

2003-0064716
2003 08 02

(54)

가, (curd) , 가 (stretching), , (Rennet)

, Pizza, , Mozzarella cheese, , cholesterol, , cholesterol free, , corn oil, , Pizza, , Pizza cheese

가

제품명	원재료명	원재료비 (%)
whole milk	part skim (pizza pie) (topping)	52~58%
heese)	(low moisture) (Raw milk) (Skim milk)	52~60%
		3.0~4.0%

가 가 . Ca, P .

1970 (2003) , , , .

가 가 LDL(low density lipoprotein) 가 LDL

가 (,) 가

FDA 「cholesterol free」 (reference amount) 1 2 mg (100 g 5 mg 100 mL 5 mg)

가 가

가

.

(corn oil) , (3.0~4.0%) (Raw milk) (Skim milk) , (Skim milk)

1 ()

(skim milk) 60~70 가 1

10 , 2 20 3.0%. 4.0%가 *Lactoba*

cillus delbrueckii subsp. *bulgaricus* *Streptococcus thermophilus* (starter)

12% (12%) 가

10⁸ cfu/g (Rennet) 9 L 44 L

1 () 2

2 (가)

(75 /16), (33) *L. bulgaricus* *S.*

thermophilus 1.47%(w/w) 가 가

(cutting), 가 (43), (whey drain), (cooling), (matting), (stretchin
g), 가 (salting), (cooling) (green cheese) 2 (10 ± 2 ,
90 ± 2%) (polyethylene film) .
(6 ± 2) .

1.

	LMMC	Low Moisture Mozzarella Cheese	Only animal fat 3.0%
	CFMC3	Cholesterol Free Mozzarella Chees e	Only vegetable fat 3.0%
	CFMC4	Cholesterol Free Mozzarella Chees e	Only vegetable fat 4.0%

2. ()

	(%)		
	LMMC	CFMC3	CFMC4
(Raw milk)	75.18	-	-
(Skim milk)	22.93	95.25	94.27
(Corn oil)	-	2.86	3.84
(Starter)	1.47	1.47	1.47
(Salt)	0.41	0.41	0.41
(Rennet)	0.01	0.01	0.01

가 , 가
(, ,)
가 , 60~70
CFMC3 CFMC4
CFMC3 CFMC4 가
가 60~70
1 10 , 2 20 ,
가 ,
가 ,

< > , SAS (Statistical Analysis System, 1993)
DMRT(Ducan's multiple range test) 5% .

< > _____

1. _____ pH

AOAC(1995) (), Gerber (), Milcoscan 104(, 65 30 ,), Lactosta
r(,) 30 0.5 mL 가
(dia. 16 mm×length 15 cm) 10 mL ()
30

1. AOAC(1995) Kosikowski(1982) pH meter(Beckman pH Meter, Denmark) pH

1. pH 가 가가

(IDF)가 50 (3). CFMC3 CFMC4가 LMMC

(P < 0.05) 가 (4).

3 3~4 pH (5). pH 3

(P < 0.05). LMMC 47.60%, CFMC3 49.00%, CFM

C4 48.50% 가 3 LMMC 46.07%, CFMC3 47.30%, CFMC4 46.10%

1.5~2.4% (matrix) (casein) 가

(casein unit) cheese 가

LMMC가 25.00% 26.63% , CFMC3 34.50% , 35.30% , CFMC4 35.00% 36.50%

가 , LMMC 24.60%, CFMC3 CFMC4 12.00% 3 LMMC 25.00%

%, CFMC3 CFMC4 12.00% 가

CFMC LMMC

LMMC가 0.41, CFMC3 0.16, CFMC4 0.27 가 pH 60 pH

(ammonia)

3.

	LMMC	CFMC3	CFMC4
(%)1)	88.57	88.20	87.90
(%)2)	3.00	3.00	4.00
(%)3)	3.23	3.10	3.05
(%)3)	4.82	4.70	4.61
(%)3)	8.64	9.01	9.04
pH4)	6.80	6.90	6.80
(%)5)	0.14	0.13	0.13
(cfu/mL)6)	68,000	10,002	95,000
(cell/mL)6)	168,000	310,667	200,332

1) AOAC (가)

2) Gerber

3) Milcoscan 104(Foss Electric, Denmark)

4) Beckman pH Meter

5) (0.1N NaOH)

6) Funke Gerber Lactostar(Funke-Dr. N. Gerber Labortechnik

GmbH, Germany)

4.

LMMC	52a	2.31a
CFMC3	55b	2.18b
CFMC4	58c	2.10c

· Mean value followed by different alphabet in same row means

significantly different at $p < 0.05$.

· ^{ab} Means with the same letter are not significantly different

at $p < 0.05$.

5.

()		(%)	(%)	(%)	pH
0	LMMC	47.60 ± 0.03a	25.00 ± 0.02c	24.60 ± 0.04a	5.23 ± 0.02b
	CFMC3	49.00 ± 0.04a	34.50 ± 0.03b	12.00 ± 0.01b	5.23 ± 0.01b
	CFMC4	48.50 ± 0.03b	35.00 ± 0.03a	12.00 ± 0.01b	5.30 ± 0.01a
7	LMMC	46.90 ± 0.04c	25.80 ± 0.03c	24.80 ± 0.02a	5.38 ± 0.04a
	CFMC3	48.00 ± 0.04a	34.90 ± 0.03b	12.10 ± 0.02b	5.30 ± 0.04c
	CFMC4	47.43 ± 0.04b	35.77 ± 0.02a	12.00 ± 0.04c	5.35 ± 0.02b
14	LMMC	46.38 ± 0.03c	26.32 ± 0.04c	25.00 ± 0.02a	5.54 ± 0.02a
	CFMC3	47.80 ± 0.03a	35.00 ± 0.01b	12.00 ± 0.01c	5.34 ± 0.01c
	CFMC4	46.90 ± 0.04b	36.10 ± 0.04a	12.10 ± 0.02b	5.44 ± 0.02b
21	LMMC	46.07 ± 0.04c	26.63 ± 0.03c	25.00 ± 0.02a	5.64 ± 0.04a
	CFMC3	47.30 ± 0.04a	35.30 ± 0.03b	12.00 ± 0.02b	5.39 ± 0.04c
	CFMC4	46.10 ± 0.02b	36.50 ± 0.04a	12.00 ± 0.02b	5.57 ± 0.02b

· Vale are mean ± standard deviation(n=3).

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$p < 0.05$.

2.

AOAC(1995) 70 mg 100 mL 가 (gas chromatography; GC)
 (flask) 0.5 N-NaOH/MeOH 8 mL 가 80
 10 , 14%(v/v) BF3 9 mL 2 n- 9 mL 가 1
 가 . GC 5 가 GC 가
 GC (HP 5890A, USA) (test tube) 2 mL 가 6 .
 , LMMC
 (palmitic acid) 가 CFMC3 CFMC4 n-6 (linoleic acid)
 가 (Oleic acid) LMMC 28.96%, CFMC3 30.
 69%, CFMC4 28.98% CFMC3 CFMC4 50%
 LMMC 3.09%
 가
 % LMMC (myristic acid) LMMC 10.54
 6.6 , CFMC4 2.6 (stearic acid) LMMC가 CFMC3
 C4 (butyric acid) LMMC 6.1% CFMC3 CFM
 (7).
 (4~12), (8~16), (18)
 CFMC3 CFMC4
 (8), LDL - 가
 CFMC3 CFMC4가 2:8 , LMMC가 7:3,
 cholesterol 가

6. 가

(Colum)	HP-FFAP 50 m×0.2 mm×0.33 μm	HP-1 30 m×250 μm×0.25 μm
가 (Carrier gas)	Helium gas	Nitrogen gas
(Colum flow)	0.56 mL/min	1.0 mL/min
(Spilt ratio)	200 : 1	15 : 1
(Oven temp.)	210	290
(Injector temp.)	250	280
(Detector temp.)	250 (Detection: FID)	300 (Detection: FID)
(Injection vol)	0.5	1

7.

		(%)		
		LMMC	CFMC3	CFMC4
	Butyric acid(C4:0)	6.10	-	-
	Caproic acid(C6:0)	2.00	-	-
	Myristic acid(C14:0)	10.54	-	-
	Palmitic acid(C16:0)	33.41	13.52	13.59
	Stearic acid(C18:0)	15.47	2.34	5.90

	Subtotal	67.52	15.86	19.49
	Oleic acid(C18:1)	28.96	30.69	28.98
	Linoleic acid(C18:2)	3.09	53.23	50.90
	Linolenic acid(C18:3)	0.43	0.22	0.63
	Subtotal	32.48	84.14	80.51
T o t a l		100.00	100.00	100.00

8.

		(%)
	Palmitic acid(C16:0)	12.30
	Stearic acid(C18:0)	1.78
	Subtotal	14.08
	Oleic acid(C18:1)	30.81
	Linoleic acid(C18:2)	54.68
	Linolenic acid(C18:3)	0.43
	Subtotal	85.92
T o t a l		100.00

3.

1 (3~5 g) 2 N (ethanol) 30 mL 가 85
 20 mL 20 mL ether 30 mL 3 (Ether)
 (phenolphthalein) (hexane) 3
 mL GC(HP 6890, USA) 6
 0.2% , D
 (lipoprotein)
 가
 2.3 mg/dL , 9 . 100 mg
 LMMC가 100 g 43.58 mg CFMC3 CFMC4
 4.34 mg (2002) 「
 가
 (2001) 가
 100g, 가 가 80 mg/100g 가 100 mg/

9.

	(mg/100g)
LMMC	43.58 ± 0.05
CFMC3	4.34 ± 0.04
CFMC4	4.34 ± 0.04

· Vale are mean ± standard deviation(n=3).

4.

(cheese trier)
(dia. 86.5 mm×deph 18.5 mm) 232 4 30
roducts Inc., Impinger 1310, USA) 가 (dia. 40.3 mm×depth 4.8 mm)
(Lincoln Foodservice P
가
C4 , 가 (p < 0.05) LMMC (melting size)가 (10). CFMC3 CFM
內 21 LMMC가 25%, CFMC3 CFMC4가 12% 가
(p < 0.05) 가 (p < 0.05) (< 4 , 10)
(free oil) 가

5.

(3 g) 232 2 10 (Lincoln Foods
ervice Products Inc., Impinger 1310, USA) 가 (uniaxial extensio
n) ,
(10). LMMC 27.2 23.3 cm , CFMC3 35.6 28.0 cm (p < 0.05) 38.1 33.0 cm
(p < 0.05). (stretch)가

10.

()	()			(cm)		
	LMMC	CFMC3	CFMC4	LMMC	CFMC3	CFMC4
0	7.0 ± 0.05a	6.0 ± 0.10b	6.0 ± 0.05b	27.2 ± 0.2c	35.6 ± 0.5b	38.1 ± 0.2a
7	7.5 ± 0.05a	6.5 ± 0.07b	6.0 ± 0.05c	26.3 ± 0.3c	34.1 ± 0.1b	38.0 ± 0.4a
14	7.8 ± 0.08a	6.7 ± 0.09b	6.1 ± 0.10c	24.1 ± 0.5c	32.0 ± 0.5b	36.0 ± 0.7a
21	8.1 ± 0.10a	6.7 ± 0.04c	7.4 ± 0.08b	23.3 ± 0.6c	28.0 ± 0.2b	33.0 ± 0.5a

· Vale are mean ± standard deviation(n=3).

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significantly different at p<0.05.

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at p<0.05.

6.

38×18×23 mm(가 × ×) 1 (Color
Techno System Corp., JC 801, Japan) L*(lightness), a*(redness), b*(yellowness) 100
X, Y, Z 93.82, 95.67 113.78 .

lowness) 9.34 14.73 L*(lightness) 82.36~56.60, a*(redness) -2.48 -4.92 b*(yel
L* (11).
CFMC3 CFMC4 69.16 56.60 LMMC
b* CFMC3가 가 CFMC3 CFMC4 가
LMMC
가
CFMC3 CFMC4 () LMMC

11.

	L*	a*	b*
LMMC	82.361	-2.476	14.308
CFMC3	69.160	-5.741	14.726
CFMC4	56.602	-4.920	9.340

7.

(6 ± 2) (dia. 20 mm×depth 20 mm) 1
(Sun Scientific Co. Ltd., CR-200D, Japan) TPA(Texture Profile Analysis)
10 (Rheometer) 12
가
(p<0.05) 가 13 (Strength) (Hardness) 14
ess) pH , , pH, 가 (hardn
(ripening cheese) α s-
(p<0.05) 가 21 CFMC3 CFMC4가 LMMC
(Cohesiveness), (Gumminess), (Brittleness)
가 (Adhesiveness) 21
LMMC가 가 가
adhesiveness (rheological properties)
(p<0.05) 14 가 21

12.

Full scale force	10 kgf
Crosshead speed	150 mm/min
Deformation rate	40%
Probe diameter	Dia. 20 mm round adapter
Sample type	Vertical round
Sample area	31.4 mm ²
Graph type	Force vs. Time

13.

()		(dyne/cm2)	(dyne/cm2)	(%)	(%)	(g)	(g)	(g)
0	LMMC	278,442.72c	834,285.31c	8.99c	18.91c	168.66c	15.16c	98.00c
	CFMC3	317,462.16b	1,010,817.44b	20.20b	47.91b	501.53b	110.65b	100.50b
	CFMC4	358,666.69a	1,112,144.75a	25.58a	58.76a	675.15a	172.71a	116.00a
7	LMMC	333,069.94c	1,028,048.88c	27.31c	37.69c	409.91c	125.47c	131.50a
	CFMC3	452,105.24b	1,319,453.92b	33.61b	65.71b	953.64b	325.95b	97.00b
	CFMC4	484,673.48a	1,408,783.17a	35.86a	76.04a	1,084.59a	419.12a	67.00c
14	LMMC	733,565.50a	2,919,663.75a	77.61a	90.58b	2,128.72a	1,652.14a	178.00a
	CFMC3	619,316.56b	2,799,171.00b	76.27b	100.00a	1,986.09b	1,514.81b	69.00c
	CFMC4	494,142.19c	2,689,209.25c	59.18c	74.52c	1,179.69c	698.19c	74.00b
21	LMMC	295,299.13c	1,049,952.50c	16.00c	29.38c	277.91c	44.47c	220.00a
	CFMC3	373,338.00a	1,118,615.75b	25.84a	53.52a	640.10a	165.42a	118.00b
	CFMC4	298,420.69b	1,187,744.00a	22.39b	49.58b	473.99b	106.12b	87.00c

· Mean value followed by different alphabet in same row means significantly different at p<0.05.

· ab Means with the same letter are not significantly different at p<0.05.

8.

(6 ± 2 , 28) 가

, , 10

.

14 (Browning) 100

1 LMMC가 가 pH 가 (flowability)

가, LMMC가 가 (Salty) CFMC4가 가 (stretching) CFMC4

가 (shiny), (oiling off), (melting)

가 (p < 0.05).

14. 가

		LMMC	CFMC3	CFMC4
	(Browning)	9.83a	9.72ab	8.03b
	(Shiny*)	11.92a	9.42b	8.75b

	(Oiling off*)	11.58a	9.67ab	9.07b
	(Salty)	9.29b	11.15a	11.27a
	(Cheese flavor)	10.78a	10.41a	10.27a
	(Melting**)	12.07a	9.27b	8.71b
	(Flowability)	10.66a	9.54ab	8.68b
	(Stretching)	10.27a	10.97a	11.87a

- Ratng scale : 0(week) to 15(strong)
- Mean value of sensory scores followed by different alphabet in same row means significantly different at $p < 0.05$.
- ab Means with the same letter are not significantly different at $p < 0.05$.
- : $p < 0.05$, ** : $p < 0.01$

가 (linoleic acid) , (palmitic acid) , 가 7:3, 2:8

· LDL - 43.58 mg/100g 4.34 mg/100g

가 1/ 10

(57)

1. () 60~80 , 가 () 1.0%