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Some Quality Criteria of Yogurt Made from Milk Added with Antibiotic at Different Levels

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Abstract: The changes in acidity, pH, viscosity and syneresis in yogurt added with penicillin at different levels were investigated. According to results, as the amount of antibiotic increased, the acidity, pH and syneresis values were increased but viscosity values were decreased. As the amount of penicillin exceeded 0.0045 IU/ml the qualitative properties of yogurt were adversely affected.

Introduction

Antibiotics have been used to treat especially mastitis and other diseases for 30 years (Bishop and White, 1984). The antibiotics that are introduced intramuscular, intravessel and via mouth may pass into milk (Ulusoy, 1985) and cause some problems in processing of some fermented milk products, depending upon treatment methods. The production technique and some quality criteria of milk products are adversely affected by antibiotic residues in milk. The consumption of antibiotic containing milk may cause serious health risk for human as well as economic loss. The antibiotic taken into body may result in immunization of microorganisms, which may not displayed predicted benefit during sickness. Antibiotic residue in milk stops growth of starter microorganisms and lactic acid production. The economic loss of factory is caused by lack of activity of starter culture used and fail to obtain fermented products such as yogurt and cheese (Halkman, 1991).The most important jeopardy for milk to be used for yogurt is the presence of antibiotic (Demirci *et al*., 1992). *Streptococcus thermophilus*, starter for yogurt production, is sensitive to 0.01 IU penicillin, as a result it fails curd formation (Demirci *et al*., 1992, Rasic and Kurmann, 1978). Of all antibiotics, the action mechanism of penicillin is well established. Low concentrations of penicillin is bacteriostatic while high concentration is bactericidal. With the effect of penicillin some morphologic, cultural and dying characteristics of bacteria may change and metabolic activity may also be halt (Çetin, 1983).

Present work was carried out to study the changes in physical and chemical properties of yogurt made from milk with different levels of penicillin, in addition to the determination of maximum penicillin and equivalent level of other antibiotics which prevent yogurt formation.

Materials and Methods

Milk to be processed into yogurt was obtained from Atatürk Uni. Agric. Fac. Pilot milk factory.

Penicillin G, to which starter culture for yogurt is the most sensitive and risky for human health (Kosikowki, 1982) was used.

S. thermophilus and *Lactobacillus bulgaricus* were obtained from Christian Hansen's Laboratory.

Preparation of milk with different levels of penicillin: Two ml of physiologic serum was introduced into 1.000 IU/ml penicillin G powder in a bottle, was shaken thoroughly and then it was transferred into 98 ml of physiologic water and shaken thoroughly and then adequate dilutions were prepared. 20 different milk samples with adequate penicillin were prepared in bottles of 150 ml by adding penicillin solutions ranging from 0.01 IU/ml to 0.1 IU/ml. One of the milk samples without penicillin was used as control.

Yogurt production from penicillin containing milk: All the milk samples containing penicillin and control group were heated at 85°C for 25 min and then cooled to 45°C. They were inoculated with pure yogurt culture at 2.5 %. Following incubation at 44°C for 3.5 h yogurt samples were stored at 42°C for 7 days. Analyses were carried out on 1st, 3rd, 5th and 7th days.

Physical and chemical analysis in yogurt samples: Percent acidity was determined as outlined by Kurt *et al*. (1993). pH values were determined with PYE UN˜CAM Model 290 MK-2 pH meter.

Viscosity of experimental yogurts were determined using Poulten RV-8 model rotary viscometer at 50 rpm with spindle number 6 as described by Tamime and Robinson (1985).

Sineresis was evaluated as outlined by Atamer *et al*. (1988).

Statistical Analysis: The data obtained were subjected to analysis of variance, those means that were statistically significant were analyzed according to Duncan's multiple range test. (Steel and Torrie, 1960).

Results and Discussion

The results of Duncan's multiple range test are presented in Table 1. As the penicillin concentration increased, yogurt samples lacked acidity development. The lowest acidity was obtained in yogurt sample with 0.01 IU/ml penicillin. The yogurt samples that contain 0.0045-0.0050 IU/ml penicillin lacked the desired body and structure. This result can account for the fact that yogurt culture failed to grow in high penicillin content. A similar result was also reported by Gönç *et al*. (1995). They reported that high antibiotic content of milk retarded the growth of yogurt culture and resulted in lack of desired yogurt structure.

The lowest pH value (4.10) was determined in control and 0.0005 IU/ml penicillin containing yogurt while the highest (5.53) was determined in 0.01 IU/ml penicillin containing yogurt samples. It was determined that as the penicillin concentration in milk increased yogurt culture failed adequate acid development. The yogurt culture failed curd formation in 0.0005 and 0.0010 IU/ml penicillin containing milk in which the minimum pH values were 5.53 and 5.51 respectively.

The lowest viscosity value (100 cp.) was determined in 0.095 IU/ml and 0.01 IU/ml penicillin containing yogurt samples, while the highest viscosity value (2825 cp.) was found in control group. Özer and Atamer (1994) reported that both the heat treatments of milk and acidity development were required for fine curd formation.

Table 1: Duncan's multiple range test of % acidity, pH, viscosity and syneresis obtained from yogurt samples with different penicillin levels

Dose (IU)	% Acidity	pH	Viscosity	Syneresis
0.0000	1.37a	4.10a	2825a	55.8a
0.0005	1.36b	4.10a	2816a	56.8c
0.0010	1.24c	4.22b	2750ab	56.7b
0.0015	1.21d	4.22b	2725b	56.9d
0.0020	1.21d	4.25c	2608c	56.9d
0.0025	1.20e	4.27d	2550c	57.1e
0.0030	1.18f	4.27d	2408d	57.4f
0.0035	0.18f	4.27d	2417d	57.5g
0.0040	1.17g	4.28e	2400d	58.7h
0.0045	0.10h	4.43f	2300e	59.1j
0.0050	0.98i	4.45f	2200f	59.9k
0.0055	0.96j	4.44f	2150f	60.2l
0.0060	0.93k	4.48g	2175f	60.6m
0.0065	0.92l	4.48g	1850g	60.9n
0.0070	0.83m	4.59h	1942h	61.3o
0.0075	0.80n	4.59h	1408i	61.7p
0.0080	0.75o	5.10i	808j	62.4q
0.0085	0.71p	5.06j	592k	62.6r
0.0090	0.67q	5.25k	200l	63.2s
0.0095	0.59r	5.51r	100m	-
0.0100	0.47s	5.53m	100m	-

(*) Averages (n=8) followed by different letters are statistically different($p<0.05$).

Table 2: The results of Duncan's multiple range test of % acidity, pH, viscosity and syneresis values determined in yogurt samples during storage at 4°C (*)

Storage (days)	%Acidity	pH	Viscosity	Syneresis
1	0.989a	4.59a	1767a	54.3a
3	0.990b	4.57b	1821b	53.8b
5	0.994c	4.56c	1892c	53.4c
7	0.999d	4.55d	1973d	53.0d

(*) Average (n=8) followed by different letters are statistically different ($p<0.05$)

They also stated that lack of either would result in defects in ordered curd structure unique to yogurt. In the same way, in this study it can be concluded that the high penicillin concentration inhibited acid formation and concomitantly retarded adequate gel formation.

The effect of penicillin addition into milk on syneresis varied with dose. The higher the penicillin dose the more the syneresis volume. The least syneresis volume (55-82%) was found in control group. The volume of syneresis is interrelated with concentration of lactic acid. Since curd was not formed, syneresis was not determined in milk samples containing 0.0095 IU/ml and 0.01 IU/ml penicillin.

The results of Duncan's multiple range test of acidity, pH, viscosity and syneresis values determined in yogurt samples during storage period at 4°C are displayed in Table 2.

The acidity of yogurt samples increased gradually during storage period. While the least acidity was determined on 1st day, the highest acidity value was found on 7th day. The acidity values determined on each period were statistically different ($p<0.05$). Koca *et al.* (1995) reported that cold conditions during storage retarded acidity.

The acidity of control yogurt group was developed quicker than antibiotic containing milk samples, of which those that contain antibiotic more than 0.001 IU/ml failed to form curd. More changes in pH were observed in control group yogurt samples during storage period than antibiotic containing yogurt samples. As the amount of antibiotic increased the change in pH decreased, and pH of some high antibiotic samples did not chang. This result can be explained by the fact that yogurt culture were affected by penicillin and failed in acid formation.

The highest viscosity value was observed in control group that stored for 7 days. No apparent change was determined in viscosity of yogurt samples with high level of antibiotic content particularly those that contain 0.0050 IU/ml penicillin or more (Table 2).

The least syneresis was in control group. Syneresis in these samples decreased during storage mostly due to hydration of casein micelles (Ulusoy, 1985). Similar results were reported by Koca *et al.* (1995). During storage syneresis in all yogurt samples was decreased but the decline in syneresis in samples with antibiotic were less than control.

As a result, the research showed that as the dose of penicillin in yogurt milk increased pH and syneresis increased but as the antibiotic level decreased percent acidity and viscosity increased. As the storage period longer, pH and syneresis decreased while percent acidity and viscosity were increased. The maximum penicillin dose that could affect yogurt production was determined as 0.0045 IU/ml, and milk containing more than this, failed desired curd formation.

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