**Effect of nisin on shelf life of low salt Tallaga cheese**

**Ekbal M. A. Ibrahim**, **Azza M. K. Sobeih**

1. Department of Food Control, Faculty of Veterinary Medicine, Moshtohor, Benha University, Moshtohor, Egypt
2. Department of Food Hygiene, Faculty of Veterinary Medicine, Kafr-El-Sheikh, Tanta University, Kafr-El-Sheikh, Egypt

Tallaga cheese was made from reconstituted partially skim milk powder (2% fat) with two salt concentrations (1% and 3%) and then (50, 100, 200 IU/ml) nisin were added. Control groups of both salted Tallaga cheeses were manufactured without addition of nisin. Furthermore, the two types of Tallaga cheese samples were kept in their whey at refrigerator temperature (2-4°C) till signs of spoilage were observed. Periodically, the control and preserved samples were examined chemically (pH and titratable acidity) and bacteriologically (aerobic plate, psychrotrophic, coliform and aerobic sporeformer counts) to determine the influence of nisin on prolongation of their shelf life. Nisin extended the shelf-life of low-salt cheese (1% salt) up to 8 days at concentration 100 IU/ml and up to 10 days for 200 IU/mL, while nisin-free cheese samples were spoiled after the 4th day of refrigeration storage. On the other hand, the shelf life of 3% salt cheese was extended up to 20 days of cold storage by addition of nisin at conc. 100 and 200 IU/ml. In contrast, the cheese samples of control group were deteriorated after the 8th day of refrigerated storage. There were significant differences (p < 0.05) between the chemical and bacteriological profiles of low salt soft cheese as a result of storage time. Actually, the nisin had a significant destructive action on contaminating coliforms and aerobic spore forming bacteria of Tallaga cheese and lead to increase its validity period.

Tallaga cheese or white soft cheese is usually made from heated milk, which is salted to a lower level than Domiati cheese and stored in the refrigerator until consumption within two weeks (Mehanna and Rashed, 1990 and Shehata et al., 1995).

In the last few years, there was an increase in the demand for reduced-sodium food, including cheese especially for people suffering from hypertension (Albernethy, 1979 and Anonymous, 1981). In addition to its preservative effect, sodium chloride exerts a major influence on cheese composition, microflora, texture, flavour and quality (Guinee and Fox, 1993).

Nisin is an antimicrobial biopeptide produced by *Lactococcus lactis* subsp. *lactis*, produced naturally in milk and widely employed as food preservative (Bender and Bender, 1995).

Fortunately, it is non toxic, heat stable antibiotic, has a good storage stability, doesn’t affect the natural product flavour or cause bad flavour and is destroyed by digestive enzymes in human (Sivasankar, 2002).

The possibility of using reconstituted dried partially skim milk for soft cheese manufacture aiming for improving body, texture (organoleptic characters), functional properties and nutritional values of the produced cheese by raising its total solid content is recommended (Abou-Donia, 1991 and El-Sheikh et al., 2001). On the other hand, Chen et al., (1991) and Zommar (2000) found that the protein content of cheese increased by lowering it is fat content and consequently cheese becomes of high nutritive value. Additionally, milk fat (saturated fat) is associated with health problems including; high blood cholesterol, coronary heart disease and some kinds of cancer (USD HHS, 1988 and Giese, 1996). Milk fat was also reported to reduce the antimicrobial effect of nisin (Bhatti et al., 2004 and Grade et al., 2004).

Therefore, the present work was carried out to study the effect of nisin at different concentration (50, 100, 200, IU/ml) as a biopreservative on shelf life of experimentally manufactured Tallaga cheese with low fat (2%) and low salt (1% and 3% sodium chloride) during storage at refrigerator temperature.

**Material and Methods**

Fresh, unripened, low salt white soft cheese (Tallaga cheese) was manufactured as described by Mehanna and Rashed (1990) and El-Sheikh et al. (2001) with slight modification as follows:

A total of 16 kg of reconstituted partially skim milk powder (2% fat) were heated at 42°C,
where CaCl$_2$ (0.02%) and rennet powder (3g /100 kg milk) were added. The bulk volume of cheese mix were divided into two portions, the first 8Kg were salted with 1% sodium chloride and the other portion with 3%, sodium chloride. Each portion (8kg) was subdivided into 4 patches (2kg each), then nisin ([AGCH- 9470 Bucks (1000 IU/mg)] was added to each patch (2kg) at concentration of 0, 50, 100, 200 IU/ml respectively.

Each 2kg of cheese mix were kept at 38-42°C for 2-3 hours till curd formation, then kept to drain for 24-36 hours in previously sterilized stainless steel frames lined with cheese cloth. The formed cheese was packaged in pre-sterilized glass jars and kept in their whey at refrigerator temperature (2-4°C). The cheese samples were examined fresh (zero time) and at intervals of 2, 4, 6, 8 and 10 days for 1% salted cheese and at 4, 8, 12, 16, 18 and 20 days for 3% salted cheese till the sings of spoilage were observed. The cheese samples were examined chemically for titratable acidity (T.A%) and pH according to Pearson (1984) and bacteriologically after preparation of the sample as described by BSI (1984).

The bacteriological examination includes determination of Aerobic plate count (APC), psychrotrophic bacterial count and coliform count as described by APHA (1992) as well as aerobic spore former count as described by (Collins and Lyne, 1984).

Results and Discussion

Table (1): Effect of nisin on chemical profile of low salt Tallaga cheese with 1% salt.

<table>
<thead>
<tr>
<th>Storage time</th>
<th>Nisin (IU/ml)</th>
<th>T.A. %</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Zero time</td>
<td>0.05</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>2 days</td>
<td>0.05</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>4 days</td>
<td>0.06</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>6 days</td>
<td>?</td>
<td>?</td>
<td>0.04</td>
</tr>
<tr>
<td>8 days</td>
<td>?</td>
<td>?</td>
<td>0.06</td>
</tr>
<tr>
<td>10 days</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

Control = Cheese without nisin.  ? = Samples organoleptically revealed signs of deterioration.  * = Significant differences (p < 0.05)

Table (2): Effect of nisin on chemical profile of low salt Tallaga cheese with 3% salt.

<table>
<thead>
<tr>
<th>Storage time</th>
<th>Nisin (IU/ml)</th>
<th>T.A. %</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Zero time</td>
<td>0.05</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>4 days</td>
<td>0.06</td>
<td>0.06</td>
<td>0.05</td>
</tr>
<tr>
<td>8 days</td>
<td>0.07</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>12 days</td>
<td>?</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>16 days</td>
<td>?</td>
<td>?</td>
<td>0.07</td>
</tr>
<tr>
<td>20 days</td>
<td>?</td>
<td>?</td>
<td>0.11</td>
</tr>
</tbody>
</table>

Control = Cheese without nisin.  ? = Samples organoleptically revealed signs of deterioration.  * = Significant differences (p < 0.05)
### Table (3): Effect of nisin on bacteriological profile of Tallaga cheese with 1% salt.

<table>
<thead>
<tr>
<th>Storage time*</th>
<th>Control 50</th>
<th>100</th>
<th>200*</th>
<th>Control 50</th>
<th>100</th>
<th>200*</th>
<th>Control 50</th>
<th>100</th>
<th>200*</th>
<th>Control 50</th>
<th>100</th>
<th>200*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero time</td>
<td>4.5 x 10⁶</td>
<td>6 x 10⁵</td>
<td>6.5 x 10⁵</td>
<td>5 x 10⁶</td>
<td>1.5 x 10⁵</td>
<td>1.1 x 10⁵</td>
<td>8.3 x 10⁵</td>
<td>4 x 10⁶</td>
<td>5 x 10⁵</td>
<td>1.1 x 10⁵</td>
<td>1 x 10⁵</td>
<td>1 x 10⁵</td>
</tr>
<tr>
<td>2 days</td>
<td>7.7 x 10⁵</td>
<td>3.4 x 10⁵</td>
<td>4.2 x 10⁵</td>
<td>8.2 x 10⁴</td>
<td>8.1 x 10⁵</td>
<td>4.5 x 10⁵</td>
<td>2.8 x 10⁵</td>
<td>1.2 x 10⁴</td>
<td>8.9 x 10⁴</td>
<td>1 x 10⁵</td>
<td>2 x 10⁴</td>
<td>1.1 x 10⁵</td>
</tr>
<tr>
<td>4 days</td>
<td>8.5 x 10⁷</td>
<td>2.4 x 10⁶</td>
<td>1.2 x 10⁷</td>
<td>7.3 x 10⁶</td>
<td>1 x 10⁶</td>
<td>5.7 x 10⁶</td>
<td>3 x 10⁶</td>
<td>1 x 10⁵</td>
<td>8.3 x 10⁵</td>
<td>1.4 x 10⁵</td>
<td>7.5 x 10⁵</td>
<td>1.5 x 10⁵</td>
</tr>
<tr>
<td>6 days</td>
<td>?</td>
<td>?</td>
<td>4.7 x 10⁶</td>
<td>1.1 x 10⁶</td>
<td>?</td>
<td>?</td>
<td>9.6 x 10⁵</td>
<td>1 x 10⁵</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>2.1 x 10³</td>
</tr>
<tr>
<td>8 days</td>
<td>?</td>
<td>?</td>
<td>7 x 10⁷</td>
<td>4.5 x 10⁶</td>
<td>?</td>
<td>?</td>
<td>1 x 10⁶</td>
<td>4.8 x 10⁵</td>
<td>?</td>
<td>?</td>
<td>2 x 10²</td>
<td>1 x 10²</td>
</tr>
</tbody>
</table>

Control = Cheese without nisin. * = Significant difference (P < 0.05) ? = Samples organoleptically revealed signs of deterioration. ND = Not detected

### Table (4): Effect of nisin on bacteriological profile of Tallaga cheese with 3% salt.

<table>
<thead>
<tr>
<th>Storage time*</th>
<th>Control 50</th>
<th>100</th>
<th>200*</th>
<th>Control 50</th>
<th>100</th>
<th>200*</th>
<th>Control 50</th>
<th>100</th>
<th>200*</th>
<th>Control 50</th>
<th>100</th>
<th>200*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero time</td>
<td>3.2 x 10⁷</td>
<td>1.3 x 10⁶</td>
<td>6 x 10⁵</td>
<td>4.1 x 10⁶</td>
<td>5.5 x 10⁵</td>
<td>4.6 x 10⁵</td>
<td>4.2 x 10⁵</td>
<td>1.2 x 10⁵</td>
<td>7 x 10⁴</td>
<td>2.1 x 10⁴</td>
<td>1.5 x 10⁴</td>
<td>1.4 x 10⁴</td>
</tr>
<tr>
<td>4 days</td>
<td>6 x 10⁷</td>
<td>3 x 10⁵</td>
<td>1 x 10⁵</td>
<td>1 x 10⁵</td>
<td>2.7 x 10⁵</td>
<td>2.2 x 10⁵</td>
<td>1.5 x 10⁴</td>
<td>1.2 x 10⁴</td>
<td>4 x 10³</td>
<td>3 x 10²</td>
<td>3 x 10²</td>
<td>5 x 10²</td>
</tr>
<tr>
<td>8 days</td>
<td>2.1 x 10⁷</td>
<td>6.1 x 10⁶</td>
<td>2.9 x 10⁷</td>
<td>1.8 x 10⁵</td>
<td>5.4 x 10⁵</td>
<td>1.1 x 10⁵</td>
<td>5.4 x 10⁴</td>
<td>1.1 x 10⁵</td>
<td>4 x 10²</td>
<td>3 x 10⁷</td>
<td>1 x 10²</td>
<td>3 x 10⁶</td>
</tr>
<tr>
<td>12 days</td>
<td>?</td>
<td>8.3 x 10⁵</td>
<td>1.5 x 10⁶</td>
<td>7 x 10⁵</td>
<td>?</td>
<td>3.6 x 10⁶</td>
<td>6 x 10⁵</td>
<td>1 x 10⁵</td>
<td>?</td>
<td>3 x 10⁷</td>
<td>2 x 10⁷</td>
<td>4 x 10⁷</td>
</tr>
<tr>
<td>16 days</td>
<td>?</td>
<td>5.6 x 10⁶</td>
<td>3.7 x 10⁶</td>
<td>?</td>
<td>?</td>
<td>1.4 x 10⁶</td>
<td>8.3 x 10⁵</td>
<td>?</td>
<td>?</td>
<td>2 x 10⁷</td>
<td>1 x 10⁷</td>
<td>?</td>
</tr>
<tr>
<td>20 days</td>
<td>?</td>
<td>8.2 x 10⁷</td>
<td>1.8 x 10⁷</td>
<td>?</td>
<td>?</td>
<td>6.4 x 10⁶</td>
<td>1.8 x 10⁶</td>
<td>?</td>
<td>?</td>
<td>7 x 10⁷</td>
<td>2 x 10⁷</td>
<td>?</td>
</tr>
</tbody>
</table>

Control = Cheese without nisin. * = Significant difference (P < 0.05) ? = Samples organoleptically revealed signs of deterioration. ND = Not detected
Inspection of Table (1, 2) revealed that the T. A% of control and 50, 100 as well as 200 IU/ml nisin treated cheese for (1% salted cheese) at the day of manufacturing were 0.05, 0.03, 0.03 and 0.01, but were 0.05, 0.05, 0.04 and 0.04 (for 3% salted cheese) at nisin conc. of 0, 50, 100 & 200 IU/ml respectively.

Increasing T. A% of the examined cheese samples, were relatively low as the samples were stored at 5-7°C (Hamed et al., 1992). The T. A% reached 0.06 and 0.05 % for nisin –free cheese and cheese with 50 IU/mL nisin, respectively at the 4th day of refrigeration. The T. A% was 0.06 for salted cheese (1%) treated with 100 and 200 IU/ml nisin at the 8th and 10th day of manufacture, while for 3% salted cheese, T. A% reached 0.07, 0.07, 0.11 and 0.10 for cheese treated with 0, 50, 100 and 200 IU/ml nisin at the 8th, 12th, 20th and 20th day of refrigeration (Table 2).

During storage, the T. A% of all cheese samples were increased as the storage period progressed, while the pH values showed an opposite trend. These results agreed with those recorded by EL-Sissi (1996) and El-Abd et al., (2003).

On the other hand, the pH values decreased gradually by increasing the sodium chloride concentration as a result of increasing the acidity (Ramet et al., 1983 and Abou-El-Nour, 1998). This can be attributed to a base exchange reaction of Na⁺ for free NH₄⁺ groups in the casein micelles with liberation of H⁺ (Ling, 1963).

The pH values at zero time for nisin treated cheese samples (with 1% salt) at conc. 0, 50, 100 and 200 IU/ml were 6.84, 6.83, 6.83 and 6.88, respectively (Table 1), while the pH decreased to 6.56 and 6.47 at the 4th day for control and 50 IU/ml nisin treated cheese, but 6.03 and 5.85 at the 8th and 10th days of storage at 2-4°C for 100 and 200 IU/ml nisin treated cheese, respectively. The pH values for fresh Tallaga cheese samples with 3% salt were 6.72, 6.72, 6.74 and 6.77 for 0, 50, 100 and 200 IU/ml nisin treated cheese samples, respectively and decreased to 6.42 and 6.19 at the 8th and 12th, days for control and 50 IU/ml nisin treated samples, but to 5.38 and 5.85 at the 20th day for 100 and 200 IU/ml nisin treated cheese respectively.

Nisin activity is enhanced at pH ranged from 5 to 6.4. (Beard et al., 1999 and Mansour et al., 1999)

Concerning to the total bacterial counts for 1 % salted Tallaga cheese samples, Table (3) shows that APC at the day of manufacturing were 4.5 x 10⁵, 6x 10⁵, 6.5 x 10⁵ and 5 x 10⁵ cfu/g for 0, 50, 100, 200 IU/ml nisin treated cheese samples respectively. The cheese samples became organoleptically deteriorated when the APC reached 8.5 x 10⁵ and 2.4 x 10⁶ cfu/ml at the 4th day of storage at 2-4°C for control and nisin treated cheese at level 50 IU/ml respectively, while for nisin treated cheese at conc. 100 and 200 IU/ml, the shelf life of 1% salted cheese extended to the 8th and 10th day of refrigerated storage when APC reached 7x 10⁷ and 3x 10⁷ cfu/g respectively.

Table (4) shows that the APC (cfu/g) for 3% salted cheese were 3.2 x 10⁵, 1.3 x 10⁵, 6x 10⁵ and 4.1 x 10⁴ for 0, 50, 100 and 200 IU/ml nisin treated cheese respectively at zero time and the shelf life extended to the 8th for control cheese samples when APC increased up to 2.1 x 10⁶ and to the 12th day for 50IU/ml nisin treated cheese when the APC reached 8.3 x 10⁵, while, for 100 and 200 IU/ml nisin treated cheese the shelf life extended to the 20th day of refrigeration as APC reached to 8.2 x 10⁷ and 1.8 x 10⁷ respectively.

Nisin is an inhibitory factor against the developed acidity in cheese (Johnson et al., 1998). Additionally, low-fat cheese always had lower pH value than fresh full–fat cheeses (Patel et al., 1986 and Zommar, 2000). The gradual decreasing of pH values may be referred to the gradual increasing of salt concentration and dry matter that accompanied with moisture losses (Zommar, 2000; El-Sheikh et al., 2001 and Abou El-Nour et al., 2004). Nisin activity is enhanced at pH ranged from 5 to 6.4. (Beard et al., 1999 and Mansour et al., 1999)

Concerning to the total bacterial counts for 1 % salted Tallaga cheese samples, Table (3) shows that APC at the day of manufacturing were 4.5 x 10⁵, 6x 10⁵, 6.5 x 10⁵ and 5 x 10⁵ cfu/g for 0, 50, 100, 200 IU/ml nisin treated cheese samples respectively. The cheese samples became organoleptically deteriorated when the APC reached 8.5 x 10⁵ and 2.4 x 10⁶ cfu/ml at the 4th day of storage at 2-4°C for control and nisin treated cheese at level 50 IU/ml respectively, while for nisin treated cheese at conc. 100 and 200 IU/ml, the shelf life of 1% salted cheese extended to the 8th and 10th day of refrigerated storage when APC reached 7x 10⁷ and 3x 10⁷ cfu/g respectively.

Table (4) shows that the APC (cfu/g) for 3% salted cheese were 3.2 x 10⁵, 1.3 x 10⁵, 6x 10⁵ and 4.1 x 10⁴ for 0, 50, 100 and 200 IU/ml nisin treated cheese respectively at zero time and the shelf life extended to the 8th for control cheese samples when APC increased up to 2.1 x 10⁶ and to the 12th day for 50IU/ml nisin treated cheese when the APC reached 8.3 x 10⁵, while, for 100 and 200 IU/ml nisin treated cheese the shelf life extended to the 20th day of refrigeration as APC reached to 8.2 x 10⁷ and 1.8 x 10⁷ respectively.
adverse effect on microbial growth (Guinee and Fox, 1993 and Sivasankar, 2002).

There was a synergistic effect between the sodium chloride and the added nisin at level 200 IU/ml, resulting in 5-log reduction of the bacterial count (Terebiznik et al., 2002).

At the same trend, psychrotrophic bacteria increased during progressive storage coming nearly parallel to APC.

Reviewing Table (3, 4) the psychrotrophic count for 0, 50, 100, 200 IU/ml nisin treated cheese were 1.5 x 10^5, 1.1 x 10^5, 8.3 x 10^4 and 4 x 10^4 cfu/g (for 1% salted cheese) and 5.5 x 10^5, 4.6 x 10^5, 4.2 x 10^5 and 1.2 x 10^6 cfu/g (for 3% salted cheese) at the day of manufacturing.

For control cheese samples with 1% salt, psychrotrophic count (cfu/g) increased to 1 x 10^6 at the 4th day of storage at 2-4°C. At the 4th, 8th and 10th days of refrigeration the psychrotrophic count reached 5.7 x 10^5, 1 x 10^6 and 3.4 x 10^5 for 50, 100 and 200 IU/ml nisin treated cheese samples (Table 3), also the count reached to 5.4 x 10^5, 3.6 x 10^5, 6.4 x 10^4 and 1.8 x 10^4 for 0, 50, 100 and 200 IU/ml nisin treated cheese with 3% NaCl (Table 4).

The high psychrotrophic count of the examined Tallaga cheese samples may be attributed to the high APC and the bacteriostatic activity of nisin on Gram-positive but not on Gram-negative bacteria (Thomas et al., 1998 and Masschalck et al., 2001).

Regarding coliforms, data in (Table 3) show clearly that the count (MPN/g) for 1% salted cheese samples, were 5x 10^3, 1.1 x 10^3, 1x10^2 and 1x10^2 at zero time and decreased to 8.3 x 10^2, 1.4 x 10^3, 2x 10^2 and 2 x 10 for 0, 50, 100 and 200 IU/ml nisin treated cheese at the time of which the signs of cheese deterioration appeared.

For 3% salted Tallaga cheese samples, the coliform counts (MPN/g) were 7x 10^4, 2.1 x 10^5, 1.5 x 10^5 and 1.4 x 10^5 at zero time and decreased to 1.1 x 10^2, 3 x 10, 7 and 2 for 0, 50, 100 and 200 IU/ml nisin treated cheese at the 8th, 12th, 20th and 20th days of refrigeration. Lower findings were reported by El-Abd et al. (2003).

The high coliform counts in the examined cheese samples at zero time may be attributed to the initial coliform count of the skim-milk powder used in cheese manufacture. Hegazi (1972) stated that presence of salt at rate less than 9% could not prevent the growth and activity of coliform in Domiati cheese. This suggestion confirmed the effect of nisin on coliform bacteria.

El-Abd et al. (2003) recommended the addition of mixed culture starter of mesophilic Lactococci and Lactobacillus casei to decrease the coliform count in low-salt cheese as a result of the attained high acidity and production of some antimicrobial substances.

Nisin has a wide spectrum activity against most Gram-positive bacteria, including spore formers (Zottola and Smith, 1993 and Delves and Gasson, 1994). It is recommended to be added to low-fat foods intended for heating to reduce the thermal resistance of selected bacterial spores while maintaining the product quality, functionality and shelf stability (Dufrenne et al., 1995; Beard et al., 1999 and Wandling et al., 1999).

In this respect, Table (3, 4) declared that the aerobic spore formers (cfu/g) for 1% salted cheese samples with 0, 50, 100 and 200 IU/ml nisin were 7.1 x 10^5, 6x 10^4, 5.3 x 10^4 and 1 x 10^4, while for 3% salted cheese samples were 5 x 10^5, 3x 10^4, 2x 10^3 and 2 x 10^2 at the time of manufacture. Regarding to 1% salted cheese stored at 2-4°C, the count of aerobic spore formers decreased to 6.5 x10^3 and 5.5 x 10^2 for control and 50 IU/ml nisin treated cheese samples, respectively. After 8 and 10 days of storage for 100 and 200 IU/ml nisin treated cheese samples, the count reached 4.3 x 10^2 and 2 x 10 cfu/g respectively (Table 3).

For 3% salted cheese after 8 and 12 days of storage, the aerobic spore forming count decreased to 1 x 10^2 and 6 x 10 cfu/g for nisin-free cheese and nisin treated (50 IU/ml). While, Tallaga cheese samples with 100 and 200 IU/ml nisin, the shelf life of such cheese samples extended to 20th days of cold storage without any aerobic spore forming count.

In general, nisin had significant effect (p< 0.05) on bacteriological aspect of Tallaga cheese during refrigeration. The spore formers decreased as the pH value increased, showing total inhibition at pH 6.0 (Mansour et al., 1999).

The combination of reduced heat treatment (RHT) of milk at 117°C for 2 seconds, nisin and low storage temperatures were suggested to be potential against Gram-positive spore-forming bacteria and to extend shelf life of dairy products (Wirjantoro et al., 2001).

From the foregoing results, this study concluded that sodium chloride salt has great effect on controlling the chemical and bacteriological deterioration of Tallaga cheese especially at concentration of 3%. Such cheese
can be consumed safely up to 8 days while those cheese samples with 1% NaCl can be consumed till 4 days only of refrigeration. Incorporation of nisin prolonged the shelf life of 1% salted cheese up to 8 days at conc. 100 IU/ml and up to 10 days at conc. 200 IU/ml. On the other hand nisin extended the shelf life of 3% salted cheese up to 20 days at refrigeration (2-4°C).

References
BSI “British Standards Institution” (1984): Microbiological examination of dairy product. BS 4285: section 2.1


