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Sekretariat Seminar Internasional
Lactic Acid Bacteria &
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Their Role in Food, Health, and Industry
Pusat Studi Pangan dan Gizi UGM
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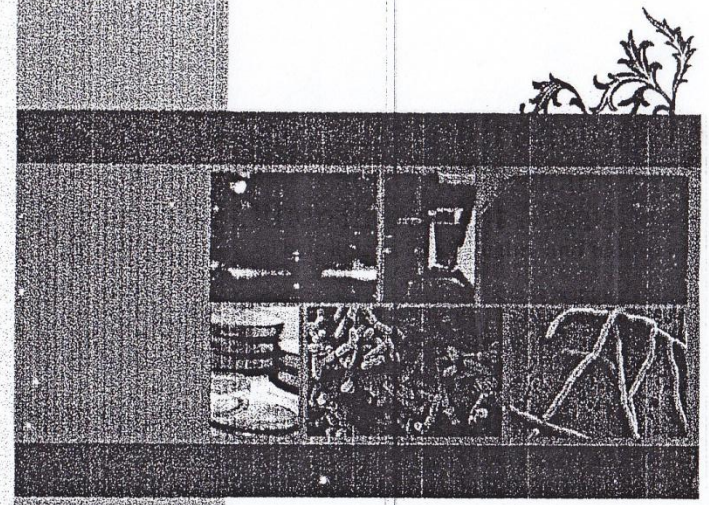

Seminar Internasional

Lactic Acid Bacteria & Other Important Microbes

Their Role in Food, Health, and Industry

Ruang Seminar Lt 3
Gedung PAU Pascasarjana UGM
Jl. Teknika Utara, Barek, Yogyakarta

Diselenggarakan oleh
ISLAB,
FORKOMIKRO
Pusat Studi Pangan dan Gizi
Univeristas Gadjah Mada

16-17 Januari 2009

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Indonesian Society of Lactic Acid Bacteria

Pusat Studi Pangan dan Gizi
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Forum Komunikasi Kurator Koleksi Mikroorganisme
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Sertifikat

Diberikan kepada :

Basuni Hamzah

Sebagai Peserta Seminar

Lactic Acid Bacteria & Culture Collections:

Their Role in Food, Health, Industry and the Important of Management of Culture Collection

Yogyakarta, 16 - 17 Januari 2009
Auditorium Fakultas Teknologi Pertanian
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A STUDY OF LACTIC ACID BACTERIA AGGLUTINATION DURING MANUFACTURE OF COTTAGE CHEESE

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ABSTRACT

In the manufacture of cottage cheese, agglutination occurs when lactic cultures form long chains and clumps of chains. These chain of cells often form a net like structure that fall to the bottom of the vat and sweeps or entraps the casein in the skim milk.

In this study, skim milk homogenized at 0, 28 (single stage), and 71 kg/cm² (dual stage, 35 kg/cm² second stage) was used in the manufacture of cottage cheese. Each lot of skim milk manufacture into cottage cheese was inoculated with one bulk starter (Lactic culture M30, lactic culture M37,or Lactococcus lactis subsp. cremoris UC310-. Each bulk starter was homogenized at 0, 35 (single stage), 176, and 246 kg/cm² (dual stage, 35 kg/cm² second stage). The 18 different bulk starters were used to inoculate the 3 different skim milk treatments to produce a total of 54 bulk starter-skim milk treatment combinations. All 54 bulk starter-skim milk treatment combinations were randomized prior to their manufacture. The experiment was replicated two times in the manufacture of 108 vats of cottage cheese. Culture agglutination was determined by pH and curd total solids.

Culture agglutination decreased as the homogenization pressure applied to bulk starter was increased. The agglutination, also, decreased with increased homogenization pressure applied to skim milk. L. lactis subsp. cremoris UC310- was more sensitive to agglutination than the other 2 commercial cultures Lactic culture M30 and M37. Lactic culture M30 could be selected as representative commercial culture that would be used to determine the effect of agglutination on yield during the manufacture of cottage cheese.

INTRODUCTION

In manufacturing cottage cheese a culture media is necessary to prepare the lactic bulk starter. Hingh cell populations can be obtainedwhen the starter grown in media at optimal conditions. Christensen (1972) indicated that slow or complete starter failure is very common in the cheese industry. Sandine (1977) identified some areas of culture problems: a) phage inhibition, b) inhibition by agglutinins, c) Agglutinins inhibit the growth of microorganism, including starter culture. One of the constituents in raw milk called 'lactenin' inhibits the growth of Lactococci (Jones and Simms, 1930). Auclair and Hirsch (1953) reported that two substances, Lactenin 1 and Lactenin 2, are responsible for inhibition. Jago (1954) found that the inhibitory substances are closely associated with the fat globules in milk and exert a mark effect because of the large surface area exposed. He also suggested that the substances are bacteriostatic rather than bactericidal and that they were enzymic in nature.

ISBN : 978-979-19546-0-0

Randolp and Gould (1968) found that the natural inhibitors of milk are active against certain lactic acid-producing Lactococci are antibodies. In manufacturing cottage cheese, agglutinins can interfere with normal acid development in milk. During normal fermentation of milk, lactic acid bacteria are distributed throughout the milk, causing even acid production. Some strains of Lactococci are not affected by agglutinins, however, susceptible strains clump together and acid production is uneven (Ryan, 1985).

Scheuble et al. (1989) studied agglutination of lactic Lactococci and found that the agglutinin concentration of milk from the eighth postpartum is sufficient to result in severe agglutination of highly susceptible strains. Milk derived from recently freshened cows contain high levels of colostrums-derived agglutinins resulting in seasonal agglutination-related problems for cheese manufacturers. Microscopic analyses showed that cells in mildly-agglutinating strains associated with each other randomly, with some cells in a chain not bound to other cells while other cells in the chain were bound to two or more cells. They propose that the severity of agglutination of a particular strain depends on the frequency with which a specific antigenic determinant is expressed on the cell surface, and on the agglutinin titer. They also speculated that long-chain strains which are sensitive to agglutinins will cause increase defects under commercial production.

There were three species of lactic Streptococci; *Streptococcus lactis*, *Streptococcus cremoris* and *Streptococcus diacetilactis* (Sandine et al. 1972). These organisms have been renamed in the current nomenclature, there are now two species of Lactococci; *Lactococcus lactis* subsp. *lactis* (formerly *Streptococcus lactis*) and *Lactococcus lactis* subsp. *cremoris* (formerly *Streptococcus cremoris*)

MATERIAL AND METHODS

In this study, skim milk homogenized at 0, 28 (single stage), and 71 kg/cm^2 (dual stage, 35 kg/cm^2 second stage) was used in the manufacture of cottage cheese. Each lot of skim milk manufacture into cottage cheese was inoculated with one bulk starter (Lactic culture M30, lactic culture M37 ,or *Lactococcus lactis* subsp. *cremoris* UC310-. Each bulk starter was homogenized at 0, 35 (single stage), 176, and 246 kg/cm^2 (dual stage, 35 kg/cm^2 second stage). The 18 different bulk starters were used to inoculate the 3 different skim milk treatments to produce a total of 54 bulk starter-skim milk treatment combinations. All 54 bulk starter-skim milk treatment combinations were randomized prior to their manufacture. The experiment was replicated two times in the manufacture of 108 vats of cottage cheese. Culture agglutination was determined by pH and curd total solids.

RESULT AND DISCUSION

After 3 h of incubation all three cultures were observed to be agglutinated (Table 1). Agglutination was determined in skim milk by monitoring the pH at the top and the bottom of the cylinder. When the top/bottom pH differential was greater than .07 agglutination was consider to

have occurred in the skim milk (Hicks et al., 1988).

When bulk cultures homogenized at 246 kg/cm2 (dual stage, 35 kg/cm2 second stage) decreased agglutination of all cultures. These data confirm the work of Milton et al. (1987) who observed that homogenization of bulk culture prior to inoculation into skim milk inhibits agglutination and increases starter counts. Agglutination was not observed when both bulk culture and skim milk were homogenized at 246 kg/cm2 (dual stage, 35 kg/cm2 second stage) and at 28 kg/cm2 (single stage), respectively. Agglutination of lactic culture M30 was observed after 2 hours of incubation even though the bulk culture had been homogenized at 35 kg/cm2 (single stage). Lactic culture M37 exhibited agglutination within 3 hours after inoculation at 5% into skim milk when the bulk culture was not homogenized. Milton et al. (1987) reported that *L. lactis* subsp. *cremoris* UC310- agglutinated within 15 min after being inoculated into skim milk columns.

When cottage cheese was manufactured in vats holding approximately 7000 g of skim milk with lactic culture M30 and M37, agglutination decreased as the pressure of homogenization of the bulk culture increased (Table 2). From these data a pressure of 246 kg/cm2 (dual stage, 35 kg/cm2 second stage) appeared to be necessary to completely inhibit agglutination.

Table 1. Effect of Bulk Culture and Skim Milk Homogenization on Agglutination of Three Cultures (Lactic culture M30 and M37, and L. lactis subsp. cremoris UC310-) as determined by pH differentials between the top and bottom of skim milk column.

Cultures	pH		
	NHBC & NHSM Top/bottom	HBC & NHSM Top/bottom	HBC & HSM Top/bottom
M30	5.31/4.52	5.23/5.21	5.18/5.17
M37	5.41/4.25	6.07/6.05	5.63/5.62
UC310-	5.76/4.78	5.16/5.13	5.30/5.27

pH = pH measurements after 3 h of incubation; NHBC = Non-homogenized bulk culture (0 kg/cm2); NHSM = non-homogenized skim milk (0 kg/cm2); HBC = Homogenized bulk culture (246 kg/cm2 dual stage, 35 kg/cm2 second stage); HSM = Homogenized skim milk (246 kg/cm2 dual stage, 35 kg/cm2 second stage

Table 2. Effect of bulk culture homogenization on agglutination of two cultures as determined by pH differentials between top and bottom of cheese milk

Lactic Culture	BCH	pH				
		Hr 1 T/B	Hr 2 T/B	Hr 3 T/B	Hr 4 T/B	Hr 5 T/B
M30	35	6.2/6.2	6.0/5.9	5.6/4.9	5.3/4.7	5.1/4.5
	176	6.2/6.2	6.0/6.0	5.8/5.6	5.4/4.8	5.1/4.6
	246	6.2/6.2	6.0/6.0	5.6/5.3	5.3/4.8	5.0/4.8
M37	35	6.3/6.3	6.2/6.2	6.0/5.8	5.7/5.4	5.5/4.8
	176	6.3/6.3	6.1/6.0	5.8/5.7	5.4/4.8	5.2/4.6
	246	6.3/6.3	6.1/6.0	5.7/5.2	5.4/4.8	5.2/4.6

BCH = Bulk culture homogenization pressure (kg/cm2); T/B = Top/Bottom

Table 3. Effect of bul culture homogenization on dry matter yields using lactic culture M30 and M37

Lactic Culture	Homogenization Pressure (kg/cm2)	DM Cheese Yield (kg/100 kg skim milk)
M30	35	3.02
	176	3.15
	246	3.14
M37	35	2.81
	176	3.00
	246	3.09

CONCLUSION

Culture agglutination decreased as the homogenization pressure applied to bulk starter was increased. The agglutination, also, decreased with increased homogenization pressure applied to skim milk. *L. lactis* subsp. *cremoris* UC310- was more sensitive to agglutination than the other 2 commercial cultures Lactic culture M30 and M37. Lactic culture M30 could be selected as representative commercial culture that would be used to determine the effect of agglutination on yield during manufacture of cottage cheese.

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