



**Development and Industrialization of Sweet Pickle
Using Domestic Cucumber**

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.

1998. 10. 25.

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:

40 가 , 60 가 가 . /

. Isopropyl alcohol

60 60 >40 >75 > , 40,
60 가 .

. 가

1: 1. 2, 20% 720 1, 000

0. 25%, 0. 33% 가

40

가 60 가 .

가 가 가 pH가 가 60

가 가 120 가 .

가 가 120 .

가 가 가 가

. 40 > > > 가

. 가 40

가 > 가 > 가 > 가

120 가 .

. 가 가 20%가

150 가

, pH 가 5. 34, 가 6. 14 .

, , 가 21. 32, 0. 87, 4. 54

. Isopropyl alcohol 525, 536, 665nm

pH 15%
 0.1% 가
 20% 가
 가 , 가
 가
 가 가
 가 가
 가
 60 ,
 25% 30%
 2
 1 30 2

2.
 , 2 7, 67%, 24. 49%,
 16. 53%, 42. 94%, 5%, 1%, 0. 02%, 0. 03%,
 0. 2%, 0. 3%, C 0. 7%, 0. 7%, 0. 3%,
 0. 02% , , 0. 1% 가
 1. 3 가 70 15
 , , ,
 , 가 1/3 1 가,
 . 3 1/3 가, ,

3.

가.

			7.0%	25.0%	17.0%	38.87%
	5%	2.0%	0.04%	0.05%	0.4%	
0.3%	C 0.7%	1.4%	0.6%	0.04%	0.1%	
1.0%	,	,	0.5%	가		
	,	.	가			
		70	15			.

				8%		
		,	5	8	9, 8%	가
가	,	.			1 1	30

	9.74%	18.97%	16.97%	30.75%	16%	5%
2%	0.1%		0.05%	0.02%	,	,
		,		.		

4.

,

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SUMMARY

. Title

Development and Industrialization of Sweet Pickle Using Domestic Cucumber

. Objective and Significance

Objectives of this study were 1) to stabilize prices of domestic succumbers and 2) to increase the incomes of cucumber producers by developing new types of cucumber products being processed from domestic cucumbers for the purpose of substituting imported pickle product which are growing rapidly in domestic consumption.

. Scope

1. Evaluating effects of various salting and de-salting conditions on properties of cucumber
 - Establishing the best condition for salt-preservation and investigating changes in physicochemical properties of cucumber during preservation
 - Investigating changes in properties of cucumber by de-salting for pickle process
2. Development of sweet pickle
 - Selecting the best formula of the seasoning for pickle process
 - Selecting natural colorants
 - Seasoning of whole cucumber

3. Developing new types of pickled cucumber products

- Spread product
- Pickled product in soy sauce

4. Investigating main facilities and processes for the establishment of the factory

- Process for the sweet pickle product
- Process for the spread product
- Process for the pickled product in soy sauce
- Main facilities in each process

. Major results and Recommendation

1. Establishing the best salting and de-salting conditions for cucumber and investigating changes in properties occurred through these processes

A. Effects of various salt concentrations on the properties of salt preserved cucumber

Changes in the properties of salt preserved cucumber were investigated by mixing cucumber and water with 1:1.2 ratio and by adding salt to each group until salt concentrations reached to 15 30%. As salt concentrations were increased, cucumber was getting constricted and smaller in diameter. Concentrations of salt in cucumber reached to demanded levels after 30 days of salt-preservation. When salt was added to have final concentrations of 25%, pH was gradually decreased until 120 days of preservation while little changes in pHs was observed after 60 days of preservation in the case of 30% salt added group. As preservation was prolonged, the redness on the surface of cucumber peels became intense. The yellowness on the surface of cucumber peels was the

most intense in the group which was preserved by 15% salt. Among the groups preserved by more than 20% of salt, no difference was observed in intensity of yellowness after 30 days of preservation. Regardless of salt concentrations, the hardness of cucumber was increased as preservation was prolonged except the group preserved by 15% salt. The absorbances of isopropyl alcohol extracts at 410, 505, 607, and 665nm were different from those of raw cucumbers. Contents of 0.05N HCl- and water-soluble pectins were decreased while those of sodiumhexameta phosphate- and 0.05N NaOH- soluble pectins were increased regardless of salt concentrations. Although contents of water-soluble pectins were increased, 0.05N NaOH-soluble pectins were decreased in the groups preserved by 15 and 20% salt until 60 days of storage. In the groups preserved by more than 25% salt, concentration of 0.05N NaOH- and sodium hexameta phosphate-soluble pectins were continuously increased during preservation.

B. Effects of various temperatures during heat treatments on the properties of salt-preserved cucumber

To investigate the effects of heat treatment on the properties of salt-preserved cucumber, cucumbers were heated in the warm water to 40, 60, and 75 for 15 min. Thereafter, cucumbers were cooled and the ratios of cucumbers : water was adjusted to 1:1.2(w/w) and salt was added to have final salt concentration of 12%. The group which was heated to 60 showed the highest scores on hardness followed by 40, no-heat, and 75 treated groups after 60 days of salt-preservation. The yellowness on the surface of cucumber peels was getting intense as temperature was increased during heat treatment, which resulted in the most intense yellowness in no-heat and 40 treated groups. The intensities of greenness and redness of the groups also differed according to different temperature applied during heat treatments. Regardless of heat treatment, no difference in the absorbance of isopropyl alcohol extracts were found. Activities of pectinesterase were the highest in 60

treated group followed by 40 , 75 , and no-heat treated group until 60 days of preservation, while activities of polygalacturonase in 40 and 60 treated groups were lower.

C. Effects of calcium addition on the properties of salt-preserved cucumber

To investigate the effects of calcium addition on the physiochemical properties of salt-preserved cucumber, the ratio of cucumber : water was adjusted to 1:1.2(w/w) to have final salt concentration of 20%. Powders of egg shells and oyster shells which were ashed at 720 and 1,000 , respectively, were added to 0.25 and 0.33% of cucumber wt., respectively. Although the degree of shrinkage was less in calcium added groups until 40 days of preservation, no distinct effect was observed among groups treated by different calcium sources after 60 days of preservation. The pHs of calcium added groups were increased as preservation was prolonged, which resulted in the highest pH in the ashed oyster shell added group after 60 days of salt preservation. The soaking fluid in calcium hydroxides added group showed lower turbidity than those in ashed powder added groups until 120 days of preservation. The redness on the surface of control cucumber which was preserved only with NaCl solution was the most intense while the group added by ashed egg shell showed the least intense redness. Lactic acid bacteria in the fluid of control cucumber grew the most rapidly followed by oyster, egg, and calcium hydroxides added cucumbers during 40 days of preservation. No matter cucumbers were added by calcium or not, contents of sodium hexametaphosphate-soluble pectin was the highest in the cucumbers followed by 0.05N NaOH-, 0.05N HCl-, and water-soluble pectins after 120 days of preservation.

D. Properties of immature and mature cucumbers during salt-preservation

Immature cucumbers which were similar in the size with cucumbers for pickle

process were preserved with final salt concentrations of 20% for 150 days. Salt concentrations in immature cucumbers were slightly higher than those in mature cucumbers. The pHs of mature and immature cucumbers after preservation were 5.34 and 6.14, respectively. The whiteness, redness, and yellowness on the surface of mature cucumber peels were 21.32, 0.87, and 4.54, respectively, which were lower than those of immature cucumbers. Differences in absorbance of isopropyl alcohol extracts at 525, 536, and 665nm were found between mature and immature cucumbers.

E. Properties of cucumbers preserved in low salt concentrations

No significant difference was observed in the final pHs among various kinds of cucumbers which were preserved with final salt concentrations of 15% as well as sorbic acid to 0.1% of cucumber wt.. When cucumbers were preserved with final salt concentrations of 20%, solely, difference was found in the final pHs among different kinds of cucumbers. The transmittance of cucumber soaking fluid in sorbic acid added groups was higher. The soaking fluid in white cucumber showed higher transmittance than that in blue cucumbers. When salt was added to 20% solely, each group showed different pH values. The intensities of whiteness and yellowness on the surface of cucumber peel were lower in the blue cucumber than white cucumber, and addition of sorbic acids seemed to have no effect on the intensities of whiteness and yellowness of cucumbers. According to sensory evaluation, the texture of white cucumber was slightly harder than that of blue one.

F. Properties of salt-preserved cucumbers during de-salting process

When cucumbers preserved by various salt concentrations were desalted by soaking either in cold or warm water(60 °C), the cucumbers which were preserved by less than final concentrations of 25% still maintained their original shapes after de-salting. When cucumbers were sliced before de-salting, salty

taste was almost removed by de-salting for 2hrs. Since texture of cucumber was getting softer as soaking time was increased, de-salting for 1hr 30min. 2hrs was considered acceptable.

G. Development of the sweet pickle product

After salt-preserved cucumbers were sliced and desalted for 2hrs, they were mixed with the seasoning which was formulated as followings : water(7.67%), vinegar(24.49%), corn syrup(16.53%), high fructose corn syrup(42.94%), sorbitol (5%), salt(1%), MSG(0.02%), sodium fumarate(0.03%), fumaric acid(0.2%), polyphosphate salt(0.3%), vitamin C(0.7%), citric acid(0.7%), malic acid(0.3%), and natural colorant(0.02%). After all ingredients were mixed and dissolved, pickle flavors were added to 0.1% concentrations. The seasoning was mixed with sliced cucumber to 1.3:1(w/w) ratio followed by packing and sterilization at 70 for 15 min..

3. Developing new types of pickled cucumber products

A. Spread product

After salt-preserved cucumbers were sliced and desalted, they were mixed with the seasoning which was formulated as followings : water(7.0%), vinegar(25.0%), corn syrup(17.0%), high fructose corn syrup(38.87%), sorbitol (5%), salt(2.0%), MSG(0.04%), sodium fumarate(0.05%), fumaric acid(0.4%), polyphosphate salt(0.3%), vitamin C(0.7%), citric acid(1.4%), malic acid(0.6%), natural colorant(0.04%), alum(0.1%), and xantan gum(1.0%). After all the ingredients were mixed and dissolved, spices were added to 0.5% concentrations. The sliced cucumbers and the seasoning were mixed and broken into small pieces by the chopper. And then, the product was packed and sterilized at 70 for 15 min..

B. Pickled product in soy sauce

To process pickled products in soy sauce, cucumbers were salt-preserved by adding salt to 8% of cucumber wt. repeatedly and then pressed by a stone. After 5 and 8 days of salt-preservation, 9 and 8% of salt, respectively, were added. Salt-preserved cucumber was sliced, desalted for 1 hr 30min. and dehydrated by a washer-dryer. The seasoning which was prepared by water(9.74%), vinegar(18.97%), soy sauce(16.97%), corn syrup(30.75%), high fructose corn syrup(16.0%), sorbitol (5.0%), salt(2.0%), MSG(0.1%), sodium fumarate(0.05%), and saccharate(0.02%) were mixed and, finally, pickled product in soy sauce was produced by soaking desalted cucumber in the seasoning.

4. Investigating main facilities and processes for the establishment of the factory

The main processes, facilities in each process, and other details for the industry-scale production of sweet pickles, spread products, and pickled products in soy sauce were investigated.

CONTENTS

Summary	-----
Introduction	-----
Materials and methods	-----
1. Materials	-----
2. Experimental methods	-----
1) Evaluating effects of various salting and de-salting conditions on the properties of cucumber	-----
(1) Establishing the best condition for salt-preservation of cucumbers	-----
① Salt-preservation of the cucumber by adding various salt concentrations	-----
⑤ Salt-preservation of the cucumber by various heatng temperatures	-----
③ Salt-preservation of the cucumber by addition of calcium	-----
⑦ Salt-preservation of the immature and mature cucumbers	-----
② Properties of cucumbers preserved in low salt concentrations	----
(2) De-salting conditions of salt-preserved cucumber	-----
(3) The physicochemical properties of cucumber	-----
① pH	-----
⑤ Salt concentrations	-----
③ Color	-----
⑦ Turbidity	-----
② Soluble pectins	-----
A. The process of alcohol-insoluble solids	-----
B. Fractionation and quantitation of soluble pectins	-----
⑥ Hardness	-----

- ① The activity of pectinesterase -----
- ⑧ The absorbance of isopropyl alcohol extracts -----
- ③ Lactic acid bacteria -----
- 2) Development of sweet pickles -----
- 3) Development of new types of pickled cucumber product -----
 - (1) Spread product -----
 - (2) Pickled product in soy sauce -----
- 4) Investigating main facilities and processes for the establishment of the factory-----

Results and discussion -----

1. Evaluating effects of various salting and de-salting conditions on the properties of cucumber -----
 - 1) Properties of salt-preserved cucumber added by various salt concentrations -----
 - (1) Changes in diameters of cucumber -----
 - (2) Salt concentrations -----
 - (3) pH -----
 - (4) Turbidity of the soaking fluid -----
 - (5) Color -----
 - (6) Lactic acid bacteria -----
 - (7) Hardness -----
 - (8) The absorbance of isopropyl alcohol extracts -----
 - (9) Soluble pectins -----
 - 2) Properties of salt-preserved cucumber treated by various heat temperatures -----
 - (1) Salt concentrations -----
 - (2) Hardness -----
 - (3) Color -----

- (4) The absorbance of isopropyl alcohol extracts -----
- (5) Pectinesterase -----
- 3) The effects of calcium addition on the properties of
salt-preserved cucumber -----
- (1) Diameters of cucumbers -----
- (2) pH and salt concentrations -----
- (3) The turbidity of the soaking fluid -----
- (4) Color -----
- (5) Lactic acid bacteria -----
- (6) Soluble pectins -----
- 4) The properties of immature and mature cucumbers
during salt-preservation -----
- 5) The properties of cucumber during low salt-preservation -----
- 6) The properties of salt-preserved cucumber by de-salting -----
- 2. Development of sweet pickles -----
- 1) Selecting the best compositions for the seasoning -----
- 2) selecting natural colorants -----
- 3) The seasoning of whole cucumbers -----
- 3. Development of new types of salt-preserved cucumber products ----
- 1) Spread product -----
- 2) Pickled product in soy sauce -----
- 4. Investigating main facilities and processes for the establishment of
the factory -----
- 1) The process for sweet pickle product -----
- 2) The process for spread product -----
- 3) The process for pickled product in soy sauce -----
- 4) Main facilities for each process -----

References -----

SUMMARY -----

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3) 가 -----

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5) -----

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1) pH -----

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- 6) -----
- 7) -----
- 8) Isopropyl alcohol -----
- 9) -----
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- 4. -----

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- . pH -----
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- . Isopropyl alcohol -----
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- . Isopropyl alcohol -----
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- 3. 가 -----

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- . pH -----
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- 4. -----
- 5. -----
- 6. -----
- 2 -----
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- 2. -----
- 3. -----
- 3 -----
- 1. -----
- 2. -----
- 4 -----
- 1. -----
- 2. -----
- 3. -----
- 4. -----

1

(Cucumber, *Cucumis salivus* L.) 3,000

1).

가

23.

가

(, ,)

가 , ,

가

가 , .

가

가 36%, 가 64% , 가

23%, 가 77% 가

가 1,800/kg, 600/kg

가

가 가 가

가 가 11 , 가 47

58 , 2,605

가 1993 58.7%, 1994 48.8%

가 가 , ,

가 , ,

가

가 가

가

가

,

,

.

4 23가

,

24 30가

35

가 가

가

가

.

2

1

100 120g 140 160g () 가
6
.

2

1. ,

가.

1)

, 1:1.2
15, 20, 25, 30%가
2 2 가
, , , , pH 가 .

2)

40, 60, 75 15
1.2 가 12%
2 2 가 .
, pH , , 가 .

3)

가

1%

105
 125
 720 , 1,000 24
 가 Ca(OH)₂가
 0.3%(Ca 0.16%) 39 1.2
 0.25% 0.33% 가
 2 2 가 25%
 , pH , 가
 0.3% 가

4)
 가
 (1.5 2.0cm 15.5 17cm) (, 2.5
 2.8cm 23 24.5cm) 10kg 1.2 가
 가 20%가 가 150 ,

5)
 a) 10kg 25mM , 20mM CaCl₂
 12% 가 3
Lactobacillus plantarum(0.08%)+sodium acetate trihydrate(
 0.01%) 가, b) 10kg 25mM , 20mM CaCl₂ 12%
 가, c) 10kg (0.1%)
 12% 가 , .

1) pH

5,000rpm 5 4 homogenizer
pH meter

2)

pH M/hr 3) 1ml
100 10ml , 1N 1ml
가 0.1N

$$(\%) = T \times 0.00585 \times F \times 100/10 \times 100/1$$

T : 0.1N (ml)

F : 0.1N

3)

(Color QUESTIII, Hunter Lab, U.S.A.)

L(lightness), a(redness/greenness), b(yellowness/blueness), E= λ L2+
a2+ b2 L=92.68, a=0.81, b=0.86 가

4)

4
(DU-7 UV/VIS Spectrophotometer) 660nm

5) 가

가)

ethanol , 가 80%가
 10 ethanol 가 85 1
 . 80% ethanol 가 60 1
 4 5
 ethanol acetone 40
 40mesh .

) 가

0.2g 100ml 가 30 2 ,
 100ml ,
 가 (water soluble pectin) . 가
 0.4% sodi um hexametaphosphate 100ml 가 30
 , 2 가 (sodi um hexametaphosphate
 soluble pectin) . 가 0.05N-HCl
 100ml 가 , 85 2 2 가
 (Hcl soluble pectin) . 가 0.05N-NaOH
 100ml 가 30 2 2 가 (NaOH
 soluble pectin) 39. 가 carbazole-sulfuric acid 39
 , 1ml 0.5ml carbazole(0.1%
 carbazole + 95% ethanol) 가 6ml 가 85
 5 가 15 525nm
 . galacturonic acid monohydrate 20 100µg/ml
 가 1ml carbazole-sulfuric acid

6)

Texture Analyser(Model TA-XT2,

England) (compression test) 가 (Middle)
(hardness) .

7)

0.15M NaCl
30 pH 0.1N NaOH 6.0
24 . 5,000rpm 15
가 75% . 6
13,000rpm 1 0.15M NaCl .
5,000rpm 15

(PE) 가 Kertesz 4).
0.15M NaCl 0.45% pectin 50ml pH 7.0 2ml
가 30 5 0.01N-NaOH 1
1x10⁻⁵ml 1unit .

(PG) 가 polygalacturonic acid
Somogyi-Nelson 4) . 0.45%
polygalacturonic acid (0.1M NaCl 0.03M citrate-phosphate , pH
5.5) 4.8ml 0.2ml 30 2
100 3 . 1ml DNS 3ml 가
100 10 21ml
550nm . α-D-galacturonic acid

8) Isopropyl alcohol

20g isopropyl alcohol 20ml homogeniser(Ace, Co., Japan)
5,000rpm 1 (Toyo, No. 2)
가 (400-700nm) scanning ,
410, 439, 473, 505, 538, 607, 632, 665nm

9)

1ml	0.85% saline	1ml
glacial acetic acid	pH 5.8	(MRS agar)
pouring culture method		37 48 72
	Quebec colony counter	

2.

가 pH,

3.

가.

가

가

가

가

8%

5

9%

가

8 8% 가 ,

4.

3

1 ,

1.

가.

1:1.2 가 15, 20, 25,
30%가 가 120

1

. 10 15% 가 84.2%
가 30% 62.1%
. 30 가
90 15% 76.59% 30% 55.52%

1.

(cm)

(%)	()					
	0	10	30	60	90	120
15	2.99 (100)	2.52 (84.3)	2.43 (81.3)	2.30 (76.9)	2.29 (76.6)	-
20	3.10 (100)	2.08 (67.1)	1.97 (63.6)	1.95 (62.9)	1.94 (62.6)	1.92 (61.9)
25	3.08 (100)	2.00 (64.9)	1.89 (61.4)	1.84 (59.7)	1.83 (59.4)	1.81 (58.8)
30	3.08 (100)	1.91 (62.1)	1.76 (57.1)	1.72 (55.8)	1.71 (55.5)	1.71 (55.5)

() :

(2), 30

30% 가 120 30%
 가
 . 15% 가 90
 가 가
 . 120 가 8
 27

2.

27 (%)	30 (%)				
	10	30	60	90	120
15	14.76	15.05	16.21	16.48	-
20	19.75	20.83	21.99	21.27	21.96
25	23.16	25.47	25.78	24.50	25.03
30	24.06	28.10	28.57	28.16	28.25

pH
 3 pH 30
 30% 15% 60
 pH가 90 8.32 15%
 90 가
 가 . 20% 15%
 90 pH가 . 25% 120

, pH 가 30%
가 .

3. pH

(%)	()				
	10	30	60	90	120
15	5.94	5.43	6.93	8.32	-
20	5.82	5.47	5.62	5.78	6.61
25	5.90	5.27	4.58	4.52	4.99
30	5.80	5.82	5.42	5.47	5.61

.
4 가
15%

10 1.297 가 30%
0.293 .

가 가 .

.
(5)
10 4가 (-1.33 -2.87)

가

, 가 .

,

4.

(0. D)

(%)	()				
	10	30	60	90	120
15	5.94	5.43	6.93	8.32	-
20	5.82	5.47	5.62	5.78	6.61
25	5.90	5.27	4.58	4.52	4.99
30	5.80	5.82	5.42	5.47	5.61

5.

/

(%)	()				
	10	30	60	90	120
15	-1.33	1.61	2.25	2.81	-
20	-1.99	0.42	1.55	1.96	1.90
25	-1.29	0.66	0.91	1.19	1.84
30	-2.87	-1.97	-0.06	0.97	1.33

6

가 15% 가 가

가

(6.15 12.52)

20% 가 30 가

6.

(%)	()				
	10	30	60	90	120
15	6.15	6.73	8.96	12.52	-
20	6.34	6.65	6.74	6.89	7.74
25	5.74	5.99	6.96	7.18	7.33
30	3.09	5.96	6.21	6.26	6.72

10

15% 가 가 가 40 20, 25% 가 가
30% 가

1 7

texture analyzer

texture profile

10

15% 가 가 14.05kg/s 가

30

가

15%

가

가

1.

7.

(kg. s)					
(%)	()				
	10	30	60	90	120
15	14.05	17.68	10.49	1.54	-
20	8.39	11.68	11.01	13.04	12.17
25	8.35	9.69	10.73	11.09	15.32
30	8.37	8.82	13.30	9.18	11.53

. Isopropyl alcohol

isopropyl alcohol ,
가 2
8 . 439, 473, 632nm
가
410, 505, 538, 607, 665nm
439, 473nm 15, 20% 가
30 가 25% 가
607nm 632nm 60
가 가 .

2. isopropyl alcohol

8.

isopropyl alcohol

(0. D)

()	(%)	Wavel ength(mm)							
		410	439	473	505	538	607	632	665
0		-	3.44	2.73	-	-	-	1.42	-
	15	4.25	2.98	1.98	0.60	0.51	0.60	-	2.24
10	20	2.75	2.00	1.42	0.35	0.26	0.37	-	1.35
	25	4.27	3.95	3.10	0.75	0.38	0.64	-	2.55
	30	4.26	3.93	3.21	0.75	0.31	0.67	-	2.55
	15	4.34	3.94	1.85	0.80	0.90	0.44	-	2.85
30	20	4.33	4.07	2.70	0.85	0.90	0.52	-	3.00
	25	4.33	3.94	4.20	0.95	0.74	0.63	-	3.20
	30	4.33	3.94	4.25	0.90	1.13	0.78	-	3.00
	15	4.32	3.50	3.96	0.67	0.67	0.64	-	2.37
60	20	4.32	3.93	3.70	0.68	0.62	0.54	-	2.19
	25	3.55	2.29	2.30	0.43	0.40	0.35	-	1.24
	30	4.31	3.21	3.88	0.38	0.53	0.49	-	1.85
	15	4.31	3.91	1.41	0.65	0.58	0.53	-	2.11
90	20	4.31	3.61	0.92	0.63	0.61	0.53	-	2.10
	25	4.31	3.91	1.67	1.00	0.90	0.74	-	2.81
	30	4.31	3.91	2.45	1.14	1.03	0.86	-	2.98
	15	-	-	-	-	-	-	-	-
120	20	4.23	3.01	1.58	0.83	0.60	0.56	-	2.45
	25	4.23	2.91	1.01	0.54	0.54	0.50	-	1.89
	30	4.22	3.87	0.54	0.47	0.47	0.47	-	1.57

. 가
 , 가
 9, 10, 11, 12 . 가 5%
 가 39% , 가 26%
 가 , 가
 가 , 가
 가 . 15, 20% 60 가
 가, 가 가
 . 25% 가 , 가
 가 가
 120 가 .

9. 15% 가
 (% AIS)

()	가				
	가	가	가	가	가
0	2.00 (15.5)	2.50 (19.4)	5.00 (38.8)	3.40 (26.3)	12.90 (100)
10	0.52 (3.5)	4.66 (30.9)	4.44 (29.4)	5.46 (36.2)	15.08 (100)
30	0.48 (4.0)	4.50 (38.0)	2.87 (24.2)	4.06 (33.8)	11.85 (100)
60	0.82 (7.3)	5.86 (51.9)	2.24 (19.9)	2.37 (20.9)	11.30 (100)
90	1.02 (11.1)	6.85 (74.6)	0.56 (6.1)	0.75 (8.2)	9.18 (100)
120	-	-	-	-	-

() : 가

10. 20%

가

(%, AIS)

()	가				
	가	가	가	가	가
0	2.00 (15.5)	2.50 (19.4)	5.00 (38.8)	3.40 (26.3)	12.90 (100)
10	0.68 (4.6)	4.09 (27.9)	5.40 (36.8)	4.50 (30.7)	8.99 (100)
30	0.40 (4.4)	1.62 (18.0)	5.22 (58.1)	1.75 (19.5)	8.99 (100)
60	0.40 (6.1)	3.01 (30.4)	2.51 (25.4)	3.77 (38.1)	9.89 (100)
90	0.62 (5.7)	5.39 (49.5)	2.00 (18.4)	2.88 (26.4)	10.89 (100)
120	0.41 (4.2)	5.21 (52.8)	1.02 (10.3)	3.22 (32.7)	9.86 (100)

() : 가

11. 25%

가

(%, AIS)

()	가				
	가	가	가	가	가
0	2.00 (15.5)	2.50 (19.4)	5.00 (38.8)	3.40 (26.3)	12.90 (100)
10	0.99 (6.9)	4.19 (29.0)	5.18 (36.1)	4.00 (27.9)	14.36 (100)
30	0.46 (3.9)	3.51 (29.7)	3.89 (32.9)	3.95 (33.5)	11.85 (100)
60	0.40 (4.3)	2.18 (23.6)	2.87 (31.2)	3.77 (40.9)	9.22 (100)
90	0.37 (3.6)	3.46 (33.2)	2.04 (19.7)	4.51 (43.5)	10.38 (100)
120	0.49 (5.4)	2.65 (29.2)	2.85 (31.4)	3.10 (34.0)	9.09 (100)

() : 가

12. 30%

가

(%, AIS)

()	가				
	가	가	가	가	가
0	2.00 (15.5)	2.50 (19.4)	5.00 (38.8)	3.40 (26.3)	12.90 (100)
10	1.24 (8.9)	4.00 (28.8)	5.10 (36.5)	3.57 (25.7)	13.91 (100)
30	0.90 (7.4)	3.50 (28.7)	4.30 (35.2)	3.50 (28.7)	12.20 (100)
60	0.37 (4.5)	1.86 (22.5)	3.48 (42.2)	2.54 (30.8)	8.25 (100)
90	0.39 (3.7)	3.84 (36.6)	1.92 (18.3)	4.34 (41.4)	10.49 (100)
120	0.39 (4.9)	2.70 (33.8)	2.82 (35.3)	2.09 (26.1)	8.00 (100)

() : 가

2.

가.

13

40, 60, 75

15

1.2

가

12%

가

가

가

30

가

가

가

, 75

가

30, 40

가

60

13.

(%)

()	()				
	10	20	30	40	60
	8.1	10.1	10.8	11.0	11.6
40	8.0	11.0	11.4	11.6	11.9
60	8.0	11.2	11.0	11.7	12.8
75	8.8	10.4	12.0	12.3	12.5

14

가 20.3kg/s 가 75 가 17.1kg/s 가 10

20 가 40 가 , 60 60 >40

> >75 .

14.

(kg/s)

()	()				
	10	20	30	40	60
	20.3	14.2	13.7	14.7	11.9
40	19.1	17.4	16.8	15.9	13.9
60	18.7	15.7	15.2	14.2	14.1
75	17.1	13.8	12.7	11.2	10.4

(15)

가 가 가

, 60 , 40 가 60

가

/ (16), 20 , 40

30 가 - +

60, 75 60 -

15.

()	()				
	10	20	30	40	60
	4.74	4.55	6.26	6.82	7.28
40	5.08	5.16	5.95	6.15	7.32
60	6.72	6.51	6.10	5.76	5.38
75	8.01	7.50	7.30	6.34	6.80

. Isopropyl alcohol

17

40

i s o p r o p y l a l c o h o l

430, 450, 632nm

40

632nm

가

430nm

500 650nm

가

16.

()	()				
	10	20	30	40	60
	-2.51	-1.55	0.41	0.35	0.29
40	-2.68	-1.32	-0.98	0.13	0.22
60	-2.58	-2.35	-2.63	-2.41	-2.40
75	-2.35	-2.01	-1.92	-2.11	-2.55

17. isopropyl alcohol

(0. D)

()	()	Wavel ength(mm)							
		410	430	450	507	533	608	632	666
	0	-	3.44	2.73	-	-	-	1.42	-
	40	2.78	1.66	-	0.30	0.40	0.19	-	1.19
40	0	-	3.77	3.22	-	-	-	1.44	
	40	2.66	1.54	-	0.34	0.34	0.15	-	1.12
60	0	-	2.67	2.67	-	-	-	-	1.74
	40	2.44	1.52	-	0.33	0.33	0.16	-	0.97
75	0	-	2.75	2.76	-	-	-	-	1.84
	40	2.20	1.22	-	0.27	0.28	0.25	-	0.92

(PE)

(PG)

PE

PG
가
18
(P.E)
(P.G)
60 24.4 가
60 >40 >75 >
40, 60 가 10.2, 10.8 60
60 가

18.

		()					
()		0	10	20	30	40	60
	PE	11.3	14.5	20.1	22.1	15.3	10.1
	PG	11.2	20.6	12.2	9.4	10.0	7.5
40	PE	20.5	22.6	30.4	32.4	22.0	17.1
	PG	10.2	27.4	9.4	8.2	7.2	5.9
60	PE	24.4	27.1	38.5	40.1	32.5	23.1
	PG	10.8	32.1	9.0	7.4	7.8	6.1
75	PE	15.2	18.3	22.1	27.1	14.2	16.0
	PG	12.2	18.2	8.1	7.6	8.6	7.5

PE : , PG :

3. 가

가 0.3%(0.16%) 39
 1: 1. 2, 25% 720
 1,000 0.25,
 0.33% 가
 가.
 19 가
 20 30% ,
 가 가 가 . 40
 가 가 가
 60 .

19. 가

(cm)

()						
	0	20	40	60	90	120
	2.89	2.02	1.99	1.98	1.98	1.96
(100)	(69.9)	(68.9)	(68.5)	(68.5)	(68.5)	(67.8)
	3.10	2.08	2.07	2.05	2.04	2.04
(100)	(67.1)	(66.8)	(66.1)	(65.8)	(65.8)	(65.8)
	3.03	2.07	2.04	2.00	2.00	1.98
(100)	(68.3)	(67.3)	(66.0)	(66.0)	(66.0)	(65.3)
	3.08	2.10	2.09	2.06	2.06	2.04
(100)	(68.2)	(67.9)	(66.9)	(66.9)	(66.9)	(66.2)

. pH

20

가

pH

60

pH가

90

가

가

가

pH가

가

60

가

가

, 120

20.

가

pH

()						
	0	20	40	60	90	120
	6.07	5.84	5.73	5.45	8.04	8.07
	6.07	5.84	6.50	7.03	8.13	8.18
	6.07	6.54	6.27	6.96	7.89	8.19
	6.07	6.12	6.82	7.53	8.16	8.11

(21)

가

가 가

가 40
 가 (25%) 가 60
 4 120

21. 가 (%)

()						
	0	20	40	60	90	120
	0. 20	12. 14	21. 99	24. 27	24. 50	24. 61
	0. 20	12. 15	24. 31	24. 15	24. 87	24. 81
	0. 20	12. 13	23. 15	24. 27	24. 67	24. 62
	0. 20	12. 15	24. 31	24. 50	24. 77	24. 72

가 0.75 가 (22) 20
 120 가
 가
 120 가

22. 가

(0. D)

()					
	20	40	60	90	120
	1. 01	1. 09	1. 12	0. 86	1. 34
	1. 07	0. 44	0. 20	0. 47	0. 48
	0. 76	0. 42	0. 28	0. 67	0. 53
	1. 07	0. 56	0. 49	0. 84	0. 81

.

/

(23),

가

20

2. 06, 1. 25

-0. 49, -0. 33

가 가

,

가 가

가

/

.

23. 가

/

()						
	0	20	40	60	90	120
	-4. 42	2. 06	2. 46	3. 55	3. 86	3. 80
	-4. 42	1. 25	2. 24	2. 42	2. 45	2. 15
	-4. 42	-0. 49	-0. 04	0. 52	0. 02	0. 70
	-4. 42	-0. 33	1. 88	1. 36	0. 50	1. 12

(24),

가

가 60

,

가

가 4
가 가 .

24. 가

()						
0	20	40	60	90	120	
4.86	5.67	5.95	8.08	7.80	6.96	
4.86	5.83	7.08	7.89	8.75	6.43	
4.86	4.94	6.81	8.01	7.53	7.15	
4.86	6.89	7.60	8.42	7.29	6.28	

.
가
20 > >
> 가 , 40 > > >
가 가

. 가
,
가 25, 26, 27, 28, 29 .
가 > 가 > 가 > 가
가 38.8, 26.3, 19.4, 15.5%
. 20 가 > 가 > 가
> 가 가 가 > 가
> 가 > 가 , 가 가 > 가 > 가
> 가 가

가 . 가 20 가 가
 가 가 가 가 가
 CaO가 Ca(OH)2 가
 가
 43.
 가 40 가
 가 > 가 > 가 > 가
 120 가 가
 가
 .
 25. 가 20 가

(%, AIS)

가				
가	가	가	가	가
2.00	2.50	5.00	3.40	12.90
(15.5)	(19.4)	(38.8)	(26.3)	(100)
0.21	2.99	2.24	2.11	7.55
(2.8)	(39.6)	(29.7)	(27.9)	(100)
0.17	3.51	2.76	3.26	11.85
(1.8)	(36.2)	(28.5)	(33.5)	(100)
0.21	3.17	1.80	3.74	9.22
(2.4)	(35.5)	(20.2)	(41.9)	(100)
0.31	2.85	1.98	3.22	8.36
(3.7)	(34.1)	(23.7)	(38.5)	(100)

() : 가

26. 가 40 가

(%, AIS)

가				
가	가	가	가	가
0.49	3.90	2.52	3.29	10.20
(4.0)	(31.9)	(20.7)	(43.4)	(100)
0.49	4.96	1.88	3.89	11.22
(4.4)	(44.2)	(16.8)	(34.6)	(100)
0.45	4.90	1.59	3.67	9.22
(4.2)	(46.2)	(15.0)	(34.6)	(100)
0.55	5.09	1.74	3.11	10.49
(5.2)	(48.5)	(16.6)	(29.7)	(100)

() : 가

27. 가 60 가

(% AIS)

가				
가	가	가	가	가
0.59	4.72	2.11	3.48	10.90
(5.4)	(43.3)	(19.4)	(31.9)	(100)
0.46	5.76	1.98	2.25	10.45
(4.4)	(55.1)	(19.0)	(21.5)	(100)
0.46	5.25	2.02	2.00	9.73
(4.7)	(53.9)	(20.8)	(20.6)	(100)
0.39	4.96	1.24	2.97	9.56
(4.1)	(51.9)	(12.9)	(31.1)	(100)

() : 가

28. 가 90 가

(%, AIS)

가				
가	가	가	가	가
0.69	5.59	1.38	3.58	11.24
(6.1)	(49.7)	(12.3)	(31.9)	(100)
0.42	5.50	0.95	3.75	10.62
(3.9)	(51.8)	(8.9)	(35.4)	(100)
0.48	5.27	0.91	4.02	10.68
(4.5)	(49.3)	(8.6)	(37.6)	(100)
0.58	4.66	0.85	4.41	10.50
(5.5)	(44.4)	(8.1)	(42.0)	(100)

() : 가

29. 가 120 가

(%, AIS)

가				
가	가	가	가	가
0.59	5.77	1.26	5.27	12.89
(4.6)	(44.8)	(9.8)	(40.8)	(100)
0.55	6.34	1.02	5.35	13.26
(4.2)	(47.8)	(7.6)	(40.4)	(100)
0.57	6.02	0.86	4.26	11.71
(4.9)	(51.4)	(7.3)	(36.4)	(100)
0.63	5.54	1.00	5.04	12.21
(5.2)	(45.4)	(8.1)	(41.3)	(100)

() : 가

1) (), 2) 40

15 (), 3) 0.1%

가 () 3

20%

5.91 pH 80 가 5.45 가 , 가 가
 가 가 가 100 ,
 가 46.7 가 .
 가 80
 3가 .

4.

가 , 가
 가
 가 (, 1.5-2.0cm 15.5-17cm)
 (, 2.5-2.8cm 23-24.5cm) 10kg 1.2
 가 가 20%가 가
 150 , 150 21.26%,
 20.10%
 , 20% . pH
 가 5.34 6.14 , ,
 , 가 21.32, 0.87, 4.54 32.03,
 1.92, 10.16 (27).

27. 150

pH	(%)				
		L	a	b	E
6.1	21.3	32.03	1.92	10.16	61.42
5.3	20.1	21.32	0.87	4.54	71.48

i s o p r o p y l a l c o h o l

500 660nm 가 , 525, 536, 665nm (28).

28. 150 i s o p r o p y l a l c o h o l

	Wavelength(nm)					
	441	476	525	536	607	665
	3.135	1.288	0.594	0.475	0.402	1.621
	3.913	1.072	1.048	1.028	0.863	3.149

5.

a) 10kg 5mM , 20mM CaCl₂ 12% 가 3 *Lactobacillus plantarum*(0.08%) + sodium acetate trihydrate(0.01%) 가 , b) 10kg 25mM , 20mM CaCl₂ 12% 가 , c) 10kg (0.1%) 12% 가 20 . 20 a b 가 가 c 60 가 . 29, 30, 31 pH , pH a b 3.7 가 15 a b 가 4.21 4.34, 4.07 4.14 . 12% 가 c 8.39

15 4.05 4.13 3
 pH .
 12% a
 c 15 6.5 6.8% b 7.2 7.9% a,
 c 가
 . (%T) a 가 3 91.44
 15, 20 61.15, 10.36 , b 10
 가 a 가 15 a 20
 10.89 , c 3, 5
 가 10 52.90 50.73
 a c .

29. 25mM , 20mM CaCl₂ 12% 3 *Lactobacillus*
plantarum + sodium acetate trihydrate 가

	()					
	0	3	5	10	15	20
pH	3.71	4.43	4.64	4.69	4.34	4.21
(%)	12.0	9.01	8.13	7.21	6.50	6.03
(%T)	98.01	91.44	89.65	85.89	61.15	10.36
	○ : ○ :	○ : (: =1:1)	○ : () ○ :	○ : () ○ : ○ :	○ : : ○ :	○ : ○ : ○ :

30. 25mM , 20mM CaCl2 12%

	()					
	0	3	5	10	15	20
pH	3.71	4.45	4.67	4.49	4.14	4.01
(%)	12.0	8.81	8.52	8.30	7.92	7.21
(%T)	98.72	98.04	97.97	80.22	10.89	10.11
	○ : ○ :	○ : (: =1:1)	○ : () ○ :	○ : () ○ : ○	○ : ○ : ○ : ○ 가 가	○ : ○ : ○ : 1,2

31. 12%

	()					
	0	3	5	10	15	20
pH	8.39	6.25	6.56	5.06	4.13	4.05
(%)	12.0	8.20	7.94	7.45	6.81	6.42
(%T)	98.50	83.92	74.10	52.90	51.81	50.73
	○ : ○ :	○ : ○	○ : ○ :	○ : () ○ : ○	○ : ○ : ○	○ : ○ : ○

12% NaCl

가

,

. . .

15%

0.1%

가

, ,

가

20%

2가

.

15%(

0.1%

)

5

가

.

20%

3

가

7 1

,

.

{ (), }

(15%+

가,

20%)

4가

.

pH

15%

가

100

4.6

20%

가

가 5.0,

가 6.36

.

가

100

가

가

100

,

가

가

,

가

가

.

6.

60

가 가
가

25%

가 30%

(12%) 60
, 60
60 가

32 60

pH 가
가

32. 60

()	pH	(%)			
2	6.13	8.06	26.6	-1.98	5.32
4	6.34	5.68	27.9	-1.37	5.07
6	6.25	5.28	28.9	-1.35	5.05
8	6.33	4.82	28.1	-1.36	4.82
10	6.37	2.84	27.6	-0.43	4.41

35.

pH

()							
0	2	5	8	12	18	24	
6.03	6.59	6.68	7.03	7.29	7.12	7.42	
5.29	5.96	6.14	6.72	7.04	7.32	7.47	

36.

(%)

()							
0	2	5	8	12	18	24	
21.26	4.63	3.47	0.87	0.52	0.41	0.12	
20.10	2.89	3.32	0.87	0.58	0.46	0.12	

가 20%

3

2.44%

(6 7mm)

2

0.25%

2

가

2

1.

가 Nalley
pH
(4 6mm) 2
1.3
0.1g 가 14 , pH
37 . 14 pH 3.4 , 42. brix
24. brix
1 5 ,

37.

(%)

	1	2	3	4	5
	26.04	22.14	22.14	22.14	22.04
	31.85	35.95	35.95	35.95	36.00
	25.95	25.95	27.95	27.95	28.00
	15.00	15.00	15.00	13.00	13.00
	0.76	0.76	0.76	0.76	0.76
	0.30	0.10	0.20	0.10	0.10
	0.10	0.10	0.10	0.10	0.10

38.

		1	2	3	4	5
pH	0	3.37	3.15	3.24	3.25	3.31
	14	3.47	3.38	3.46	3.37	3.43
(° Bx)	0	43.2	43.0	42.0	42.0	42.4
	14	24.7	24.6	24.3	24.4	24.6

39.

		%			
		6	7	8	9
		22.18	21.06	21.70	21.50
		37.36	37.36	37.36	37.36
		22.24	22.14	22.04	22.14
		16.36	16.26	16.40	16.30
		0.95	0.95	0.95	0.95
		0.10	0.60	0.10	-
		0.02	0.10	0.50	0.50
		0.25	0.25	0.25	0.05
		0.03	0.06	0.03	0.03
		0.05	0.10	0.05	0.05
		0.06	0.12	0.12	0.12
	C	0.10	0.30	0.10	0.30
		0.10	0.30	0.20	0.30
		0.10	0.30	0.10	0.30
		0.10	0.10	0.10	0.10

40.

	6	7	8	9
pH	3.15	3.10	3.53	2.82
(° Bx)	32.0	40.8	40.4	39.4

41.

	(%)		
	10	11	12
	-	-	-
	37.36	37.36	37.36
	40.72	40.22	39.72
	16.62	16.62	16.62
	1.00	1.50	2.00
	2.00	2.00	2.00
	0.02	0.02	0.02
	0.03	0.03	0.03
	0.20	0.20	0.20
	0.25	0.25	0.25
C	0.70	0.70	0.70
	0.70	0.70	0.70
	0.30	0.30	0.30
	0.10	0.10	0.10

42.

		10	11	12
pH	0	3.02	3.08	3.10
	14	3.54	3.52	3.61
(° Bx)	0	61.0	60.6	62.2
	14	34.6	35.4	35.9

43.

		%		
		13	14	15
		-	10	20
		37.36	33.54	29.95
		40.62	36.49	33.67
		16.62	15.11	11.80
		1.00	0.91	0.83
		2.00	1.82	1.67
		0.02	0.02	0.02
		0.03	0.03	0.03
		0.20	0.18	0.17
		0.25	0.23	0.21
C		0.70	0.60	0.60
		0.70	0.60	0.60
		0.30	0.27	0.25
		0.10	0.10	0.10

(Nalley) 가

가

44.

(%)

	16	17	18	19
	10	7.67	-	10
	33.54	23.54	23.51	33.54
	16.54	42.94	42.94	48.09
	31.57	-	-	-
	-	17.53	25.20	-
	5	5	5	5
	1	1	1	1
	0.02	0.02	0.02	0.02
	0.03	0.03	0.03	0.03
	0.2	0.2	0.2	0.2
	0.3	0.3	0.3	0.3
C	0.7	0.7	0.7	0.7
	0.7	0.7	0.7	0.7
	0.3	0.3	0.3	0.3
	0.1	0.1	0.1	0.1

가 , 가 (45 23)
 53. brix, pH 3.18) 가 가 .

45.

(%)

	20	21	22	23	24
	-	10	7.67	7.67	6.67
	33.54	33.54	24.49	24.49	24.49
	58.09	25.06	42.94	16.53	47.94
	-	23.03	16.53	42.94	12.53
	5	5	5	5	5
	1	1	1	1	1
	0.02	0.02	0.02	0.02	0.02
	0.03	0.03	0.03	0.03	0.03
	0.2	0.2	0.2	0.2	0.2
	0.3	0.3	0.3	0.3	0.3
C	0.7	0.7	0.7	0.7	0.7
	0.7	0.7	0.7	0.7	0.7
	0.3	0.3	0.3	0.3	0.3
	0.1	0.1	0.1	0.1	0.1

2.

가 (46). 가 가

가 , 0.1% 가
 가 , 0.1%
 가가
 가 (23) ,

46.

(%)	Lightness	Redness	Yellowness	E
0	91.25	-0.76	6.73	10.97
0.025	86.37	-4.55	36.07	38.79
0.050	83.07	-2.79	47.19	50.18
0.100	78.77	3.79	49.20	54.15
0.150	77.21	8.21	49.71	54.80

70 15

23

pH

0.02% 가
 7.67%, 24.49%,
 16.53%, 42.94%, 5%, 1%, 0.02%,
 0.03%, 0.2%, 0.3%, C 0.7%, 0.7%, 0.3%,
 0.02% , 0.1%
 가

3.

44

23

3

1

2

1)

3

3

가 , 2) 5 가

2

3

가 35. brix 3 23. brix , 2 가

38.4. brix 3 34. brix , 3 가

43. brix 가 40.2. brix . 5 가

27.8. brix 3 17.9. brix , 2 가

30.4. brix 3 26.6. brix , 3 가

35.8. brix 가 3 32.3. brix, 4 가 39.4 3 37.2

. brix , 5 가 43.2. brix 41. brix

, pH 3.1 .

가

가

가

3

1.

47

47.

(%)

	1	2	3
	7.67	8.11	7.0
	24.49	18.11	25.0
	42.62	38.87	38.87
	16.53	24.60	18.0
	5	5	5
	1	1.5	2.0
	0.02	0.03	0.04
	0.03	0.04	0.05
	0.2	0.3	0.4
	0.3	0.45	0.3
C	0.7	1.05	0.7
	0.3	0.45	0.6
	0.7	1.05	1.4
	0.04	0.04	0.04
	0.3	0.3	0.5
	0.1	0.1	0.1

가 3

47 3

가, 가 가

1.0% 가 가

7.0%, 25%, 38.87%, 17%,

5%, 2%, 0.04%, 0.05%, 0.4%, 0.3%,

C 0.7%, 0.3%, 1.7%, 0.04%, 0.1%, 1.0%

, 0.5% 가 2 3

, 70 15

2.

가

가 8%

2 3

5 9%

가

. 20 8% 가

, 2

23%, pH 5.5 .

가

0.6cm

1 1 30

48, 49

1

48.

	1	2	3	4
33		28.97	28.97	20.45
34		28.97	28.97	20.45
-		13.14	13.14	19.27
-		15.25	20.25	27.82
3		10.47	-	-
-		3	3	4
-		0.05	0.05	0.07
-		0.02	0.02	0.04
-		0.03	0.03	0.04
-		-	-	-
-		-	5.47	7.81

2 5

6

3.51%

가

8(49. 4. BRIX, pH 3. 95, 5. 85%)

49.

	5	6	7	8
	20. 45	18. 97	18. 97	18. 97
	20. 45	18. 97	17. 97	16. 97
	28. 80	30. 75	30. 75	30. 75
	18. 29	16. 40	16. 0	16. 0
	-	-	-	-
	4	5	5	5
	0. 07	0. 1	0. 1	0. 1
	0. 04	0. 05	0. 05	0. 05
	0. 04	0. 02	0. 02	0. 02
	-	-	1. 0	2. 0
	7. 81	9. 74	9. 74	9. 74

1 1 30

9. 74%,

18. 97%, 16. 97%, 30. 75%, 16%, 5%, 2%,
 0. 1%, 0. 05%, 0. 02%

4

1.

가.

○ , 가

○ , .

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○ FRP

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○ ,

가 가 15% 가

0.1% 가,

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7, 67%,

24. 49%,

16. 53%,

42. 94%,

5%,

1%,

0. 02%,

0. 03%,

0. 2%,

0. 3%,

C 0. 7%,

0. 7%,

0. 3%,

0. 02%

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0. 1%

가

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o

2 3

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o

가

가

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o

70

15

가 20

가

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2.

가.

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o

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o

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2 3

o

1 30 2

o

o

		7.0%,	25.0%,	17.0%,	38.87%,
5.0%,	2.0%,	0.04%,		0.05%,	0.4%,
0.3%,	C 0.7%,		1.4%,	0.6%,	0.04%,
0.1%,	1.0%				

0.5% 가

o

가

2 3

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가 20

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FRP

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가

8%

o 2 3

9%

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가

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9.74%,

18.97%,

16.97%,

30.75%,

16%,

5%,

2%,

0.1%,

0.05%,

0.02%

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 , 6(2), 1(1990)
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 30. , , : .
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