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Research Paper

Influence of gelling substance on sensory quality blueberry (climax) jelly

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Abstract. The present research includes four Blueberry jam formulations. For gelling the following were used: synthetic high methoxyl pectin (F1); synthetic high methoxyl pectin obtained from passion fruit skin extraction (F2); synthetic low methoxyl pectin (F3), and synthetic low methoxyl amidated (F4). Physical, chemical and sensorial properties were analyzed, such in pulp as jelly. Results form sensory alanysis showed, clearly, the tasters' preference for the jelly elaborated with synthetic high methoxyl pectin (F1) and synthetic low methoxyl amidated pectin (F4). From purchase intention histogram, it could be noted good acceptance for conventional products (F1 and F2) . Although jelly processing reduced the initial anthocyanins, blueberry jelly still can be considered a good anthocyanins source. Thus, the results revealed good perspectives for the application of this fruit in the food industry.

Keywords: Blueberry, jam, sensorial analysis, gelling.

INTRODUCTION

The United States is the the world's largest producer of blueberries, harvesting 84% of the harvest consists of cultivated blueberires. Most of the advantages associated with wild blueberries are related to living a disease-free, healthy life. While life-extension is one benefit of optimum health, disease prevention and anti-aging associated with maintaining youth by combating age-related diseases and ailments is the benefit we should be most concerned with (Antunes et al., 2006; Antoniolli et al., 2011). The first collection introduced in Brazil was formed by *rabbiteye* cultivars (Silveira et al., 2011). According Reque et al. (2014), Brazilian blueberry has reached great values in foreign market, showing a horticulture good alternative (Agarwal et al, 2007; Erig and Schuch, 2005; Pelizza et al., 2011).

However, in Brazil, Blueberry culture areas are still small, around 20 hectares, restricted to the Rio Grande do Sul and São Paulo and Minas Gerais mountain regions. Such regions have great potential in producing Blueberry (*Vaccinium ashei*), since this species has high profitability due to low inputs uses and, so far, clean production ease, safeguarding the environment and food safety (Antunes et al., 2006; Reque, 2014).

On the other hand, one of the major problems in Blueberry trade is the high perishability, even under refrigeration. On this context, several attempts in reducing the waste emerge and, among these, the production of fruit derivatives, being jelly one of the most widely used processes, because it follows a simple methodology, requires little equipment, besides the great acceptability of the product (Lago et al., 2011; Pinto et al., 2011; Damiani et al., 2012).

Jellies are made by cooking crushed or chopped fruits with sugar until the mixture reaches 65 ° Brix. Sugar is necessary for the gel to form, otherwise jelly recipes as a syrupy gel will form. Besides sugar, acid and pectin are necessary in obtaining jams (Brands, 2003).

The acidity level is also important to jelling. The gel will not set if there is too little acid. Too much acid will cause the gel to lose liquid or weep (Brees, 1999).

Pectin is a carbohydrate found in fruits. When sugar is added, the pectin in fruit or commercial pectin precipitates out and forms insoluble fibers. An acid, such as lemon juice or citric acid, aids in the process. The insoluble fibers produce a mesh-like structure that traps the fruit juice or other liquid, much like a sponge absorbs water. This enables a gel to form. There are three tipes of pectins: High methoxyl (HM, used for conventional products), low methoxyl amidated and low methoxyl conventional. For light jams there is low methoxyl pectin (LM) products which allow making jams and jellies with less sugar (McGee, 1997).

The proposal of present research includes four Blueberry jam formulation, from fruit *Climax* species. It was elaborated conventional and light jellies and, for gelling four different ways were used: synthetic high methoxyl pectin (HM), high methoxyl pectin obtained from passion fruit skin extraction, synthetic low methoxyl (LM) pectin, and low methoxyl amidated (LM) pectin mixed with gums mixture. Gums use increased light jam consistency and coloration. Pectin obtained from passion fruit skin extraction was used in order to create an alternative for small producer, to prevent the not consumed fruits wastefulness.

MATERIALS AND METHODS

Materials

For jelly processing, fruits from southeastern regions of the country (Saint Clair, Santo Antonio do Pinhal, Brazil, Lattitude -22° 49' 38'', Longitude -45° 39' 45'') were used. Blueberries do not ripen at the same time and therefore should be collected incrementally during the harvest, according to the cultivar. The received fruits were washed in chlorinated water (25 ppm) and afterwards selected; damaged fruits on peel were discarded and maturation stage was tested using a texturometer (Texture Analyser, TA- TX2) with 1.0 cm^2 probe. The test consisted on 5.0 mm penetration of in the whole fruit, and checking the necessary force.

For pulp preparing, the fruits were pulped by pulp machine (Macanuda, DMCI model). Part of the pulp was separated for physical-chemical analysis and the rest used in jelly processing.

Jelly preparing

For conventional jellies (not light) processing, it was used the proportion pulp/sugar of 3/2; respecting ATM pectin (synthetic or obtained from Passion fruit bark extraction), it has been added to the mix at a ratio of 1.0% of pulp quantity. Process of pectin extraction from passion fruit peel, followed Bobbio and Bobbio (2003) methodology, where a mixture of passion fruit peel with water (1: 1) was homogenized, and the pH adjusted to 3.0. Then the mixture was heated to boiling for 30 min; after cooled, it was was filtered and 95% ethanol added until precipitation of the pectin. Such processing resulted in the extraction of pectin with final humidity of 94.08%.

Cooking was in stainless steel jacketed cooker (Kromodinâmica, 0.250 m^3, steaming water, internal mixing systems, 2700 W 220 v, Joinville/Brazil) with, where the pulp added to 30% of sucrose amount was heated until the mixture reaches 35° Brix (measured in Refractometer, Instrutherm, model RT-90-ATC, São Paulo/Brazil). Once reached such consistency, the remaining sugar with hydrated pectin (in 0.15 kg of water for each 0.008 kg of pectin) were added and the mixture kept under heating till reached 67° Brix.

Light formulations were prepared according Granada et al. (2005), where sucrose amount was 50% of conventional jellies, according; BTM pectin was added on 1.5% pulp amount, and was all added at once, and processed in stainless steel jacketed boiler (Kromodinâmica, 0.250 m^3, steaming water, internal mixing systems, 2700 W 220 v, Joinville/Brazil), until the product reached a total solids content corresponding to 37° Brix. In this stage, $CaCl_2$ was added (55 mg per gram of pectin proportion). For synthetic low methoxyl amidated (F4), xantana and carrageenan mix (1: 1 w/w), were used on 2% of sucrose weight proportion.

Once processed, the jelly was placed in 250 g glass jars, closed with metal lid (previously sanitized) and stored at room temperature.

Analytical method

The fruit samples were analyzed through physicochemical analysis of: pH (Adolfo Lutz 1985, method N. 4.7.1) using a pH meter (Model PA 200 Marconi) with 0.01 scale division; acidity, by titration with 0.1M NaOH of 0.010 kg of the fruit homogenized with destiladae water (100 ml) using phenolphthalein as an indicator 1% (Adolfo Lutz, N.4.7.2); total soluble solids in benchtop refractometer (Warszawar model RL3), with smaller scale division of 0.5° Brix (Adolfo Lutz, 315/IV); humidity, by infrared moisture analyzer (Gehaka IV in 2002, version 5.0) (Adolfo Lutz, 309/IV); otal anthocyanins was determined by Lima et. al. (2003), based on the neutralization of the charges of the uronic acid residues by free free calcium ions, causing the gelation of pectin and its precipitation.

Table 1. Blueberry formulations jam yield.

Formulation	Yield (%)
F1	69.00
F2	66.70
F3	90.80
F4	94.64

F1: jam with synthetic high methoxyl pectin (HM); F2: jam with high methoxyl pectin (HM) extracted from passion fruit; F3: light jam with synthetic low methoxyl (LM) pectin; F4: light jam with synthetic low methoxyl amidated (LM) pectin mixed with gums.

The jelly was evaluated relating: pH (idem in fruit); acidity (idem in fruit); total soluble solids (idem in fruit); total anthocyanins(idem in fruit); total and reducer sugar content (Adolfo Lutz, 309/IV) by sample clarifying (with zinc acetate and potassium ferrocyanide), filtration and titration of the filtrate with Fehling's solution until complete discoloration of indicator (LIMA et al., 2003); Water activity, using water activity meter equipment (Texto 65-PC) which consists of a combined hygrometer with thermometer used to measure relative humidity; which is based on filtration of the sample, dissolved in hot water.

Sensorial analysis

The products were also evaluated on sensorial acceptance test with nine point hedonic scale and purchase intent, by a group of 50 untrained judges; the samples were served in codified (with three numeral) discardble white glass and sensorial attributes evaluated were: flavor, color, appearance and texture. The results were submitted to Anova and Tukey Test with significance level of 5%.

In many different types of experiments, with one or more treatments, one of the most widely used statistical methods is analysis of variance or simply ANOVA. The simplest ANOVA can be called "one way" or "single-classification" and involves the analysis of data sampled from more then one population or data from experiments with more than two treatments. Tukey's test, is a single-step multiple comparison procedure and statistical test. It is used in conjunction with an ANOVA to find means that are significantly different from each other. This test compares all possible pairs of means, and is based on a *studentized range distribution* (*q*) (this distribution is similar to the distribution of *t*from the *t*-test).

Present research has been submitted to Research Ethical Committee (Declaration N. 0455/07).

RESULTS

The average yield of each formulation is given in Table 1.

Centesimal composition of the fruit lots used in jellies preparation as well as for the final product, are in given Table 2. Each analysis was carried out in duplicate to verify divergence in results.

Sensory analysis results shown in Table 3, where MDS is the medium difference standard. The purchase intention histogram, in Figure 1.

DISCUSSION

From Table 1, the *light* formulations presented higher yield, due to less water evaporation during cooking, which was finalized when the soluble solids content reached 35° Brix (for conventional jelly preparation, baking occurred until 65° Brix).

The results presented in Table 2 are according with Connor et al. (2002), Moyer et al. (2002), Sellappan et al. (2002), Koponen et al. (2007), Rodrigues et al. (2011) and Lago et al. (2011). Respecting to centesimal composition of *in natura* fruit, this presented composition characteristic of the product, according to bibliographical research, although jelly processing reduced the initial anthocyanins (in almost 50% for conventional jams; the light product showed smaller losses of these compounds) blueberry jelly can also be considered a source of this nutrient.

Jelly processing reduced the initial anthocyanins in almost 50% for conventional jams (F1). F3 showed smaller losses of these compounds. The presence of oxygen, ascorbic acid, hydroxymethylfurfural, sulfur dioxide (used in the sugar refining process) and heating are factors that may have interfere in pigment degradation (Bobbio and Bobbio, 2003). As the heating time was lower in *light* jam processing, the degradation of this compound by heat action was also bland. The heat processing and ascorbic acid presence in large quantities have influenced anthocyanin degradation; this case includes blueberries produced in Santo Antonio do Pinhal (SP), where ascorbic acid levels are among the 33.60 7.64 mg/100 g (Castro, 2007; Pinto and Balista, 2008). This can be evidenced by Mota (2006) which, using fruits with lower content of Ascorbic acid in processing jelly (as, for example, the Blackberry, with ascorbic acid content of approximately 0.71 mg/100 g) noted that the anthocyanins losses, after processing, were approximately 8%.

The least processing time for light jellies showed water activity between 21.5% (F3) and 22.96% (F4) in excess in comparing with standard jelly, prepared with synthetic ATM pectin (F1).

Table 2. Physico-chemical analyses of blueberry fruit and jellies samples.

Parameter	Fruit	F1	F2	F3	F4
Soluble solids (° Brix)	10 (0)	71.50 (0.707)	67.33 (0.577)	40 (0.000)	38.67 (1.154)
Humidity (%)	89.98 (0.13)*	and	and	and	and
Water activity (AW)	and	0.749 (0.0017)*	0.818 (0.0135)*	0.910 (0.0274) *	0.921 (0.00141) *
Reducing sugars (%)	and	47.5 (1.27)*	23.70 (0.55) *	24.90 (1.38) *	17.57 (1.520) *
Total sugars (%)	and	76.15 (0.68)*	65.25 (0.91) *	33.18 (0.91) *	39.02 (0.09) *
PH		2.43 (0.042)*	2.43 (0.008) *	2.53 (0.007) *	3.31 (0.042) *
Acidity (% Citric acid)	0.72 (0.007)*	0.66 (0.008)*	0.70 (0.047) *	0.78 (0.007) *	0.32 (0.008) *
Total anthocyanins (MG/100 G Fruit)	191.68 (6.19) *	89.86 (0.84)*	108.14 (8.96)*	109.30 (7.28) *	64.13 (4.67) *

and: analysis not done; *The results in parenthesis are the standard deviations.

Table 3. Sensory analysis of the variety of Blueberry jelly *Climax*.

Sample	Color	Appearance	Flavor	Texture
F1	7.08^{a}	5.85^{a}	6.56^{a}	5.06^{a}
F2	7.27^{a}	6.77^{c}	6.44^{a}	6.73^{c}
F3	6.40^{b}	4.98^{b}	4.69^{b}	3.98^{b}
F4	6.29^{b}	5.79^{d}	4.90^{b}	5.50^{a}
MDS	0.48	0.68	0.93	0.80

F1: jam with synthetic high methoxyl pectin (HM); F2: jam with high methoxyl pectin (HM) extracted from passion fruit; F3: light jam with synthetic low methoxyl (LM) pectin; F4: light jam with synthetic low methoxyl amidated (LM) pectin mixed with gums

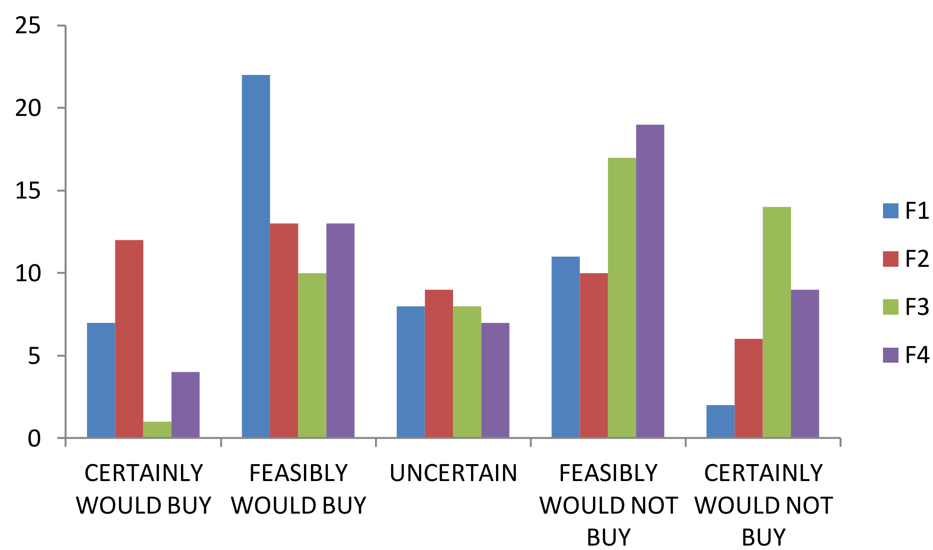

Figure 1. Histogram of purchase intent of Blueberry jam.

From Table 2, the levels of total sugars in light formulations presented reductions around 43.57% (F3) and 51.24% (F4), when compared with F1. Nachtigall et al. (2004) obtained similar results when comparing four different *light* hibiscus jellies formulations with the same product standard formulation, prepared on sucrose and glucose basis.

Based on the results in Table 3, there was greater preference in F2, for all attributes. These also show that F1 and F2 presented no significant difference between, respecting to color and flavor. On other hand, the light products (F3 and F4) had differed from other formulations, with lower notes for all attributes.

From purchase intention histogram (Figure 1), it could be noted good acceptance for conventional products (F1 and F2), presenting, respectively, 74 and 68% of approval. For light products, the acceptance was low with, respectively, 38 and 48% for F3 and F4.

CONCLUSION

From the results, it could concluded that:

1. Although jelly processing reduced the initial anthocyanins blueberry jelly can also be considered a source of this nutrient;
2. F1 and F2 presented no significant difference between, respecting to color and flavor;
3. The light products had differed from other formulations, with lower notes for all attributes;
4. F1 and F2 had good acceptance than light products.

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