# Butia ice cream: optimizing acceptability of a new product

## A. Curutchet, D. Gioscia, P. Arcia

*Laboratorio Tecnológico del Uruguay, Av. Italia 6201, 11500, Montevideo, Uruguay*

## INTRODUCTION

The "butia" is the fruit of the Butia capitata palm, native of the East of Uruguay, Brazil and northeast of Argentina. Butia pulp has been used in the development of very different products incorporated into the local culture and several of them have been currently commercialized (Betancurt et al., 2008). Sensory evaluation by consumers is important in product development itself for new-product development guidance, product improvement and optimization (Choi, et al. 2007). A useful tool for optimizing sensory quality of food products is the application of the Response Surface Methodology (RSM) to model the variation in acceptance in relationship with composition. The aim of this work was to optimize the formulation of butia ice cream, reaching to a product with maximum acceptability that could be easily transferred to the local people that nowadays process butia

## MATERIALS AND METHODS

### Samples composition

Samples were prepared using the following ingredients: whole milk and skimmed milk powder (UHT, Conaprole, Uruguay), sieved butia pulp (Ángel Alberto Moreira, Uruguay), sucrose, butia liqueur (Caseras de India Muerta, Uruguay) and thickener (emulgel E21: galactomannans, xanthan gum, mono and diglycerides of edible fatty acids and polysorbate, L&G, Uruguay).
To optimize the formulation of the butia ice cream, samples composition was selected according to a two-factor central composite design with replicates of the central point for estimating the pure error (Gacula, 1993).
Concentration range for sucrose (from 10 to 26 %) and butia pulp (from 15 to 35 %), was selected on the basis of previous work.
In samples formulation, contents of whole milk (39 %), skimmed milk powder (2,4 %), butia liqueur (5.2 %) and thickener (0.24 %) were constant.

### Samples preparation

Samples were prepared in batches of 3.5 kg. Dry ingredients were dispersed under stirring into the liquid ingredients with a mechanical mixer. The mix was then batch pasteurized at 65°C for 20 min and rapidly cooled to 20 °C in a water bath. Then, samples were mixed during 11 minutes in an ice cream maker (Pastomaster 30, Carpigiani, Italy). Finally, samples were transferred to a closed flask and stored at -20°C until sensory evaluation.

### Sensory evaluation

Sensory evaluation was carried out in a standardized test room (ISO 8589, 1988) in morning session under artificial daylight type illumination. Forty regular ice cream consumers with ages ranged between 20 and 60 years old were recruited. Consumers evaluated 10 samples, (40 ml) served at -14±1°C in transparent plastic cups coded with three digits random numbers. Each consumer evaluated the acceptability of each sample using a 9-point hedonic scale (1 = "I dislike extremely", 9 = "I like extremely").

### Data analysis

One way analysis of variance (ANOVA) was performed on acceptability data in order to study the effects of formulation.
Overall acceptability data were submitted to a multivariate regression analysis and fitted to a second order model equation provided in the design:
$$Y = B_0 + B_1 X_1 + B_2 X_2 + B_{11} X_1^2 + B_{22} X_2^2 + B_{12} X_{12} + Error$$
where Y is the overall acceptability, $B_0$ is the intercept (constant), $B_1$, $B_2$ the linear, $B_{11}$, $B_{22}$ the quadratic and $B_{12}$ the interaction effects, $X_1$ and $X_2$ the independent variables: concentrations of sucrose and butia pulp respectively and the random error component.

## RESULTS AND DISCUSSION

Analysis of variance showed differences in acceptability between samples attributed to the formulation (F = 10.82, p <0.001). Acceptability varied from 4.0 for the formulation 5, up to 7,4 for the formulation 6 (Fig. 1).
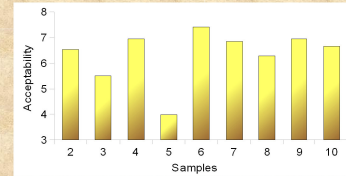


**Figure 1.** Mean values of the acceptability of the samples. Samples that do not share letters are significant differences in acceptability

In order to analyze the relationship between the overall acceptability and samples composition, data were fitted to the model proposed by the RSM for two composition variables.
The equation that represents the relationship between overall acceptability and concentrations of sucrose (S) and butia pulp (B) is as follows

> **Acceptability** = $11.154 - 0.464\,\mathbf{B} + 0.024\,\mathbf{S}\,\mathbf{B} - 0.012\,\mathbf{S}^2$
> ($R^2$ adjusted = 98.9)
> **B** = Butia pulp in %; **S** = Sucrose in %

According to the model, both sucrose and butia pulp concentrations affected significantly overall acceptability of product but in a different way.
Furthermore, the term associated to the interaction between the effects of both ingredients was significant indicating that the effect of butia pulp on the acceptability depended on the sucrose concentration and vice versa. This effect can be seen in the surface plot (Fig. 2). Increasing butia pulp content decreased acceptability in ice cream with low sugar content but increased acceptability when high sugar content is employed.
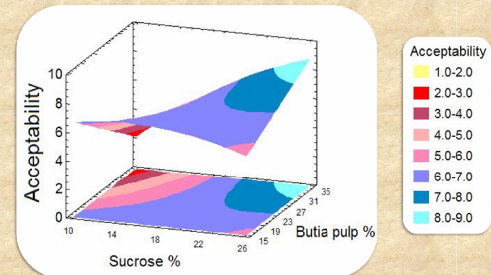


**Figure 2.** Response surface plot for overall acceptability of butia ice cream as a function of sucrose and butia pulp concentrations.

Changes on overall acceptability as a function of concentration of ingredients were studied using contour plot (Fig. 3). According to this graph, the maximum value for acceptability can be obtained at concentrations of sucrose between 23 and 26 % and butia pulp concentrations between 29 and 35 %. The knowledge of concentration ranges and interactions between components allows the development of different formulations to maintain an optimal overall acceptability and meeting the different interests that are wanted in the development of a new product.

## CONCLUSION

A butia ice cream with a maximum acceptability value can be obtained at sugar concentrations between 23 and 26 % and butia pulp concentrations between 29 and 35 %.

RSM was a useful tool to identify the best sugar and butia pulp combination to develop an innovative ice cream

### REFERENCES

Betancurt, P.; Gioscia, D.; Ayres, C.; Arcia, P. (2008). Fruto autóctono butia: innovación y transferencia tecnológica. INNOTEC. N° 3, pp. 72.
Choi, I.; Phillips, R.; Resurreccion, A. (2007). Consumer-based optimization of a third-generation product made from peanut and rice flour. Journal of Food Science, 72, pp. 443-449.
Gacula, M. (1993). Design and analysis of sensory optimization. Trumbull: Food and Nutrition Press.
ISO. (1988). General guidance for the design of test room. Standard No 8589:1988. International Organization for Standardization, Geneva, Switzerland.