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BAB VI
KESIMPULAN DAN REKOMENDASI

6.1 Kesimpulan

Bacillus subtilis dengan kode isolat BR610 yang diisolasi dari usus ikan baronang, *Siganus guttatus*, memiliki potensi untuk dikembangkan sebagai probiotik. *Bacillus subtilis* BR610 dapat dikombinasikan dengan inulin dan disalut dengan alginat yang diisolasi dari Sargassum dalam bentuk sediaan probiotik berupa butiran mikrokapsul sinbiotik. Butiran mikrokapsul sinbiotik *Bacillus subtilis* BR610 ini dapat dicampurkan ke dalam formulasi pakan ikan baronang sebanyak 0,1-1%. Penambahan 0,1-1% butiran mikrokapsul sinbiotik *B. subtilis* BR610 dalam pakan ikan baronang, *Siganus guttatus*, dapat memberikan nilai koefisien kecernaan pakan yang lebih baik sehingga meningkatkan laju pertumbuhan spesifik dan bobot mutlak ikan serta menurunkan jumlah pakan yang dikonsumsi setiap hari dan rasio konversi pakan. Penambahan butiran mikrokapsul sinbiotik *B. subtilis* BR610 dalam pakan ikan baronang juga dapat meningkatkan aktifitas enzim protease dan amilase dalam saluran pencernaan ikan, kadar lemak, mikrofili usus, ekspresi gen pertumbuhan dan imun sehingga ikan baronang menjadi lebih bertahan hidup saat dipapar dengan *Streptococcus agalactiae* IBNM2.

6.2 Rekomendasi

Berdasarkan hasil penelitian ini, kami merekomendasikan penggunaan butiran mikrokapsul sinbiotik *B. subtilis* BR610 0,1-1% sebagai formulasi pakan aditif untuk ikan, baik dalam skala produksi yang kecil seperti pembuatan pakan secara mandiri oleh pembudidaya, maupun dalam skala industri.

Lampiran 1. Hasil blastn susunan Nukleotida Isolat yang diisolasi dari usus Ikan baronang, *S. guttatus*

RID: WEMEU4BD013
Job Title:570 T
Program: BLASTN
Database: nt Nucleotide collection (nt)
Query #1: Query ID: lcl|Query_5966875 Length: 439

Sequences producing significant alignments:

Description / Accession	Scientific Name	Common Name	Taxid	Max Score	Total Score	Query cover	E Value	Per. Ident	Acc. Len
Vibrio sp. strain LQ2 16S ribosomal RNA gene, partial sequence MN420866.1	Vibrio sp.	NA	678	811	811	100%	0.0	100.00	1413
Vibrio sp. strain pSSB-07 16S ribosomal RNA gene, partial... MH315835.1	Vibrio sp.	NA	678	811	811	100%	0.0	100.00	1433
Vibrio sp. strain pSSB-05 16S ribosomal RNA gene, partial... MH315834.1	Vibrio sp.	NA	678	811	811	100%	0.0	100.00	1431
Vibrio sp. strain pSSB-03 16S ribosomal RNA gene, partial... MH315832.1	Vibrio sp.	NA	678	811	811	100%	0.0	100.00	1434
Vibrio sp. strain pSB-07 16S ribosomal RNA gene, partial sequence MH315830.1	Vibrio sp.	NA	678	811	811	100%	0.0	100.00	1435
Vibrio sp. strain MW-31 16S ribosomal RNA gene, partial sequence MH315828.1	Vibrio sp.	NA	678	811	811	100%	0.0	100.00	1430
Vibrio sp. strain MW-19 16S ribosomal RNA gene, partial sequence MH315826.1	Vibrio sp.	NA	678	811	811	100%	0.0	100.00	1422
Vibrio sp. strain MW-18 16S ribosomal RNA gene, partial sequence MH315825.1	Vibrio sp.	NA	678	811	811	100%	0.0	100.00	1433
Vibrio sp. strain MW-03 16S ribosomal RNA gene, partial sequence MH315818.1	Vibrio sp.	NA	678	811	811	100%	0.0	100.00	1427
Vibrio fluvialis strain msr10 16S ribosomal RNA gene, partial... MH244244.1	Vibrio fluvi...	NA	676	811	811	100%	0.0	100.00	1423
Vibrio fluvialis strain msr1 16S ribosomal RNA gene, partial... MH244235.1	Vibrio fluvi...	NA	676	811	811	100%	0.0	100.00	1426

RID: WCDB9XTR016
Job Title:570K SB
Program: BLASTN
Database: nt Nucleotide collection (nt)
Query #1: Query ID: lcl|Query_1179413 Length: 367

Sequences producing significant alignments:

Description / Accession	Scientific Name	Common Name	Taxid	Max Score	Total Score	Query cover	E Value	Per. Ident	Acc. Len
Vibrio sp. strain 201707CJKOP-Y21 16S ribosomal RNA gene,... MG593585.1	Vibrio sp.	NA	678	678	678	100%	0.0	100.00	1457
Vibrio sp. strain pSSB-07 16S ribosomal RNA gene, partial... MH315835.1	Vibrio sp.	NA	678	678	678	100%	0.0	100.00	1433
Vibrio sp. strain pSSB-03 16S ribosomal RNA gene, partial... MH315832.1	Vibrio sp.	NA	678	678	678	100%	0.0	100.00	1434
Vibrio sp. strain pSB-07 16S ribosomal RNA gene, partial sequence MH315830.1	Vibrio sp.	NA	678	678	678	100%	0.0	100.00	1435
Vibrio sp. strain MW-31 16S ribosomal RNA gene, partial sequence MH315828.1	Vibrio sp.	NA	678	678	678	100%	0.0	100.00	1430
Vibrio sp. strain MW-18 16S ribosomal RNA gene, partial sequence MH315825.1	Vibrio sp.	NA	678	678	678	100%	0.0	100.00	1433
Vibrio sp. strain PrVb096 16S ribosomal RNA gene, partial... MF948987.1	Vibrio sp.	NA	678	678	678	100%	0.0	100.00	1454
Vibrio sp. strain XS35 16S ribosomal RNA gene, partial sequence OQ617989.1	Vibrio sp.	NA	678	678	678	100%	0.0	100.00	947
Vibrio fluvialis strain NBRC 103150 16S ribosomal RNA gene,... OQ147499.1	Vibrio fluvi...	NA	676	678	678	100%	0.0	100.00	947
Vibrio sp. strain YZF-9 16S ribosomal RNA gene, partial sequence ON365756.1	Vibrio sp.	NA	678	678	678	100%	0.0	100.00	1256
Vibrio sp. strain pSSB-05 16S ribosomal RNA gene, partial... MH315834.1	Vibrio sp.	NA	678	676	676	99%	0.0	100.00	1431

RID: WEPH8GMG013
Job Title:4358373_621_0008SB_resend
Program: BLASTN
Database: nt Nucleotide collection (nt)
Query #1: Query ID: lcl|Query_6384245 Length: 305

Sequences producing significant alignments:

Description / Accession	Scientific Name	Common Name	Taxid	Max Score	Total Score	Query cover	E Value	Per. Ident	Acc. Len
Bacterium NLAE-zl-H257 16S ribosomal RNA gene, partial sequence JX006770.1	bacterium NL...	NA	1201571	564	564	100%	5e-156	100.00	1424
Bacterium NLAE-zl-H155 16S ribosomal RNA gene, partial sequence JX006383.1	bacterium NL...	NA	1201461	560	560	99%	7e-155	100.00	1432
Proteus sp. 914B6_12EMac 16S ribosomal RNA gene, partial sequence KU644482.1	Proteus sp. ...	NA	1794628	556	556	100%	9e-154	99.67	1128
Proteus mirabilis strain H230110-002_C02_11_27F.ab1 16S... OR082828.1	Proteus mira...	NA	584	556	556	100%	9e-154	99.67	1304
Bacillus aerophilus strain 0125 16S ribosomal RNA gene, partia... KP236258.1	Bacillus aer...	NA	293389	556	556	100%	9e-154	99.67	1093
Proteus mirabilis strain ATCC 43071 16S ribosomal RNA gene,... OQ891221.1	Proteus mira...	NA	584	556	556	100%	9e-154	99.67	1444
Proteus mirabilis strain AER311-8 16S ribosomal RNA gene,... KR967387.1	Proteus mira...	NA	584	556	556	100%	9e-154	99.67	1439
Proteus sp. (in: enterobacteria) strain ZM12 16S ribosomal RNA... OQ587830.1	Proteus sp. ...	NA	229037	556	556	100%	9e-154	99.67	1121
Proteus columbae strain NKZP V11 16S ribosomal RNA gene, parti... OQ551100.1	Proteus colu...	NA	1987580	556	556	100%	9e-154	99.67	1401
Proteus faecis strain NKZP V6 16S ribosomal RNA gene, partial... OQ550486.1	Proteus faecis	NA	2050967	556	556	100%	9e-154	99.67	1405
Proteus mirabilis strain ASM1 16S ribosomal RNA gene, partial... OQ427153.1	Proteus mira...	NA	584	556	556	100%	9e-154	99.67	1273

RID: WERU3W5401N
Job Title:konsensus 610b
Program: BLASTN
Database: nt Nucleotide collection (nt)
Query #1: Query ID: lcl|Query_274565 Length: 503

Sequences producing significant alignments:

Description	Scientific Name	Common Name	Taxid	Max Score	Total Score	Query cover	E Value	Per. Ident	Acc. Len	Accession
Bacillus sp. (in: firmicutes) strain AB1 16S ribosomal RNA gen...	Bacillus sp....	NA	1409	907	907	100%	0.0	99.20	1323	OR227362.1
Uncultured bacterium clone b7-25 16S ribosomal RNA gene, parti...	uncultured b...	NA	77133	907	907	100%	0.0	99.20	801	KT341648.1
Bacillus sp. (in: Bacteria) strain ALB31 16S ribosomal RNA gen...	Bacillus sp....	NA	1409	907	907	100%	0.0	99.20	1248	OL629653.1
Bacillus tropicus strain MC3 16S ribosomal RNA gene, partial...	Bacillus tro...	NA	2026188	907	907	100%	0.0	99.20	1176	ON968610.1
Bacillus sp. (in: Bacteria) strain JS1 16S ribosomal RNA gene,...	Bacillus sp....	NA	1409	907	907	100%	0.0	99.20	1323	MZ345631.1
Bacillus sp. (in: Bacteria) strain AK3 16S ribosomal RNA gene,...	Bacillus sp....	NA	1409	907	907	100%	0.0	99.20	1323	MW493119.1
Bacillus subtilis strain C3 16S ribosomal RNA gene, partial...	Bacillus sub...	NA	1423	907	907	100%	0.0	99.20	1135	JX120508.1
Bacillus subtilis strain BCRC 17435 16S ribosomal RNA gene,...	Bacillus sub...	NA	1423	907	907	100%	0.0	99.20	1545	EF423598.1
Uncultured bacterium gene for 16S rRNA, partial sequence, clon...	uncultured b...	NA	77133	904	904	100%	0.0	99.01	1478	AB286638.1
Bacillus subtilis strain S1 16S ribosomal RNA gene, partial...	Bacillus sub...	NA	1423	902	902	100%	0.0	99.01	1459	PP123895.1
Bacillus subtilis strain JK45 16S ribosomal RNA gene, partial...	Bacillus sub...	NA	1423	902	902	100%	0.0	99.01	1354	PP112043.1

RID: WENBJB3S013
Job Title:605T SB
Program: BLASTN
Database: nt Nucleotide collection (nt)
Query #1: Query ID: lcl|Query_5471983 Length: 365

Sequences producing significant alignments:

Description	Scientific Name	Common Name	Taxid	Max Score	Total Score	Query cover	E Value	Per. Ident	Acc. Len	Accession
Vibrio fluvialis strain PS32 16S ribosomal RNA gene, partial...	Vibrio fluvi...	NA	676	675	675	100%	0.0	100.00	510	MT471010.1
Vibrio sp. strain LQ2 16S ribosomal RNA gene, partial sequence	Vibrio sp.	NA	678	675	675	100%	0.0	100.00	1413	MN420866.1
Vibrio sp. strain 201707CJKOP-Y177 16S ribosomal RNA gene,...	Vibrio sp.	NA	678	675	675	100%	0.0	100.00	1446	MG593741.1
Vibrio sp. strain 201707CJKOP-Y21 16S ribosomal RNA gene,...	Vibrio sp.	NA	678	675	675	100%	0.0	100.00	1457	MG593585.1
Vibrio furnissii strain CMFRI/Vfur-01 16S ribosomal RNA gene,...	Vibrio furni...	NA	29494	675	675	100%	0.0	100.00	909	MG077072.1
Vibrio sp. strain pSSB-07 16S ribosomal RNA gene, partial...	Vibrio sp.	NA	678	675	675	100%	0.0	100.00	1433	MH315835.1
Vibrio sp. strain pSSB-05 16S ribosomal RNA gene, partial...	Vibrio sp.	NA	678	675	675	100%	0.0	100.00	1431	MH315834.1
Vibrio sp. strain pSSB-03 16S ribosomal RNA gene, partial...	Vibrio sp.	NA	678	675	675	100%	0.0	100.00	1434	MH315832.1
Vibrio sp. strain pSB-07 16S ribosomal RNA gene, partial sequence	Vibrio sp.	NA	678	675	675	100%	0.0	100.00	1435	MH315830.1
Vibrio sp. strain MW-31 16S ribosomal RNA gene, partial sequence	Vibrio sp.	NA	678	675	675	100%	0.0	100.00	1430	MH315828.1
Vibrio sp. strain MW-19 16S ribosomal RNA gene, partial sequence	Vibrio sp.	NA	678	675	675	100%	0.0	100.00	1422	MH315826.1

RID: WENAB5Z9016
Job Title:605K SB
Program: BLASTN
Database: nt Nucleotide collection (nt)
Query #1: Query ID: lcl|Query_6788441 Length: 319

Sequences producing significant alignments:

Description	Scientific Name	Common Name	Taxid	Max Score	Total Score	Query cover	E Value	Per. Ident	Acc. Len	Accession
Vibrio fluvialis strain PS32 16S ribosomal RNA gene, partial...	Vibrio fluvi...	NA	676	590	590	100%	9e-164	100.00	510	MT471010.1
Vibrio sp. strain LQ2 16S ribosomal RNA gene, partial sequence	Vibrio sp.	NA	678	590	590	100%	9e-164	100.00	1413	MN420866.1
Vibrio sp. strain 201707CJKOP-Y177 16S ribosomal RNA gene,...	Vibrio sp.	NA	678	590	590	100%	9e-164	100.00	1446	MG593741.1
Vibrio sp. strain 201707CJKOP-Y21 16S ribosomal RNA gene,...	Vibrio sp.	NA	678	590	590	100%	9e-164	100.00	1457	MG593585.1
Vibrio furnissii strain CMFRI/Vfur-01 16S ribosomal RNA gene,...	Vibrio furni...	NA	29494	590	590	100%	9e-164	100.00	909	MG077072.1
Vibrio sp. strain pSSB-07 16S ribosomal RNA gene, partial...	Vibrio sp.	NA	678	590	590	100%	9e-164	100.00	1433	MH315835.1
Vibrio sp. strain pSSB-05 16S ribosomal RNA gene, partial...	Vibrio sp.	NA	678	590	590	100%	9e-164	100.00	1431	MH315834.1
Vibrio sp. strain pSSB-03 16S ribosomal RNA gene, partial...	Vibrio sp.	NA	678	590	590	100%	9e-164	100.00	1434	MH315832.1
Vibrio sp. strain pSB-07 16S ribosomal RNA gene, partial sequence	Vibrio sp.	NA	678	590	590	100%	9e-164	100.00	1435	MH315830.1
Vibrio sp. strain MW-31 16S ribosomal RNA gene, partial sequence	Vibrio sp.	NA	678	590	590	100%	9e-164	100.00	1430	MH315828.1
Vibrio sp. strain MW-19 16S ribosomal RNA gene, partial sequence	Vibrio sp.	NA	678	590	590	100%	9e-164	100.00	1422	MH315826.1

RID: WERV5GS601N
Job Title:konsensus 610c
Program: BLASTN
Database: nt Nucleotide collection (nt)
Query #1: Query ID: lcl|Query_277357 Length: 442

Sequences producing significant alignments:

Description	Scientific Name	Common Name	Taxid	Max Score	Total Score	Query cover	E Value	Per. Ident	Acc. Len	Accession
Staphylococcus gallinarum strain KA10 16S ribosomal RNA gene,...	Staphylococc...	NA	1293	780	780	99%	0.0	98.64	1311	ON533512.1
Staphylococcus sp. LF20 16S ribosomal RNA gene, partial sequence	Staphylococc...	NA	1211359	780	780	99%	0.0	98.64	1462	JX114802.1
Uncultured bacterium clone nby424g04c1 16S ribosomal RNA gene,...	uncultured b...	NA	77133	780	780	99%	0.0	98.64	1372	HM825187.1
Uncultured Staphylococcus sp. clone MJJ0113_G5 16S ribosomal R...	uncultured S...	NA	189668	774	774	99%	0.0	98.41	789	MN134192.1
Staphylococcus gallinarum strain AB328 16S ribosomal RNA gene,...	Staphylococc...	NA	1293	774	774	99%	0.0	98.41	1419	MT436104.1
Staphylococcus gallinarum strain MEB36 16S ribosomal RNA gene,...	Staphylococc...	NA	1293	774	774	99%	0.0	98.41	785	MT393772.1
Staphylococcus gallinarum strain MB63 16S ribosomal RNA gene,...	Staphylococc...	NA	1293	774	774	99%	0.0	98.41	755	MT393769.1
Staphylococcus gallinarum strain GC33 16S ribosomal RNA gene,...	Staphylococc...	NA	1293	774	774	99%	0.0	98.41	1359	MT214175.1
Staphylococcus gallinarum strain GC21 16S ribosomal RNA gene,...	Staphylococc...	NA	1293	774	774	99%	0.0	98.41	1407	MT214169.1
Staphylococcus gallinarum strain GXIMD124 16S ribosomal RNA...	Staphylococc...	NA	1293	774	774	99%	0.0	98.41	775	MT111735.1
Staphylococcus gallinarum strain ObaCOsho_3 16S ribosomal RNA...	Staphylococc...	NA	1293	774	774	99%	0.0	98.41	1099	MN857726.1

RID: WEPJH4S1016
Job Title:konsensus 610a
Program: BLASTN
Database: nt Nucleotide collection (nt)
Query #1: Query ID: lcl|Query_7851103 Length: 557

Sequences producing significant alignments:

Description	Scientific Name	Common Name	Taxid	Max Score	Total Score	Query cover	E Value	Per. Ident	Acc. Len	Accession
Bacillus subtilis strain 0623_748_009_PCR_B_5_27_F_C05 16S...	Bacillus sub...	NA	1423	1029	1029	100%	0.0	100.00	1218	OR199894.1
Bacillus sp. (in: firmicutes) strain S14 16S ribosomal RNA gen...	Bacillus sp....	NA	1409	1029	1029	100%	0.0	100.00	1432	OR196089.1
Bacillus subtilis strain BG79 16S ribosomal RNA gene, partial...	Bacillus sub...	NA	1423	1029	1029	100%	0.0	100.00	1439	OR196001.1
Bacillus subtilis strain BG75 16S ribosomal RNA gene, partial...	Bacillus sub...	NA	1423	1029	1029	100%	0.0	100.00	1441	OR195993.1
Bacillus licheniformis strain LS-1 16S ribosomal RNA gene,...	Bacillus lic...	NA	1402	1029	1029	100%	0.0	100.00	1365	OR192901.1
Bacillus subtilis strain LA-2 16S ribosomal RNA gene, partial...	Bacillus sub...	NA	1423	1029	1029	100%	0.0	100.00	1365	OR192849.1
Bacillus spizizenii strain GMPCOW4 16S ribosomal RNA gene,...	Bacillus spi...	NA	96241	1029	1029	100%	0.0	100.00	1516	OR187152.1
Bacterium strain Bacillus 16S ribosomal RNA gene, partial...	bacterium	NA	1869227	1029	1029	100%	0.0	100.00	1162	OR186282.1
Bacillus inaquosorum strain LBA001 chromosome, complete genome	Bacillus ina...	NA	483913	1029	1029	100%	0.0	100.00	4200707	CP127095.1
Bacillus subtilis strain HDB8150 16S ribosomal RNA gene, parti...	Bacillus sub...	NA	1423	1029	1029	100%	0.0	100.00	1467	OR177852.1
Bacillus stercoris strain S2 16S ribosomal RNA gene, partial...	Bacillus ste...	NA	2054641	1029	1029	100%	0.0	100.00	1188	OR165819.1

Lampiran 2. Populasi probiotik B. subtilis BR610 yang diisolasi dari usus baronang, *S. guttatus* dalam media nutrient broth dengan perlakuan penambahan inulin.

Inkubasi (jam)	Populasi probiotik (log cfu/mL) dalam inulin (%)				Rerata
	0	0,05	0,1	1	
4	8,489±0,04	7,787±0,21	8,169±0,19	7,743±0,29	8,047±0,35[a]
8	9,520±0,30	9,416±0,2	9,168±0,17	8,975±0,45	9,269±0,25[c]
12	9,309±0,54	8,813±0,13	8,666±0,38	8,673±0,37	8,865±0,30[c]
24	8,958±0,10	9,041±0,27	8,960±0,54	9,210±0,55	9,042±0,12[c]
48	8,933±0,53	8,891±0,35	9,316±0,24	9,389±0,29	9,132±0,26[c]
72	8,728±0,66	8,814±0,57	9,433±0,59	9,494±0,47	9,117±0,40[c]
96	8,561±0,62	8,893±0,59	8,721±0,58	9,149±0,35	8,831±0,25[bc]
120	7,398±0,42	8,000±1,02	8,343±1,04	8,857±0,71	8,149±0,61[ab]
144	7,547±0,78	7,371±1,07	7,643±1,06	8,373±0,59	7,734±0,44[a]
168	7,472±0,79	7,031±0,83	7,806±0,78	8,073±0,45	7,596±0,45[a]
Rerata	8,491±0,77 [ab]	8,405±0,80[a]	8,622±0,62[ab]	8,793±0,58[b]	

Catatan: notasi yang berbeda pada kolom atau baris yang sama menunjukkan signifikansi pada taraf $p<0,05$

Lampiran 3. Laju enkapsulasi dan efisiensi enkapsulasi probiotik B. subtilis BR610 yang diisolasi dari usus baronang, S. guttatus dalam butiran mikrokapsul sinbiotik yang dibuat dengan menggunakan teknik ekstrusi.

		A	B	C=AxB	D	E	EY= (B/E)*100%		F=((DxE)/C)x 100%	G
Probiotik	Konsentrasi Alginat	Volume suspensi yang ditambahkan (mL)	Populasi sel (koloni/mL suspensi sel)	Jumlah sel total dalam suspensi (koloni)	Massa beads yg dihasilkan (gram)	Populasi sel dalam beads (koloni/gram)	Laju Enkapsulasi (%)	Rata-rata laju Enkapsulasi (EY)	Efisiensi enkapsulasi (%)	Rata-rata efisiensi (%)
610	1,0%	50	17000000	850000000	28,75	3000000	17,6	26,8	10,15	16,3
	1,0%	50	189500000	9475000000	29,2	59500000	31,4		18,34	
	1,0%	50	129500000	6475000000	32,58	40500000	31,3		20,38	
	2,0%	50	144250000	7212500000	39,26	60250000	41,8	41,0	32,80	32,3
	2,0%	50	123250000	6162500000	36,57	52250000	42,4		31,01	
	2,0%	50	174500000	8725000000	42,75	67750000	38,8		33,20	
	3,0%	50	327500000	16375000000	40,68	57750000	17,6	19,1	14,35	17,2
	3,0%	50	156250000	7812500000	48,37	26250000	16,8		16,25	
	3,0%	50	372000000	18600000000	46,06	85000000	22,8		21,05	

Lampiran 4. Diameter butiran mikrokapsul sinbiotik *B. subtilis* BR610 yang yang dibungkus dengan alginat menggunakan metode ekstrusi

Diameter (24 G)								
1%			2%			3%		
A1	A2	A3	B1 (mm)	B2	B3	C1	C2	C3
2250,98	2036,42	2041,2	2611	2502	2469,5	2292	2598,5	2630
1030,675	1679,65	2434,88	2506	1885,5	2468	2089,5	2525	2660
2108,24	2048,1	1877,95	2452,5	2629	2111,5	2522,5	2256,5	2842,5

2367,225	1136,1	1919,03	2514,5	2230,5	1722	2733	2864,5	2939
2485,135	1192,745	2617,585	2057,5	1328	2545,5	2456	1918	2794
1806,435	2036,51	1433,925	2627	1480	1797	2297,5	2241	2644
2429,79	1601,18	2021,11	2273,5	2221	2480,5	2829,5	2190	2869,5
2408,94	1807,875	2336,795	2350,5	2159,5	1385,5	2966	2538,5	2829,5
1979,735	1498,925	2371,275	2956,5	2113,5	1962	3058	2611	3201,5
2660,17	1955,275	2306,965	2632,5	2340	2451,5	2902	2669,5	2877
2332,165	1573,87	2705,73	2671	2361,5	1900,5	3044	2163,5	2526,5
2405,73	2376,765	2805,185	1995,5	2178,5	2406	2846	2955,5	2901,5
1974,72	2069,33	2762,395	2353	2705,5	2130,5	3081,5	2736	2822
2330,59	1642,545	2673,115	2366,5	2410	2434,5	2783	2622,5	3011
2641,375	1801,06	1815,305	2598,5	2558,5	2403,5	2753,5	2542,5	3505,5
2391,58	1807,59	2158,115	2509	2372	1882,5	2621	2658,5	2867
2214,785	2015,65	6987,455	2714,5	1757	2264	2539	2569,5	3095
2920,085	2022,35	1940,445	2308,5	2323,5	2395,5	2661	2707	2520,5
2298,51	2201,19	2237,565	2691,5	2273,5	2743,5	2063	2456	2821,5
2361,195	1588,335	958,735	2569,5	2329,5	1756	2867,5	2332	3028
2230,58	2103,71	2177,175	2643,5	2493	2514,5	2070,5	2373,5	2530
1666,565	2321,125	2218,71	2663,5	2160	2811,5	2610,5	2292	2886,5
7393,5	2030,575	2415,965	2762,5	2272	1981	3015,5	2261,5	2918,5
2244,18	1604,57	2233,205	2268,5	1312,5	2354	2883	3081,5	2792
1871,905	2025,68	1435,6	2693	2200,5	2107,5	2581	2563,5	2870,5
2257,11	2323,325	1492,945	2520,5	2320,5	1979,5	2806,5	2305	3445
2185,84	1999,82	2413,235	2692	1974	1948,5	3300	2776,5	2781
2536,29	1586,93	1638,715	2672	1503	2517,5	2770	2456	2932,5
2396,41	1515,53	2444,695	2537,5	2814	2048,5	2392,5	2530	3029,5
1993,8	1460,9	2076,39	2404	1946,5	2429	2405	2481,5	2793,5
1934,785	2120,675	1412,295	2818,5	1606	2167,5	2417,5	2197,5	2904
2019,535	2121,345	1854,51	2526	2378,5	2145,5	2724	2706	3104,5
2455,99	1368,545	1969,95	2634,5	2633	1677,5	2333	2534,5	3113
2158,245	1189,315	1466,465	2714,5	2253	2189	2537	2571,5	3281
1982,47	1810,52	2721,92	2369,5	2536,5	1678	3046,5	2791	3293,5
2005,685	1835,245	2085,545	2680	1781	1999	2649	2075	3310,5
2362,31	1793,37	2090,155	2640,5	2155	1958	2773,5	2521,5	3353
2144,225	1573,58	2194,61	2496	2471,5	1665,5	2773	2217,5	2799,5
2379,76	1216,955	1798,79	2692,5	1321	2390	2833,5	1727	1907,5
2177,155	1800,76	1501,04	2358,5	2465,5	2586,5	3569	1603,5	2927,5
2162,73	1342,03	2091,14	2379	2250	2441	2712,5	2186,5	2825,5
1464,14	1564,39	1019,895	2745,5	2370	2551,5	2669	2481,5	2752
2563,47	1543,235	2196,89	2437,5	1542,5	2074	2892,5	2424	2946
2226,105	1325,31	2188,535	1987	1615	2100	2929	3025,5	2670
2142,79	1377,87	1856,395	2210,5	1288,5	1860	2915	2952	2857
2166,595	1464,24	1987,665	2622	2228,5	2165	2434,5	2508	3431,5
1763,995	1470,725	2272,6	2675,5	2398,5	2525	2473	2801,5	3496,5
2221,89	1553,325	1968,23	2322,5	2071	1781,5	2512,5	2576,5	2714,5
2490,08	1921,35	2124,69	2333	2094,5	2000	2344	1896,5	2922
2385,195	1134,64	1793,165	2903,5	2386	2134	2942	2304	2512,5

2307,475	590,45	1982,35	2641	2936,5	2007,5	2113	2507,5	3472,5
1755,775	643,555	2258,395	2320	2405	2554,5	2405,5	2568	2644,5
1651,775	1539,025	2185,2	2016	2455	2661,5	2443	2359	2835
2005,715	1982,465	1926,88	2386	2078	1614	2125,5	2282,5	3244
1980,76	1650,845	2270,225	2621,5	2453,5	2109,5	3357	2830,5	3360,5
1776,7	1987,96	2289,8	2688	2511,5	2510	2900	2749,5	2875
1553,795	2271,435	2042,195	2279	2315,5	2218	2839,5	2072	3118
2865,32	1992,47	2244,625	2592,5	2202,5	2484,5	3226	2946	2613,5
1736,71	1671,475	2345,28	2116	2065,5	2494,5	3474	2220,5	3044,5
1817,48	2115,205	1130,19	2414	2320	2538,5	2818	2414	2633
2304,105	955,21	1852,355	2350	2246	2780	3046	1549	3432,5
2075,84	1387,89	2147,835	2632,5	2486	2216	2410,5	2186,5	1887,5
1530,565	1880,485	1632,77	2375	2139,5	2186	3005,5	3096	2973,5
2108,465	1871,69	2024,585	2169	2036,5	2345	2548	2057,5	2950,5
1422,615	1574,745	1764,2	2323,5	2128,5	2483	2144,5	2872,5	3229
1407,72	1314,11	1873,92	2421	2231,5	2671,5	2140	2442,5	2457,5
1826,845	1697,705	1800,935	2492,5	2468	1418	2555,5	2285	2905,5
2028,425	1574,125	2115,515	2672,5	2347,5	1517	2954,5	2565	2796
2212,47	1520,615	1538,495	2587,5	2192,5	1686,5	3365,5	2247	2627
2138,015	1596,625	1777,305	2568	2196	2572,5	3021,5	2779,5	2800
1828,605	1624,15	1841,055	2327	2267,5	1804,5	3045	3004,5	2663
1784,655	1615,835	1805,59	2341	2503	2087,5	2758	2424	2757
2394,63	1853,585	2010,805	2531	2267	2099,5	2255	2875	3428,5
2240,3	1611,56	2050,685	2751	2240,5	2021	2086,5	2452	1810
1992,315	1919,675	1679,075	2690	1918,5	2573	2116,5	2424,5	3126,5
1934,555	2091,495	1790,495	2731	2769	2760,5	2254	2605	2772
1880,535	1841,065	1773,495	2645,5	2032	2601	3015	2709	3229
2173,035	1414,79	2152,461	2370,5	1301,5	2417,5	2982,5	2558	2922
2213,8	1387,63	1800,12	2467	2040	2409,5	2504,5	2461,5	2925,5
1925,96	1560,635	2183,82	2439	2467	2230	3021,5	2183,5	2041,5
1814,78	1820,975	2375,53	2334	2195,5	2611,5	2178	2507	3001,5
2101,205	1782,845	2448,585	2316	2650	2026	3461,5	2446,5	2710,5
2145,17	1546,05	2227,395	2973	2143	1898	2836	2483,5	2655
2051,23	1577,03	2006,11	2392,5	1977	1952,5	2563,5	2784,5	2338
2236,67	2065,81	2318,175	2113,5	2484	1966,5	2553	2777,5	2548,5
846,155	2098,64	1606,425	2633	1305,5	2614	3593	2509,5	2948
1867,91	843,63	1500,715	2373,5	2301,5	2269	3229	2636,5	2746
1864,445	1540,84	2088,93	2643,5	2321,5	2121	2234,5	2255	2848,5
2137,22	950,65	2312,725	2441,5	2518,5	1699	2704,5	2505	3571
1954,895	1655,35	1774,95	1919,5	2439,5	2525,5	2452	2556	1794
1437,595	1339,07	1844,57	2661,5	1664,5	1000,5	3043	2594,5	2632
2169,31	1287,505	2092,9	2745,5	2071,5	1417,5	2712,5	2663	2545,5
2153,58	1976,455	1231,295	2549	2956,5	2763	2669,5	2468,5	2784
2001,15	1230,12	1367,415	2578,5	2481	2123,5	2856,5	2672,5	2921,5
1748,385	909,71	1220,16	2368,5	1969	1936,5	2529	2480,5	2774
1664,48	1702,38	1426,645	2560	2299	1310	2724	2766,5	2925,5
2057,61	1734,66	1456,29	2425	1755	2019,5	2779	2685	2743

2177,24	1834,155	1202,09	2542,5	2306,5	1425	2685,5	2351	2801,5
2047,41	2067,51	1458,71	2275,5	2309	2600,5	3052	2807	2850,5
2075,83	2112,08	1082,84	2615,5	2513,5	2576,5	2795	2398,5	2568,5
2128,09	**1674,05**	**2008,79**	**2495,83**	**2196,83**	**2174,17**	**2713,03**	**2494,53**	**2857,68**
629,82	**364,11**	**642,15**	**209,33**	**362,03**	**378,97**	**354,62**	**292,97**	**344,69**

Lampiran 5. Populasi probiotik dalam butiran mikrokapsul sinbiotik setelah cekaman suhu

	suhu	Penurunan Populasi
0	70	30,4
0	70	31,8
0	70	34,8
1	70	26,5
1	70	27,5
1	70	24,1
2	70	22,7
2	70	23,8
2	70	31,1
3	70	26,8
3	70	21,6
3	70	33,3
0	90	39,6
0	90	39,5
0	90	41,3
1	90	20,2
1	90	25,3
1	90	46,4
2	90	27,6
2	90	28,5
2	90	43,1
3	90	28,9
3	90	30,5
3	90	19,3

Lampiran 6. Populasi probiotik dalam butiran mikrokapsul sinbiotik setelah cekaman cairan empedu.

Konsntrasi alginat	empedu	Populasi
1%	10%	3,725
1%	10%	3,578
1%	10%	3,829
2%	10%	6,514
2%	10%	7,141
2%	10%	6,823
3%	10%	4,699
3%	10%	4,699
3%	10%	5,740

Lampiran 7. Hasil analisis proksimat pakan uji untuk pembesaran ikan baronang di karamba jaring apung

Perlakuan	Parameter (% Bahan Kering Pakan)						
	Abu	BETN	Lemak	Protein	Serat Kasar	Energi Pakan (kkal/kg)	Konversi
A	11,21086	43,02606	10,22553	30,621852	4,91569958	3073,998248	1,094811
A	11,00011	49,21044	10,49522	23,955312	5,33891933	3025,588141	1,074229
A	11,33565	46,53194	10,78834	26,523524	4,82054521	3061,888222	1,052521
B	11,40547	41,63209	10,80966	31,301202	4,85157996	3108,9584	1,063943
B	10,97625	50,04749	10,75462	22,923483	5,29815303	3030,596306	1,055409
B	10,83474	48,73524	10,65556	25,021079	4,75337268	3052,287099	1,053963
C	10,66791	44,85302	9,847304	29,770437	4,86132752	3058,148956	1,038745
C	10,90428	45,4257	10,90428	27,741935	5,02379693	3090,333157	1,057641
C	10,75029	42,89504	11,2703	30,213308	4,87106017	3140,157063	1,061233
D	13,31047	39,87783	10,51334	31,60433	4,69403065	3048,558568	1,071696
D	10,81279	49,12244	10,40535	24,613456	5,0459674	3033,28458	1,044714
D	11,39042	47,67915	10,61855	25,190362	5,12151872	3036,173986	1,043079
E	11,16336	41,31676	10,11085	31,799351	5,60967417	3077,068637	1,119695
E	10,99619	49,47197	10,28851	24,060969	5,18236255	3015,949918	1,088732
E	11,53079	47,85437	10,34519	25,107544	5,16210261	3016,325674	1,049208

Lampiran 8. Hasil analisa uji kecernaan pakan mikrokapsul sinbiotik oleh ikan baronang

Perlakuan	Koefisien Kecernaan		
	Protein	Lemak	BETN
K	90,56	88,06	92,4
K	86,31	89,44	93,01
P10%	91,34	95,2	87,34
P10%	81,8	90,15	80,46
S0,1%	89,72	91,78	94,58
S0,1%	90,31	93,91	88,29
S1%	92,02	93,35	93,79
S1%	88,25	94,84	94,4
S10%	87	85,3	86,41
S10%	87,33	84,85	88,01

Lampiran 9. Hasil Analisa pengaruh pakan mikrokapsul sinbiotik *B. subtilis* BR610 terhadap performa pertumbuhan ikan baronang

Perlakuan	SGR	Konsumsi pakan harian	Bobot mutlak	FCR	Efisiensi Pakan	Average daily grouth	length gain (cm)
A1	1,236497	2,200986	742	1,8531	0,539636	13,01754	3,366579
A2	1,22857	2,246348	708	1,902542	0,525612	12,42105	3,148684
A3	1,229857	2,326923	707	1,968883	0,507902	12,40351	3,351053
B1	1,116902	2,163268	656,9	2,001827	0,499544	11,52456	3,183158
B2	1,24727	2,252446	750	1,881333	0,531538	13,15789	3,428947
B3	1,256435	2,180361	764	1,808901	0,552822	13,40351	3,586579
C1	1,31116	2,315098	798	1,847118	0,541384	14	3,615789

C2	1,267399	2,274294	749	1,871829	0,534237	13,14035	3,587105
C3	1,293085	2,297877	789	1,856781	0,538567	13,84211	3,571579
D1	1,32783	2,191237	817	1,728274	0,578612	14,33333	3,885
D2	1,263059	2,174383	757	1,795244	0,557027	13,2807	4,024211
D3	1,285636	2,233304	748	1,814171	0,551216	13,12281	3,787105
E1	1,260335	2,206698	790,45	1,825542	0,547782	13,86754	3,792368
E2	1,201581	2,16403	676,7	1,870844	0,534518	11,87193	3,492368
E3	1,205863	2,263285	683	1,95022	0,512763	11,98246	2,830789

Lampiran 10. Hasil analisa enzim dalam usus ikan baronang yang diberi pakan mikrokapsul sinbiotik *B. subtilis* BR610

Perlakuan	enzim (U/mL/menit)		
	Protease	Amilase	selulose
A1	0,026	0,729	1,13
A2	0,015	0,74	1,448
A3	0,039	0,736	1,522
B1	0,041	0,77	1,702
B2	0,066	0,844	1,32
B3	0,11	0,759	1,443
C1	0,091	0,848	1,637
C2	0,09	0,704	1,249
C3	0,01	0,91	1,467
D1	0,012	0,852	1,526
D2	0,009	0,738	1,216
D3	0,012	0,57	0,767
E1	0,016	0,726	1,153
E2	0,012	0,823	1,702
E3	0,014	0,774	1,22

Lampiran 11. Hasil analisa histologi usus ikan baronang yang diberi pakan mikrokapsul sinbiotik *B. subtilis* BR610

Kode	Lebar Basal (µm)	Vili	
		Panjang (µm)	Lebar (µm)
A	28,6±8,1	134,85±33,6	66,5±18,7
B	43,84±5,3	146,36±54,8	44,97±14,1
C	43,46±8,4	180,71±44,3	57,86±15,6
D	33,85±6,5	147,7±44,8	44,09±12,2
E	50,65±4,5	187,92±57,9	54,23±17,5

Lampiran 12. Hasil analisa proksimat karkas ikan baronang yang diberi pakan mikrokapsul sinbiotik *B. subtilis* BR610

KODE SAMPEL	PARAMETER (%)				
	KADAR ABU	AIR	LEMAK	PROTEIN	SERAT KASAR
IKAN AWAL	15,61	7,68	17,62	56,6	0,47
Ikan Hasil Panen					
A1	15,2	4,36	17,8	61,42	0,55

A2	15,05	4,12	17,46	62,2	0,5
A3	16,67	3,77	17,42	61,6	0,51
B1	17,26	4,27	18,51	46,53	0,21
B2	17,04	4	18,5	57,22	0,25
B3	17,21	5,23	18,37	58,52	0,23
C1	15,86	8,61	12,9	58,82	0,4
C2	16,31	5,77	12,13	61,71	0,45
C3	15,91	6,58	12,77	61,56	0,42
D1	15,98	4,11	22,38	56,13	0,33
D2	15,88	3,3	22,48	55,69	0,33
D3	18,11	2,59	22,7	55,14	0,38
E1	17,34	3,6	13,79	62,7	0,66
E3	17,49	2,58	13,68	63,88	0,64
E4	15,23	3,77	14,43	64,1	0,65

Lampiran 13. Gejala klinis ikan baronang pasca injeksi Streptococcus agalactie IBNM2

Kode	Hari Pasca Injeksi *Streptococcus agalactie* IBNM2											
	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12
A1	0	2	2	1	4	0	0	0	0	0	5	4
A2	0	0	0	4	21	4	5	0	0	0	0	0
A3	0	0	0	7	8	4	4	4	4	4	5	4
B1	0	1	1	11	13	5	0	0	0	0	0	0
B2	0	1	1	6	2	0	0	0	0	4	4	8
B3	0	0	0	4	8	4	4	0	0	0	0	0
C1	0	0	0	4	4	9	4	2	5	0	0	0
C2	0	0	0	13	9	4	4	8	5	4	4	0
C3	0	0	0	0	1	4	4	0	0	4	4	4
D1	0	0	0	6	8	5	5	0	0	0	0	4
D2	0	0	0	4	4	0	0	0	0	0	0	0
D3	0	0	0	7	6	4	4	4	4	0	0	4
E1	0	0	0	13	4	4	4	5	5	0	0	0
E2	0	1	1	0	0	0	4	0	0	0	0	0
E3	0	1	1	3	4	4	4	8	8	4	4	0

Ket.
Skoring

0 Ikan Normal
1 Bibir ikan hitam, warna kerapu, sirip tegak
2 Ikan berwarna gelap, perut kembung, masih respon pakan
3 Mata ikan berwarna merah masih respon pakan
4 Mata ikan berwarna merah, bengkak/melotot, perut kembung, pergerakan tidak aktif, dan tidak nafsu makan
5 Ikan mati