

BAB V

PENUTUP

A. Kesimpulan

Berdasarkan hasil penelitian yang telah dilakukan dapat disimpulkan bahwa:

Pertama, bakteri endofit dari umbi tanaman talas mempunyai aktivitas antibakteri terhadap *S. aureus* ATCC 25923.

Kedua, nilai daya hambat aktivitas antibakteri dari bakteri endofit *Pseudomonas knackmussii* pada fermentasi hari ke-2 sebesar 9,11 mm, hari ke-3 sebesar 9,69 mm dan hari ke-4 sebesar 8,30 mm. Nilai daya hambat aktivitas antibakteri dari bakteri endofit *Bacillus siamensis* pada fermentasi hari ke-2 sebesar 7,15 mm, hari ke-3 sebesar 9,20 mm dan hari ke-4 sebesar 8,62 mm

Ketiga, waktu optimum fermentasi bakteri endofit dari umbi tanaman talas yang memiliki aktivitas antibakteri terbesar pada hari ke-3.

B. Saran

Dalam penelitian ini masih banyak kekurangan, maka perlu dilakukan penelitian lebih lanjut mengenai:

Pertama, perlu dilakukan penelitian lebih lanjut untuk mengetahui bagaimana kurva fase pertumbuhan dari bakteri endofit umbi tanaman talas *Pseudomonas knackmussii* dan *Bacillus siamensis*.

Kedua, perlu dilakukan penelitian lebih lanjut untuk mengetahui senyawa metabolit sekunder yang dihasilkan oleh bakteri endofit *Pseudomonas knackmussii* dan *Bacillus siamensis* yang berpotensi sebagai aktivitas antibakteri.

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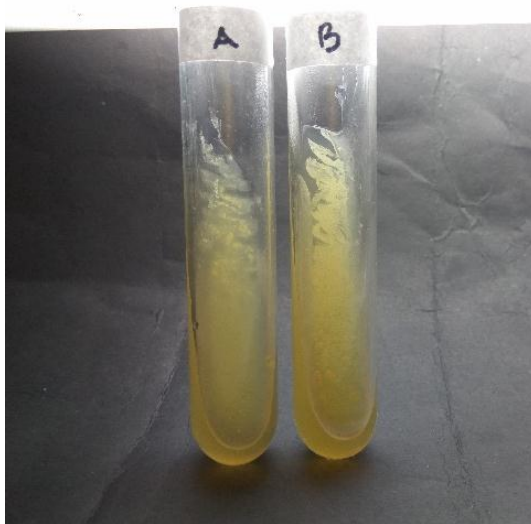
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Lampiran 1. Suspensi Bakteri Uji Standar Mc Farland

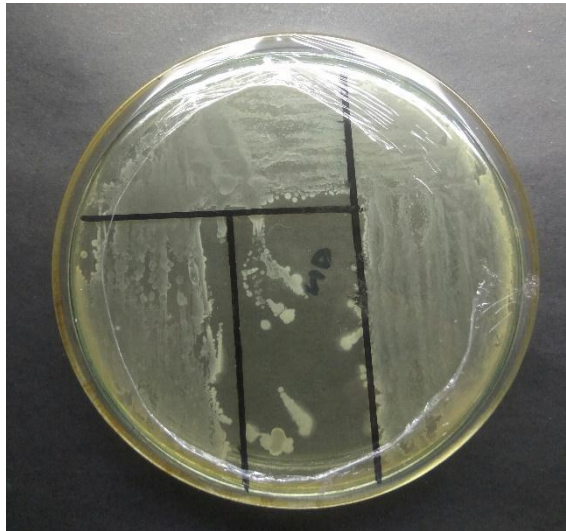


Lampiran 2. Kultur Bakteri Endofit

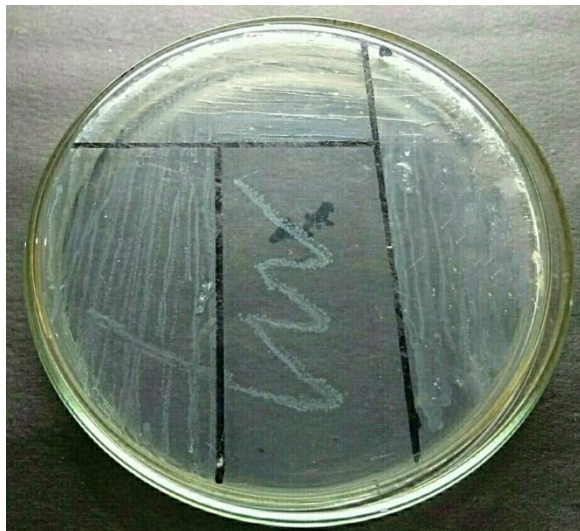


Keterangan: (A) Bakteri Endofit *Pseudomonas knackmussii*; (B) Bakteri Endofit *Bacillus siamensis*

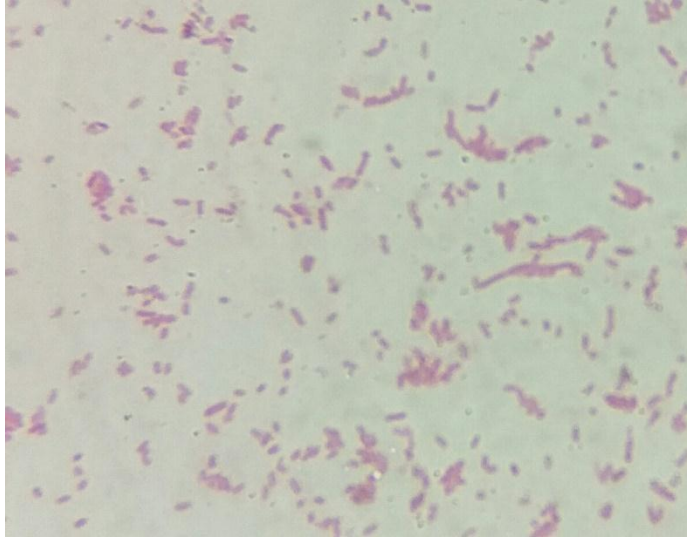
Lampiran 3. Hasil Uji Morfologi Bakteri Endofit *Bacillus siamensis* pada Media NA



Lampiran 4. Hasil Uji Morfologi Bakteri Endofit *Pseudomonas knackmussii* pada Media PSA



Lampiran 5. Hasil Uji Pewarnaan Gram Bakteri Endofit *Pseudomonas knackmussii* dan *Bacillus siamensis*

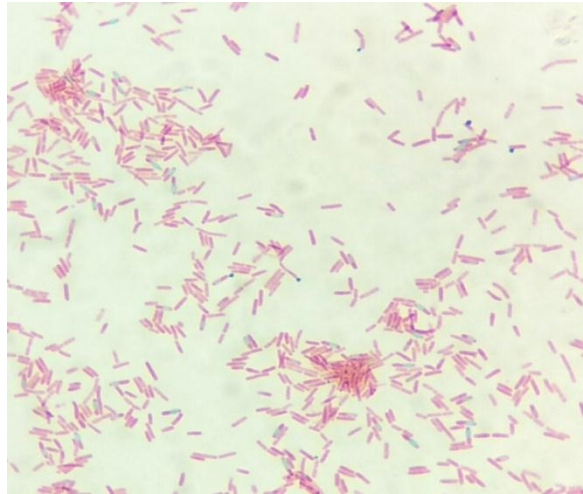


Bakteri Endofit *Pseudomonas knackmussii*



Bakteri Endofit *Bacillus siamensis*

Lampiran 6. Hasil Uji Pewarnaan Spora Bakteri Endofit *Bacillus siamensis*



Lampiran 7. Hasil Uji Biokimia Bakteri Endofit *Pseudomonas knackmussii*



KIA



SIM



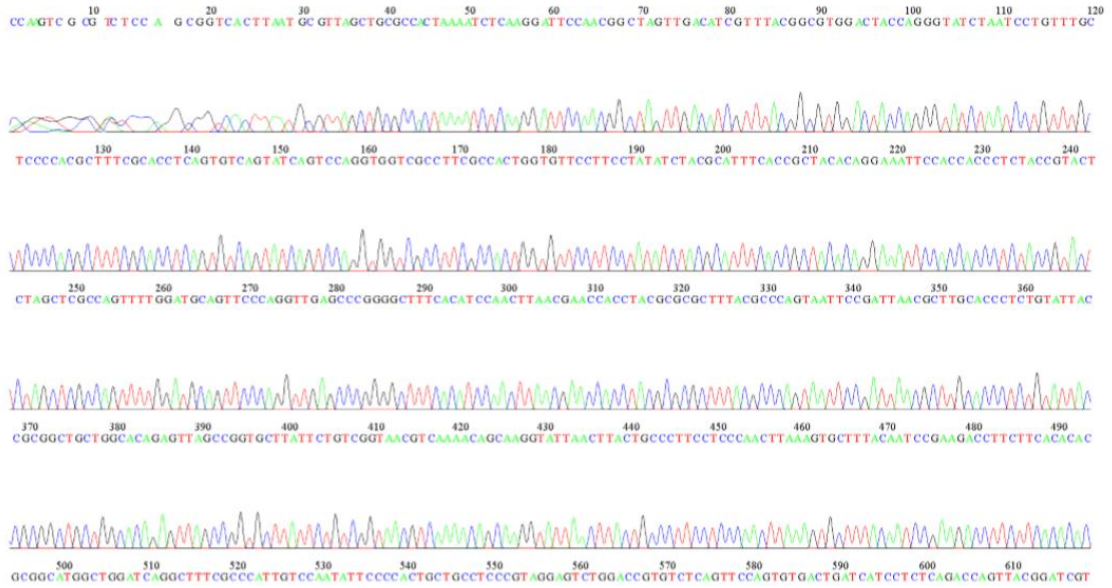
LIA



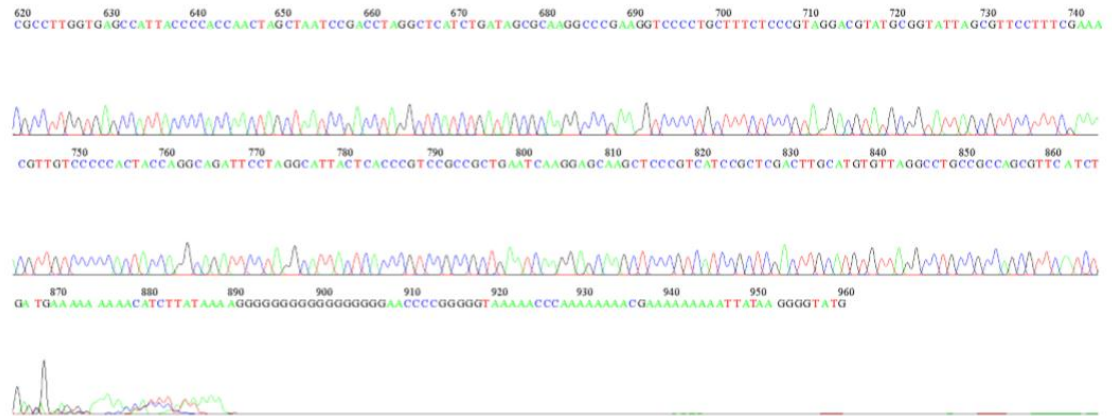
CITRAT

Lampiran 8. Identifikasi Molekuler Bakteri Endofit *Pseudomonas knackmussii* Berdasarkan Marka gen 16S rRNA

File: isolat_1_907R.ab1 Run Ended: 2018/8/8 8:32:49 Signal G:4724 A:4204 C:8062 T:6366
 Sample: isolat_1_907R Lane: 54 Base spacing: 15.167326 960 bases in 20089 scans Page 1 of 2

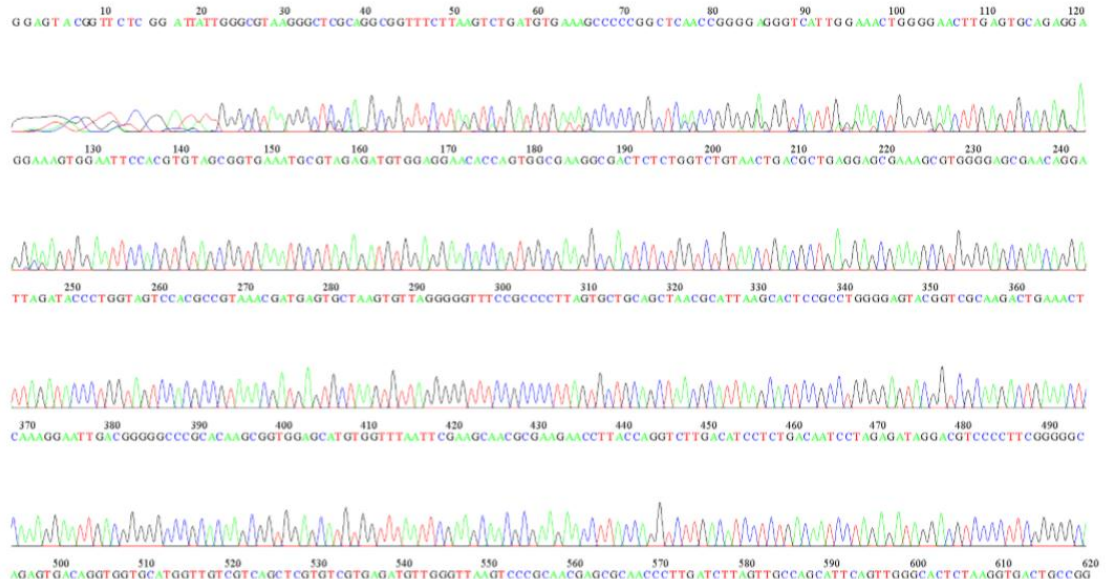


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 Sample: isolat_1_907R Lane: 54 Base spacing: 15.167326 960 bases in 20089 scans Page 2 of 2

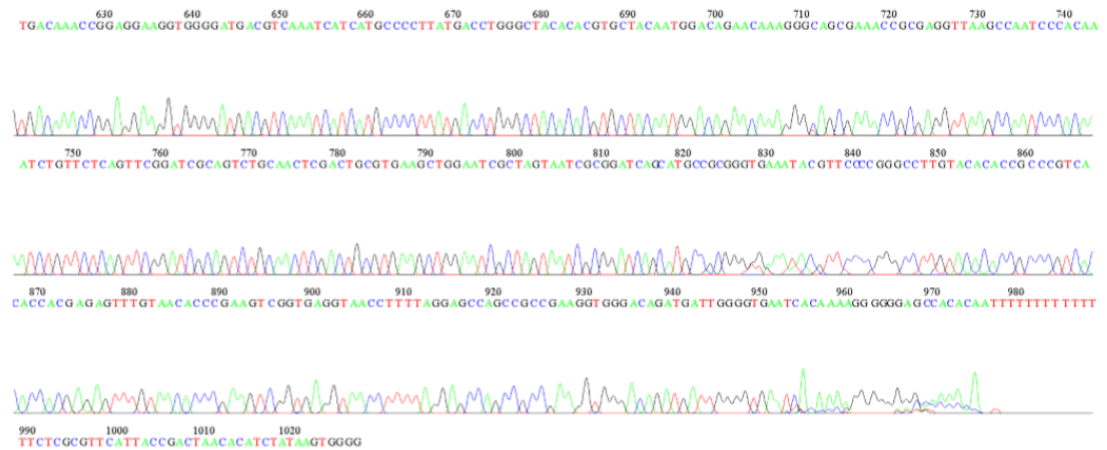


Lampiran 9. Identifikasi Molekuler Bakteri Endofit *Bacillus siamensis* Berdasarkan Marka gen 16S rRNA

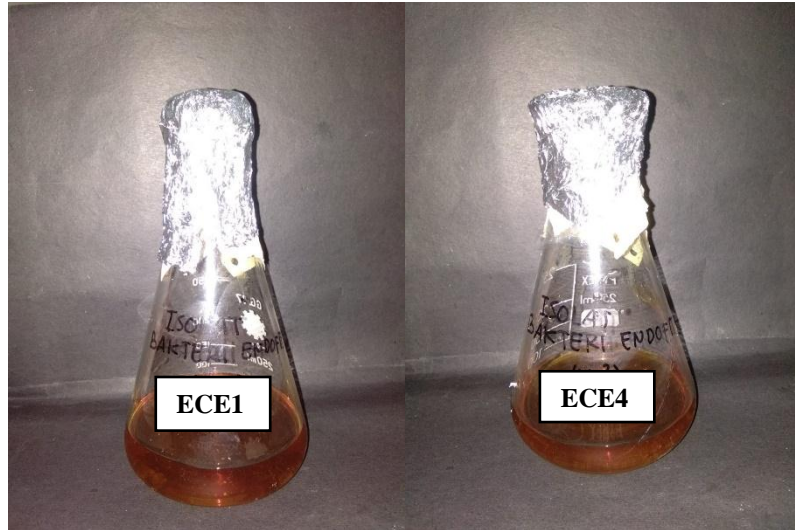
File: isolat_4_785F.ab1 Run Ended: 2018/8/8 8:32:49 Signal G:4027 A:3614 C:4471 T:3674
 Sample: isolat_4_785F Lane: 52 Base spacing: 15.109042 1029 bases in 19518 scans Page 1 of 2



File: isolat_4_785F.ab1 Run Ended: 2018/8/8 8:32:49 Signal G:4027 A:3614 C:4471 T:3674
 Sample: isolat_4_785F Lane: 52 Base spacing: 15.109042 1029 bases in 19518 scans Page 2 of 2

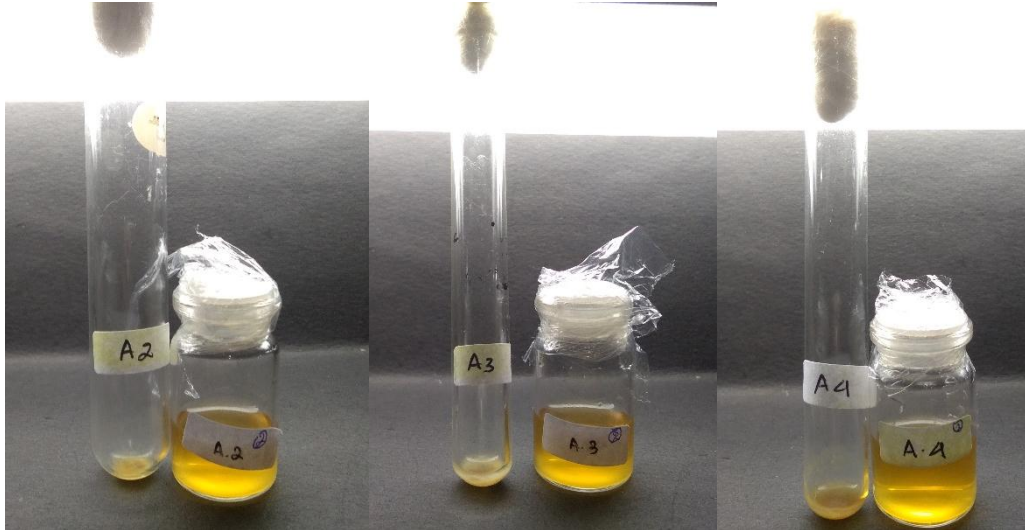


Lampiran 10. Fementasi Bakteri Endofit *Pseudomonas knackmussii* dan *Bacillus siamensis*

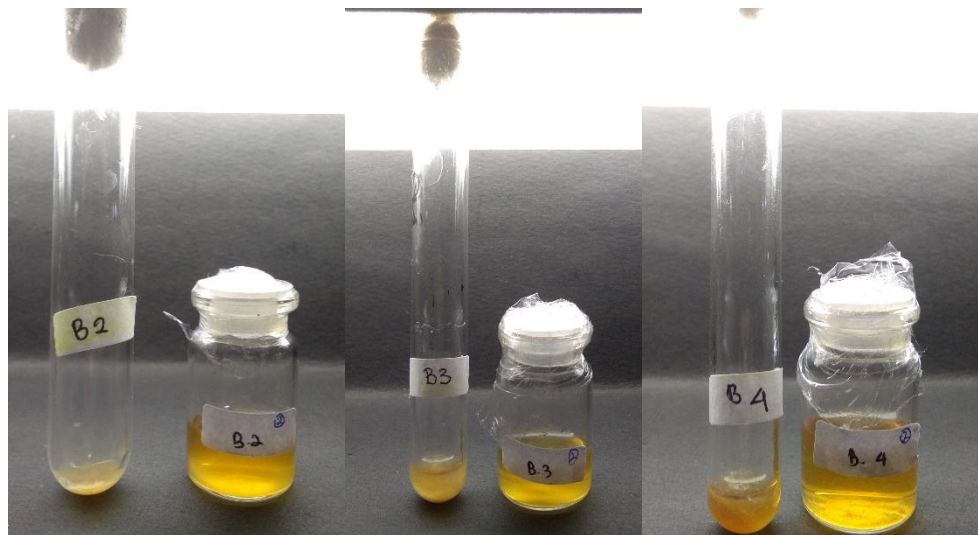


Keterangan: (ECE1) Bakteri Endofit *Pseudomonas knackmussii*; (ECE4) Bakteri Endofit *Bacillus siamensis*

Lampiran 11. Hasil Supernatan dan Endapan Bakteri Endofit *Pseudomonas knackmussii* dan *Bacillus siamensis*

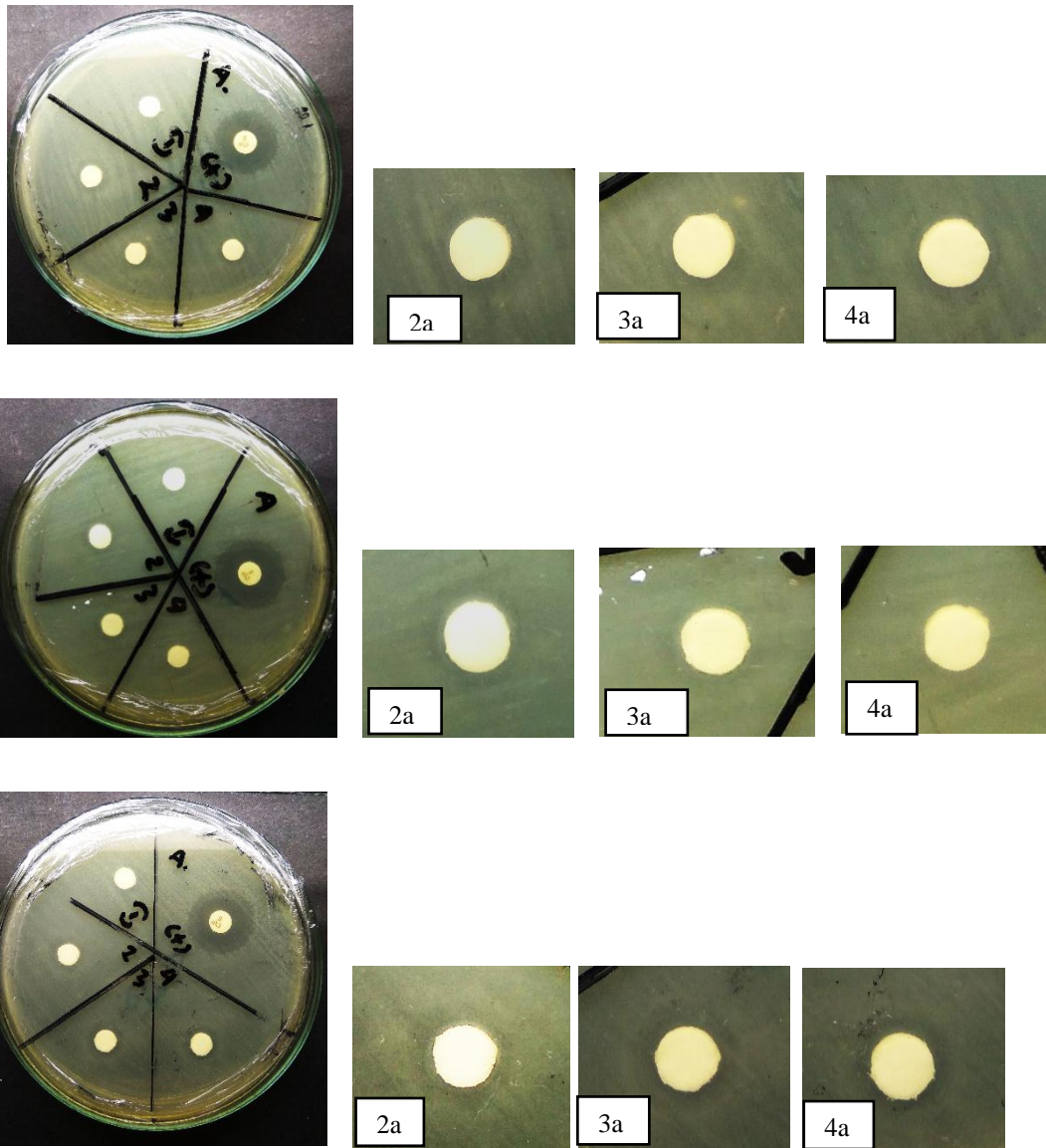


Keterangan: (A2) Supernatan Bakteri Endofit *Pseudomonas knackmussii* Hari Ke-2; (A3) Supernatan Bakteri Endofit *Pseudomonas knackmussii* Hari Ke-3; (A4) Supernatan Bakteri Endofit *Pseudomonas knackmussii* Hari Ke-4



Keterangan: (B2) Supernatan Bakteri Endofit *Bacillus siamensis* Hari Ke-2; (B3) Supernatan Bakteri Endofit *Bacillus siamensis* Hari Ke-3; (B4) Supernatan Bakteri Endofit *Bacillus siamensis* Hari Ke-2

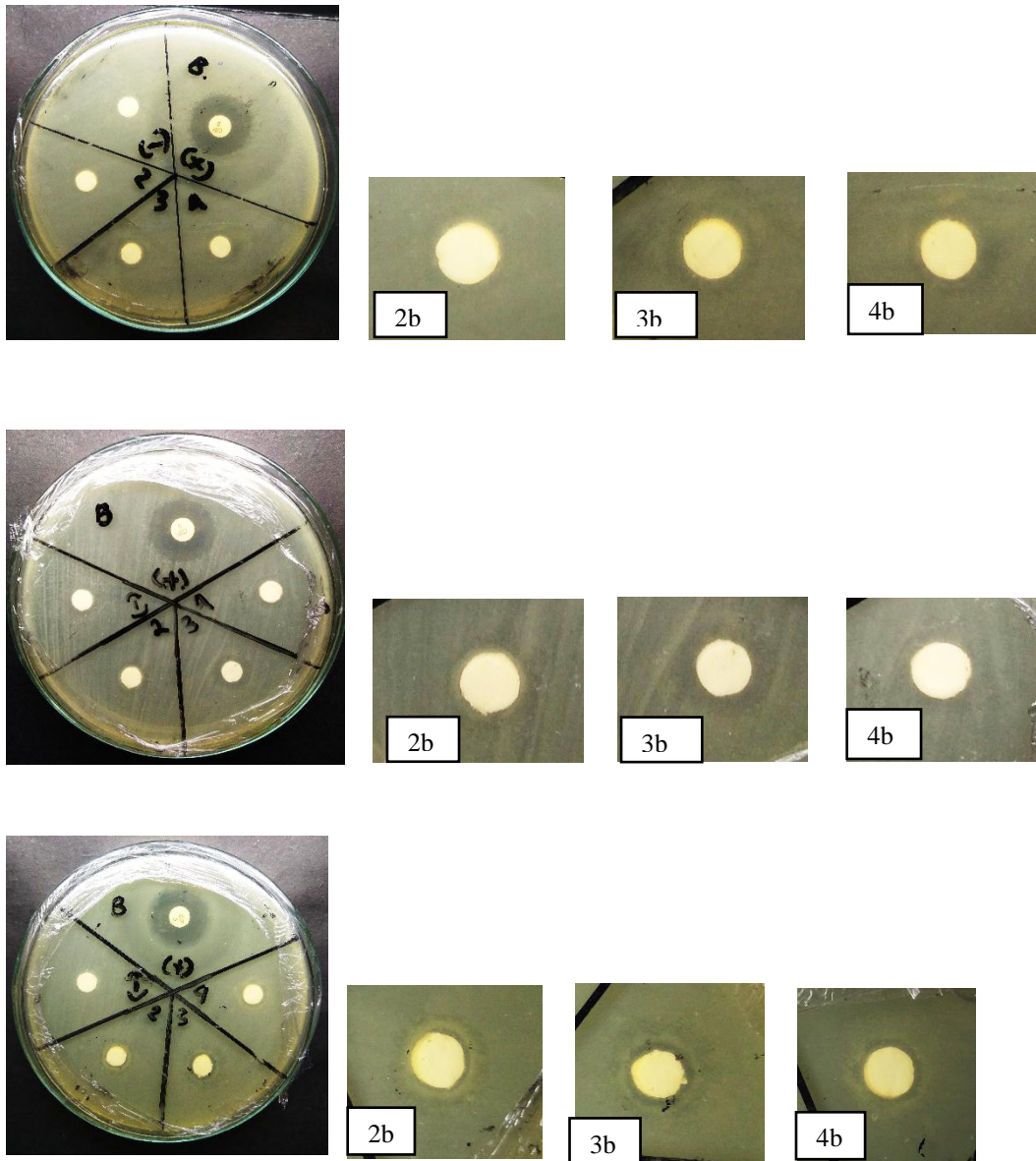
Lampiran 12. Hasil Uji Aktivitas Antibakteri dari Bakteri Endofit *Pseudomonas knackmussii*



Keterangan :

- (-) : Kontrol negatif (kertas cakram tanpa senyawa antibakteri)
- (+) : Kontrol positif (antibiotik ciprofloxacin 5 μ g)
- (2) : Fermentasi hari ke-2
- (3) : Fermentasi hari ke-3
- (4) : Fermentasi hari ke-4

Lampiran 13. Hasil Uji Aktivitas Antibakteri dari Bakteri Endofit *Bacillus siamensis*



Keterangan :

- (-) : Kontrol negatif (kertas cakram tanpa senyawa antibakteri)
- (+) : Kontrol positif (antibiotik ciprofloxacin 5 μ g)
- (2) : Fermentasi hari ke-2
- (3) : Fermentasi hari ke-3
- (4) : Fermentasi hari ke-4

Lampiran 14. Hasil Pencarian Dugaan Protein Antibakteri yang Disintesis oleh Bakteri Endofit *Pseudomonas knackmussii* pada Laman Web Uniprot

UniProtKB results

UniProtKB consists of two sections:

- Reviewed (Swiss-Prot) - Manually annotated**
Records with information extracted from literature and curator-evaluated computational analysis.
- Unreviewed (TrEMBL) - Computationally analyzed**
Records that await full manual annotation.

The UniProt Knowledgebase (UniProtKB) is the central hub for the collection of functional information on proteins, with accurate, consistent and rich annotation. In addition to capturing the core data mandatory for each UniProtKB entry (mainly, the amino acid sequence, protein name or description, taxonomic data and citation information), as much annotation information as possible is added.

Filter by: BLAST Align Download Add to basket Columns

Quote terms: "pseudomonas knackmussii"

Entry	Entry name	Protein names	Gene names	Organism	Length
A0A024HE19	A0A024HE19_PSEKB	Tol-Pal system protein TolQ	tolQ PKB_1389	<i>Pseudomonas knackmussii</i> (strain DSM 6978 / LMG 23759 / B13)	231
A0A024HDR2	A0A024HDR2_PSEKB	TonB, C-terminal	PKB_1391	<i>Pseudomonas knackmussii</i> (strain DSM 6978 / LMG 23759 / B13)	349

Display

Protein | Tol-Pal system protein TolQ
Gene | tolQ
Organism | *Pseudomonas knackmussii* (strain DSM 6978 / LMG 23759 / B13)
Status | Unreviewed - Annotation score: ●●○○○ - Protein inferred from homology¹

Function¹

Part of the Tol-Pal system, which plays a role in outer membrane invagination during cell division and is important for maintaining outer membrane integrity.
UniRule annotation -

GO - Biological process¹

- bacteriocin transport Source: InterPro
- cell cycle Source: UniProtKB-KW
- cell division Source: UniProtKB-UniRule

View the complete GO annotation on QuickGO ...

Keywords¹

Biological process Cell cycle, Cell division UniRule annotation -

Names & Taxonomy¹

Protein names¹ Recommended name: Tol-Pal system protein TolQ UniRule annotation -

Gene names¹ Name: tolQ UniRule annotation - Imported -
ORF Names: PKB_1389 Imported -

Organism¹ *Pseudomonas knackmussii* (strain DSM 6978 / LMG 23759 / B13) Imported -

Taxonomic Identifier¹ 1301098 [NCBI]

Taxonomic lineage¹ Bacteria > Proteobacteria > Gammaproteobacteria > Pseudomonadales > Pseudomonadaceae > Pseudomonas > **DB**

Display

Protein | Submitted name: TonB, C-terminal
Gene | PKB_1391
Organism | *Pseudomonas knackmussii* (strain DSM 6978 / LMG 23759 / B13)
Status | Unreviewed - Annotation score: ●○○○○ - Protein predicted¹

Function¹

GO - Molecular function¹

- transporter activity Source: InterPro

View the complete GO annotation on QuickGO ...

GO - Biological process¹

- bacteriocin transport Source: InterPro

View the complete GO annotation on QuickGO ...

Names & Taxonomy¹

Protein names¹ Submitted name: TonB, C-terminal Imported -

Gene names¹ ORF Names: PKB_1391 Imported -

Organism¹ *Pseudomonas knackmussii* (strain DSM 6978 / LMG 23759 / B13) Imported -

Taxonomic Identifier¹ 1301098 [NCBI]

Taxonomic lineage¹ Bacteria > Proteobacteria > Gammaproteobacteria > Pseudomonadales > Pseudomonadaceae > Pseudomonas > **DB**

Proteomes¹ UP000025241 Component¹: Chromosome

Subcellular location¹

Protein Tol-Pal system protein TolQ dan TonB, C-terminal

Lampiran 15. Hasil Pencarian Dugaan Protein Antibakteri yang Disintesis oleh Bakteri Endofit *Bacillus siamensis* pada Laman Web Uniprot

The screenshot shows the UniProtKB search results for the query "bacillus siamensis bacteriocin". The search bar at the top contains the query and the UniProtKB logo. Below the search bar, there are navigation links for BLAST, Align, Retrieve/ID mapping, and Peptide search. The main heading is "UniProtKB results".

Below the heading, there is a section titled "UniProtKB consists of two sections:" with two sub-sections: "Reviewed (Swiss-Prot) - Manually annotated" and "Unreviewed (TrEMBL) - Computationally analyzed".

On the left side, there is a "Filter by" section with a dropdown menu set to "Unreviewed (1) TrEMBL". Below this, there is a "Popular organisms" section with "Bacillus siamensis (1)" listed. A "View by" section is also present with a "Results table" button.

The main content area shows a table of search results. The table has columns for Entry, Entry name, Protein names, Gene names, Organism, and Length. The first row shows the entry A0A268DTK5 with the protein name Bacteriocin and gene names CHH79_09480 and CWD84_04735. The organism is Bacillus siamensis and the length is 111. There are also buttons for BLAST, Align, Download, Add to basket, and Columns.

The screenshot shows the UniProtKB protein details page for the protein Bacteriocin. The top section displays the protein name "Bacteriocin" and the gene name "CHH79_09480". The organism is "Bacillus siamensis". The status is "Unreviewed - Annotation score: ●○○○○ - Protein predicted".

Below this, there is a "Names & Taxonomy" section. The protein name is "Bacteriocin" (Imported). The gene names are "ORF Names: CHH79_09480, CWD84_04735" (Imported). The organism is "Bacillus siamensis" (Imported). The taxonomic identifier is "659243 [NCBI]". The taxonomic lineage is "Bacteria > Firmicutes > Bacilli > Bacillales > Bacillaceae > Bacillus > Bacillus amyloliquefaciens group".

The "Subcellular location" section shows the protein is a "Transmembrane" protein, located at positions 65-93, with a description of "Helical" and "Sequence analysis".

The "GO - Cellular component" section shows the protein is an "integral component of membrane" (Source: UniProtKB-KW).

On the left side, there is a "Display" section with a dropdown menu set to "Entry". Below this, there is a "Feature table" section with a list of features: Function, Names & Taxonomy, Subcellular location, Pathology & Biotech, PTM / Processing, Expression, Interaction, Structure, Family & Domains, Sequence, Similar proteins, Cross-references, Entry information, and Miscellaneous.

Protein Bacteriosin

UniProt

UniProtKB bacillus siamensis surfactin

BLAST Align Retrieve/ID mapping Peptide search Help Contact

UniProtKB results

UniProtKB consists of two sections:

- Reviewed (Swiss-Prot) - Manually annotated**
Records with information extracted from literature and curator-evaluated computational analysis.
- Unreviewed (TrEMBL) - Computationally analyzed**
Records that await full manual annotation.

The UniProt Knowledgebase (UniProtKB) is the central hub for the collection of functional information on proteins, with accurate, consistent and rich annotation. In addition to capturing the core data mandatory for each UniProtKB entry (mainly, the amino acid sequence, protein name or description, taxonomic data and citation information), as much annotation information as possible is added.

Help UniProtKB help video Other tutorials and videos Downloads

Filter by: BLAST Align Download Add to basket Columns

Unreviewed (1)
TrEMBL

Popular organisms
Bacillus siamensis (1)

View by
Results table

Taxonomy
Waiting for www.google-analytics.com

Quote terms: "bacillus siamensis"

Entry	Entry name	Protein names	Gene names	Organism	Length
A0A268DMZ8	A0A268DMZ8_9BACI	Surfactin synthetase	CHH79_18810	Bacillus siamensis	434

1 to 1 of 1 Show 25

Display

Entry

Publications

Feature viewer

Feature table

None

Function

Names & Taxonomy

Subcellular location

Pathology & Biotech

PTM / Processing

Expression

Interaction

Structure

Family & Domains

Sequence

Similar proteins

Cross-references

Entry information

Miscellaneous

Protein Submitted name: **Surfactin synthetase**

Gene **CHH79_18810**

Organism *Bacillus siamensis*

Status Unreviewed - Annotation score: ●○○○○ - Protein predicted¹

Function¹

Caution
The sequence shown here is derived from an EMBL/GenBank/DBJ whole genome shotgun (WGS) entry which is preliminary data. Imported

Names & Taxonomy¹

Protein names¹ Submitted name: Surfactin synthetase Imported

Gene names¹ ORF Names: CHH79_18810 Imported

Organism¹ *Bacillus siamensis* Imported

Taxonomic identifier¹ 659243 [NCBI]

Taxonomic lineage¹ Bacteria > Firmicutes > Bacilli > Bacillales > Bacillaceae > Bacillus > Bacillus amyloliquefaciens group

Proteomes¹ UP000215585 Component: Unassembled WGS sequence

Family & Domains¹

Domains and Repeats

Feature key	Position(s)	Description	Actions	Graphical view	Length
Domain ¹	1 - 422	Condensation InterPro annotation	Add BLAST		422

Family and domain databases

Protein Surfactin

UniProtKB results

UniProtKB consists of two sections:

- Reviewed (Swiss-Prot) - Manually annotated**
Records with information extracted from literature and curator-evaluated computational analysis.
- Unreviewed (TrEMBL) - Computationally analyzed**
Records that await full manual annotation.

The UniProt Knowledgebase (UniProtKB) is the central hub for the collection of functional information on proteins, with accurate, consistent and rich annotation. In addition to capturing the core data mandatory for each UniProtKB entry (mainly, the amino acid sequence, protein name or description, taxonomic data and citation information), as much annotation information as possible is added.

Filter by: BLAST Align Download Add to basket Columns 1 to 4 of 4 Show 25

Quote terms: "bacillus siamensis"

Entry	Entry name	Protein names	Gene names	Organism	Length
A0A385CIC8	A0A385CIC8_9BACI	Iturin A synthetase A	ituA	Bacillus siamensis	278
A0A385CJG7	A0A385CJG7_9BACI	Iturin A synthetase B	ituB	Bacillus siamensis	170
A0A385CIS0	A0A385CIS0_9BACI	Iturin A synthetase C	ituC	Bacillus siamensis	197
A0A385CIT6	A0A385CIT6_9BACI	Iturin A synthetase D	ituD	Bacillus siamensis	216

Display

Entry

Protein Submitted name: **Iturin A synthetase A**

Gene **ituA**

Organism *Bacillus siamensis*

Status Unreviewed - Annotation score: ●○○○○ - Protein predictedⁱ

Functionⁱ

GO - Molecular functionⁱ

- catalytic activity ⁱ Source: InterPro
- phosphopantetheine binding ⁱ Source: InterPro

View the complete GO annotation on QuickGO ...

Names & Taxonomyⁱ

Protein names ⁱ	Submitted name: Iturin A synthetase A ⁱ Imported ^v
Gene names ⁱ	Name: ituA ⁱ Imported ^v
Organism ⁱ	Bacillus siamensis ⁱ Imported ^v
Taxonomic identifier ⁱ	659243 [NCBI]
Taxonomic lineage ⁱ	Bacteria > Firmicutes > Bacilli > Bacillales > Bacillaceae > Bacillus > Bacillus amyloliquefaciens group ⁱ

PTM / Processingⁱ

Amino acid modifications

Feature key	Position(s)	Description	Actions	Graphical view	Length
Modified residue ⁱ	52	O-(pantetheine 4'-phosphoryl)serine ⁱ PROSITE-ProRule annotation ^v			1

View table

Results table

Taxonomy

Keywords

Protein Iturin A

Lampiran 16. Hasil Uji Statistik Bakteri Endofit *Pseudomonas knackmussii*

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Diameter Zona Hambat	9	9,0333	,63855	7,97	9,90

One-Sample Kolmogorov-Smirnov Test

		DiameterZona Hambat
N		9
Normal Parameters ^{a,b}	Mean	9,0333
	Std. Deviation	,63855
Most Extreme Differences	Absolute	,159
	Positive	,132
	Negative	-,159
Kolmogorov-Smirnov Z		,476
Asymp. Sig. (2-tailed)		,977

a. Test distribution is Normal.

b. Calculated from data.

Test of Homogeneity of Variances

Diameter Zona Hambat

Levene Statistic	df1	df2	Sig.
,703	2	6	,532

ANOVA

Diameter Zona Hambat

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2,941	2	1,470	27,473	,001
Within Groups	,321	6	,054		
Total	3,262	8			

Multiple Comparisons

Dependent Variable: Diameter Zona Hambat

LSD

(I) Hari Fermentasi	(J) Hari Fermentasi	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Fermentasi Hari Ke-2	Fermentasi Hari Ke-3	-,57667*	,18890	,022	-1,0389	-,1145
Fermentasi Hari Ke-2	Fermentasi Hari Ke-4	,81667*	,18890	,005	,3545	1,2789
Fermentasi Hari Ke-3	Fermentasi Hari Ke-2	,57667*	,18890	,022	,1145	1,0389
Fermentasi Hari Ke-3	Fermentasi Hari Ke-4	1,39333*	,18890	,000	,9311	1,8555
Fermentasi Hari Ke-4	Fermentasi Hari Ke-2	-,81667*	,18890	,005	-1,2789	-,3545
Fermentasi Hari Ke-4	Fermentasi Hari Ke-3	-1,39333*	,18890	,000	-1,8555	-,9311

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

Diameter Zona Hambat

Duncan^a

Hari Fermentasi	N	Subset for alpha = 0.05		
		1	2	3
Fermentasi Hari Ke-4	3	8,2967		
Fermentasi Hari Ke-2	3		9,1133	
Fermentasi Hari Ke-3	3			9,6900
Sig.		1,000	1,000	1,000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3,000.

Lampiran 17. Hasil Uji Statistik Bakteri Endofit *Bacillus siamensis*

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Diameter Zona Hambat	9	8,3211	,93336	7,07	9,52

One-Sample Kolmogorov-Smirnov Test

		DiameterZH
N		9
Normal Parameters ^{a,b}	Mean	8,3211
	Std. Deviation	,93336
Most Extreme Differences	Absolute	,230
	Positive	,208
	Negative	-,230
Kolmogorov-Smirnov Z		,690
Asymp. Sig. (2-tailed)		,728

a. Test distribution is Normal.

b. Calculated from data.

Test of Homogeneity of Variances

Diameter Zona Hambat

Levene Statistic	df1	df2	Sig.
1,442	2	6	,308

ANOVA

Diameter Zona Hambat

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6,706	2	3,353	76,337	,000
Within Groups	,264	6	,044		
Total	6,969	8			

Multiple Comparisons

Dependent Variable: Diameter Zona Hambat

LSD

(I) Hari Fermentasi	(J) Hari Fermentasi	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Fermentasi Hari Ke-2	Fermentasi Hari Ke-3	-2,05000*	,17112	,000	-2,4687	-1,6313
Fermentasi Hari Ke-2	Fermentasi Hari Ke-4	-1,47333*	,17112	,000	-1,8920	-1,0546
Fermentasi Hari Ke-3	Fermentasi Hari Ke-2	2,05000*	,17112	,000	1,6313	2,4687
Fermentasi Hari Ke-3	Fermentasi Hari Ke-4	,57667*	,17112	,015	,1580	,9954
Fermentasi Hari Ke-4	Fermentasi Hari Ke-2	1,47333*	,17112	,000	1,0546	1,8920
Fermentasi Hari Ke-4	Fermentasi Hari Ke-3	-,57667*	,17112	,015	-,9954	-,1580

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

Diameter Zona Hambat

Duncan^a

Hari Fermentasi	N	Subset for alpha = 0.05		
		1	2	3
Fermentasi Hari Ke-2	3	7,1467		
Fermentasi Hari Ke-4	3		8,6200	
Fermentasi Hari Ke-3	3			9,1967
Sig.		1,000	1,000	1,000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3,000.