Effect of Cooking and Vacuum Packaging on Chemical Composition and Sensory Characteristics of White Soft Cheese

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Abstract: The effect of cooking and vacuum packaging on weight, chemical composition and sensory characteristics of white soft cheese was studied. Cheese was manufactured from pasteurized (72°C/1 min) milk, with the addition of 1% (w/w) starter culture (Lactococcus lactis ssp. lactis and Lactococcus lactis ssp. cremoris), 0.02% (w/w) CaCl2 and rennet (1 tablet/100 lb milk). Curd was cut into small cubes and immersed in salted whey (4% NaCl) for 48 hr, and then cheese was divided into four parts, the first of which was left control, while the second, third and fourth trials were vacuum packaged in plastic pouches. The third and fourth parts were cooked at 38°C and 40°C respectively, and all trials were stored at 5°C for 45 days. Weight, chemical composition and sensory characteristics were determined on cheese. Results indicated that control cheese (no cooking, no vacuum packaging) gained weight, while C0P1 lost more weight. Fat, protein, total solids, ash and acidity were high in cooked vacuum packaged cheese than control. Cooked vacuum packaged cheese had better flavour, taste, body and overall acceptability.

Key words: White soft cheese, Cooking, Vacuum packaging, Chemical composition, Sensory characteristics

INTRODUCTION

Sudanese white cheese is a pickled cheese made traditionally from cow milk in the rural areas. The cheese is usually made without pasteurization of milk or addition of starter culture which might lead to spoilage during storage [1].

Vacuum packaging is the procedure that results in a reduced oxygen level in a sealed package. The anaerobic environment of vacuum packaging prevents the growth of spoilage microorganisms especially aerobic ones which are responsible for off-odors, slime and texture changes [16].

Vacuum packaging has been satisfactorily applied to varieties of cheeses such as Cheddar, Provolone, Whey cheese, Turkish Kasar cheese, Halloumi cheese and Greek whey cheese [1,6,14,18,19,23].

Reduction of weight loss due to water evaporation and excessive rind formation, prevention of mold development and mite attack, unnecessary control of relative humidity in ripening rooms and labour reduction during cheese storage are the main advantages claimed for curing procedure. However, defects due to excessive gas production by starter bacteria or by contaminating heterofermentative lactobacilli [22] may arise in packaged cheese.

Scalding or cooking ensues the protein matrix to shrink, and the increase in temperature speeds up the metabolism of bacteria, enclosed within the curd, that causes lactic acid production to increase and the pH to decline and this assists in shrinking the particles to expel more whey. Lactose and salts (in whey solution) retained in the curd are proportional to the amount of moisture in the curd, and also the calcium phosphate associated with the casein in the colloidal state gradually becomes solubilized as the pH falls [23].

The objective of this study was to determine weight, chemical composition and sensory characteristics of white cheese packaged under vacuum.

MATERIALS AND METHODS

Cheese Making: Four trials of white soft cheese were manufactured from pasteurized (72°C/1 min) milk, inoculated with 1% frozen concentrated starter culture (1:1 combination of Lactococcus lactis ssp. lactis and Lactococcus lactis ssp. cremoris) dissolved in tap water at room temperature and added to milk at 40°C as direct set vat (DVS). After 30 min, rennet (1 tablet/100 Lb milk) and CaCl2 (0.02% w/w) were added, and the mixture was stirred for 5 min and left undisturbed to develop a curd. The weight of the fresh
curd was determined. Curd was cut into small cubes (2.5X2.5 X2.0 cm) and the third and fourth trials were cooked for 30 min at 38°C and 40°C respectively. Cheese was pressed overnight and salted (4% NaCl w/w) for 48 hr in pasteurized whey (at 72°C/ 1 min). The second, third and fourth trials were vacuum packaged in plastic pouches (Multivac A 20015, Wolfartschwenden, Germany), while the first trial was packed in the salted whey in glass bottles. Cheese was stored in the refrigerator at 5°C for 45 days. Chemical analysis, sensory evaluation and weight were determined.

Determination of Chemical Composition: Fat, protein, total solids, ash contents and titratable acidity were determined according to AOAC [1].

Sensory Evaluation: A panel of 10 untrained panelists were chosen to judge on the quality of cheese (color, flavour, body, taste, saltness and overall acceptability) using an evaluation sheet where colour ranged from 1= not acceptable to 4= acceptable; flavour 1= bland to 4 extremely intense; taste 1=absent to 4=excessive acid; body 1=smooth to 4=pasty; saltness 1=moderate to 4=too salty; overall acceptability 1=not acceptable to 4=acceptable.

Statistical Analysis: Statistical analysis was done using Analysis of Variance (ANOVA) models to estimate the effect of cooking temperature and vacuum packaging on weight, chemical composition and sensory characteristics of cheese. Student Neuman-Kuei's test was used for mean separation between treatments at P ≤ 0.05 [21].

RESULTS AND DISCUSSION

Table 1 shows the effect of cooking and vacuum packaging on weight and chemical composition of white cheese. The control treatment (C0P0) gained weight (+15.9%±3.66), while the rest of the treatments lost weight with highest loss being in C0P1 (-3.04%±0.72). The lower weight loss in cooked and vacuum packaged cheese could be attributed to low moisture content of cheese as cooking temperature leads to curd contraction and water expulsion [22,24]. Weight gain in control sample was probably due to absorption of pickling whey by curd [7].

The fat content of cheese was lowest in C0P0, and this agreed with Abdalla et al. [1] and Alla Gabo [4] who observed a decrease in fat content being due to leakage of some fat into the brine solution, while the highest values in vacuum packaged cheese was due to low moisture content of cheese [24].

The protein content was lowest in C0P0 cheese, and this was due to protein degradation leading to the formation of water soluble compounds, some of which were lost in the pickling solution [1,4,7,9,17,23]. However, neither cooking nor vacuum packaging affected the protein content of cheese and this might be due to the fact that vacuum packaging does not allow for water loss during storage, in addition to the fact that no movement of water from the curd during storage [24].

The total solids content was high in cooked vacuum packaged cheese compared to control sample, and again this is a direct effect of low moisture content of cheese and absence of diffusion of whey outside the curd. However, the result of lower total solids content of control was in agreement with Dariani et al. [7] and Abdalla et al. [1] who reported that decrease in total solids was due to degradation of total protein, dissolution of total protein, salts and fat into pickling solution or absorption of pickling whey by curd. Cooking temperature significantly affected total solids [1].

The ash content constitutes the inorganic part of the solid matter. The ash content was lowest in C0P0. During pickling, ash content followed a trend somewhat similar to total solids, indicating that ash content in curd and whey was very much affected by diffusion of salt from curd into whey [1].

The titratable acidity was found to be insignificantly (P>0.05) affected by cooking and vacuum packaging although the highest values were obtained from C1P1 and lowest were in C0P0. Vacuum packaging also increased the acidity and this was in agreement with the results of Kaushik et al. [11] who reported that maximum titratable acidity was obtained in cheese vacuum packaged in plastic films. In addition, during refrigeration storage, the rate of increase in titratable acidity was higher in cheese without vacuum than in cheese with vacuum.

Table 2 presents the effect of cooking and vacuum packaging on sensory characteristics of white soft cheese. Colour was not affected by cooking and vacuum packaging, where the colour of cheese was acceptable in all treatments. However, the flavour of cheese was more intense in control sample than the other treatments. The taste of cheese was moderately acrid in C0P0 and C1P1. The body of cheese was smooth in all treatments, while cheese in all treatments was slightly salty. Cheese in all treatments was acceptable.

From the results, it was clear that neither cooking, nor vacuum packaging affected the colour of cheese. However, cooking and vacuum packaging slightly improved the flavour and taste of cheese [6,14], while vacuum packaging slightly improved the body of
cheese. Increased cooking temperature and vacuum packaging slightly improved the overall acceptability of cheese. These results are in agreement with the findings of Nunez et al. who revealed that vacuum packaging improved rheological characteristics of cheese, while the results are in disagreement with the findings of Kaushik et al. who reported that packaging material had no influence on rheological characteristics of cheese.

REFERENCES


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**Table 1: Effect of cooking and vacuum packaging on chemical composition of cheese**

<table>
<thead>
<tr>
<th>Composition (%)</th>
<th>Cooking/vacuum packaging</th>
<th>S.L.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C0P0</td>
<td>C0P1</td>
</tr>
<tr>
<td>Weight loss/gain</td>
<td>+15.92±3.66a</td>
<td>-3.04±0.72d</td>
</tr>
<tr>
<td>Fat</td>
<td>18.88±1.53b</td>
<td>25.13±0.23a</td>
</tr>
<tr>
<td>Protein</td>
<td>17.99±1.49c</td>
<td>23.85±0.32a</td>
</tr>
<tr>
<td>Total solids</td>
<td>42.56±1.44c</td>
<td>49.86±0.37a</td>
</tr>
<tr>
<td>Ash</td>
<td>3.53±0.07b</td>
<td>3.77±0.09a</td>
</tr>
<tr>
<td>Titratable acidity (lactic acid)</td>
<td>0.62±0.06a</td>
<td>0.66±0.06a</td>
</tr>
</tbody>
</table>

Means within the same row bearing the same superscripts are not significantly different (P>0.05).

*** = P<0.001
* = P<0.05
NS = Not significant

**Table 2: Effect of cooking and vacuum packaging on the sensory characteristics of white cheese**

<table>
<thead>
<tr>
<th>Sensory characteristics</th>
<th>Cooking/vacuum packaging</th>
<th>S.L.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C0P0</td>
<td>C0P1</td>
</tr>
<tr>
<td>Colour</td>
<td>3.51±0.07a</td>
<td>3.35±0.05a</td>
</tr>
<tr>
<td>Flavour</td>
<td>2.69±0.11a</td>
<td>2.46±0.11b</td>
</tr>
<tr>
<td>Taste</td>
<td>2.21±0.13a</td>
<td>1.21±0.13c</td>
</tr>
<tr>
<td>Body</td>
<td>1.36±0.05b</td>
<td>1.30±0.05b</td>
</tr>
<tr>
<td>Saltiness</td>
<td>2.14±0.01a</td>
<td>2.21±0.13a</td>
</tr>
<tr>
<td>Overall acceptability</td>
<td>3.69±0.06b</td>
<td>3.71±0.05ab</td>
</tr>
</tbody>
</table>

Means within the row bearing similar superscripts are not significantly different (P>0.05).

*** = P<0.001
** = P<0.01
* = P<0.05
NS = Not significant


