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Effect of Storage Period on Chemical Composition and Sensory Characteristics of Vacuum Packaged White Soft Cheese

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Abstract: The effect of storage period on chemical composition and sensory characteristics of white soft cheese was studied. Cheese was made from pasteurized cow milk, cooked and vacuum packaged. Chemical composition and sensory characteristics were determined at 0, 15, 30 and 45 day intervals. Results showed that fat, protein and total solids content decreased with the advancement of storage period, while ash content and titratable acidity increased throughout storage period. Formal Ripening Index and Shilovish Ripening Index increased as storage period progressed. Sensory evaluation indicated that colour and body of cheese did not significantly change during storage period, while flavour, taste, saltiness and overall acceptability gradually improved throughout the storage period.

Key words: Storage period, vacuum packaged white soft cheese, chemical composition, sensory characteristics

Introduction

White pickled cheese of the Sudan is a product traditionally made from raw milk to which salt (6-20%) has been added (Abdalla *et al*., 1993; Abdalla and Davidson, 1990). Cheese making in Sudan is the major preservation method for surplus milk in rural areas especially during rainy season when plenty of milk is available (El Owni and Hamid, 2007; El Owni and Hamid, 2008). It is the major type of cheese in Sudan beside Mudaffara and recently Gouda and Mozzarella are introduced (Elsheikh, 1997; Ibrahim, 2008). White cheese is usually made from raw milk and without the use of starter culture (Abdalla *et al*., 1993) and is usually packed in plastic containers, a practice which leads to deterioration of quality of cheese (Osman, 2005).

Cooking temperature in cheese vat influences moisture removal from curd during cheese making and differences in moisture content could be a significant impact on cheese. Thus differences in cooking temperature may affect chemical composition and sensory characteristics of cheese (Yun *et al*., 1993). Vacuum packaging is found to be effective in improving the quality and shelf life of cheese (Papaioannou *et al*., 2007; Atasever *et al*., 2003; Tarakci and Kucukoner, 2006; Favati *et al*., 2007; Pintado and Malcata, 2000).

The objective of this study was to evaluate the chemical composition and sensory characteristics of vacuum packaged white soft cheese during storage.

Materials and Methods

Cheese manufacture: White soft cheese was manufactured from pasteurized (72°C/1 min) cow milk. The starter culture (1% w/w of 1:1 combination of *Lactococcus lactis ssp. lactis* and *Lactococcus lactic ssp. cremoris*) was added to milk at 40°C as direct vat set (DVS), followed by addition of $CaCl_2$ (0.02% w/w) and rennet (1 tablet/100 lb milk). The milk was stireed for 5 minutes and left undisturbed to develop a curd. The curd was then cut into small cubes (ca. 2.5 x 2.5 x 2.0cm) for cooking purposes, cooked at 40°C for 30 min, poured into small wooden moulds lined with cheesecloth and pressed overnight (ca. 2.5kg weight). The collected whey was pasteurized at 72°C/1 min, cooled and stored in the refrigerator. After pressing, the curd was removed and cut into small cubes and immersed into the collected whey for 48 hr.

Cheese was vacuum packaged in plastic pouches (Multivac A 20015, Wolfartschwenden, Germany), and stored in the refrigerator at 5°C for 45 days. Chemical composition, ripening indices and sensory characteristics were determined at 0, 15, 30 and 45 day intervals.

Chemical analysis: Cheese was analyzed for fat, protein, total solids, ash and titratable acidity according to AOAC (1990), while Formal Ripening Index (FRI) and Shilovich Ripening Index (SRI) were determined according to Abdel-Tawab and Hofi (1966).

Sensory evaluation: A panel of 10 untrained panelists were chosen and asked to judge on the quality of cheese (colour, flavour, body, taste, saltiness 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; saltiness 1 = moderate to 4 = too salty; overall acceptability 1 = not acceptable to 4 = acceptable.

Statistical analysis of data: Statistical analysis was done using Analysis of Variance (ANOVA) models to estimate the effect of storage period on chemical composition, ripening and sensory characteristics of cheese. Student Neuman-Kuel's test was used for mean separation between treatments at P = 0.05 (SAS, 1988).

Results and Discussion

Table 1 presents the chemical composition of cooked vacuum packaged white cheese during storage period of 45 days. Fat, protein and total solids content decreased gradually throughout the storage period (P < 0.001). Fat content decreased from 25.13±0.30 at the beginning to 22.50±1.64 at the end of storage period, the protein content decreased from 23.26±0.48 at day zero to 20.23±1.51 at the end and total solids content from 48.47±0.04 to 47.20±1.51 at the end of storage period of 45 days. However, ash content and titratable acidity increased throughout the storage period (P < 0.05). The ash content increased from 3.50±0.08% at day zero to 3.73±0.01 at day 45, while titratable acidity increased from 0.66±0.06% at the beginning to 0.74±0.02% at the end of storage period.

The results of fat content were in agreement with the results of Hayaloglu *et al.* (2005) and in disagreement with the findings of Tarakci and Kucukoner (2006) who found no significant variation in fat content during ripening period of 90 days of vacuum packaged Turkish Kashar cheese and El Owni and Hamid (2008) who found increasing fat content during storage period of Sudanese White cheese.

The decrease in protein content during storage might be due to protein degradation leading to formation of soluble compounds (Abdalla *et al.*, 1993). This result is in agreement with the results of Hayaloglu *et al.* (2005) who reported decreasing protein content during ripening of White-brined cheese. However, this result is in disagreement with the findings of El Owni and Hamid (2008) and Tarakci and Kucukoner (2006).

Decrease in total solids content was mainly due to degradation of total protein and decrease in fat content during storage period (Dariani *et al.*, 1980; Hayaloglu *et al.*, 2005). However, this result is in disagreement with the results of El Owni and Hamid (2008) who reported increasing total solids content with the advancement of storage period. This discrepancy between the two results could be due to method of packaging, while in our study cheese was vacuum packaged, in the study of El Owni and Hamid (2008) cheese was packed in salted whey in anti-acid tins.

The ash content increased with the advancement of storage period and this result is in agreement with the findings of El Owni and Hamid (2008) who reported increasing ash content during storage period. The increase in ash content could be attributed to decrease in moisture (Abdalla and Abdel Razig, 1997).

Table 1: Effect of storage period on chemical composition of white soft cheese

	Storage period (days)				
Composition (%)	0	15	30	45	S.L.
Fat	25.13±0.30^{a}	23.38±1.07^{b}	23.00±1.44^{c}	22.50±1.64^{d}	***
Protein	23.26±0.48^{a}	21.16±0.76^{b}	20.02±1.02^{c}	20.23±1.51^{c}	***
Total solids	48.47±0.04^{a}	47.51±1.21^{b}	47.01±1.35^{b}	47.20±1.51^{b}	***
Ash	3.50±0.08^{b}	3.75±0.06^{a}	3.67±0.04^{ab}	3.73±0.01^{a}	*
Titratable acidity (%lactic)	0.66±0.06^{ab}	0.60±0.03^{b}	0.67±0.06^{ab}	0.74±0.02^{a}	*

Means within the same row bearing the same superscripts are not significantly different (P > 0.05), *** = P < 0.001, * = P < 0.05.

Table 2: Effect of storage period on ripening index of White soft cheese

	Storage period (days)				
Ripening index (%)	0	15	30	45	S.L.
Formal Ripening Index	12.08±0.30^{d}	15.25±0.55^{c}	16.72±0.30^{b}	19.98±0.35^{a}	***
Shilovish Ripening Index	18.80±0.47^{d}	23.73±0.85^{c}	26.63±0.83^{b}	31.33±0.59^{a}	***

Means within the same row bearing the same superscripts are not significantly different (P > 0.05), *** = P < 0.001.

Table 3: Effect of storage period on sensory characteristics of white soft cheese

	Storage period (days)				
Sensory characteristics	0	15	30	45	S.L.
Colour	3.44±0.66^{a}	3.48±0.05^{a}	3.44±0.13^{a}	3.51±0.09^{a}	NS
Flavour	2.14±0.16^{b}	2.45±0.17^{a}	2.36±0.13^{a}	3.35±0.05^{ab}	*
Taste	1.75±0.04^{c}	2.11±0.01^{b}	2.23±0.09^{b}	2.45±0.12^{a}	***
Body	1.35±0.06^{b}	1.40±0.06^{a}	1.35±0.03^{a}	1.29±0.05^{a}	NS
Saltness	1.61±0.07^{c}	1.85±0.13^{b}	1.63±0.10^{b}	2.04±0.12^{a}	***
Overall acceptability	3.55±0.09^{b}	3.63±0.08^{ab}	3.74±0.07^{a}	3.80±0.08^{a}	*

Means within the row bearing similar superscripts are not significantly different (P > 0.05). *** = P < 0.001, * = P < 0.05, NS = Not significant.

The increase in acidity towards the end of storage period was mainly due to increase in lactic acid by the action of lactic acid bacteria (Tarakci and Kucukoner, 2006; El Owni and Hamid, 2008; Hayaloglu *et al.*, 2005).

Table 2 shows the effect of storage period on ripening of cheese. It was observed that Formal Ripening Index (FRI) and Shilovish Ripening Index (SRI) increased with the advancement of storage period. FRI increased from 12.08±0.30 at the beginning to 19.98±0.35 at the end of storage period ($P < 0.001$), while SRI increased from 18.80±0.47 to 31.33±0.59 at the end of storage period. Increasing ripening index with time is in agreement with the reports of Tarakci and Kucukoner (2006); Abdalla and Abdel Razig (1997) and Abdel Razig (2000). The increase was mainly due to breakdown of proteins with the advancement of storage period (Abdu and Dawood, 1977; Saleem and Abdel Salam, 1979).

Table 3 presents the effect of storage period on sensory characteristics of cheese. Colour and body of cheese did not significantly ($P > 0.05$) change during the storage period. These results are in disagreement with the findings of El Owni and Hamid (2008). However, the flavour, taste, saltiness and overall acceptability gradually improved throughout the storage period. These results agree with the findings of Tarakci and Kucukoner (2006) and Saleem and Abdel Salam (1979) who reported increasing values for flavour and overall acceptability during ripening.

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