



Microbial and Sensorial Quality of Ice Cream Fortified with Oyster (*Crassostrea iredalei*) Puree

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Abstract

Oyster (*Crassostrea iredalei*) are edible bivalve mollusk that contains nutrients that could enhance the nutritional value of dairy products such as ice cream. This study was conducted to determine the microbial and sensorial quality of ice cream fortified with oyster puree at 0% 5%, 10% and 15% concentration during 4 weeks' frozen storage period. Based on the sensory evaluation results, treatment 2 (10%) obtained the highest overall acceptance mean score of 8.50 (like extremely), but showed no significant difference ($p>0.05$) with other treatments. The addition of oyster puree did not affect the sensory attributes and the overall acceptability of the products. All treatments were still acceptable on week 4 in terms of sensory attributes. For the basis of microbial analysis, all treatments revealed to have an acceptable microbial count that is below the standard limit of 100,000 CFU/ml (5 log CFU/ml) from week 0 to week 4. Development of ice cream fortified with oyster puree is feasible to increase its nutritional value.



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Introduction


Oysters (*Crassostrea iredalei*) are edible bivalve mollusk usually found in all tropical region. Oysters are very popular food in many parts of the world including European countries, Australia, USA, and in South East Asian countries, such as the Philippines. They are usually sold as fresh in wet markets. It is also ideal for export to Asian, US and European markets.

Ice cream is a frozen dairy product made by suitable blending and processing of cream, milk products, and other ingredients such as sugar, flavor, stabilizer or color, incorporated with air during the freezing process. It is equally liked by people of all ages.¹ The quality of ice cream depends mainly upon the ingredients used, processing parameters and the storage conditions.²

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Fortification of fish protein in ice cream has been studied.^{2,3,10} Ice cream is produced in Japan by using different types of aquatic products. Ice cream added with crab, with eel, with saury fish, with octopus, and with shrimp is available on Japanese markets.^{4,5} However, information on oyster fortification is very limited. Ingredients from fishery products can have a negative impact on sensory characteristics of the products, despite improving its nutritional and functional quality.² If not used at an appropriate level, it was reported to have negative effects both on flavor and odor of the product.^{3,6} However, there is still growing number of food products added with fish ingredients available on the market.^{7,8}

Development of ice cream fortified with fish and other aquatic products could be an effective way to enhance nutritional and functional value of ice cream. Presently, there is no available oyster ice cream product in the market. Hence, the present study attempts to develop an acceptable ice-cream fortified with oyster puree. Specifically, the study aims to assess the microbial and sensorial quality of oyster ice cream during 28 days' storage.

Materials and Methods

Sample Collection

Samples were collected in the wet market of Catbalogan City, Samar, Philippines. They were packed in a styrofoam box with ice, and transported immediately to the fish processing laboratory in Samar State University Mercedes Campus. Samples were washed with clean potable water to remove dirt, sand and unwanted particles attaching to the bivalve.

Oyster Puree Preparation

Cleaned oyster samples were subjected to water bath at 100 °C for 1 minute.⁹ Oyster meat was immediately

removed manually from the shell using sterile knife and blended using electronic blender until pasty texture was attained.

Product Formulation

The product was prepared following the formulation shown in Table 1. Ingredients such as all-purpose cream and condensed milk were beaten until totally mixed. Oyster puree was added to the mixture and continued beating until thick and fluffy texture is attained. Diced cheese, fresh milk and white sugar were incorporated to the mixture. The mixture was stirred while cooling to incorporate air and prevent the formation of ice crystals and froze overnight[10]. The product was stored for 28 days at frozen temperature (-10 °C), and was monitored every 7 days to determine its microbial and sensorial quality.

Microbial Analysis

Total plate count (TPC) was determined by spread plating the serially diluted samples (up to 10⁶) into Plate Count Agar medium. Plates were incubated for 24 hours at 37 °C. Colonies were counted and recorded as log CFU/ml.¹¹

Sensory Evaluation

A panel of 10 semi-trained sensory evaluators performed the sensory analysis of samples using a 9-point hedonic scale sensory score card. Sensory evaluation was based on the sensory characteristics such as color, odor, texture, flavor and general acceptability of the product. The adjectival rating is as follows:

8.5 – 9.0 = Like extremely

7.5 – 8.4 = Like very much

6.5 – 7.4 = Like moderately

5.5 – 6.4 = Like slightly

Table 1: Product formulation of oyster ice cream

Ingredients	Control	Treatment 1	Treatment 2	Treatment 3
Oyster puree (% by total volume)	0%	5%	10%	15%
All-purpose cream	200 ml	200 ml	200 ml	200 ml
Condensed milk	150 ml	150 ml	150 ml	150 ml
Fresh milk	100 ml	100 ml	100 ml	100 ml
Diced cheese	30 g	30 g	30 g	30 g
White sugar	20 g	20 g	20 g	20 g

Table 2: Mean scores (mean \pm SD*) of sensory attributes in all treatments

Attribute	Week	Treatments			
		Control 0%	T1 5%	T2 10%	T3 15%
Color	0	8.60 \pm 0.69 ^a	8.20 \pm 0.78 ^a	8.10 \pm 0.87 ^a	7.90 \pm 0.87 ^a
	1	8.50 \pm 0.52 ^a	8.10 \pm 0.73 ^a	7.90 \pm 0.73 ^a	8.10 \pm 0.99 ^a
	2	8.90 \pm 0.31 ^a	8.00 \pm 0.81 ^b	7.80 \pm 0.78 ^b	8.30 \pm 0.67 ^{ab}
	3	8.60 \pm 0.51 ^a	8.10 \pm 0.73 ^a	7.90 \pm 0.99 ^a	7.90 \pm 0.99 ^a
	4	7.90 \pm 1.19 ^a	7.90 \pm 1.10 ^a	8.40 \pm 0.96 ^a	7.90 \pm 0.99 ^a
Odor	0	8.10 \pm 1.37 ^a	8.10 \pm 1.10 ^a	8.30 \pm 0.67 ^a	8.10 \pm 0.73 ^a
	1	8.30 \pm 0.82 ^a	8.30 \pm 0.67 ^a	8.30 \pm 0.82 ^a	8.10 \pm 0.87 ^a
	2	8.70 \pm 0.48 ^a	8.20 \pm 0.63 ^{ab}	7.90 \pm 0.87 ^b	8.50 \pm 0.52 ^{ab}
	3	8.40 \pm 0.69 ^a	8.40 \pm 0.96 ^a	7.90 \pm 1.10 ^a	8.10 \pm 1.19 ^a
	4	8.10 \pm 0.99 ^a	7.80 \pm 0.63 ^a	8.30 \pm 0.82 ^a	7.60 \pm 1.17 ^a
Flavor	0	8.30 \pm 1.05 ^a	8.00 \pm 0.94 ^a	8.30 \pm 0.48 ^a	8.20 \pm 0.63 ^a
	1	8.30 \pm 0.82 ^a	8.20 \pm 0.91 ^a	8.50 \pm 0.52 ^a	8.20 \pm 0.91 ^a
	2	8.90 \pm 0.31 ^a	7.90 \pm 1.10 ^b	7.80 \pm 0.78 ^b	8.50 \pm 0.52 ^{ab}
	3	8.30 \pm 0.67 ^a	8.20 \pm 1.03 ^a	8.20 \pm 1.03 ^a	8.00 \pm 1.15 ^a
	4	7.80 \pm 1.22 ^a	7.80 \pm 1.03 ^a	8.20 \pm 1.22 ^a	8.10 \pm 0.73 ^a
Texture	0	8.20 \pm 1.31 ^a	8.50 \pm 0.52 ^a	8.40 \pm 0.51 ^a	7.90 \pm 0.87 ^a
	1	7.90 \pm 0.99 ^a	8.10 \pm 0.56 ^a	8.20 \pm 0.63 ^a	8.40 \pm 0.69 ^a
	2	8.80 \pm 0.42 ^a	8.20 \pm 0.91 ^a	8.00 \pm 0.94 ^a	8.60 \pm 0.51 ^a
	3	8.30 \pm 0.82 ^a	8.10 \pm 1.10 ^a	8.10 \pm 1.28 ^a	8.30 \pm 0.94 ^a
	4	7.80 \pm 1.22 ^a	8.10 \pm 0.73 ^a	8.20 \pm 0.91 ^a	8.00 \pm 0.94 ^a
Overall	0	8.40 \pm 0.96 ^a	8.30 \pm 0.67 ^a	8.60 \pm 0.51 ^a	8.20 \pm 0.78 ^a
	1	8.30 \pm 0.67 ^a	8.40 \pm 0.51 ^a	8.70 \pm 0.67 ^a	8.50 \pm 0.70 ^a
	2	8.80 \pm 0.42 ^a	8.20 \pm 0.78 ^a	8.10 \pm 0.87 ^a	8.60 \pm 0.51 ^a
	3	8.80 \pm 0.42 ^a	8.20 \pm 0.91 ^a	8.40 \pm 0.84 ^a	8.30 \pm 0.94 ^a
	4	7.60 \pm 1.26 ^a	8.30 \pm 0.67 ^a	8.50 \pm 0.70 ^a	8.10 \pm 0.87 ^a

*Distinct letters in the same row differ significantly ($p < 0.05$)

Table 3: Microbial count (log CFU/ml \pm SD*) of oyster ice cream

Week	Treatments				STANDARD LIMIT [14]
	Control 0%	T1 5%	T2 10%	T3 15%	
0	3.09 \pm 0.02 ^a	3.26 \pm 0.08 ^{ab}	3.26 \pm 0.02 ^{ab}	3.37 \pm 0.04 ^b	100,000 CFU/ml or (5 log CFU/ml)
1	3.74 \pm 0.06 ^a	3.95 \pm 0.07 ^{ab}	3.99 \pm 0.06 ^b	4.06 \pm 0.03 ^b	
2	3.93 \pm 0.04 ^a	4.14 \pm 0.04 ^{ab}	4.17 \pm 0.04 ^b	4.17 \pm 0.08 ^b	
3	4.16 \pm 0.02 ^a	4.34 \pm 0.03 ^b	4.41 \pm 0.01 ^{bc}	4.48 \pm 0.02 ^c	
4	4.23 \pm 0.04 ^a	4.52 \pm 0.03 ^b	4.58 \pm 0.01 ^b	4.62 \pm 0.02 ^b	

*Distinct letters in the same row differ significantly ($p < 0.05$)

- 4.5 – 5.4 = Neither like nor dislike
 3.5 – 4.4 = Dislike slightly
 2.5 – 3.4 = Dislike moderately
 1.5 – 2.4 = Dislike very much
 0.5 – 1.4 = Dislike extremely

Statistical Analysis

Data on microbial and sensorial analyses were subjected to one-way ANOVA and a post-hoc analysis, the Tukey's test, to determine significant difference. All statistical analyses were performed using the statistical software, Sigma Plot 11.0 The level of significance was set at a level of 0.05, $p < 0.05$.

Results and Discussion

Table 2 shows the mean scores of sensory attributes of the samples during the 4 weeks' storage period. Treatment 2 containing 10% oyster puree obtained the highest mean score in all sensory attributes. But shows no significant difference with other treatments. For the overall acceptability, treatment 2 also obtained the highest final score of 8.50 but also shows to have no significant difference ($p > 0.05$) with other treatments during the 4 weeks' storage. Based on the overall results, the addition of oyster puree did not affect the sensory attributes and the overall acceptability of the products. Same results were obtained by Shaviklo *et al.*² where the fortification of fish protein powder (30 and 50g kg⁻¹) did not influence the sensory attribute of the ice cream product.

Table 3 shows the microbial count of samples in all treatments. Based on the results, the microbial count increases as the percentage of oyster puree also increases. It was suspected that the raw material oyster was one of the major source

of microorganisms. It has been reported that raw materials used for ice cream preparation are the main sources of microbial contamination.¹² However, the microbial count in all treatments from week 0 to week 4 is below the standard limit. It is important to determine the microbiological quality of ice cream. It is consumed by people of all ages, hence, it should be microbiologically safe.¹³

The addition of oyster puree did not affect the sensory attributes and the overall acceptability of the products. Treatment 2 containing 10% oyster puree obtained the highest mean score in all sensory attributes and in the overall acceptance. Moreover, fortification at higher levels (15%) may be feasible in terms sensory attributes since it revealed to have high acceptance score over the 4 weeks' storage period showing no significant difference with treatment 2. For the basis of microbial analysis, all products were in the safe limit and still fit for human consumption up to the final week of storage period. Treatment with higher level of oyster puree (15%) may also be feasible in terms of the microbial results. Furthermore, the development of ice cream with the addition of oyster puree could be an effective way of enhancing the nutritional value of ice cream. Further studies on the fortification of oyster puree at higher level may be possible and study on consumer acceptance test.

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Conflict of Interest

All authors declare no conflict of interest.

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