“RIPENING OF WHITE CHEESE IN LARGE-CAPACITY BRINE TANKS”

Sakkas L.¹
Zoidou E.¹
Moatsou G.¹
Moschopoulou E.¹
Papatheodorou K.²
Massouras Th.¹

¹AGRICULTURAL UNIVERSITY OF ATHENS
DPT OF FOOD SCIENCE AND HUMAN NUTRITION
LABORATORY OF DAIRY SCIENCE
²SHM HELLAS AEBE; PILION TYROKOMIKI
WHITE BRINED CHEESES

- White soft cheeses ripened and preserved in brine
- Curds not heated
- Soft but sliceable
- Acid and a bit salty flavour

Greek legislation:
- Moisture → ≤ 58%
- Fat in dry matter → ≥ 35%
WHITE BRINED CHEESES

• Ripening of Greek white cheese in brine:
  1. wooden barrels (≈ 50 Kg)
  2. tin containers (≈ 17-18 Kg)
• Size not defined by Greek legislation
• Small pieces: packed and sold separately

• Large-capacity (≈ 500 Kg) brine tanks very helpful
• Cheese making in brine tanks not very common
• In Greece, mainly big plants use tanks (cheese repackaging)
AIM OF THE PROJECT

• Compare characteristics of white brined cheese ripened in tanks and cheese ripened in conventional containers

• Two types of containers used:
  a) 500 Kg stainless steel tanks (INOX DESIGN KATERIS A.E)
  b) 17 Kg tin containers
Cheese manufacture

- Three cheese making trials - same method and conditions
- SHM HELLAS AE BE: Pilion Tyrokomiki Cheese Plant
- Ewes’ milk from the Magnesia Region of Greece
- Period: 9/7/2012 – 16/7/2012
Cheese manufacture

- Milk pasteurization
- Cooling to 35°C
- Cheese coagulation
- Curd cutting-Draining
  - Dry salting
- Accumulation-Turning over-Placement on pallets to drain
  - After 24h placement of cheese blocks in tins and tanks
    - Dry salting and brine addition
Cheese manufacture

Placement of cheese blocks in tanks
Cheese manufacture

Addition of brine
Cheese manufacture

Tank filling with brine over cheese surface

Placement of silicon cord to seal the lid
Cheese manufacture

Adjustment of internal lid

Adjustment of external lid
Cheese manufacture

- Ripening room (20°C): 8 days
- Cold room (1°C): completion of ripening and preservation until distribution
- Cheese and brine sampling: days 1, 8, 60, 90 and 180

Sealing of lid with latch-keys
MATERIALS AND METHODS

• Physicochemical analyses
  ✓ pH
  ✓ Total solids-moisture content (IDF 4A:1982)
  ✓ Fat content (IDF 5/ISO 1735:2004)
  ✓ Evaluation of proteolysis by Kjeldahl (ISO 17837/IDF 25:2008) and HPLC (Nega and Moatsou, 2012)
  ✓ NaCl content (ISO 5943:2006)
  ✓ Ash content (IDF 27:1964)
  ✓ Mineral determination (Ca, Mg, Na, K) by the atomic absorption spectrometric (AAS) method (IDF 154:1992)
  ✓ Fatty acid composition (FAMES) (IDF 182:1999, IDF 184:1999)
  ✓ Aroma compound of cheese by SPME GC-MS (IDF 172:1995, Massouras et al, 2006)
MATERIALS AND METHODS

• Microbiological analyses
  ✓ Total aerobic counts  *(IDF 100B:1991)*
  ✓ Yeasts and molds  *(IDF 94B:1991)*

• Textural analyses
  ✓ Determination of **hardness, cohesiveness, adhesiveness, elasticity, gumminess and chewiness** using a Shimadzu Testing Machine, AGS–500NG  *(Kaminarides and Stachtiaris, 2000)*

• Sensory evaluation
  ✓ Colour
  ✓ Flavour
  ✓ Odour
  ✓ Body-texture
  ✓ Maturity level
Mean pH values of cheeses during ripening and preservation in tanks and tins
Moisture content of cheeses during ripening and preservation in tanks and tins
Fat content of cheeses during ripening and preservation in tanks and tins
Physicochemical characteristics

- **NaCl**
  ✓ NaCl content and salt-to-moisture ratio were similar in both cheeses (2.74 – 3.24 %)

- **Ash**
  ✓ No significant differences (3.29 – 3.81%)

- **Protein content of brine**
  ✓ Lower content in tank brine → lower protein loss of tank cheese
Mean physicochemical composition of cheeses during ripening and preservation in tanks (T) and tins (M). Average ± standard deviation

<table>
<thead>
<tr>
<th>Content(%)</th>
<th>1</th>
<th>8</th>
<th>60</th>
<th>90</th>
<th>180</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
<td>M</td>
<td>T</td>
<td>M</td>
<td>T</td>
</tr>
<tr>
<td>Moisture</td>
<td>56,29</td>
<td>52,96</td>
<td>55,13</td>
<td>54,32</td>
<td>53,04</td>
</tr>
<tr>
<td></td>
<td>±1,30</td>
<td>±1,00</td>
<td>±1,53</td>
<td>±0,57</td>
<td>±1,39</td>
</tr>
<tr>
<td>Fat</td>
<td>22,79</td>
<td>23,47</td>
<td>23,23</td>
<td>23,84</td>
<td>24,25</td>
</tr>
<tr>
<td></td>
<td>±1,86</td>
<td>±0,92</td>
<td>±0,62</td>
<td>±0,87</td>
<td>±1,21</td>
</tr>
<tr>
<td>Protein</td>
<td>16,23</td>
<td>16,15</td>
<td>15,76</td>
<td>15,90</td>
<td>16,09</td>
</tr>
<tr>
<td></td>
<td>±1,46</td>
<td>±0,20</td>
<td>±0,63</td>
<td>±0,19</td>
<td>±0,35</td>
</tr>
<tr>
<td>NaCl</td>
<td>0,23</td>
<td>2,74</td>
<td>2,56</td>
<td>2,94</td>
<td>2,77</td>
</tr>
<tr>
<td></td>
<td>±0,03</td>
<td>±0,62</td>
<td>±0,43</td>
<td>±0,30</td>
<td>±0,29</td>
</tr>
<tr>
<td>Ash</td>
<td>1,45</td>
<td>3,38</td>
<td>3,30</td>
<td>3,44</td>
<td>3,29</td>
</tr>
<tr>
<td></td>
<td>±0,06</td>
<td>±0,36</td>
<td>±0,34</td>
<td>±0,32</td>
<td>±0,23</td>
</tr>
</tbody>
</table>
Nitrogenous fractions of cheeses (KJELDAHL)

Ratios of nitrogenous fractions of cheeses during ripening and preservation in tanks (T) and tins (M). Average ± standard deviation

<table>
<thead>
<tr>
<th>Age of cheese (days)</th>
<th>Type of container</th>
<th>% WSN/TN</th>
<th>% TCA-N/TN</th>
<th>% TCA-N/WSN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>8,19 ± 0,88</td>
<td>3,84 ± 0,15</td>
<td>47,31 ± 6,34</td>
</tr>
<tr>
<td>8</td>
<td>T</td>
<td>10,41 ± 2,46</td>
<td>6,33 ± 1,23</td>
<td>61,35 ± 5,28</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>10,29 ± 2,51</td>
<td>7,31 ± 1,53</td>
<td>71,50 ± 6,19</td>
</tr>
<tr>
<td>60</td>
<td>T</td>
<td>9,48 ± 1,80</td>
<td>6,00 ± 0,78</td>
<td>64,16 ± 8,34</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>9,99 ± 2,45</td>
<td>6,82 ± 1,69</td>
<td>68,20 ± 2,71</td>
</tr>
<tr>
<td>90</td>
<td>T</td>
<td>10,67 ± 2,84</td>
<td>8,05 ±2,40</td>
<td>75,61 ± 9,05</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>11,69 ± 2,30</td>
<td>10,03 ± 1,07</td>
<td>87,07 ± 9,92</td>
</tr>
<tr>
<td>180</td>
<td>T</td>
<td>9,99 ± 3,81</td>
<td>8,97 ± 2,72</td>
<td>91,76 ± 11,56</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>10,21 ± 4,89</td>
<td>9,30 ± 3,31</td>
<td>94,40 ± 11,43</td>
</tr>
</tbody>
</table>
Nitrogenous fractions of cheeses and brines (HPLC)

Changes of \((55-100 \text{ min portion})/(10-55 \text{ min portion})\) ratio of the respective areas in chromatogram of HPLC analysis of brines and nitrogenous fractions of cheeses during ripening and preservation in tanks and tins.
## Fatty acid composition

<table>
<thead>
<tr>
<th>Fatty acid class</th>
<th>Cheese in TANKS</th>
<th>Cheese in TINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFA</td>
<td>73.94 - 77.71</td>
<td>74.50 - 77.27</td>
</tr>
<tr>
<td>MUFA</td>
<td>29.05 - 31.01</td>
<td>29.34 – 31.38</td>
</tr>
<tr>
<td>PUFA</td>
<td>2.92 - 4.72</td>
<td>2.38 – 3.53</td>
</tr>
<tr>
<td>(MUFA+PUFA)</td>
<td>31.97 - 35.73</td>
<td>31.72 – 34.91</td>
</tr>
<tr>
<td>SFA/(MUFA+PUFA)</td>
<td>2.07 – 2.39</td>
<td>2.13 - 2.44</td>
</tr>
<tr>
<td>Athiromatic index</td>
<td>2.48 – 2.87</td>
<td>2.56 - 2.88</td>
</tr>
<tr>
<td>(C12+4*C14+C16)/(MUFA+PUFA)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Aroma compound profile

• 156 aroma compounds identified in volatile fraction:
  ✓ alcohols
  ✓ aldehydes
  ✓ ketones
  ✓ esters
  ✓ organic acids
  ✓ furans
  ✓ hydrocarbons

• Alcohols and esters most abundant (number, quantity)
• No differences between two types of cheese
Microbiological characteristics

Mean counts of yeasts-molds and mean total aerobic counts (log10 cfu/g) of cheese and brine during ripening and preservation in tanks (T) and tins (M)
Mineral composition of cheese and brine (mg/100g) at day 60
Textural properties of cheese (hardness, elasticity, cohesiveness) at day 60
## Sensory evaluation

<table>
<thead>
<tr>
<th>AGE OF CHEESE (DAYS)</th>
<th>TYPE OF CONTAINER</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>TANK</td>
<td>8.90 ± 0.08</td>
</tr>
<tr>
<td></td>
<td>TIN</td>
<td>8.73 ± 0.18</td>
</tr>
<tr>
<td>90</td>
<td>TANK</td>
<td>9.10 ± 0.46</td>
</tr>
<tr>
<td></td>
<td>TIN</td>
<td>9.15 ± 0.20</td>
</tr>
<tr>
<td>180</td>
<td>TANK</td>
<td>8.27 ± 0.55</td>
</tr>
<tr>
<td></td>
<td>TIN</td>
<td>8.43 ± 0.46</td>
</tr>
</tbody>
</table>
CONCLUSIONS

• No differences in main characteristics between cheese ripened and preserved for 180 days in large-capacity brine tanks (500 Kg) and cheese ripened in 17 Kg tin containers with same method and conditions.

• With regard to important characteristics for quality classification according to legislation (moisture and fat content) 60-day cheese ripened and preserved in large-capacity tanks met the Greek standards for grade A white brined cheeses.

• Big plants should be able to use large-capacity brine tanks since cheese characteristics are not affected negatively and handling and repackaging of cheese are facilitated.
ACKNOWLEDGEMENTS

• The authors would like to thank «INOX DESIGN KATERIS A.E» and ”SHM HELLAS AEBE: Pilion Tyrokomiki” for financing this project, especially Mr. Kostas Papatheodorou and Mrs. Philitisa Chatzitriantafyllou for cheese manufacture, cheese sampling and their essential assistance throughout the project period.