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(71) /
-1001 , . . 17, 1

(72) -8220 38 /

-8220 38 /

-8220 38 /

(74)

:

(54)

;

, , , , , , , , 가

가

가

가

De Schrijver et al.(6) 6%

가 가

가 , VFA(volatile fatty acids) (

(ileostomate), (11)).

()

Silvester et al.(24)

Englyst et al.(8)

, Englyst et al. 91%

가 가

Muir et al(20)

De Schrijver et al.(6) 가 가

(retrograded) -

Ranhotra et al.(22) 가 가

Ito et al.(15) , 가 가 3가 가

가

Roe et al.(23) 가 -

Morna(19) 가 가 가 가

,
;

가

가

pH

가

(*Streptococcus bovis*)
spergillus) K-27 ,
(*Thermomyces lanuginosus*)

(*Bacillus circulans*) F2 ,
(*Cryptococcus*) S-2 , (A
(*Bacillus licheniformis*)

가

가

가가

/

가가

가

가

가

(pig), (hog) (boar) 50% 20% 5%

(finishing)' (grower)' (transition)' (starter)'

가 (capon), 가

(Monesine sodium), (Lasalocid), (Amprolium), (Salinomycin) and (Sulfaquinoxaline) (Chlortetracycline) (Oxytetracycline) (Bacitracin),

가

eveloper)' (6) '가 (layer)' (d

가

가

가

70 80%

가

(1 4)
-D-(1 6)

-D-

75%

-D-(1 6)
25%

-D-

(1 4)

가
가
가
(retrogradation)

가
가
(setback)

가

(pullanase)

(debranching)
(cyclodextrin glucanotransferase)

D-

가
(1 6)

가

(1 4)

-D-

(macroingredient)

가
가

(crosslinking)

가

가

(3).

4

:

1 -

가

2 -

가

3 -

가

()

4 -

4가
)

가

(,

()
가
t al.(10)

(,)

Goni e

(%)	
가 (<1%)	()

	()
	()
(1-2.5%)	
	(가)
	(가)
(2.5-5%)	
(5-10%)	(, ,)
	가
	가 (, ,)
(>10%)	가
	가
	(amylomaize)

가 / 4 1-4 가

Muir et al(Am.J.Nutr. 1995, vol.61, pages 82-89)

가

가

/ 가

() 가

(breakdown)

ndoenzyme)

((1 4)

(e

(*Bacillus circulans*) F2 가 17% 가 (17).

(*Cryptococcus* sp) S-2 가 가

(*Aspergillus oryzae*) 15 3 (80

2 mM CaCl₂ 30 70 50%) pH 3 >50% (6 pH).

1992 Gruchala and Pomeranz(12) 가 가 60 12 (

2 가). (*Bacillus licheniformis*) 가

16% K-27 41%

가

가 가

가 (CGTase) (transglycosylation) . CGTase 가

(25)(27).

(maltogenic) NovamylTM (Novo Nordisk A/S) CGTase 가

(4).

CGTase (TermamylTM , Novo Nordisk A/S)

(*Thermoanaerobacterium thermo-*

sulfurogenes)(ToruzymelTM , Novo Nordisk A/S) CGTase

90

K-27 K-27 - (2

1).

(Pseudomonas saccharophila) (mal

totetroase) EC 3.2.1.60 1,4- -

F2 , S-

2 , K-27 ,

/

PCT WO 9601323 Ezyme Microbiol. Technol.(1992), 14, 112-1

16

가

가 Gruchala and Pomeranz(12)

al.(18)

Englyst et al.(9);(8), Silvester et al.(24) and Morales et

()
(,)

가

가

/

가

가

95

20

50

pH

pH

pH

pH

3

7 pH

Al - Kahtani
tilis)

(1).

(*Bacillus amyloliquefaciens*)

가

(7).

(2).

(*Bacillus sub*

가

/ 가

(

).

가

egazyme International Ireland Ltd.
 dure, AOAC Method 2002.02, AACC Method 32-40).

(Resistant Starch Assay Proce^M

), (guar gum) (xanthum gum) 가 (adjuvant),

7

가

1982 Englyst et al.(Analyst, 107, p.307-318, 1982) (1).
 Englyst et al.(Analyst, 107, p.307-318, 1982) / Berry(J. Cereal Science, 4, p.301-304, 1986)
 100 가
 (ileostomy) Englyst et al.(Am.J.Clin.Nutr, 42, p.778-787, 1985; Am.J.Clin.Nutr, 44, p.42-50, 1986; Am.J.Clin.Nutr, 45, p.423-431, 1987)

1990 / European Research Program EURESTA(Englyst et al. Europena J.Clin.Nutr, 46, suppl.2, S33-S50) (Champ)
 p)(Europena J.Clin.Nutr, 46, suppl.2, S51-S62) Berry(J. Cereal Science, 4, p.301-304, 1986)
 pH 6.9

Muir and O'Dea(Muir, J.G. amp; O'Dea, K.(1992) Am.J.Clin.Nutr, 56, 123-127)
 15 pH 5.0, 37
 (가 , DMSO)

Faisant et al.(Faisant, N., Planchot, V., Kozlowski, F., M.-P.Pacouret, P. Colona. amp; M. Champ. (1995) Sciences des Aliments, 15, 83-89), Goni et al.(Goni, I., Garcia-Diz, E., Manas, E. amp; Saura-Calixto, F.(1996), Fd. Chem., 56, 445-449), Akerberg et al.(Akerberg, A.K.E., Liljberg, G.M., Granfeldt, Y.E. Drews, A.W. amp; Bjorck, M.E.(1998), Am. Soc. Nutr. Sciences, 128, 651-660) Champ et al.(Champ, M., Martin, L., Noah, L amp; Gratas, M. (1999) In Complex carbohydrates in foods(S.S.Cho, L. Prosky amp; M. Dreher, Eds.) pp. 169-187. Marcel Dekker, Inc., New York, USA)

(), pH
 가(가)

Megazyme International Ireland Ltd.

(Resistant Starch Assay Procedure, AOAC Method 2002.02, AACC Method 32-40).

1. _____

, 가 가 가 가
 . () 가

2. 가 _____

. 가 가 가

1 1 가 .

1% - .

: Phadebas Amylase Test - tablet (Pharmacia Diagnostics).

: (1000 ml 가 0.9 g , 2.0 g 2.2 g)

2 2.2 g : (500 ml 가 0.9 g , 2.0 g)

가 가) : (2 g 10 10 ml)

0.5 M NaOH

640 nm

0.2 ml (tablet) 가 4.0 ml 가 10 15 +37 5 +37 10
 3500 rpm . 1.0 ml 0.5 M NaOH 가 . 10
 0.3 0.5 가 620 nm .

_____ :

가 가 4.0 ml 2.0 ml 2
2.0 ml

4.2 ml 5 +37 가 10 15 +
37 . 1.0 ml 0.5 M NaOH 가 . 10 350
0 rpm .

$$(U/g) = \frac{Act \cdot Df}{1000}$$

Act = Phadebas Amylase Test tablet

(U/)

Df = (ml/g)

1000 = ml

가

$$= \frac{\{ \quad \}}{\{ \quad \}} * 100\%$$

3. _____

1 mm . 5%
(-).

100 mg 50-ml 10 ml KCl-HCl pH 1.5가 가 (2 M HCl
0.05 M NaOH). 100 mg KCl-HCl
pH 1.5 가 . 0.2 ml (1 /10 ml KCl-HCl)
가 40 60 . 40
. 9 ml 0.1 M Tris-maleate pH 6.9가 가 (2 M HCl
0.5 M NaOH pH) 1 ml - (Tris-maleate ml 40 mg -).
37 16 . (15 , 30)

00 g

3 ml 가 가 . 3 ml 4 M KOH가 가
30 . 5.5 ml 2 M HCl 3 ml 0.4 M , pH 4.75가 가
(2 M HCl 0.5 M NaOH pH) 80 μl 가 가 . 60
56

(15 , 3000 g) . 10 ml 1

3.1. _____ (10-60 ppm)

0.5 ml , . 1 ml (GOD-PAP)
가 . 37 30 .

5 45 가 500 nm
가 (10-60 ppm)

×0.9 mg

4. _____

4.1. _____

50 g 1.0 mm (mincer) 4 mm
 AOAC Method 925.10(14) AOAC Method 925.10

4.2. _____

100 mg (sodium maleate) ()
 pH 6) AMG(3 U/ml) 4.0 ml - (10 mg/ml)가
 (200 /) 37 . 16 가
 3,000 rpm 10 4.0 ml IMS(99% v/v)
 2 ml 50% IMS - . 6 ml 50% IMS가 가 3,000 rpm 10
 가

2 ml 2 M KOH가 가 / 20 ()
 MG(3200 U/ml) 가 8 ml 1.2 M (pH 3.8) . 0.1 ml A
 50 30

>10% 100 ml () 가
 (aliquote)가 3,000 rpm 10

<10% () 3,000 rpm 10

GOPOD 0.1 ml (2)가 (16 × 100 mm) , 3.0 ml
 (Glucose Oxidase-Peroxidase-aminoantipyrine - 0.4 mM pH 7.4
 , >12000 U/L; , >650 U/L; 4-) 50

20
 0.1 ml 0.1 M (pH 4.5) 3.0 ml GOPOD
 0.1 ml (1 mg/ml) 3.0 ml GOPOD . 50
 가 510 nm

4.3. _____

(, %) :

>10% :

$$= E \times F \times 100 / 0.1 \times 1 / 1000 \times 100 / W \times 162 / 180$$

$$= E \times F / W \times 90.$$

<10% :

$$= E \times F \times 10.3 / 0.1 \times 1 / 1000 \times 100 / W \times 162 / 180$$

$$= E \times F / W \times 9.27.$$

$$E = ()$$

$$F = = 100 (\mu g) / 100 \mu g$$

100/0.1 = (100 ml 0.1 ml); 1/1000 =
 W = [' ' ×(100-)/100];
 100/W =
 162/180 = -
 10.3/0.1 = 가 10.3 ml 0-10%
 (10.3 ml 0.1 ml).

5. 가

WO9601323 2 가 (LTAA, Genencor International Inc.)

5.1.

Megazyme(Megazyme International Ireland Limited) Resistant Starch Assay Kit(Cat. n
 o. K-RSTAR) . Resistant Starch Assay Procedure(AOAC Method 2002.02 AACC Method 32-40)
 16 1.5
 (AMG) (L
 TAA, Genencor International Inc.) 37 1.5 가
 (Industrial methylated spirits, IMS,) 가
 AMG 가 /
 (GOPOD)
 (LTAA) Phadebas amy
 lase test(Pharmacia amp; Upjohn)

5.2. 가

100 mg (Corning ; 16 ×125 mm)
 AMG(3 U/ml) 4.0 ml - (10 mg/ml)
 0.4 U 가
 37 15 1.5 4.0 ml IMS(99% v/v)
 3,000 rpm 20 100 ml
 100 ml 2 ml 0.2 ml AMG(3200 U/ml) 가
 50 30
 0.1 ml 가 (16 ×100 mm) , 3.0 ml GOP
 OD 50 20 0.1 ml 0.1 M ()
 pH 4.5) 3.0 ml GOPOD 0.1 ml (1 mg/ml) 3.
 0 ml GOPOD (4) . 50 20
 510 nm

5.3.

(, %) :

= E ×G ×D ×100/0.1 ×1.1 ×1/1000 ×100/W ×162/180

= E ×(G ×D)/W ×99.

E = ()

G = $\frac{100 (\mu\text{g})}{100 \mu\text{g}}$
 D = ; $100/0.1 = (100 \text{ ml} / 0.1 \text{ ml}); 1.1 = 1.5$ AMG가
 가 ,
 1/1000 =
 162/180 = -
 5.4. _____

AMG) , () 1 . (

[1]

		0.4 $\mu\ell$ LTAA
	48.97	49.45
	51.02	49.51
		50.09
		52.27
:	49.995	50.33

LTAA가 - AMG 가

(%) 2 .

[2]

	0.4 $\mu\ell$ LTAA	0.4 u
	49.45	53.99
	49.51	56.03
	50.09	55.98
	52.27	56.64
	50.33	55.66

99%) 가 가 (

6. _____

:

57.71%

가 48 31.52%

6.30%

NaCl 0.40%

DL 0.20%

1.46%

/ 1.25%

100%

30 80

가

(pelletizer)

7. 가

7.1. -

가	5	1-10 U
(starter)	(holding pen)	
(grower)		6
() 6		

/

36 (pig)가(7.5 - 9 kg)

0	가	7	가
(piglet)	27.5 kg	16.0 kg	
	10	25 kg	

(FCR)

가 가

7.2. - (broiler)

5	가	1-10 U
---	---	--------

6 () 42 8

20 40 가 20 40

(FCR)

가 가

가

;

1. ;
- :
- a.
- b.
- c. pH
- d.
2. 1 ,
3. 1 2 ,
4. 1, 2 3 , pH
5. ,
6. , 가
7. , (cyclodextrin glycosyl transferase, CGTase)

8. 7 , CGTase (*Thermoanaerobacterium thermo sulfurogenes*)
9. 7 8 , CGTase Toruzyme™
10. 7 , CGTase Novamyl™
11. 1 , (*Bacillus circulans*) F2 , (*Aspergillus oryzae*) , (*Cryptococcus*) S-2 , (*Aspergillus*) K-27 , (*Bacillus licheniformis*) , (*Bacillus subtilis*) , (*Bacillus amylolique faciens*)
12. 11 , (Thermamyl)
13. , 가
14. 13 , 가
15. ; :
- a.
- b.
- c. pH
- d.
16. 15 ,
17. 15 16 ,
18. 15, 16 17 , pH
19. 15 18 ,
20. 15 19 , 가
21. 15 20 , 가
22. 가 21
23. :
- a.
- b.
- c. pH
- d.

- 24. 23 ,
- 25. 23 24 ,
- 26. 23, 24 25 , pH
- 27. 23 26 ,
- 28. 23 27 , 가
- 29. 23 28 , 가
- 30. 29 , 가
- 31. , :
- a.
- b.
- c. pH
- d.
- 32. 가 ,
- 33. ,
- 34. , ; :
- a.
- b.
- c. pH
- d.

가

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(57)

1.

, ;

2.

1 ,

3.

1 2 , pH

4.

, 가

5.

,
 (*Streptococcus bovis*) , (*Bacillus circulans*) F2 ,
) K-27 , (*Cryptococcus*) S-2 , (*Aspergillus*
momyces lanuginosus) (*Bacillus licheniformis*) (*Ther*

6.

, 가

7.

6 , 가

8.

;

9.

8 ,

10.

8 9 , pH

11.

8 10 , 가

12.

가 8 11

13.

가 12

14.

15.

14 ,

16.

14 15 , pH

- 14 17. 16 , 가
- 14 18. 17 , 가
- 18 19. , 가
- 20. ,
- 21. ,
- 22. ,
- 20 23. 22 ,
- 20 24. 23 , pH
- 25. ,
- 26. , ;
- 25 27. 26 ,
- 25 28. 27 , pH
- 29.
- 30.
- 31.
- 32.
- 33.