

DAFTAR PUSTAKA

- Alakpa, E. V. *et al.* (2017) 'Nacre Topography Produces Higher Crystallinity in Bone than Chemically Induced Osteogenesis', *ACS Nano*, 11(7), pp. 6717–6727. Available at: <https://doi.org/10.1021/acsnano.7b01044>.
- Alamsjah, Moch.A., Hanindika, D. and Sugijanto, N.E. (2014) 'The Isolation Development of Chondroitin Sulphate from Cuttlebone (*Sepia phraonis*), Ray's Cartilage (*Raja* sp.), and Shark (*Carcharinus falciformes*)', *Jurnal Ilmiah Perikanan dan Kelautan*, 6(2), pp. 129–132. Available at: <https://doi.org/10.20473/jipk.v6i2.11296>.
- Caton, J.G. *et al.* (2018) 'A new classification scheme for periodontal and peri-implant diseases and conditions – Introduction and key changes from the 1999 classification', *Journal of Clinical Periodontology*, 45(S20). Available at: <https://doi.org/10.1111/jcpe.12935>.
- Chandha, M.H. *et al.* (2022) 'Pinctada Maxima Pearl Shells as a Promising Bone Graft Material in the World of Dentistry', *Open Access Macedonian Journal of Medical Sciences*, 10(D), pp. 109–115. Available at: <https://doi.org/10.3889/oamjms.2022.8529>.
- Cho, Y.-D. *et al.* (2021) 'Periodontal Wound Healing and Tissue Regeneration: A Narrative Review', *Pharmaceuticals*, 14(5), p. 456. Available at: <https://doi.org/10.3390/ph14050456>.
- Coringa, R. *et al.* (2018) 'Bone substitute made from a Brazilian oyster shell functions as a fast stimulator for bone-forming cells in an animal model', *PLOS ONE*, 13(6), p. e0198697. Available at: <https://doi.org/10.1371/journal.pone.0198697>.
- Creecy, A., Damrath, J.G. and Wallace, J.M. (2021) 'Control of Bone Matrix Properties by Osteocytes', *Frontiers in Endocrinology*, 11. Available at: <https://doi.org/10.3389/fendo.2020.578477>.

- Diaz-Rodriguez, P. *et al.* (2019) 'Current Stage of Marine Ceramic Grafts for 3D Bone Tissue Regeneration', *Marine Drugs*, 17(8), p. 471. Available at: <https://doi.org/10.3390/md17080471>.
- Faßbender, M. *et al.* (2014) 'Stimulation of Bone Healing by Sustained Bone Morphogenetic Protein 2 (BMP-2) Delivery', *International Journal of Molecular Sciences*, 15(5), pp. 8539–8552. Available at: <https://doi.org/10.3390/ijms15058539>.
- Green, D., Lai, W.-F. and Jung, H.-S. (2014) 'Evolving Marine Biomimetics for Regenerative Dentistry', *Marine Drugs*, 12(5), pp. 2877–2912. Available at: <https://doi.org/10.3390/md12052877>.
- Green, D.W., Kwon, H.-J. and Jung, H.-S. (2015) 'Osteogenic Potency of Nacre on Human Mesenchymal Stem Cells', *Molecules and Cells*, 38(3), pp. 267–272. Available at: <https://doi.org/10.14348/molcells.2015.2315>.
- Halloran, D., Durbano, H.W. and Nohe, A. (2020) 'Bone Morphogenetic Protein-2 in Development and Bone Homeostasis', *Journal of Developmental Biology*, 8(3), p. 19. Available at: <https://doi.org/10.3390/jdb8030019>.
- Hasegawa, Y., Takayama, T. and Iwano, Y. (2021) 'Clinical classification of tooth position in the alveolar bone housing with periodontal defects', *Journal of Dental Sciences*, 16(2), pp. 795–798. Available at: <https://doi.org/10.1016/j.jds.2020.11.011>.
- Ibrahim, N. *et al.* (2018) 'Wound Healing Properties of Selected Natural Products', *International Journal of Environmental Research and Public Health*, 15(11), p. 2360. Available at: <https://doi.org/10.3390/ijerph15112360>.
- Jangid, D.R. *et al.* (2016) 'International Journal of Current Research in Medical Sciences Bone Grafts in Periodontal Regeneration: Factors Impacting Treatment Outcome', *Int. J. Curr. Res. Med. Sci*, 2(7), pp. 20–24. Available at: <http://s-o-i.org/1.15/ijcrms-2016-2-8-3>.
- Khoswanto, C. (2019) 'Optimum Concentration Anredera cordifolia (Ten .) Steenis Gel in Increasing the Expression BMP-2 and the number of Osteoblasts Post

- Tooth Extraction in Wistar Rats', in. Available at: <https://api.semanticscholar.org/CorpusID:204769618>.
- Kini, U. and Nandeesh, B.N. (2012) 'Physiology of Bone Formation, Remodeling, and Metabolism', in *Radionuclide and Hybrid Bone Imaging*. Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 29–57. Available at: https://doi.org/10.1007/978-3-642-02400-9_2.
- Kumar, P., Vinitha, B. and Fathima, G. (2013) 'Bone grafts in dentistry.', *Journal of pharmacy & bioallied sciences*, 5(Suppl 1), pp. S125-7. Available at: <https://doi.org/10.4103/0975-7406.113312>.
- Lamora, A. *et al.* (2016) 'TGF- β Signaling in Bone Remodeling and Osteosarcoma Progression', *Journal of Clinical Medicine*, 5(11), p. 96. Available at: <https://doi.org/10.3390/jcm5110096>.
- Li, X. *et al.* (2018) 'Calcium carbonate nanoparticles promote osteogenesis compared to adipogenesis in human bone-marrow mesenchymal stem cells', *Progress in Natural Science: Materials International*, 28(5), pp. 598–608. Available at: <https://doi.org/10.1016/j.pnsc.2018.09.004>.
- Manzari-Tavakoli, A. *et al.* (2022) 'The Cross-Talks Among Bone Morphogenetic Protein (BMP) Signaling and Other Prominent Pathways Involved in Neural Differentiation', *Frontiers in Molecular Neuroscience*, 15. Available at: <https://doi.org/10.3389/fnmol.2022.827275>.
- Matsushita, Y., Ono, W. and Ono, N. (2020) 'Skeletal Stem Cells for Bone Development and Repair: Diversity Matters', *Current Osteoporosis Reports*, 18(3), pp. 189–198. Available at: <https://doi.org/10.1007/s11914-020-00572-9>.
- Mizoguchi, T. and Ono, N. (2020) 'The diverse origin of bone-forming osteoblasts', *Journal of Bone and Mineral Research*, 36(8), pp. 1432–1447. Available at: <https://doi.org/10.1002/jbmr.4410>.
- Monika, R., Pringgenies, D. and Setyati, W.A. (2021) 'Potensi Ekstrak Teripang *Stichopus hermannii*, Semper 1868 (Holothuroidea : Stichopodidae) sebagai

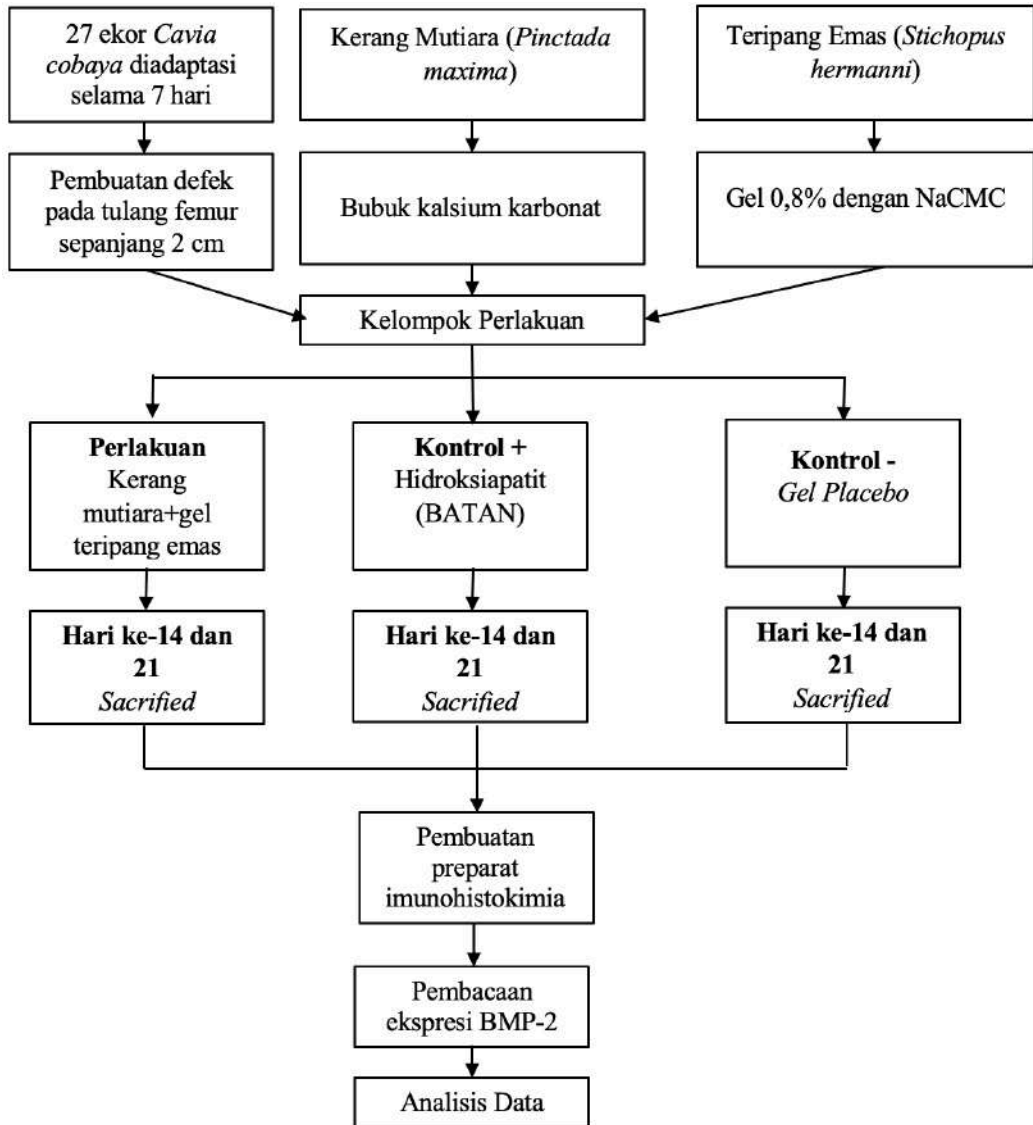
- Penghasil Senyawa Antibakteri terhadap *Streptococcus mutans* Clarke, 1924 (Bacilli : Streptococcaceae)', *Journal of Marine Research*, 10(3), pp. 421–427. Available at: <https://doi.org/10.14710/jmr.v10i3.31097>.
- Müller, W., Schröder, H. and Wang, X. (2017) 'The Understanding of the Metazoan Skeletal System, Based on the Initial Discoveries with Siliceous and Calcareous Sponges', *Marine Drugs*, 15(6), p. 172. Available at: <https://doi.org/10.3390/md15060172>.
- Oliveira, É.R. *et al.* (2021) 'Advances in Growth Factor Delivery for Bone Tissue Engineering', *International Journal of Molecular Sciences*, 22(2), p. 903. Available at: <https://doi.org/10.3390/ijms22020903>.
- Omi, M. and Mishina, Y. (2022) 'Roles of osteoclasts in alveolar bone remodeling', *genesis*, 60(8–9). Available at: <https://doi.org/10.1002/dvg.23490>.
- Pangestuti, R. and Arifin, Z. (2018) 'Medicinal and health benefit effects of functional sea cucumbers', *Journal of Traditional and Complementary Medicine*, 8(3), pp. 341–351. Available at: <https://doi.org/10.1016/j.jtcme.2017.06.007>.
- Prameswari, N., Soetjipto and Rahayu, R.P. (2016) 'Osteogenesis at Tension Site by *Stichopus hermannii* Application as Relapse Orthodontic Prevention', *International Journal of ChemTech Research*, pp. 686–693.
- Rahayu, S., Kurniawidi, D.W. and Gani, A. (2018) 'Pemanfaatan Limbah Cangkrang Kerang Mutiara (*Pinctada Maxima*) Sebagai Sumber Hidroksiapatit', *Jurnal Pendidikan Fisika dan Teknologi*, 4(2), pp. 226–231. Available at: <https://doi.org/10.29303/jpft.v4i2.839>.
- Rousseau, M. (2011) 'Nacre, a Natural Biomaterial', in *Biomaterials Applications for Nanomedicine*. InTech. Available at: <https://doi.org/10.5772/22978>.
- Sandana, I.K.I. *et al.* (2017) 'Potential of *Stichopus hermannii* gel and Hyperbaric Oxygen Therapy in accelerating orthodontic treatment', *Jurnal Kedokteran Gigi Universitas Padjadjaran*, 29(3). Available at: <https://doi.org/10.24198/jkg.v29i3.15951>.

- Senadheera, T.R.L., Dave, D. and Shahidi, F. (2020) 'Sea Cucumber Derived Type I Collagen: A Comprehensive Review', *Marine Drugs*, 18(9), p. 471. Available at: <https://doi.org/10.3390/md18090471>.
- Setiawatie, E.M. *et al.* (2019) *Carbonate Hydroxyapatite-Hyaluronic Acid as Bone Healing Accelerator: in-vitro and in-vivo Studies on the Alveolar Bone of Wistar Rats*, *Journal of International Dental and Medical Research*. Available at: <http://www.jidmr.com>.
- Sharma, H. and Sharma, A. (2019) 'Bone morphogenetic proteins: Revivifying periodontium', *Indian Journal of Multidisciplinary Dentistry*, 9(1), p. 58. Available at: https://doi.org/10.4103/ijmd.ijmd_21_19.
- Sularsih and Wahjuningsih, E. (2015) 'Dental Journal Expression of bone morphogenetic protein-2 after using chitosan gel with different molecular weight on wound healing process of dental extraction', *Dental Journal (Majalah Kedokteran Gigi)*, 48(2), pp. 53–58. Available at: <http://e-journal.unair.ac.id/index.php/MKG53>.
- Takayama, T., Imamura, K. and Yamano, S. (2023) 'Growth Factor Delivery Using a Collagen Membrane for Bone Tissue Regeneration', *Biomolecules*, 13(5), p. 809. Available at: <https://doi.org/10.3390/biom13050809>.
- Tomatala, P. (2014) 'Efektifitas penggunaan bingkai jaring pada penjarangan benih kerang mutiara, *Pinctada maxima*', *e-Journal BUDIDAYA PERAIRAN*, 2(1). Available at: <https://doi.org/10.35800/bdp.2.1.2014.3786>.
- Wang, J., Chen, J. and Yang, C. (2007) '[Effects of soluble matrix of nacre on bone morphogenetic protein-2 and Cbfa1 gene expressions in rabbit marrow mesenchymal stem cells].', *Nan fang yi ke da xue xue bao = Journal of Southern Medical University*, 27(12), pp. 1838–40.
- Wei, L. *et al.* (2019) 'Periodontal regeneration using bone morphogenetic protein 2 incorporated biomimetic calcium phosphate in conjunction with barrier membrane: A pre-clinical study in dogs', *Journal of Clinical Periodontology*, 46(12), pp. 1254–1263. Available at: <https://doi.org/10.1111/jcpe.13195>.



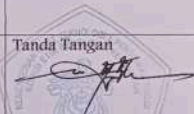
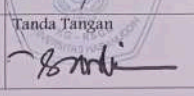
- White, K.A., Cali, V.J. and Olabisi, R.M. (2021) 'Micropatterning biomineralization with immobilized mother of pearl proteins', *Scientific Reports*, 11(1), p. 2141. Available at: <https://doi.org/10.1038/s41598-021-81534-8>.
- Wilkinson, H.N. and Hardman, M.J. (2020) 'Wound healing: cellular mechanisms and pathological outcomes', *Open Biology*, 10(9). Available at: <https://doi.org/10.1098/rsob.200223>.
- Wu, M., Chen, G. and Li, Y.-P. (2016) 'TGF- β and BMP signaling in osteoblast, skeletal development, and bone formation, homeostasis and disease', *Bone Research*, 4(1), p. 16009. Available at: <https://doi.org/10.1038/boneres.2016.9>.
- Yan, X. *et al.* (2010) 'A Pilot Study Evaluating the Effect of Recombinant Human Bone Morphogenetic Protein-2 and Recombinant Human Beta-Nerve Growth Factor on the Healing of Class III Furcation Defects in Dogs', *Journal of Periodontology*, 81(9), pp. 1289–1298. Available at: <https://doi.org/10.1902/jop.2010.090655>.
- Yang, N. and Liu, Y. (2021) 'The Role of the Immune Microenvironment in Bone Regeneration', *International Journal of Medical Sciences*, 18(16), pp. 3697–3707. Available at: <https://doi.org/10.7150/ijms.61080>.
- Zaidi, A. and Green, L. (2019) 'Physiology of haemostasis', *Anaesthesia & Intensive Care Medicine*, 20(3), pp. 152–158. Available at: <https://doi.org/10.1016/j.mpaic.2019.01.005>.
- Zhang, G. *et al.* (2017) 'Nacre, a natural, multi-use, and timely biomaterial for bone graft substitution', *Journal of Biomedical Materials Research Part A*, 105(2), pp. 662–671. Available at: <https://doi.org/10.1002/jbm.a.35939>.

LAMPIRAN

Lampiran 1. Alur penelitian



Lampiran 2. Rekomendasi persetujuan etik

 KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI UNIVERSITAS HASANUDDIN FAKULTAS KEDOKTERAN GIGI RUMAH SAKIT GIGI DAN MULUT KOMITE ETIK PENELITIAN KESEHATAN Sekretariat : Lantai 2, Gedung Lama RSGM Unhas JL.Kandea No. 5 Makassar <small>Contact Person: drg. Muhammad Ikbal, Sp.Prof/Nur Aedah AR TELP. 08134297101/08114919191</small>					
REKOMENDASI PERSETUJUAN ETIK					
Nomor: 0137/PL.09/KEPK-FKG-RSGM UNHAS/2023					
				Tanggal: 28 Juli 2023	
Dengan ini menyatakan bahwa protokol dan dokumen yang berhubungan dengan protokol berikut ini telah mendapatkan persetujuan etik:					
No. Protokol	UH 17120876	No Protokol Sponsor			
Peneliti Utama	drg. Adelia Chandra Carolina	Sponsor	Pribadi		
Judul Peneliti	Efektivitas Kombinasi Bone Graft yang Mengandung Cangkang Kerang Mutiara (Pinctada Maxima) dan Gel Teripang Emas (Sticopus Hermani) terhadap Regenerasi Tulang Melalui Ekspresi Bone Morphogenetic Protein-2				
No. Versi Protokol	1	Tanggal Versi	13 Juli 2023		
No. Versi Protokol		Tanggal Versi			
Tempat Penelitian	1. Laboratorium Biokimia Politeknik Negeri Pangkep 2. Laboratorium Lembaga Penelitian dan Pengembangan Sains Fak.MIPA UNHAS 3. Laboratorium Terpadu Dept.Kimia, Fak.MIPA UNHAS 4. Klinik Hewan Docpet JLAF.Pettarani,Makassar 5. Laboratorium PA RSP Universitas Hasanuddin 6. Laboratorium Biokimia-Biomolekuler Fakultas Kedokteran Universitas Brawijaya				
Dokumen Lain					
Jenis Review	<input type="checkbox"/> Exempted <input checked="" type="checkbox"/> Expedited <input type="checkbox"/> Fullboard	Masa Berlaku	28 Juli 2023-28 Juli 2024		
			Frekuensi Review Lanjutan		
Ketua Komisi Etik Penelitian	Nama: Dr. drg. Marhamah, M.Kes	Tanda Tangan			
Sekretaris Komisi Etik Penelitian	Nama: drg. Muhammad Ikbal, Sp.Prof	Tanda Tangan			

Kewajiban peneliti utama:

- Menyerahkan Amandemen Protokol untuk persetujuan sebelum diimplementasikan
- Menyerahkan laporan SAE ke Komisi Etik dalam 24 Jam dan dilengkapi dalam 7 hari dan lapor SUSAR dalam 72 jam setelah peneliti utama menerima laporan.
- Menyerahkan laporan kemajuan (*progress report*) setiap 6 bulan untuk penelitian resiko tinggi dan setiap setahun untuk penelitian resiko rendah.
- Menyerahkan laporan akhir setelah penelitian berakhir.
- Melaporkan penyimpangan dari protokol yang disetujui (*protocol deviation/violation*)
- Mematuhi semua aturan yang berlaku.

realme

Shot on realme 8i

Lampiran 3. Proses ekstraksi cangkang kerang mutiara

Lampiran 4. Perlakuan hewan coba dan pengambilan jaringan

Lampiran 5. Hasil Normalitas BMP-2 hari ke-14 dan ke-21

Tests of Normality							
		KELOMPOK		Kolmogorov-Smirnov ^a		Shapiro-Wilk	
		Statistic	df	Sig.	Statistic	df	Sig.
BMP2	K - (14)	,241	5	,200 [*]	,821	5	,119
	T (14)	,136	5	,200 [*]	,987	5	,967
	B (14)	,141	5	,200 [*]	,979	5	,928
	K - (21)	,237	5	,200 [*]	,961	5	,814
	T (21)	,237	5	,200 [*]	,961	5	,814
	B (21)	,229	5	,200 [*]	,867	5	,254
OCN	K - (14)	,243	5	,200 [*]	,894	5	,377
	T (14)	,237	5	,200 [*]	,961	5	,814
	B (14)	,237	5	,200 [*]	,961	5	,814
	K - (21)	,237	5	,200 [*]	,961	5	,814
	T (21)	,273	5	,200 [*]	,852	5	,201
	B (21)	,201	5	,200 [*]	,881	5	,314
OB	K - (14)	,221	5	,200 [*]	,902	5	,421
	T (14)	,287	5	,200 [*]	,914	5	,490
	B (14)	,254	5	,200 [*]	,914	5	,492
	K - (21)	,231	5	,200 [*]	,881	5	,314
	T (21)	,221	5	,200 [*]	,902	5	,421
	B (21)	,237	5	,200 [*]	,961	5	,814
OC	K - (14)	,136	5	,200 [*]	,987	5	,967
	T (14)	,237	5	,200 [*]	,961	5	,814
	B (14)	,237	5	,200 [*]	,961	5	,814
	K - (21)	,141	5	,200 [*]	,979	5	,928
	T (21)	,231	5	,200 [*]	,881	5	,314
	B (21)	,221	5	,200 [*]	,902	5	,421
WB	K - (14)	,230	5	,200 [*]	,924	5	,559
	T (14)	,206	5	,200 [*]	,973	5	,897
	B (14)	,203	5	,200 [*]	,938	5	,654
	K - (21)	,203	5	,200 [*]	,959	5	,800
	T (21)	,268	5	,200 [*]	,835	5	,152

B (21)	,277	5	,200	,825	5	,127
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*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Lampiran 6. Hasil uji deskriptif dan homogenitas BMP-2 hari ke-14

Descriptives

BMP2

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
K - (14)	5	7,00	1,000	,447	5,76	8,24	6	8
T (14)	5	11,00	1,581	,707	9,04	12,96	9	13
B (14)	5	10,20	1,924	,860	7,81	12,59	8	13
Total	15	9,40	2,293	,592	8,13	10,67	6	13

Test of Homogeneity of Variances

BMP2

Levene Statistic	df1	df2	Sig.
,781	2	12	,480

Lampiran 7. Hasil uji ANOVA dan multivariat BMP-2 hari ke-14

ANOVA

BMP2

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	44,800	2	22,400	9,333	,004
Within Groups	28,800	12	2,400		
Total	73,600	14			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: BMP2

Tukey HSD

(I) KELOMPOK	(J) KELOMPOK	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
K - (14)	T (14)	-4,000*	,980	,004	-6,61	-1,39
	B (14)	-3,200*	,980	,017	-5,81	-,59
T (14)	K - (14)	4,000*	,980	,004	1,39	6,61
	B (14)	,800	,980	,700	-1,81	3,41
B (14)	K - (14)	3,200*	,980	,017	,59	5,81
	T (14)	-,800	,980	,700	-3,41	1,81

*. The mean difference is significant at the 0.05 level.

Lampiran 8. Hasil uji deskriptif dan homogenitas BMP-2 hari ke-21

Descriptives

BMP2

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
K - (21)	5	8,40	1,140	,510	6,98	9,82	7	10
T (21)	5	12,60	1,140	,510	11,18	14,02	11	14
B (21)	5	11,60	1,817	,812	9,34	13,86	10	14
Total	15	10,87	2,264	,584	9,61	12,12	7	14

Test of Homogeneity of Variances

BMP2

Levene Statistic	df1	df2	Sig.
1,903	2	12	,191

Lampiran 9. Hasil uji ANOVA dan multivariat BMP-2 hari ke-21

ANOVA

BMP2

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	48,133	2	24,067	12,237	,001
Within Groups	23,600	12	1,967		
Total	71,733	14			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: BMP2

Tukey HSD

(I) KELOMPOK	(J) KELOMPOK	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
K - (21)	T (21)	-4,200*	,887	,001	-6,57	-1,83
	B (21)	-3,200*	,887	,009	-5,57	-,83
T (21)	K - (21)	4,200*	,887	,001	1,83	6,57
	B (21)	1,000	,887	,516	-1,37	3,37
B (21)	K - (21)	3,200*	,887	,009	,83	5,57
	T (21)	-1,000	,887	,516	-3,37	1,37

*. The mean difference is significant at the 0.05 level.

Lampiran 10. Lembar Perbaikan Ujian Seminar Hasil

Nama : Adelia Chandra Carolina
 NIM : J035211001
 Tanggal Ujian : 22 Maret 2024
 Judul : Efektivitas Kombinasi Cangkang Kerang Mutiara (*Pinctada Maxima*) Dan Gel Teripang Emas (*Sticopus Hermanii*) Terhadap Regenerasi Tulang Melalui Ekspresi *Bone Morphogenetic Protein-2*

No.	Nama Dosen Penguji/ Pembimbing	Koreksi Tesis	Paraf
1	drg. Sitti Raoda Juanita Ramadhan, Sp. Perio	Perbaiki pada bagian Limitasi bahwa bahan dasar hidroksiapatit karena bahan dasar <i>bone graft</i> dari kalsium karbonat tidak tersedia di pasaran Indonesia sudah betul sehingga tidak perlu di tulis Jawaban : Penulis sudah memperbaiki untuk menghapus limitasi pada kalimat tersebut.	