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Research Article

Effect of Bioactive Glass-Based Primer on Dentin Adhesion with a Universal-Adhesive System

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ABSTRACT

Cheese is one of the most widely used ingredients in prepared foods for imparting taste, texture and nutritional qualities. Cheese making evolved centuries ago as a means of concentrating raw milk *via* acid precipitation of milk. Fermentation of the milk sugars would cause the acidified milk to curdle and the swaying motion would break up the curd and provide solid curd and drinkable whey. The curds would be removed, drained and lightly salted to provide a tasty and nourishing high protein food. The objectives of cheese making are to obtain the optimum cheese composition with respect to moisture, acidity, pH, fat, protein and minerals. Each type of milk imparts the characteristic quality of cheese made from it and the resulting cheese will diver in its proprieties, body texture and flavor.

Keywords: Cheese; Raw milk; Acidified milk; Nutritional qualities

INTRODUCTION

There are great varieties of cheese, some are perishable and must be consumed within few days while others can be stored for years. Natural cheese should be stored at suitable temperatures to ensure good quality because a high temperature leads to evaporation of moisture and growth of unwanted bacteria and other faults [1].

Most of the cheese produced in Africa is made on a small scale and generally at farm level. There is very little scientific information available on the cheese made at farm level; the recipe or the process is passed on from parents to children by observation and practical experience. The quality of the farm-made cheese can be variable because the ingredients and techniques used are so dependent on local conditions and available facilities to produce a product which has a good shelf-life and nutrient density [2]. Therefore, this project was used to investigate effects of heat treatment on physico-chemical and sensory quality of cheese produced from cow milk with the following specific objectives:

- To evaluate the effect of dairy milk source on the quality of cheese production with temperature variations.
- To evaluate the sensory characteristics of the cheeses.
- To determine the chemical composition (moisture, protein, fat and ash) content of cheeses.

MATERIALS AND METHODS

The experiment of the cheese production process was conducted in Dire Dawa university in chemical engineering laboratory. And the determination of proximate composition and sensory quality evaluation of the product was conducted in Haramaya university, food technology and process engineering laboratory [3].

Experimental materials

The raw milk sample was acquired from two Dire Dawa private dairy farms and processed cheese as soon as possible.

Experimental design

The samples were divided into three groups treating of raw milk in three different temperatures and two different milk sources. A 2 × 3 factorial design (CRD) giving 6 treatments with three replicates was used for statistical analysis [4].

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Method for cheese production by heat treatment

Heat the skimmed milk gradually to about 40°C, 50°C and 60°C until distinct curd mass forms. Cool the curd mass for about one hour. Cheese curds were separated from the whey either by ladling the curd into a separate container or by pouring the curds and whey through a sieve or fine mesh cloth and allowing the whey to drain into a container [5]. To obtain a firmer curd the cheese may be slightly pressed but these were reduced the yield of cheese. About four grams of salt were added to every 100 g of cheese to give a slightly longer shelf-life. Finally, the cheese was stored in a clean container in a cool place. At ambient temperatures of about 30°C the shelf-life of the cheese is no more than about two days while at 4°C it is about seven days.

Chemical composition

The protein content was determined by Kjeldahal method and the fat content was determined by soxlet, the moisture and ash content were determined by internationally recognized methods [6].

Sensory evaluation

A ten member panelists were used to analyze organoleptic properties of cheese samples. Cheese samples were placed in white plastic cups, labeled and placed on benches in a way that there was no interference between the panelists. Water was provided to the panelists to rinse their mouth after each taste. The products were assessed for aroma, taste, color and overall acceptability on a seven-point Hedonic scale (7-excellent; 6-very good; 5-good; 4-average; 3-fair; 2-poor; 1- very poor) and the attribute mean score was calculated [7].

Statistical analysis

Data collected were analyzed with Analysis of Variance (ANOVA) using the Statistical Analysis System (SAS institute and Cary, NC) and means significant difference were separated using Duncan's multiple range tests at $p<0.05$.

RESULTS AND DISCUSSION

Effect of temperature variation interaction on chemical composition of cheese

Table 1 shows the moisture content of the various types of cheese. The moisture content of MMT2 cheese was 71.34%, which was higher than the value 52.49% obtained by Sameen et al. The moisture content of MMT3 was 54.56 ± 13.25, which is lower than the value (65.3) obtained. The low moisture content of cheese may partly contribute to have had better shelf life time. The moisture content of cheese from this study was greater than 62.50% and 61.70% (for local cheese, processed with *Carica papaya* and *Caltropis procera)* [8]. All the above reported values were lower than 70.75% reported. These differences may be attributed to different processing methods adopted by these scientists. It must be noted however that the higher moisture content is not preferred because it could favor the growth and proliferation of microorganism thus reduces the shelf-life of cheese.

Table 1: Effect of lemon juice concentration and temperature variation interaction on proximate composition of cheese.

Sample code	Ash%	Protein%	Moisture%	Fat%
MMT1	1.78 ± 0.25^{c}	14.69 ± 0.57^{cd}	66.36 ± 0.13^{abc}	10.90 ± 0.67^{bc}
MMT2	1.60 ± 0.07^{c}	13.75 ± 0.26^{d}	71.34 ± 0.43^{a}	7.30 ± 5.59^{bc}
MMT3	1.60 ± 0.40^{c}	16.07 ± 0.00^{bc}	54.56 ± 13.25^{cde}	1.79 ± 1.22^{c}
YMT1	2.72 ± 0.67^{a}	18.80 ± 1.34^{a}	57.42 ± 12.31^{bcd}	8.41 ± 1.52^{bc}
YMT2	1.97 ± 0.00^{bc}	16.71 ± 0.62^{b}	67.48 ± 0.24^{ab}	22.51 ± 2.10^{ab}
YMT3	1.65 ± 0.00^{c}	17.46 ± 0.05^{ab}	66.13 ± 0.27^{abc}	29.28 ± 2.20^{a}

The fat content of the cheese sample ranged from 1.79%-29.28% as illustrated in Table 1. The fat content for all cheese samples varied significantly ($P<0.05$) resulting from differences among processing conditions. The high fat content (29.28%) was recorded in the milk sample treated at 50°C (YMT3) and lowest (1.79%) was for milk sample treated at 50°C (MMT3) but the difference was the source of milk. So, the fat content of YMT3 in Table 1 was 29.28% ± 2.20% higher than the value obtained by Sameen et al., and who found that fat content of 16.5% ± 2.3% were found [9].

The ash content of the cheese samples in the present study is also higher than the ash content (1.16%) of cheese reported by Kassa. The highest ash contents were recorded in cheese samples YMT1 (2.72%) and the lowest was recorded at MMT2 and MMT3 (1.60%). The protein content of YMT1 was 18.80% ± 1.34%, which is lower than the values 23.33% ± 2.12% and 22.1% ± 0.1% obtained by Sameen, et al. The higher protein and ash contents of cheese samples suggest that it could serve as an important source of amino acids and mineral for human beings. Analysis of amino acid and minerals composition of cheese could give an insight about the major types of amino acids and minerals that it contains and thus its actual nutritional value. Hence the amino acid and mineral profiles of cheese deserve investigation [10].

Effect of main factors of temperature variations on proximate composition of cheese

Temperature variations had significant (P<0.05) effect on the moisture content of cheese products (Table 2). The moisture content of T1, T2 and T3 were not significant (P<0.05) differences among the cheese samples. The high moisture content (69.41%) was recorded in T2 was not significantly different with other cheese samples. So, the highest moisture content that was observed in temperature variations were (69.41%) of 50°C heat treated milk samples. The low moisture contents of formulations are required for convenient packaging and transport of products. Reduced moisture content ensured the inhibition of microbial growth, hence is an important factor in food preservation. This indicates that if the moisture content is higher it is favorable for the growth of micro-organism [11].

Temperature variation had a significant effect at (P<0.05) on the protein and ash content of cheese samples. The ash content of the cheese sample was highest at T1 (2.25% ± 0.68%) and lowest ash content was observed at T3 (1.62) had significantly different. Ash content represents the total mineral content in foods. As shown in Table 2, the ash content was not significant difference between sources of milk. There were significant differences in the crude protein and crude fat among the source of milk. Crude protein, crude fat and ash contents of cheese from this study were lower than results obtained from most literatures but crude fat obtained from this study was higher than what was reported for cheese treated with different concentrations of honey [12].

Table 2: Effect of main factors of temperature variations on chemical composition of cheese.

Factors				
PC	**Ash%**	**Moisture%**	**Protein%**	**Fat%**
T1	2.25 ± 0.68^{ab}	61.89 ± 8.78^{a}	16.74 ± 2.51^{a}	9.66 ± 1.72^{a}
T2	1.78 ± 0.21^{ab}	69.41 ± 2.24^{a}	15.23 ± 1.75^{a}	14.90 ± 5.82^{a}
T3	1.62 ± 0.23^{b}	60.35 ± 10.16^{a}	16.76 ± 0.79^{a}	15.53 ± 5.94^{a}
MM	2.12 ± 0.53^{a}	57.78 ± 9.63^{a}	15.24 ± 1.27^{a}	8.09 ± 0.79^{a}
YM	2.02 ± 0.44^{a}	52.97 ± 12.32^{a}	15.51 ± 2.69^{a}	18.05 ± 11.21^{b}
CV	21.83	11.93	10.98	7.34

Effect of temperature variation interaction on sensory quality of cheese

Organoleptic test was carried out on the freshly prepared cheese samples. This was to determine the general acceptance, taste, aroma and appearance/color of the cheese samples. Ten people tasted the cheese samples and graded the samples from poor to excellent with regards to the parameters.

The interaction effect of temperature variation had a significant (P<0.05) effect on the color of cheese samples. The color of the cheese that was treated at 50°C were the most preferred (like very much) by the panelists and the highest cheese color (6.40 ± 0.69) was observed in T2 of heat treated milk sample.

The interaction effect of temperature variation had a significant (P<0.05) effect on the aroma of cheese samples (Table 3). The highest value of cheese aroma (5.90) was recorded in the YMT2 cheese sample (like very much) and lowest 5.10 was recorded in MMT3 of cheese sample (like slightly). Also the interaction effect of temperature variation had a significant effect on taste of cheese samples. The panelists, however, noted that color, taste and overall acceptability of the cheese processed were highly acceptable. Overall acceptability of cheese was significantly (P<0.05) affected by temperature variation (Table 3). The highest processing means 6.00 (like very much) was recorded in heat treated cheese, processed at T1 of MM sample and T2 of YM processed cheese.

Table 3: Effect of lemon temperature variation interaction on sensory quality of cheese.

Sample code	Aroma	Taste	Color	Overall acceptability
MMT1	5.60 ± 0.69^{abc}	6.00 ± 0.00^{ab}	6.30 ± 0.82^{ab}	6.00 ± 0.00^{a}
MMT2	5.70 ± 0.48^{ab}	5.60 ± 0.51^{abcd}	6.40 ± 0.69^{a}	5.90 ± 0.31^{ab}

MMT3	5.10 ± 0.87[abc]	5.50 ± 0.52[abcd]	6.10 ± 0.73[abc]	5.50 ± 0.70[ab]
YMT1	5.50 ± 0.52[abc]	5.70 ± 0.82[abc]	5.40 ± 0.69[bcd]	5.30 ± 0.48[ab]
YMT2	5.90 ± 0.31[a]	5.60 ± 0.51[abcd]	6.40 ± 0.69[a]	6.00 ± 0.00[a]
YMT3	5.80 ± 0.42[ab]	5.60 ± 0.51[abcd]	5.90 ± 0.99[abcd]	5.70 ± 0.67[ab]

Effect of main factors of temperature variations on sensory quality of cheese

The mean sensory scores for cheese sample were summarized in Table 4. The sensory scores for color, flavor, taste and overall acceptability for all of the products had a mean value greater than 4.95, indicating that they were well liked by the panelists. The ANOVA of hedonic scores for the sensory attributes revealed that had not significant difference (P<0.05) between cheese samples.

Temperature variation had a significant (P<0.05) effect of color of cheese samples.

The highest value of color (6.40) was in 50°C heat treatment cheese (like very much) and lowest 5.45 (like slightly) was in the T3 cheese produced. Vision plays a major role in sensory analysis and the appearance of food can have a major effect on its acceptability. The data in Table 4 show that the color of the cheese sample was like slightly in all treatments of cheese sample. The color of 50°C heat treatment cheese sample was higher mean scores than other cheese samples seen below Table 4. Temperature variations significantly (P<0.05) affected the aroma of cheese shown in Table 4. The highest scores were obtained for cheese prepared from 50°C heat treated milk (5.80). Panelists like very much the aroma of cheese prepared at 50°C heat treatment cheese.

Table 4: Effect of main factors of lemon juice concentrations and temperature variations on sensory quality of cheese.

Factors				
PC	**Aroma**	**Taste**	**Color**	**Overall acceptability**
T1	5.55 ± 0.60[ab]	5.85 ± 0.58[a]	5.85 ± 0.87[abc]	5.65 ± 0.48[ab]
T2	5.80 ± 0.41[a]	5.60 ± 0.50[a]	6.40 ± 0.68[a]	5.95 ± 0.22[a]
T3	5.45 ± 0.75[ab]	5.55 ± 0.51[a]	6.00 ± 0.85[ab]	5.60 ± 0.68[ab]
Sources				
MM	5.41 ± 0.92[a]	5.65 ± 0.75[a]	5.96 ± 0.86[a]	5.70 ± 0.72[a]
YM	5.30 ± 1.01[a]	5.36 ± 0.82[b]	5.61 ± 1.05[b]	5.51 ± 0.79[a]

CONCLUSION

The results of this study have demonstrated that the effect of heat treatments (40°C, 50°C and 60°C) on physico-chemical and sensory quality of cheese produced from cow milk. The manufactured cheese sample was subjected to proximate composition (moisture, ash, crude fat and crude protein) and sensory quality (aroma, taste, color and overall acceptability) analysis. Therefore, temperature variation had significant effects on the cheese quality. So, temperature variations were found to have significant effects on the proximate composition of cheese. The moisture, ash, crude protein and crude fat content were found significantly (p<0.05) different as compared to each treatment. The proximate composition analysis result showed that highest moisture content was found in 50°C heat treated cheese sample (MMT2). Whereas, ash, crude protein and crude fat content were highest in 40°C heat treated cheese samples.

Overall acceptability of cheese sample was significantly (p<0.05) affected by temperature variations. The interaction effect of temperature variations had a significant effect on cheese overall acceptability. Among the products, cheese treated at the 50°C (YMT2) was like very much and aroma, color and taste of cheese were highest in 50°C heat treated cheese samples. From this the sensory quality of cheese produced at 50°C was better as compared to the other produced cheese samples.

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