APPENDIX A

Media

1. Media composition and Preparation

1.1 De Man, Rogasa, and Sharpe agar (MRS broth and agar)

Composition per liter:

Glucose	20.0	g
Beef extract	10.0	g
Yeast extract	5.0	g
Sodium acetate ($CH_3COONa\ 3H_2O$)	5.0	g
K_2HPO_4	2	g
Ammonium citrate	2	g
$MgSO_4.7H_2O$	0.2	g
$MnSO_4.4H_2O$	0.2	g
Tween 80	1.0	g
Agar	15.0	g
Distilled water	1	L
pH 6.2±0.2 at 25°C		

Preparation of Medium: Add component to distilled/deionized water and adjust volume to 1.0 L. Mix thoroughly and sterile at 121 ^{0}C for 15 min.

1.2 Glucose Yeast Peptone (GYP broth and agar)

Composition per liter:

Glucose	10.0	g
Yeast extract	10.0	g
Peptone	10.0	g
Salt solution (see below)	5.0	ml
Agar	15.0	g
Distilled water	1	L

pH 6.2±0.2 at 25°C

Salt solution:

$MgSO_4 .7 H_2O$	40.0	g
$MnSO_4 .4 H_2O$	2.0	g
$FeSO_4 .7 H_2O$	2.0	g
NaCl	2.0	g
Distilled water	1	L

Preparation of Medium: Add component to distilled/deionized water and adjust volume to 1.0 L. Mix thoroughly and sterile at 121 ^{0}C for 15 min.

APPENDIX B

1. Composition of chemical solution and Preparation

1.1 2% of Sodium alginate solution (w/v)

Composition per 100 millitre:

Sodium alginate	2.0 g
H_2O	100 ml

Preparation: Add sodium alginate to distilled/deionized water and adjust volume to 100 ml. Mix thoroughly and heat to dissolve. Sterile at 121 ^{0}C for 15 min.

1.2 0.5% of κ-carrageenan solution (w/v)

Composition per 100 millitre:

κ-carrageenan	0.5 g
NaCl	0.9 % (w/v)
H_2O	100 ml

Preparation: Add NaCl to distilled/deionized water and adjust volume to 100 ml. Mix thoroughly, Then add NaCl solution to κ-carrageenan and heat to dissolve. Sterile at 121 ^{0}C for 15 min.

1.3 0.1 M of Calcium chloride (w/v)

Composition per 0.5 liter:

Calcium chloride	7.35 g
H_2O	500 ml

Preparation: Add calcium chloride to distilled/deionized water and adjust volume to 0.5 L. Mix thoroughly and sterile at 121 ^{0}C for 15 min.

1.4 0.3 M of Potassium chloride (w/v)

Composition per 0.5 liter:

Potassium chloride	11.10 g
H_2O	500 ml

Preparation: Add potassium chloride to distilled/deionized water and adjust volume to 0.5 L. Mix thoroughly and sterile at 121 ^{0}C for 15 min.

1.5 Glycerol solution

Composition per 0.5 liter:

Glycerol	325 ml
$MgSO_4.7H_2O$	6.02 g
Tris HCl	1.51 g
H_2O	500 ml
pH 8.0 at 25 ^{0}C	

Preparation: Add component to distilled/deionized water and adjust volume to 0.5 L. Mix thoroughly and sterile at 121 ^{0}C for 15 min.

1.6 Simulated Gastric Juices Solution (Rao *et al*., 1989)

Composition per 100 millitre:

HCI solution	0.08 M
NaCl	0.2% (w/v)
pH 1.5 at 25 ^{0}C	

Preparation: Add NaCl to distilled/deionized water, Then add HCI solution to NaCl solution and adjust volume to 100 ml. Mix thoroughly and sterile at 121 ^{0}C for 15 min.

1.7 Bile Salt Solution (Modified by Clark and Martin, 1994)

Composition per 100 millitre:

Ox Bile, Bacteriological	0.15%,0.3% (w/v)
H_2O	100 ml

Preparation: Add bile salt to distilled/deionized water and adjust volume to 100 ml. Mix thoroughly and sterile at 121 ^{0}C for 15 min.

APPENDIX C

Lactobacillus fermentum 2311M

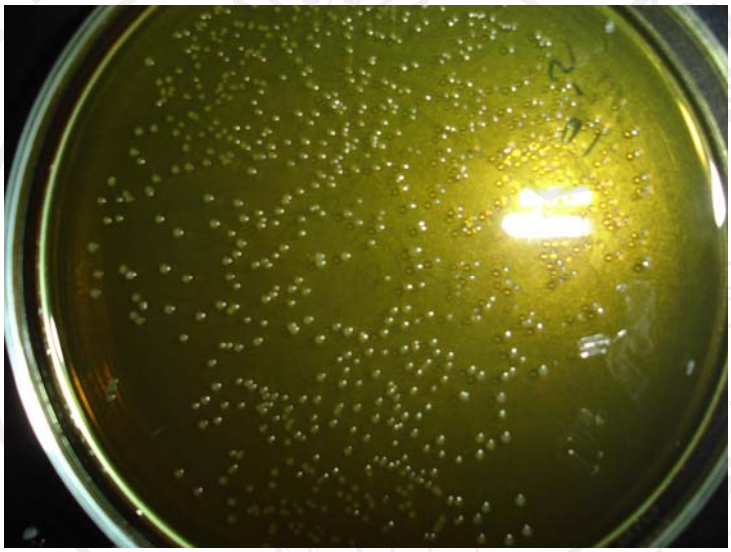

Figure 24 The morphology of *L. fermentum* 2311M on MRS agar + Bromocresol purple (oval shape with yellow zone around colony)

Table 9 Absorbance at 600 nm by *L. fermentum* 2311M after incubated at 37 ^{o}C for 24 h

Viable cell (cfu/ml)	A_{600}
0	0
0.22	0.079
0.55	0.101
0.58	0.125
0.74	0.180
1.56	0.276
1.82	0.305
2.24	0.428
2.56	0.558

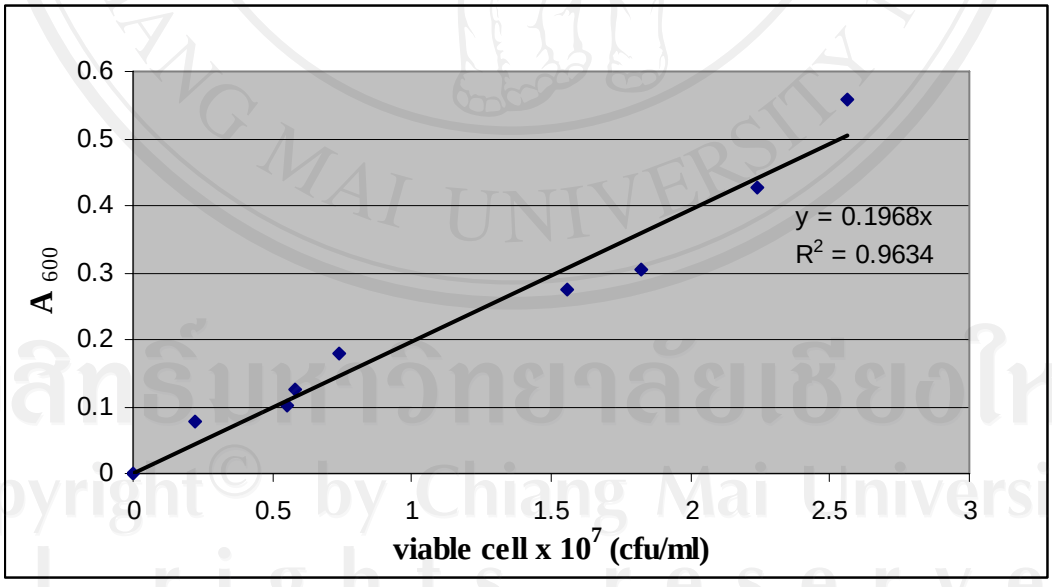

Figure 25 Standard curve of viable cells (*L. fermentum* 2311M) at OD_{600} after incubated at 37 ^{o}C for 24 h

APPENDIX D

Data of statistical analysis

1. Alginate beads

1.1 Encapsulated cells and free cells at pH 6.5 for 3 h. (0, 1, and 3)

ANALYSIS OF VARIANCE TABLE FOR LOG

SOURCE	DF	SS	MS	F	P
TRT (A)	5	0.00159	3.189E-04	0.41	0.8299
REF (B)					
A*B	12	0.00923	7.693E-04		
TOTAL	17	0.01083			

LSD (T) COMPARISON OF MEANS OF LOG BY TRT

TRT	MEAN	HOMOGENEOUS GROUPS
E0	9.4170	I
E1	9.4120	I
E3	9.4107	I
F0	9.4030	I
F1	9.3947	I
F3	9.3910	I

THERE ARE NO SIGNIFICANT PAIRWISE DIFFERENCES AMONG THE MEANS.

CRITICAL T VALUE 2.179 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.0493
STANDARD ERROR FOR COMPARISON 0.0226

ERROR TERM USED: TRT*REF, 12 DF

1.2 Encapsulated cells and free cells at pH 1.5 for 3 h. (0, 1 and 3)

ANALYSIS OF VARIANCE TABLE FOR LOG

SOURCE	DF	SS	MS	F	P
TRT (A)	5	84.9192	16.9838	2848.05	0.0000
REF (B)					
A*B	12	0.07156	0.00596		
TOTAL	17	84.9908			

LSD (T) COMPARISON OF MEANS OF LOG BY TRT

TRT	MEAN	HOMOGENEOUS GROUPS
E0	9.3243	I
F0	9.2007	I
E1	5.5910	.. I
E3	5.2197	 I
F1	4.8110	 I
F3	3.6810	 I

THERE ARE 5 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.179 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.1374
STANDARD ERROR FOR COMPARISON 0.0631

ERROR TERM USED: TRT*REF, 12 DF

1.3 Encapsulated cells and free cells at bile salt 0% for 3 h. (0, 0.5, 1, 1.5, 2, 2.5 and 3)

ANALYSIS OF VARIANCE TABLE FOR LOG

SOURCE	DF	SS	MS	F	P
TRT (A)	13	0.01538	0.00118	0.35	0.9754
REF (B)					
A*B	28	0.09485	0.00339		
TOTAL	41	0.11023			

LSD (T) COMPARISON OF MEANS OF LOG BY TRT

TRT	MEAN	HOMOGENEOUS GROUPS
F0	9.1771	I
E0	9.1748	I
E0.5	9.1633	I
F0.5	9.1605	I
E1.5	9.1469	I
E1	9.1446	I
F1	9.1422	I
F1.5	9.1398	I
E2.5	9.1378	I
E2	9.1368	I
F2	9.1287	I
E3	9.1282	I
F2.5	9.1179	I
F3	9.1100	I

THERE ARE NO SIGNIFICANT PAIRWISE DIFFERENCES AMONG THE MEANS.

CRITICAL T VALUE 2.048 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.0973
STANDARD ERROR FOR COMPARISON 0.0475

ERROR TERM USED: TRT*REF, 28 DF

1.4 Encapsulated cells and free cells at bile salt 0.15% for 3 h. (0, 0.5, 1, 1.5, 2, 2.5 and 3)

ANALYSIS OF VARIANCE TABLE FOR LOG

SOURCE	DF	SS	MS	F	P
TRT (A)	13	98.7540	7.59646	1197.83	0.0000
REF (B)					
A*B	28	0.17757	0.00634		
TOTAL	41	98.9316			

LSD (T) COMPARISON OF MEANS OF LOG BY TRT

TRT	MEAN	HOMOGENEOUS GROUPS
F0	9.1470	I
E0	9.1413	I I
E0.5	9.0137	.. I I
E1	8.9193	.... I I
E1.5	8.8097	..... I I
E2	8.7227	 I
F0.5	8.6813	 I
E2.5	8.3683	 I
E3	8.1647	 I
F1	7.6513	 I
F1.5	6.4637	 I
F2	5.8230	 I
F2.5	5.3743	 I
F3	4.3507	 I

THERE ARE 12 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.048 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.1332
STANDARD ERROR FOR COMPARISON 0.0650

ERROR TERM USED: TRT*REF, 28 DF

1.5 Encapsulated cells and free cells at bile salt 0.3% for 3 h. (0, 0.5, 1, 1.5, 2, 2.5 and 3)

ANALYSIS OF VARIANCE TABLE FOR LOG

SOURCE	DF	SS	MS	F	P
TRT (A)	13	321.399	24.7230	4022.01	0.0000
REF (B)					
A*B	28	0.17211	0.00615		
TOTAL	41	321.571			

LSD (T) COMPARISON OF MEANS OF LOG BY TRT

TRT	MEAN	HOMOGENEOUS GROUPS
E0	9.1233	I
F0	8.7577	.. I
E0.5	8.3000	 I
F0.5	8.2163	 I
E1	6.8983	 I
E1.5	6.4720	 I
E2	6.3517	 I
F1	6.3513	 I
E2.5	5.6093	 I
E3	5.5040	 I
F1.5	5.0013	 I
F2	3.5587	 I
F2.5	0.0000	 I
F3	0.0000	 I

THERE ARE 9 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.048 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.1311
STANDARD ERROR FOR COMPARISON 0.0640

ERROR TERM USED: TRT*REF, 28 DF

2. κ-carrageenan beads

2.1 Encapsulated cells and free cells at pH 6.5 for 3 h. (0, 1, and 3)

ANALYSIS OF VARIANCE TABLE FOR LOG

SOURCE	DF	SS	MS	F	P
TRT (A)	5	0.00263	5.258E-04	0.21	0.9525
REF (B)					
A*B	12	0.03026	0.00252		
TOTAL	17	0.03289			

LSD (T) COMPARISON OF MEANS OF LOG BY TRT

TRT	MEAN	HOMOGENEOUS GROUPS
E0	9.2369	I
F0	9.2229	I
E1	9.2214	I
E3	9.2178	I
F1	9.2107	I
F3	9.1972	I

THERE ARE NO SIGNIFICANT PAIRWISE DIFFERENCES AMONG THE MEANS.

CRITICAL T VALUE 2.179 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.0893
STANDARD ERROR FOR COMPARISON 0.0410

ERROR TERM USED: TRT*REF, 12 DF

2.2 Encapsulated cells and free cells at pH 1.5 for 3 h. (0, 1 and 3)

ANALYSIS OF VARIANCE TABLE FOR LOG

SOURCE	DF	SS	MS	F	P
TRT (A)	5	81.5307	16.3061	4117.94	0.0000
REF (B)					
A*B	12	0.04752	0.00396		
TOTAL	17	81.5782			

LSD (T) COMPARISON OF MEANS OF LOG BY TRT

TRT	MEAN	HOMOGENEOUS GROUPS
E0	9.0797	I
F0	9.0707	I
E1	5.5463	.. I
E3	5.1440	 I
F1	4.7587	 I
F3	3.5497	 I

THERE ARE 5 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.179 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.1119
STANDARD ERROR FOR COMPARISON 0.0514

ERROR TERM USED: TRT*REF, 12 DF

2.3 Encapsulated cells and free cells at bile salt 0% for 3 h. (0, 0.5, 1, 1.5, 2, 2.5 and 3)

ANALYSIS OF VARIANCE TABLE FOR LOG

SOURCE	DF	SS	MS	F	P
TRT (A)	13	0.01477	0.00114	0.31	0.9858
REF (B)					
A*B	28	0.10369	0.00370		
TOTAL	41	0.11846			

LSD (T) COMPARISON OF MEANS OF LOG BY TRT

TRT	MEAN	HOMOGENEOUS GROUPS
E0	9.2493	I
E0.5	9.2300	I
F0	9.2296	I
E1	9.2291	I
F0.5	9.2194	I
E1.5	9.2143	I
F1	9.2086	I
E2.5	9.2073	I
E2	9.2043	I
F1.5	9.1996	I
F2	9.1977	I
E3	9.1975	I
F3	9.1828	I
F2.5	9.1795	I

THERE ARE NO SIGNIFICANT PAIRWISE DIFFERENCES AMONG THE MEANS.

CRITICAL T VALUE 2.048 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.1018
STANDARD ERROR FOR COMPARISON 0.0497

ERROR TERM USED: TRT*REF, 28 DF

2.4 Encapsulated cells and free cells at bile salt 0.15% for 3 h. (0, 0.5, 1, 1.5, 2, 2.5 and 3)

ANALYSIS OF VARIANCE TABLE FOR LOG

SOURCE	DF	SS	MS	F	P
TRT (A)	13	93.0383	7.15679	2130.56	0.0000
REF (B)					
A*B	28	0.09406	0.00336		
TOTAL	41	93.1323			

LSD (T) COMPARISON OF MEANS OF LOG BY TRT

TRT	MEAN	HOMOGENEOUS GROUPS
E0	9.1493	I
F0	8.9857	.. I
E0.5	8.6180	 I
F0.5	8.5370	 I
E1	8.0783	 I
F1	7.5327	 I
E1.5	7.3720	 I
E2	6.9737	 I
E2.5	6.5667	 I
E3	6.1927	 I
F1.5	6.1787	 I
F2	5.7377	 I
F2.5	5.0513	 I
F3	3.9923	 I

THERE ARE 12 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.048 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.0969
STANDARD ERROR FOR COMPARISON 0.0473

ERROR TERM USED: TRT*REF, 28 DF

2.5 Encapsulated cells and free cells at bile salt 0.3% for 3 h. (0, 0.5, 1, 1.5, 2, 2.5 and 3)

ANALYSIS OF VARIANCE TABLE FOR LOG

SOURCE	DF	SS	MS	F	P
TRT (A)	13	318.432	24.4947	7594.26	0.0000
REF (B)					
A*B	28	0.09031	0.00323		
TOTAL	41	318.522			

LSD (T) COMPARISON OF MEANS OF LOG BY TRT

TRT	MEAN	HOMOGENEOUS GROUPS
E0	8.8437	I
F0	8.6683	.. I
E0.5	8.5123	 I
F0.5	8.0557	 I
E1	6.9110	 I
F1	6.2363	 I
E1.5	6.1387	 I
E2	5.0353	 I
E2.5	4.8920	 I
F1.5	4.8920	 I
E3	4.4583	 I
F2	3.5283	 I
F2.5	0.0000	 I
F3	0.0000	 I

THERE ARE 12 GROUPS IN WHICH THE MEANS ARE
NOT SIGNIFICANTLY DIFFERENT FROM ONE ANOTHER.

CRITICAL T VALUE 2.048 REJECTION LEVEL 0.050
CRITICAL VALUE FOR COMPARISON 0.0950
STANDARD ERROR FOR COMPARISON 0.0464

ERROR TERM USED: TRT*REF, 28 DF

APPENDIX E

1. Alginate beads

1.1 Initial cells for encapsulation = 2.00×10^{10} cfu/ml

1.2 NaCl + Cells = 2.23×10^{10} cfu/ml

1.3 Alginate+ Cells = 2.32×10^{10} cfu/ml

1.4 Cells of alginate beads/ 1 g of alginate bead

= 2.60×10^{8} cfu/1 ml of phosphate buffer

∗Phosphate buffer 9 ml: bead 1 g

∗ Bead 0.120 g, phosphate buffer = 1.080 ml ⟶ $(2.60 \times 10^{8} \times 1.080)$

= 2.80×10^{8} cfu/1.080 ml of phosphate buffer

∗ Phosphate buffer 1.080 ml = Bead 0.120 g

= 2.80×10^{8} cfu/0.120 g

∗ Total of alginate bead from process = 5.130 g

$$= \frac{2.80 \times 10^{8} \times 5.130}{0.120} \text{ cfu/5.130 g}$$

$$\frac{\textbf{Cells of alginate beads}}{\textbf{Total of beads in process}} = 1.19 \times 10^{10} \text{ cfu/5.130 g}$$

$$\frac{\textbf{Cells of alginate beads}}{\textbf{1 g of alginate bead}} = 2.31 \times 10^{9} \text{ cfu/ g}$$

1.5 Cells leak in $CaCl_2$ solution = 1.81×10^7 cfu/1 ml of $CaCl_2$

∗ Total of $CaCl_2$ solution = 50 ml ⟶ $(1.81 \times 10^7 \times 50)$

= 9.05×10^8 cfu/50 ml of $CaCl_2$

∗ Total of initial cells in process = 2 ml

= 9.05×10^8 cfu/50 ml of $CaCl_2$

= 9.05×10^8 cfu/2 ml of cells

↕

Cells leak in $CaCl_2$ solution = 4.52×10^8 cfu/1 ml of cell

∗ Weight of alginate beads leak in container = 1.250 g

∗ Bead 1.00 g ⟶ 2.31×10^9 cfu

Bead 1.250 g ⟶ $\frac{2.31 \times 10^9 \times 1.250}{1}$ = 2.89×10^9 cfu

$$\frac{\text{∗ Cells of alginate beads leak in container}}{\text{Total of beads leak in container}} = 2.89 \times 10^9 \text{ cfu/1.250 g}$$

$$\frac{\text{∗ Cells of alginate beads in process}}{\text{Total of beads in process}} + \frac{\text{Cells of alginate beads leak in container}}{\text{Total of bead leak in container}}$$

= 1.19×10^{10} cfu/5.130 g + 2.89×10^9 cfu/ 1.250 g

= 1.48×10^{10} cfu/6.380 g

$$\frac{\textbf{Total of cells of alginate bead}}{\textbf{Total of alginate bead}} = 1.48 \times 10^{10} \text{ cfu/6.380 g}$$

∗ Total of initial cells in process = 2 ml

= 1.48×10^{10} cfu/6.380 g

↕

= 1.48×10^{10} cfu/2 ml of cells

∗ 1.48×10^{10} cfu ⟶ cell 2 ml

1.6 Cells of alginate beads leak in container

$* 1.48 \times 10^{10}$ cfu ⟶ cell 2 ml

2.89×10^{9} cfu ⟶ $\frac{2 \times 2.89 \times 10^{9}}{1.48 \times 10^{10}} = 0.39$ ml

$*$ 0.39 ml ⟶ 2.89×10^{9} cfu

1 ml ⟶ $\frac{2.89 \times 10^{9} \times 1}{0.39} = 7.18 \times 10^{9}$ cfu

Cells of alginate beads leak in container = 7.18×10^{9} cfu/1 ml of cell

1.7 Cells of alginate beads in process

$* 1.48 \times 10^{10}$ cfu ⟶ cell 2 ml

1.19×10^{10} cfu ⟶ $\frac{2 \times 1.19 \times 10^{10}}{1.48 \times 10^{10}} = 1.61$ ml

$*$ 1.61 ml ⟶ 1.19×10^{10} cfu

1 ml ⟶ $\frac{1.19 \times 10^{10} \times 1}{1.61} = 7.39 \times 10^{9}$ cfu

Cells of alginate beads in process = 7.39×10^{9} cfu/ 1 ml of cell

1.8 Initial cells for encapsulation = Cells in Alginate beads + Cells in alginate beads leak in container + Cells leak in $CaCl_2$ solution

2.00×10^{10} cfu/ ml = $7.39 \times 10^{9} + 7.18 \times 10^{9} + 4.52 \times 10^{8}$ cfu/ ml

2.00×10^{10} cfu/ ml = 1.50×10^{10} cfu/

2. κ-carrageenan beads

2.1 Initial cells for encapsulation = 2.00×10^{10} cfu/ml

2.2 NaCl + Cells = 2.14×10^{10} cfu/ml

2.3 κ-carrageenan + Cells = 2.08×10^{10} cfu/ml

2.4 Cells of κ-carrageenan beads/ 1 g of κ-carrageenan bead

= 2.02×10^{8} cfu/1 ml of 0.9% NaCl

∗ 0.9% NaCl 9 ml: bead 1 g

∗ Bead 0.1624 g, 0.9% NaCl = 1.460 ml ⟶ $(2.02 \times 10^{8} \times 1.460)$

= 2.94×10^{8} cfu/1.460 ml of 0.9% NaCl

∗ 0.9% NaCl 1.460 ml = Bead 0.1624 g

= 2.94×10^{8} cfu/0.1624 g

∗ Total of κ-carrageenan bead from process = 6.050 g

$$= \frac{2.94 \times 10^{8} \times 6.050}{0.1624} \text{ cfu/6.050 g}$$

Cells of κ-carrageenan beads = 1.09×10^{10} cfu/6.050 g

Total of beads in process

Cells of κ-carrageenan beads = 1.80×10^{9} cfu/ g

1 g of κ-carrageenan bead

2.5 Cells leak in KCl solution = 1.38×10^7 cfu/1 ml of KCl

∗ Total of KCl solution = 50 ml ⟶ $(1.38 \times 10^7 \times 50)$

= 6.90×10^8 cfu/50 ml of KCl

∗ Total of initial cells in process = 2 ml

= 6.90×10^8 cfu/50 ml of KCl

↕

= 6.90×10^8 cfu/2 ml of cells

Cells leak in KCl solution = 3.45×10^8 cfu/1 ml of cell

∗ Weight of κ-carrageenan beads leak in container = 0.500 g

∗ Bead 1.00 g ⟶ 1.80×10^9 cfu

Bead 0.500 g ⟶ $\frac{1.80 \times 10^9 \times 0.500}{1} = 9.00 \times 10^8$ cfu

$$\frac{\text{∗ Cells of κ-carrageenan beads leak in container}}{\text{Total of beads leak in container}} = 9.00 \times 10^8 \text{ cfu/0.500 g}$$

$$\frac{\text{∗ Cells of κ-carrageenan beads in process}}{\text{Total of beads in process}} + \frac{\text{Cells of κ-carrageenan beads leak in container}}{\text{Total of bead leak in container}}$$

= 1.09×10^{10} cfu/6.050 g + 9.00×10^8 cfu/0.500 g

= 1.18×10^{10} cfu/6.550 g

$$\frac{\textbf{Total of cells of κ-carrageenan bead}}{\textbf{Total of κ-carrageenan bead}} = 1.18 \times 10^{10} \text{ cfu/6.550 g}$$

∗ Total of initial cells in process = 2 ml

= 1.18×10^{10} cfu/6.550 g

= 1.18×10^{10} cfu/2 ml of cells

∗ 1.18×10^{10} cfu ⟶ cell 2 ml

2.6 Cells of κ-carrageenan beads leak in container

∗ 1.18×10^{10} cfu ⟶ cell 2 ml

9.00×10^{8} cfu ⟶ $\frac{2 \times 9.00 \times 10^{8}}{1.18 \times 10^{10}} = 0.15$ ml

∗ 0.15 ml ⟶ 9.00×10^{8} cfu

1 ml ⟶ $\frac{9.0 \times 10^{8} \times 1}{0.15} = 6.00 \times 10^{9}$ cfu

Cells of κ-carrageenan beads leak in container = 6.00×10^{9} cfu/1 ml of cell

2.7 Cells of κ-carrageenan beads in process

∗ 1.18×10^{10} cfu ⟶ cell 2 ml

1.09×10^{10} cfu ⟶ $\frac{2 \times 1.09 \times 10^{10}}{1.18 \times 10^{10}} = 1.85$ ml

∗ 1.85 ml ⟶ 1.09×10^{10} cfu

1 ml ⟶ $\frac{1.09 \times 10^{10} \times 1}{1.85} = 5.89 \times 10^{9}$ cfu

Cells of κ-carrageenan beads in process = 5.89×10^{9} cfu/ 1 ml of cell

2.8 Initial cells for encapsulation = Cells of κ-carrageenan beads + Cells of κ-carrageenan beads leak in container + Cells leak in KCl solution

2.00×10^{10} cfu/ ml = 5.89×10^{9} + 6.00×10^{9} + 3.45×10^{8} cfu/ ml

2.00×10^{10} cfu/ ml = 1.22×10^{10} cfu/ml