	1.77
Calc. density	3.221 g/cm ³
Reference	Hughes J M Cameron M, Crowley K D, "Ordering of divalent cations in the apatite structure: Crystal structure refinements of natural Mn- and Sr-bearing apatite sample Sr:29", <i>American Mineralogist</i> 76 , 1857-1862 (1991)

Percentage

Hydroxyapatite = 98%

Fluorapatite = 2%



LABORATORIUM PENELITIAN DAN PENGEMBANGAN SAINS
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
UNIVERSITAS HASANUDDIN

Jl. Perintis Kemerdekaan Km. 10 Tamalanrea, Makassar 90245
Telp. 0411-586016 • Fax. 0411-588551 • Email : lpps_fmipa.unhas@gmail.com

LAPORAN HASIL PENGUJIAN
CERTIFICATE OF ANALYSIS

Nomor Pekerjaan : LPPS.XI-2306-13/1

- I. Pelanggan / Principal**
- 1.1 Nama / Name : Windasari
1.2 Alamat / Address : Jln. BPD, No. 4 Sudiang Raya
1.3 Telepon / Phone : 082349240413
1.4 Personil Penghubung / Contact Person : -
1.5 Email / Email : windasari4565@gmail.com
- II. Contoh Uji / Sample**
- 2.1 Kode Sampel / Sampel Code : LPPS.X-2306-13/1
2.2 Kemasan / Packaging : Botol Vial
2.3 Nama Sampel / Sample Name : Hidroksiapatit Cangkang Tutut
2.4 Jumlah Sampel / Number of Sample : 1
2.5 Tanggal Sampling / Date of Sampling : -
2.6 Diterima / Date of Received : 16 Juni 2023
2.7 Tanggal Uji / Date of Analysis : 22 Juni 2023
2.8 Jenis Uji / Type of Analysis : XRD

III. Hasil Uji / Result

Strongest 3 peaks

No.	Peak No.	2Theta (deg)	d (Å)	I/I	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1.	8	32.0624	2.78932	100	0.70170	271	8873
2.	9	33.0558	2.70773	62	0.41930	169	3858
3.	20	49.5875	1.83688	41	0.39500	111	2317

Makassar, 13 Juli 2023

Penanggung Jawab Mutu

Prof. Dr. Nunuk Hariani Soekanto, MS
NIP. 19601215 198702 2 001

Catatan:

- Hasil Uji hanya berlaku untuk contoh tersebut di atas
- Dilarang mengutip/menyalin sebagian isi hasil uji ini

*** Basic Data Process ***

Group : Standard
 Data : cangkang#tutut

# Strongest 3 peaks							
no.	peak no.	2Theta (deg)	d (Å)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	8	32.0624	2.78932	100	0.70170	271	8873
2	9	33.0558	2.70773	62	0.41930	169	3858
3	20	49.5875	1.83688	41	0.39500	111	2317

# Peak Data List							
peak no.	2Theta (deg)	d (Å)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)	
1	17.0700	5.19023	3	0.38000	8	258	
2	21.9500	4.04610	6	0.42000	15	422	
3	23.0200	3.86040	7	0.40000	19	430	
4	26.0110	3.42288	35	0.40200	94	2183	
5	28.2100	3.16086	9	0.48000	24	595	
6	29.0900	3.06721	14	0.42000	38	876	
7	31.3200	2.85372	9	0.34000	24	505	
8	32.0624	2.78932	100	0.70170	271	8873	
9	33.0558	2.70773	62	0.41930	169	3858	
10	34.1860	2.62075	24	0.41200	66	1683	
11	35.6100	2.51914	6	0.38000	17	394	
12	39.3400	2.28846	7	0.40000	20	441	
13	39.9455	2.25515	27	0.41900	72	1663	
14	42.1200	2.14362	8	0.36000	23	522	
15	43.9700	2.05762	6	0.34000	17	336	
16	45.4250	1.99504	5	0.35000	14	253	
17	46.8243	1.93863	39	0.40140	105	2348	
18	48.2250	1.88554	15	0.41000	41	793	
19	48.6600	1.86970	7	0.40000	18	365	
20	49.5875	1.83688	41	0.39500	111	2317	
21	50.6320	1.80141	20	0.36800	53	1004	
22	51.4033	1.77617	14	0.36670	39	740	
23	52.2140	1.75049	14	0.41200	37	798	
24	53.2700	1.71825	20	0.38000	54	1068	
25	55.9900	1.64105	7	0.36000	19	369	
26	57.2100	1.60892	4	0.34000	12	230	
27	60.2200	1.53550	6	0.68000	17	656	
28	61.7433	1.50122	8	0.39330	23	465	
29	63.1350	1.47143	10	0.37000	26	529	
30	64.1675	1.45023	16	0.46500	44	1110	
31	65.1700	1.43032	10	0.38000	28	599	
32	66.5250	1.40444	4	0.41000	11	281	
33	69.8100	1.34617	3	0.30000	8	175	
34	71.7550	1.31438	5	0.39000	14	277	
35	72.3350	1.30527	4	0.43000	12	243	
36	74.0200	1.27967	6	0.48000	17	539	

*** Basic Data Process ***

```
# Data Information
  Group           : Standard
  Data            : cangkang#tutut
  Sample Name    : serbuk
  Comment        :
  Date & Time    : 06-22-23 09:51:48

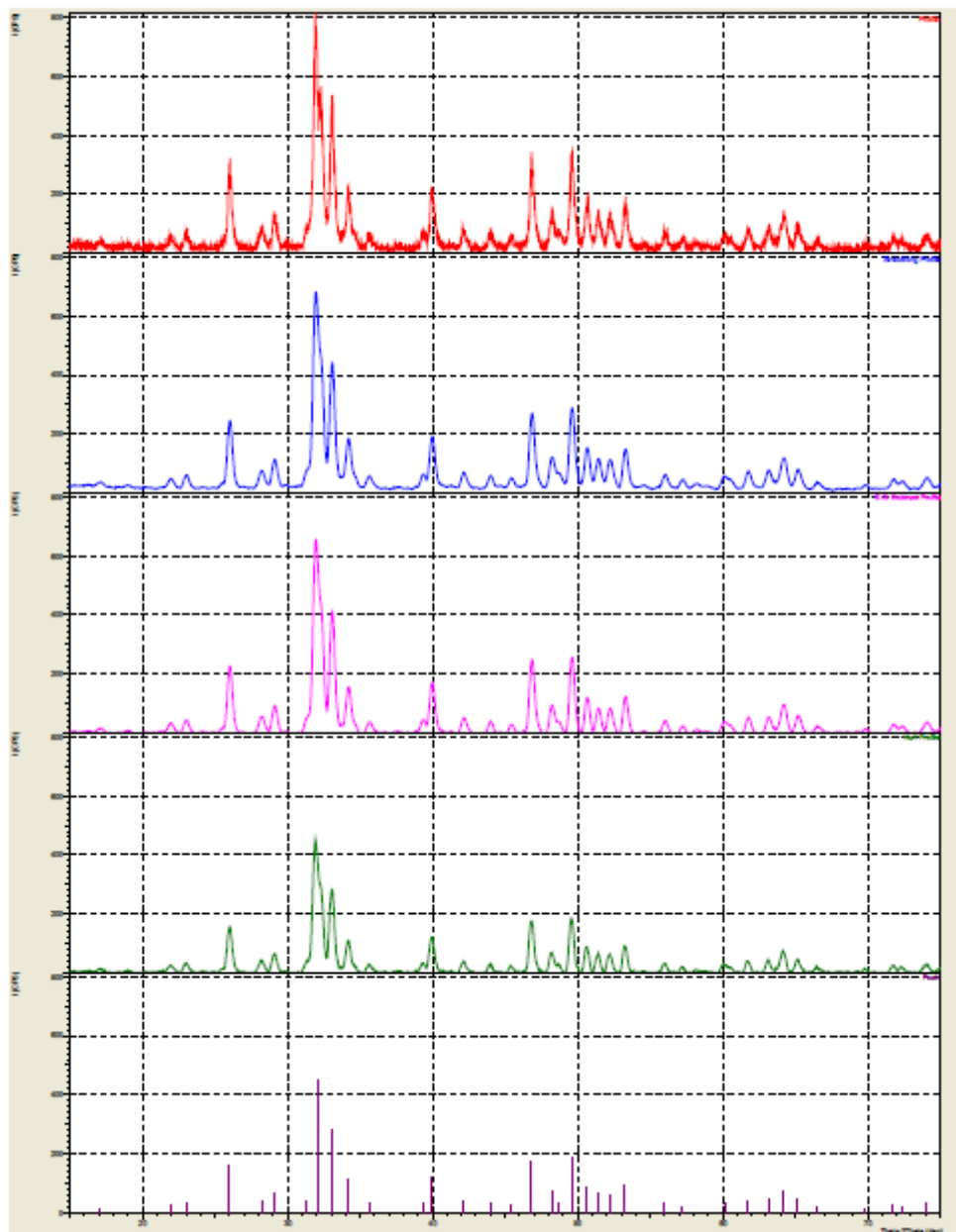
# Measurement Condition
  X-ray tube
  target         : Cu
  voltage        : 40.0 (kV)
  current        : 30.0 (mA)

  Slits
  Auto Slit     : not Used
  divergence slit : 1.00000 (deg)
  scatter slit  : 1.00000 (deg)
  receiving slit : 0.30000 (mm)

  Scanning
  drive axis    : Theta-2Theta
  scan range    : 15.0000 - 75.0000 (deg)
  scan mode     : Continuous Scan
  scan speed    : 2.0000 (deg/min)
  sampling pitch : 0.0200 (deg)
  preset time   : 0.60 (sec)

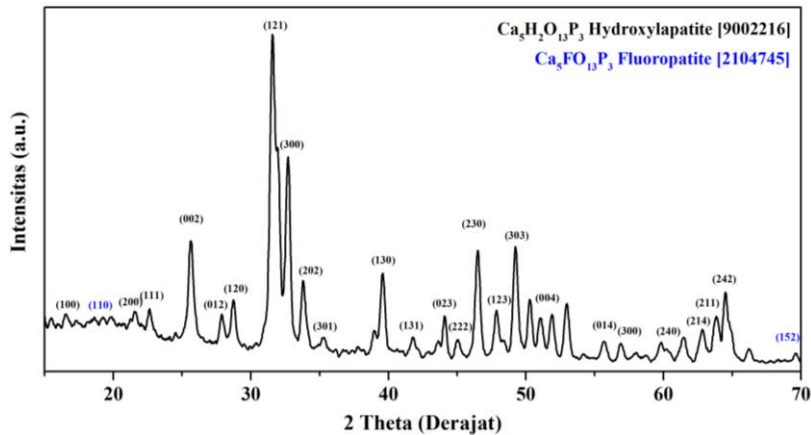
# Data Process Condition
  Smoothing      [ AUTO ]
  smoothing points : 31
  B.G.Subtraction [ AUTO ]
  sampling points : 37
  repeat times    : 30
  Kal-a2 Separate [ MANUAL ]
  Kal a2 ratio    : 50 (%)
  Peak Search     [ AUTO ]
  differential points : 37
  FWHM threshold  : 0.050 (deg)
  intensity threshold : 30 (par mil)
  FWHM ratio (n-1)/n : 2
  System error Correction [ NO ]
  Precise peak Correction [ NO ]
```

< Group: Standard Data: cangkang#tutut >



2.2.3.2. Komposit Komposit Hidroksiapatit/Kolagen/Seng Nitrat

XRD Pattern



Percentage

Hydroxylapatite = 97%

References

Formula sum	Ca ₅ H ₂ O ₁₃ P ₃
Entry number	96-900-2217
Figure-of-Merit (FoM)	0.867074
Total number of peaks	134
Peaks in range	73
Peaks matched	63
Intensity scale factor	1.00
Space group	P 6 ₃ /m
Crystal system	hexagonal
Unit cell	a= 9.4232 Å c= 6.8833 Å
I/lcor	1.59
Calc. density	3.157 g/cm ³
Reference	Wilson R. M., Elliot J. C., Dowker S. E. P., "Rietveld refinement of the crystallographic structure of human dental enamel apatites Sample: Prep.63b, synthetic", American Mineralogist 84 , 1406-1414 (1999)
Formula sum	Ca ₄ 852 F ₀ .89 O ₁₂ P ₃ Si ₀ .148
Entry number	96-900-1389
Figure-of-Merit (FoM)	0.783678
Total number of peaks	133
Peaks in range	72
Peaks matched	59
Intensity scale factor	1.35
Space group	P 6 ₃ /m
Crystal system	hexagonal
Unit cell	a= 9.3786 Å c= 6.8922 Å
I/lcor	1.77
Calc. density	3.221 g/cm ³
Reference	Hughes J.M., Cameron M., Crowley K.D., "Ordering of divalent cations in the apatite structure: Crystal structure refinements of natural Mn- and Sr-bearing apatite sample Sr.29", American Mineralogist 76 , 1857-1862 (1991)

*** Basic Data Process ***

Group : Standard
 Data : windasari#hidroksiapatit

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	11	31.6790	2.82220	100	0.72200	146	5064
2	12	32.6657	2.73917	61	0.45140	89	2091
3	21	46.4593	1.95301	35	0.41470	51	1137

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	16.5700	5.34570	3	0.26000	5	96
2	18.5500	4.77933	3	0.06000	4	31
3	19.2700	4.60235	3	0.26000	4	80
4	19.8700	4.46471	3	0.26000	4	73
5	21.5000	4.12976	5	0.40000	8	214
6	22.6400	3.92433	8	0.28000	11	222
7	25.6250	3.47356	31	0.48000	45	1246
8	27.8616	3.19959	10	0.38330	14	294
9	28.7050	3.10747	14	0.45000	21	503
10	30.9400	2.88790	7	0.20000	10	152
11	31.6790	2.82220	100	0.72200	146	5064
12	32.6657	2.73917	61	0.45140	89	2091
13	33.7983	2.64992	21	0.46330	30	775
14	35.2600	2.54334	5	0.40000	7	191
15	38.9200	2.31218	8	0.40000	11	247
16	39.5466	2.27698	26	0.42670	38	831
17	41.7600	2.16126	5	0.40000	7	161
18	43.6100	2.07377	5	0.26000	7	115
19	44.0550	2.05385	12	0.41000	18	352
20	45.0300	2.01162	6	0.34000	9	182
21	46.4593	1.95301	35	0.41470	51	1137
22	47.8400	1.89981	13	0.42000	19	419
23	48.4000	1.87913	3	0.12000	4	50
24	49.1983	1.85049	34	0.41670	49	1064
25	50.2450	1.81437	16	0.41000	24	488
26	51.0233	1.78851	13	0.39330	19	374
27	51.8600	1.76160	14	0.44000	20	446
28	52.9133	1.72899	18	0.41330	27	613
29	55.6500	1.65027	7	0.46000	10	220
30	56.8400	1.61851	6	0.36000	9	195
31	59.7300	1.54692	5	0.26000	8	180
32	61.4100	1.50856	7	0.42000	10	210
33	62.7750	1.47900	9	0.39000	13	285
34	63.7900	1.45790	14	0.46000	20	477
35	64.4750	1.44405	22	0.47000	32	894
36	66.1700	1.41111	5	0.38000	7	183
37	69.5950	1.34980	3	0.27000	5	93

*** Basic Data Process ***

```
# Data Infomation
  Group           : Standard
  Data            : windasari#hidroksiapatit
  Sample Nmae    : powder
  Comment        :
  Date & Time     : 12-13-23 13:48:56

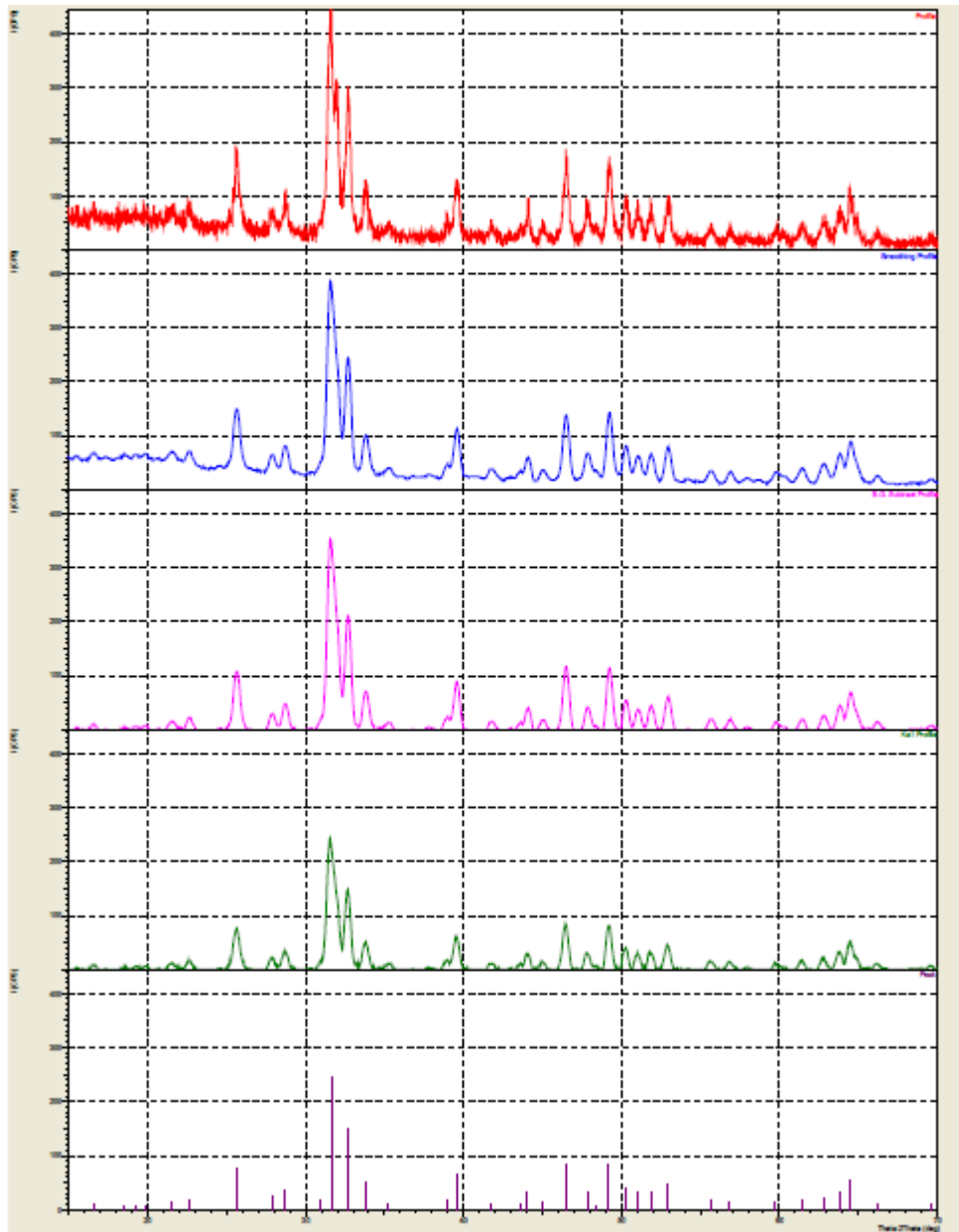
# Measurement Condition
  X-ray tube
  target         : Cu
  voltage        : 40.0 (kV)
  current        : 30.0 (mA)

  Slits
  Auto Slit      : not Used
  divergence slit : 1.00000 (deg)
  scatter slit   : 1.00000 (deg)
  receiving slit  : 0.30000 (mm)

  Scanning
  drive axis     : Theta-2Theta
  scan range     : 15.0000 - 70.0000 (deg)
  scan mode      : Continuous Scan
  scan speed     : 2.0000 (deg/min)
  sampling pitch : 0.0200 (deg)
  preset time    : 0.60 (sec)

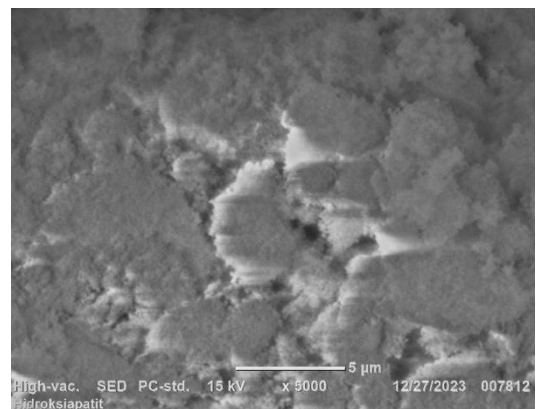
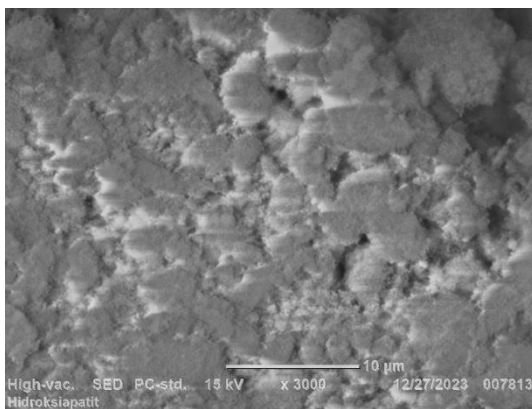
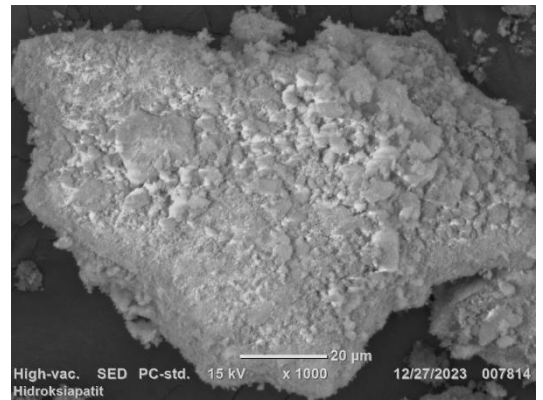
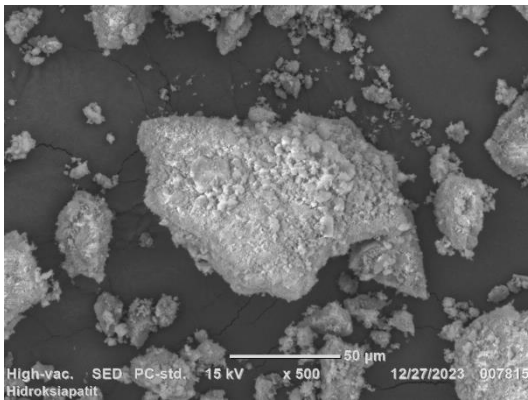
# Data Process Condition
  Smoothing      [ AUTO ]
  smoothing points : 35
  B.G.Subtruction [ AUTO ]
  sampling points : 39
  repeat times    : 30
  Kal-a2 Separate [ MANUAL ]
  Kal a2 ratio    : 50 (%)
  Peak Search     [ AUTO ]
  differential points : 37
  FWHM threhold   : 0.050 (deg)
  intensity threshold : 30 (par mil)
  FWHM ratio (n-1)/n : 2
  System error Correction [ NO ]
  Precise peak Correction [ NO ]
```

< Group: Standard Data: windasari#hidroksiapatit >

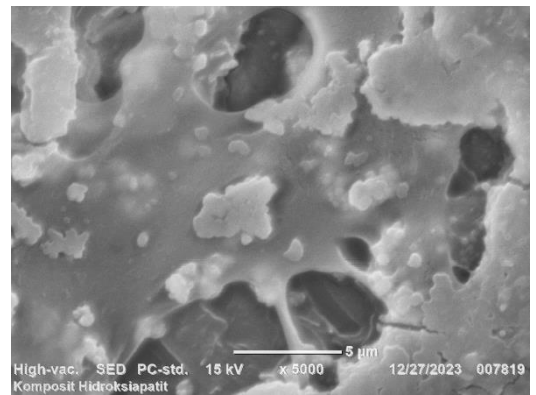
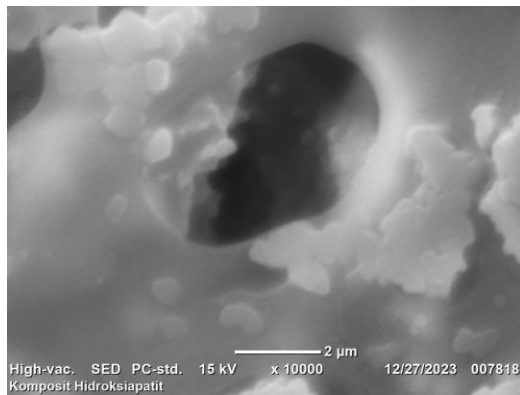
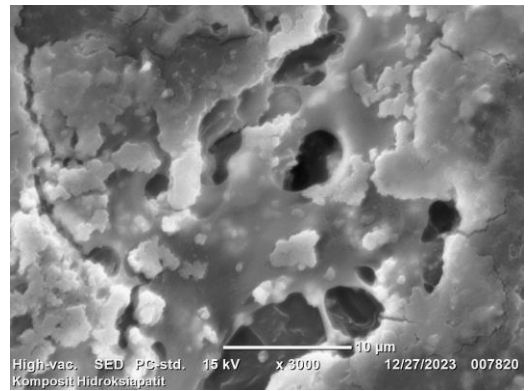
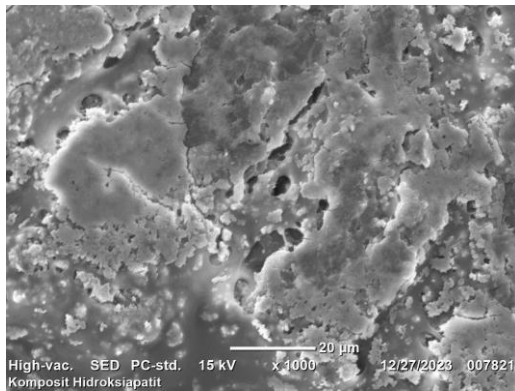


2.2.4. Hasil Karakterisasi SEM

2.2.4.1. Hidroksiapatit









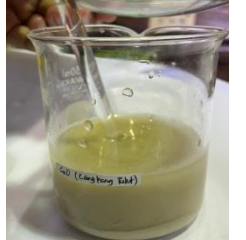

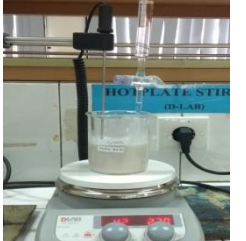

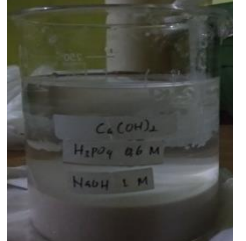

2.2.4.2. Komposit Komposit Hidroksiapatit/Kolagen/Seng Nitrat





2.2.5. Uji Viskositas



LAMPIRAN 3. Dokumentasi Penelitian

 <p>Sampel cangkang tutut</p>	 <p>Sampel cangkang tutut dikeringkan</p>	 <p>Serbuk cangkang tutut setelah dihaluskan</p>	 <p>Serbuk cangkang tutut dikalsinasi</p>
 <p>Sampel cangkang tutut setelah kalsinasi (CaO)</p>	 <p>Penimbangan serbuk CaO</p>	 <p>Serbuk CaO dilarutkan menjadi larutan Ca(OH)₂</p>	 <p>Larutan Ca(OH)₂ diaduk dengan <i>magnetic stirrer</i></p>
 <p>Larutan Ca(OH)₂ dititrasi dengan larutan H₃PO₄</p>	 <p>Pengukuran pH</p>	 <p>Suspensi setelah diendapkan selama 24 jam</p>	 <p>Endapan yang terbentuk disaring</p>

			
<p>Endapan yang diperoleh dikeringkang dengan oven</p>	<p>Endapan yang telah kering kemudian dikalsinasi</p>	<p>Serbuk hidroksiapatit (HAp) yang dihasilkan</p>	<p>Penimbangan serbuk HAp untuk komposit</p>
			
<p>Pengadukan serbuk HAp selama 2 jam</p>	<p>Penimbangan serbuk kolagen</p>	<p>Pengadukan kolagen selama 2 jam</p>	<p>Penimbangan zink nitrat</p>
			
<p>Pembuatan HPMC 2%</p>	<p>Pengadukan komposit HAp/Kolagen/Zn</p>	<p>Hasil suspensi komposit HAp/kolagen/Zn</p>	