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Preliminary study of the production of apple pomace and quince jelly

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Abstract

Apple pomace, a cheap by-product of apple juice and cider production, is rich in pectins and flavour compounds. Thus, a possible way of valorization of apple pomace was using it for jelly production. Fresh apple pomace from Braeburn, Gala, Golden Delicious and Granny Smith was used for the preparation of jelly to study the amount of sugar and quince content and the cooking time effect. The response surface methodology was used to study the preparation of apple pomace jelly and responses studied were textural characteristics and overall acceptability. The hardness of jelly was not affected by the factors studied whereas cohesiveness and overall acceptability were affected by the concentration of quince and sugar. The most appreciated jellies were those prepared with the highest quince concentration and the lowest sugar concentration.

Keywords: Apple pomace; Quince; Jelly production; Surface response method; Texture analysis; Sensory analysis

1. Introduction

Apple pomace, a very cheap and primary by-product of apple juice and cider production is used as a source of pectin (Hwang, Kim, & Kim, 1998), as animal feed (Sandhu & Joshi, 1997), as dietary fibres (Leontowicz et al., 2001) or as a source of phenolic compounds (Schieber, Hilt, Berardini, & Carle, 2004). Recently, flavour compounds were studied to valorize apple pomace and Tsurumi, Shiraishi, Ando, Yanagida, & Takeda (2001) have shown that the flavour obtained from apple pomace was almost equal to the flavour of an apple. Thus, another way of valorization of this by-product was using it as a potential food ingredient for jelly production (Barwal & Kalia, 1997).

Since apple pomace is rich in pectins, between 13 and 39 % of pectins (Renard et al., 1996) it is possible to obtain jellies without incorporating gel additive. The formation of jelly implies a controle of the cooking time and temperature, and the concentration of sugar sufficient for the required gelification to occur without compromising the flavour, the colour and the texture of the jelly.

The average cooking time is about 10–35 min at temperature about 120 °C. However, as noted by Belitz and Grosch (1999) those values can vary, and depend on the kind and variety of the fruit, and the gel-forming ability under comparable conditions is directly proportional to the molecular weight and inversely proportional to the degree of esterification. On the other hand, the same authors have indicated that the pH of the medium to be an important factor influencing the gelification. The pH can vary between 2.8 and 3.5.

The sensory analysis is often used for the formulation stage of new products or the optimization of existing products (Abdullah & Cheng, 2001; Mendes, Menezes, Aparecida, & Da Silva, 2001). The sensory preference testing is the most suitable response but physical measurements seemed necessary to complete that experimental design.

The purpose of the study was to present the methodology for optimization of the production of jelly from apple pomace and quince which increased pectins content and improved taste, based on a consumer preference test. This hedonic test was rounded by the texture analysis.

2. Materials and methods

2.1. Materials

Apple pomace was provided by Espoir Jus de Fruit (49, France) and used without any enzymatically treatment.

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Braeburn, Gala, Golden Delicious and Granny Smith were present in the pomace in the same proportion (25% for each apple variety). Additional pectin was brought by quince fruits (12.5–28.5%).

3. Methods

3.1. Experimental design

The formulation was studied using a factorial experimental design with 3 variables: the quince fruit concentration (12.5–28.5%), sugar concentration (43–50%) and heating time (25–30 min) on the texture and sensory analyses (Table 1). The concentration of apple pomace was in the range 21.5–44.5%. As the central point of the experimental design was repeated twice, the total number of experimental points was 10.

The analysis of variance (ANOVA) was performed by using Statgraphic software in order to determine the significance of the effects of these variables. An empirical model was built:

$$Y_e = b_o + b_1X_1 + \cdots + b_iX_i + b_{12}X_1X_2 + \cdots + b_{ij}X_iX_j + \cdots, \quad (1)$$

where Y_e is the estimated response, b_0 the model constant, b_i and b_{ij} the model coefficients reflecting the simple and interactive effects, respectively, and X_i the coded input variables. The coefficient b was calculated by multiple linear regression and their significance was estimated by means of ANOVA.

3.2. Preparation of the samples

Before the preparation of jelly the apple pomace and quince fruit cube were ground in a two-stage homogenizer (Homogénéisateur ALM) with a flow 80 l/h rate (Fig. 1). Jelly was prepared from this puree (pH about 3.4) by adding water (25 g of water per 100 g of apple pomace) and boiled during 15 min. Sugar solubilized in boiling water (20 g of water per 100 g of sugar) and syrup added to the extract after heating at 121 °C during 20 min. The mixture was cooked at 100 °C during the required time (Table 1) and jelly was poured into a rectangular mould (10 cm × 15 cm) and dried at room temperature for 48 h.

3.3. Sensory evaluation

Sensory evaluations were conducted in the sensory laboratory of École Supérieure d'Agriculture (ESA) in Angers (France). A panel of seventy consumers, consisting of 35 females and 35 males at age 18–45, took part in this study. They were invited to give an hedonic evaluation for the overall acceptability of fruits on a ten point scale from 1 (bad) to 10 (excellent). The samples of jelly (3 cm × 2 cm × 1 cm parallelepiped shape) were presented to each panellist in a random order. Taking into account the large number of samples (10), the samples were tasted during two sessions the same day in order to prevent the panellist from tiredness.

3.4. Texture analysis

The hardness of jelly fruits was characterized by a texture profile analysis (TPA) test using an universal testing machine (MTS synergy 200H). The test consist of two cycles of compression. The samples were compressed by 3 mm with a crosshead speed of 20 mm/min). The tests were performed in 5 replicates on jelly fruit (width: 1 cm; length: 2 cm; thickness: 1 cm). The hardness and cohesiveness were determined according to Bourne (2002).

4. Results and discussion

4.1. Textural analysis

A great variation of the hardness values (from 2.6 to 64 N) between products is shown in Table 1. The apple pomace jellies were heterogeneous as showed the variation

Table 1
Conditions, coding and results of the experiments of the factorial design

	Variables			Results		
	Quince (g/100 g)	Sugar (g/100 g)	Heating time (min)	Hardness[a] (N)	Cohesiveness[a]	Preference[b]
J0[c]	20.5	46.5	27.5	6.64 (±0.31)	0.46 (±0.06)	6.40 (±0.13)
J1	12.5	50	30	4.88 (28.7)	0.35 (3.4)	4.74 (4.1)
J2	28.5	50	30	12.40 (60.7)	0.20 (32.1)	6.12 (3.2)
J3	28.5	50	25	14.62 (23.0)	0.26 (20.2)	6.21 (3.1)
J4	12.5	50	25	2.64 (61.1)	0.31 (31.2)	4.52 (4.4)
J5	28.5	43	25	13.78 (15.5)	0.47 (18.3)	6.71 (2.9)
J6	12.5	43	25	15.80 (39.3)	0.49 (14.2)	5.70 (3.4)
J7	12.5	43	30	6.33 (50.4)	0.59 (7.6)	5.88 (3.3)
J8	28.5	43	30	63.89 (34.8)	0.25 (42.9)	6.50 (3.0)

[a]Means of 5 repetitions and values in parenthesis are coefficient of variation (%).
[b]Means of 70 values of preference and values in parenthesis are coefficient of variation (%).
[c]In replicate.