CHEMICAL COMPOSITION, SENSORY QUALITY AND ACCEPTABILITY OF CREAM CHEESE FROM PURE BUFFALO'S MILK ADDED WITH MALUNGGAY (*Moringa oleifera* L.) LEAF POWDER

Ojoriz S. Apilado[1], Maria Cynthia R. Oliveros[1], Ione G. Sarmago[1], Veneranda A. Magpantay[1] and Rosalina M. Lapitan[2]

ABSTRACT

The addition of malunggay leaf powder (MLP) in cream cheese produced from pure buffalo's milk was investigated to compare the nutritive value, sensory quality and consumer acceptability and determine the optimum level of inclusion of MLP. The cream cheese was produced from pure buffalo's milk and was mixed with 0% MLP (T1), 0.5% MLP (T2), 1% MLP (T3) and 1.5% MLP (T4). Moisture, fat, protein and calorie content of the cream cheese did not differ significantly among treatments while crude fiber content increased significantly with the addition of MLP. The sensory characteristics of pure cream cheese were significantly higher than those with added MLP. The inclusion levels of MLP had significant negative quadratic relationship with the color and general acceptability of the cheese. Texture, aroma, flavor and aftertaste had significant negative linear relations with the levels of MLP. Consumer acceptability of cream cheese with 0.5, 1 and 1.5% MLP was lower than 0% MLP. This indicates that malunggay leaf powder cannot be added to cream cheese from buffalo's milk at the levels used in the study. Inclusion rate for malunggay powder lower than 0.5% should be considered in the production of cream cheese.

Keywords: buffalo's milk, cream cheese, malunggay, sensory quality

INTRODUCTION

The most predominant cheese produced by the local dairy industry from small-scale to medium-scale processors is white cheese. The development of new products could help widen the variety of cheeses produced from pure buffalo's milk, thereby increasing the utilization of locally produced buffalo's milk. With the high fat content of buffalo's milk of 7-8% (Devendra, 1979), production of cream cheese could be appropriate because of its desired high fat characteristic. Cream cheese, a soft, acid-coagulated and unripened cheese, is a popular product with its standard characteristic of moisture content not more than 55%, milk fat not less than 33%, a pH of 4.4-4.9 and salt content of not more than 1.4%.

[1]Animal and Dairy Sciences Cluster, College of Agriculture, University of the Philippines Los Baños (UPLB), Laguna, Philippines (email: ojoriz.apilado@yahoo.com); [2]Philippine Carabao Center at UPLB, Laguna, Philippines.

Sennan and Izumi (1983) stated that there is a constantly increasing consumption of cream cheese every year, suggesting its popularity. However, health-conscious consumers tend to be less inclined to buy the product because of its high fat content. The current study aimed to develop a technology for the production of cream cheese from pure buffalo's milk that will be more appealing to health-conscious consumers. The cheese milk was not standardized and relied solely on the actual fat content of buffalo's milk. The addition of malunggay leaf powder (MLP) into the cream cheese was envisioned to increase the nutritive value of the product, specifically increasing the fiber content of the cheese. Essentially, the cream cheese that will be produced has a lower fat content compared to imported commercial products, thus, offering more health benefits to the consumers. The study was conducted to assess the nutritive value of cream cheese from pure buffalo's milk added with MLP, evaluate the sensory quality and consumer acceptability of the cheese, and determine the acceptable level of inclusion of MLP in cream cheese.

MATERIALS AND METHODS

Experimental treatments and designs

Four separate mixtures of cream cheese were prepared from pure buffalo's milk with different levels of inclusion of MLP: Treatment 1, 0% MLP (control); Treatment 2, 0.5% MLP; Treatment 3, 1.0% MLP; and Treatment 4, 1.5% MLP. The experiment used a completely randomized design with three replications. Each batch of cream cheese produced was considered as a replicate.

Milk collection and testing

The fresh buffalo milk used in the experiment was obtained from the Philippine Carabao Center at the University of the Philippines Los Baños. All batches of milk were sampled and tested for chemical components such as fat, protein and total solids content using a milk analyzer (ULTRA Ekomilk milk analyzer, Bulteh 2000 Ltd., Zagora, Bulgaria).

Processing of malunggay leaf powder

Young and mature leaves of malunggay were gathered and dried at 60ºC for 5 hr in a hot-air oven. All the dried leaves were powdered in a pinning machine. The MLP was subjected to protein and crude fiber determination.

Processing of cream cheese

Three liters of buffalo's milk were used in each treatment for every batch of cheese manufactured. The milk had an average fat of 8.42%, and an average protein content of 3.09%. The average titratable acidity of the milk was 0.19% lactic acid. The cheese mix was prepared from pure buffalo's milk. The cheese-mix was not standardized such that the fat content was solely based on the actual amounts of fat in the fresh buffalo's milk. The cheese milk was preheated to 50ºC, homogenized at 1500 psi then pasteurized at 72ºC for 15 sec. The milk was

immediately cooled to 32ºC and 1% microbial starter (*Flora danica*) was added thereafter. The cheese milk was left to ripen for 15 min, after which, 0.5% rennet was added. The cheese-milk was incubated at room temperature for 18 hr. At the end of the 18-hr incubation, the average titratable acidity was measured. The endpoint titratable acidity in the study was 0.83% lactic acid. The cheese-mix was heated to 65ºC with constant stirring for 30 min then immediately cooled to 35ºC. The curd was placed in cheesecloth and hung overnight in a cold room set at 5ºC. The cheese was removed from the cloth bag then 1% fine salt was added. MLP was added to cheese-mix belonging to treatments 2, 3, and 4. The products were packed in plastic containers and stored at refrigeration temperature of 5ºC.

Data collection

Product yield was used as basis for the efficiency of the production. Product yield was computed by dividing the weight of the cheese after ripening prior to addition of MLP by the starting amount of milk used multiplied by 100.

Approximately 100 g of sample were obtained from each treatment in every batch of cheese produced. The cheese samples were used for the determination of the chemical composition of the cheese. The moisture, fat, and protein content were determined using the standard methods of AOAC (1995). The calorie content was determined using PARR 6200 Bomb Calorimeter. The crude fiber content of the cheese was computed using the crude fiber content of dried malunggay leaves of 19.4% as reported by Yameogo *et al.* (2011).

Cream cheese samples were served to invited experienced panelists. The samples were rated for color, texture, aroma, flavor, aftertaste and general acceptability using a Linear Scale 0-100 (Mabesa, 1986). Three sensory sessions were conducted with each session considered as a replicate. Consumer test was done in front of a dairy bar. Walk-in customers served as panelists who evaluated all the cream cheese samples using a 7-Point Hedonic Scale with 1 as “Dislike Very Much” and 7 as “Like Very Much”.

Statistical analysis

The data on chemical components and product yield were analyzed using the Analysis of Variance (ANOVA) in a Completely Randomized Design using the SAS (version 9.1). Sensory quality data were analyzed using ANOVA in a Randomized Complete Block Design with panelists as the blocking factor. All significant means were compared using the Bonferroni (Dunn) t-test. Trend analysis was done on the data on sensory quality. Regression analysis for curve estimate was used on the sensory data to determine the optimum level of inclusion of MLP. Descriptive statistics was used on the consumer acceptability data.

RESULTS AND DISCUSSION

Product yield and nutritive value

The average yield of cream cheese from pure buffalo’s milk was 30%. Almost similar yields were obtained from the cheese in different treatments because

the composition of the cheese-mix used was similar. The chemical composition of the cream cheese is presented in Table 1. The moisture, fat, protein and calorie content did not differ among treatments. This was expected because the cheese milk used in the production for all treatments were similar. The addition of MLP did not alter the chemical components of the cheese, except for the crude fiber content. Although MLP used in the study had a protein content of 30.59%, no significant differences were observed in the protein content of the different groups. This could probably be due to the low inclusion rate used in the current study. Significant crude fiber values were observed in cheese added with MLP. Dachana *et al.* (2010) reported that by increasing the inclusion of malunggay in the cookies, the protein, iron, calcium, beta-carotene, and dietary fiber content of the cookies increased. In comparison to the imported commercial cream cheese available with a fat content of 30% as stated by United States Department of Agriculture (USDA), the fat content of the cheese produced was comparatively low because no additional cream was added during processing. The chemical composition of the experimental cream cheese closely adheres to the USDA standards for low-fat cream cheese of not more than 70% moisture, milk fat of not more than 16.5% and salt content of not more than 1.4%.

Table 1. Chemical composition of cream cheese with different levels of malunggay leaf powder.

Components	Treatment				%CV
	0	0.5%	1.0%	1.5%	
Moisture (%)	50.53	58.04	56.54	53.94	6.28
Fat (%)	16.92	13.58	17.08	15.08	12.95
Protein (%)	11.87	9.29	11.60	12.20	16.27
Crude Fiber (%)	0.00^{b}	1.06^{a}	0.45^{ab}	1.12^{a}	11.90
Calorie (cal/g)	3782.4	3129.0	3468.3	3269.3	11.12

Means within row with different superscripts are different ($P<0.05$).

Sensory quality

The cream cheese from pure buffalo's milk had significantly higher sensory characteristics than cream cheese with MLP (Table 2). High significant sensory scores of the cream cheese from pure buffalo's milk indicate that the product is preferred more by consumers than cheese with MLP. The addition of MLP resulted in significant decrease in color scores, with the lowest score obtained from cream cheese with 1.0 and 1.5% MLP. The texture and aroma of cream cheese added with 0.5, 1.0 and 1.5% MLP were significantly lower than the pure cream cheese. The lowest flavor ratings were obtained in cream cheese added with 1% and 1.5% MLP. A similar trend was observed in the scores for aftertaste. These results imply that the flavor was negatively influenced by the strong undesirable aftertaste noted. The general acceptability of all cream cheese added with MLP was significantly lower than cream cheese without MLP. The decrease in the sensory scores could be caused by the increase in the bitterness of the cheese as the inclusion rate

Table 2. Sensory characteristics of cream cheese with different levels of malunggay leaf powder.

Characteristics	Treatment				%CV
	0	0.5%	1.0%	1.5%	
Color	85.31^{a}	73.71^{b}	65.76^{c}	65.26^{c}	15.28
Texture	86.07^{a}	70.88^{b}	70.62^{b}	62.26^{b}	20.59
Aroma	77.95^{a}	69.67^{ab}	64.17^{b}	64.43^{b}	24.09
Flavor	82.98^{a}	71.41^{b}	63.55^{bc}	60.83^{c}	21.17
Aftertaste	81.24^{a}	64.57^{b}	54.31^{c}	60.21^{c}	26.30
General Acceptability	84.31^{a}	67.41^{b}	60.21^{bc}	55.81^{c}	20.68

Means within row with different superscripts are different (P<0.05).

Color: 0 (extremely undesirable) to 100 (extremely desirable); Texture: 0 (extremely sandy) to 100 (extremely smooth); Aroma: 0 (extremely undesirable) to 100 (extremely desirable); Flavor: 0 (extremely undesirable) to 100 (extremely rich and full); After taste: 0 (extremely undesirable) to 100 (extremely desirable); and General Acceptability: 0 (extremely unacceptable) to 100 (extremely acceptable).

increases. The sensory panelists detected a strong bitter taste in treatments having 1% and 1.5% MLP. In a study by Nambiar and Parnami (2008) wherein they mixed malunggay leaves in Indian recipe foods to increase nutritional content, sensory quality was assessed to be acceptable with an average score of 3.25 on a 5-Point Hedonic Scale. Similarly, in the study made by Dachana *et al.* (2010), the most acceptable addition of dried malunggay leaves in the cookies was 10%. The difference in the optimum level of inclusion of MLP for each product could be attributed to how the flavor of the food gets affected by the addition of ingredients.

Trend comparisons revealed that there was a significant negative quadratic trend in the color and general acceptability of the experimental cream cheese (Table 3). There was a decrease in color scores with the addition of MLP, however, similar

Table 3. Trend relationships of the sensory characteristics of cream cheese with different levels of malunggay leaf powder.

Sensory characteristic	Trend	P value
Color	Quadratic	0.0014**
Texture	Linear	<0.0001**
Aroma	Linear	<0.0001**
Flavor	Linear	<0.0001**
Aftertaste	Linear	<0.0001**
General acceptability	Quadratic	<0.0040**

*Highly significant.

color scores were obtained in 1% and 1.5% MLP. Texture, aroma, flavor and after-taste revealed a significant negative linear trend indicating that there is a progressive decrease in texture, aroma, flavor and aftertaste characteristics with increasing levels of MLP in the cream cheese.

Regression analysis showed that color and general acceptability readings were similar at 1.0% and 1.5% inclusion rate (Table 4). Regression equations indicate that the inclusion of MLP at 0.5%, 1.0%, and 1.5% had negative effect on sensory characteristics. Cream cheese added with 0.50, 1.0 and 1.5% MLP had lower sensory quality.

Table 4. Regression equations of the sensory characteristics of cream cheese with different levels of malunggay leaf powder.

Sensory characteristic	Regression Equation	P value
Color	$y=85.50+(-30.26)X+11.10X^2$	0.000**
Texture	$y=83.13+(-14.23)X$	0.005**
Aroma	$y=76.83+(-11.24)X$	0.010**
Flavor	$y=80.83+(-14.86)X$	0.000**
Aftertaste	$y=78.84+(-22.92)X$	0.000**
General acceptability	$y=83.97+(-37.32)X+12.53X^2$	0.000**

**Highly significant.
X: level of inclusion of malunggay leaf powder in the cream cheese.

Consumer acceptability

The overall consumer acceptability rating of cream cheese with different levels of MLP were lower compared to cream cheese without malunggay leaf (Table 5). Similar trends were observed based on sex, cheese eaters, occupation, type of cheese eaten and familiarity to cream cheese. However, for consumers belonging to 47-62 years of age, higher acceptability was given on cream cheese with MLP. Murphy (1993), reported that taste preferences change as someone becomes older, with older people having a tendency of considering the nutritional content of a food instead of its flavor. This, however, does not prove to be significant because this group only represents 7% of the respondents. Consumer respondents also noticed a bitter taste on cream cheese added with MLP.

CONCLUSION

The chemical composition of cream cheese with and without added malunggay leaf powder did not differ significantly in moisture, fat, protein and calorie content but differed significantly in computed crude fiber content. Increasing level of addition of MLP resulted in increased fiber content in the cheese. The sensory quality assessment revealed significantly higher ratings for color, texture, aroma, and flavor of cream cheese from pure buffalo's milk without added MLP. There was no undesirable off-flavor detected in the pure cream cheese. Cream cheese with

Table 5. Consumer acceptability* of cream cheese with different levels of malunggay leaf powder.

Group	Treatment			
	0	0.5%	1.0%	1.5%
	M ± SD	M ± SD	M ± SD	M ± SD
Overall	5.58±1.20	4.84±1.56	4.71±1.36	4.45±1.65
Cheese eater	5.58±1.21	4.86±1.55	4.69±1.37	4.46±1.64
Sex				
Male	5.18±1.36	4.79±1.70	4.57±1.63	4.39±1.74
Female	5.86±1.00	4.88±1.46	4.82±1.13	4.49±1.59
Age group				
14-30	5.57±1.21	4.63±1.55	4.57±1.37	4.25±1.65
31-46	5.42±1.31	5.92±1.26	5.07±1.11	4.92±1.11
47-62	5.89±1.05	6.20±0.92	6.20±0.63	6.40±0.70
Occupation				
Working	5.67±1.06	5.35±1.40	5.10±1.30	4.90±1.40
Not working	5.55±1.24	4.70±1.58	4.61±1.37	4.32±1.70
Type of cheese eaten				
White	5.78±1.24	5.01±1.52	4.90±1.38	4.73±1.61
Processed	5.59±1.23	4.85±1.53	4.66±1.38	4.40±1.62
Imported	5.74±1.17	4.99±1.52	4.69±1.42	4.49±1.67
Familiarity to cream cheese				
Yes	5.80±1.04	4.92±1.53	4.76±1.36	4.49±1.65
No	5.17±1.42	4.67±1.65	4.63±1.32	4.31±1.70

*7: like very much; 6: like moderately; 5: like slightly; 4: neither like nor dislike; 3: dislike slightly; 2: dislike moderately; 1: dislike very much.

increasing levels of added MLP revealed a significant negative quadratic relationship with color and general acceptability. Texture, aroma, flavor and after-taste showed a significant negative trend with increasing levels of MLP in the cream cheese. Consumer acceptability of pure cream cheese was higher than the cheese with added MLP. The results indicate that cream cheese of good sensory quality and high consumer acceptability can be produced from pure buffalo's milk without the need to standardize to higher fat content. The consumer acceptability scores of cream cheese with MLP decreased with increasing level of added MLP. This was attributed to the bitter flavor imparted by the malunggay leaf powder. Inclusion rate for malunggay powder lower than 0.5% should be considered in the production of cream cheese. An alternative processing method for malunggay should be used to reduce the bitter flavor of the leaves.

ACKNOWLEDGEMENT

The authors would like to express their gratitude to the Philippine Carabao Center at UPLB for the financial support provided for the study.

REFERENCES

AOAC**.** 1995. *Association of Official Analytical Chemists Official Method of Analysis*. Cunnif P (ed.). Virginia: AOAC International.

Dachana KB, Rajiv J, Indrani D and Prakash J. 2010. Effect of dried moringa (*Moringa oleifera lam*) leaves on rheological, microstructural, nutritional, textural and organoleptic characteristics of cookies. *J Food Quality* 33 (5): 660-677.

Devendra C.1979. Milk production in goats compared to buffalo and cattle in humid tropics. *J Dairy Sci* 63: 1755-1767.

Mabesa LB. 1986. *Sensory Evaluation of Foods: Principles and Methods*. College of Agriculture, University of the Philippines Los Baños.

Murphy C. 1993. Nutrition and chemosensory perception in the elderly. *Critical Rev Food Sci Nutr* 33 (1): 3-15.

Nambiar VS and Parnami S. 2008. Standardization and organoleptic evaluation of drumstick (*Moringa oleifera*) leaves incorporated into traditional Indian recipes. *Trees for Life J* 3: 2.

Sennan HY and Izumi HK. 1985. *Process for Producing Cream Cheese Type Food*. Fuji Oil Company, Osaka, Japan. Accessed 03 April 2012. http:// www.google.com/patents/US4534982.

Yameogo CW, Bengaly MD, Savadogo A, Nikiema PA and Traore SA. 2011. Determination of chemical composition and nutritional values of *Moringa oleifera* leaves. *Pakistan J Nutr* 10: 264-268.