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Cane Honey: Process, Quality and Harmlessness

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Abstract: The purpose of this study was to obtain hydrolyzed honey, evaluate its quality, harmlessness, and productivity of the process, in order to diversify and make dynamic the panela production. The quality and food safety about the product is determined by the control in every stage of the process especially in natural clarification and concentration. Two pH factors were tested and the final concentration of the solution was tested by response variables such as viscosity, flavor, and the presence of crystals. The results showed that pH and concentration impact considerably the quality and safety. These are objectively valued through a sensorial and microbiological analysis. The production yield regarding hydrolyzed honey is vital for panela and natural sugar production since it increases with the extraction of juice in an efficiency manner.

Keywords: panela industry, manufacturing honey, concentration, flavor, stability, nutritious, safe food.

I. INTRODUCTION

In the agro-industry sector regarding panela prevails activities of artisanal character more than industrial. However, some efforts related to technological improvements have been done in the production of panela, natural sugar, and recent studies about hydrolyzed honey for commercial purposes (Kumar, 2010; FAO, 2013). The same happened with honey production, there are no quality standards and some improvements are evident in investment studies. The lack of quality, harmlessness, diversification of production, estimation of production yield, and use of sub products are some problems, which have been generated. Cane honey elaborated with a technical process ensures the quality and harmlessness of the product in the market.

1.1 Process

In order to produce honey after post-harvest and transportation of sugar cane to the factory, the juice extraction, cleaning and clarification, hydrolysis and evaporation, final concentration and bottled. All stages in the process are important for the quality of the final product. Natural clarification stages, concentration and juices concentration , pH factors, temperature and time of the process have an impact in the production, since quality characteristics, as well as viscosity, turbidity, brightness, color, flavor and odor, stability and absence of crystals in the product are demonstrated (Quezada y Gallardo, 2014a).

Honey is known as melao (sugar cane syrup). It results of sugar solution concentration (da Silva et al, 2010), too liquid brown sugar with 0.1% metabisulfite (Priyanka et al, 2016).

The black honey produced manually. It is a product which appearing slowly in Panamá and Paraguay (Central AmericanaDATA.com, 2015; Fretes and Martinez, 2011; FAO, 2013). It is one of the traditional products and the management of it in factories is rudimentary, inadequate bottles and transportation make difficult the handling, sale, and consumption (Parra, 2001). The trapiche honey is a brown, dense, and viscous liquid and a pleasant aroma (Garcia et al, 2007).

Honey results of a hydrolysis process. It is a carbohydrate which is constituted mainly of inverted sugars and sucrose, viscous, translucent, and light or shiny brown color, or amber yellow color; it is due to the concentration of sweet substances of sugar cane juice. Sucrose hydrolysis in inverted sugar is gotten by the action of an acid to high temperatures or by enzymes. This phenomenon is due to a break of the weak glucoside link (Solis; Calleja and Duran, 2010). The sucrose inversion of sugar cane juice starts at 80°C. It is evident at 100°C and it depends on factors such as pH, temperature, and boiling duration (Chungu; Kimambo and Bali, 2001).

The final concentration gets hydrolyzed honey, it influences in the yield and consequently in the productivity and profit. The lower time it takes to obtain the better results, the process is more productive. The productivity in the sector called panelero depends on the product obtained. In order to obtain honey cane or molasses is necessary to incorporate citric acid from 100 to 110 °C (Caicedo, 2012), and from 103 to 105 °C o 106 °C (65 to 75 °brix) in this way is possible to obtain the final concentration (da Silva et al, 2010; Nath et al, 2015), depending agro-climatic zone, while the panela requires 90 °brix and for natural sugar is 95° Brix.

1.2. Quality and harmlessness

Is In addition, it is an important aspect for the production of food and drink, and it is normally considered as degree of excellence in the product, as well as a measure to protect and promote the public. Is when the buyer/consumer wants and is willing to pay for it (da Silva et al, 2010).

The health significance is in its consumption. Research studies indicate that the regular use of any raw sugar increases the intake of antioxidants components. Therefore, cane honey contains between six or seven times more components with antioxidant capacity than brown sugar and the potential use of these products as sugar substitutes may affect beneficially dietary and against anemia (Jagannadha; Madhusweta and Das, 2007; Seguí, 2013; Pankaj, Satish and Jaiswal, 2013). Raspadura (brown sugar). It is food fortifying and health protector (Plácido; Silverio and Pellegrini, 2013).

The nutritious quality about honey is evident in its components: 30 to 36% water, 40 to 60% sucrose, inverted components 15 to 25%, calcium 0.3%, iron 8.5 to 10 mg/100 mg, phosphorus 05/100 mg, protein 0.1/100 mg, and vitamin B 14/100 mg, since the product stays stable between 8 to 10 days (Jaswant; Solomon and Dilip, 2013). For 100 grams of food, cane honey or molasses is higher in thiamine (0.041 mg) and niacin (0.93 mg), calcium (205 mg), and iron (4.72 mg) in relation to other sweeteners such as fructose, white sugar, bee honey, brown sugar and it is lower in energy with 290 kcal and American Dietetic Association incorporates cane honey as recommended food for vegetarians especially its nutrients (UVE, 2005). Soluble solids varies between 65 and 75 brix, 76.6% in carbohydrates, low in protein and high in energy (2.85 Mcal/Kg), about sugars, 80 to 90% is sucrose because of its high content of moisture. Honey is fermented and inverted in reducing sugars. Honey is separated in two phases, one of them is constituted by crystallized sucrose and the other one is constituted by liquid sucrose rich in sugars (Garcia et al, 2007), similar to bee honey (82% carbohydrates, 38.2 fructose, 31% glucose, and 17% water (Kappico; Suzuki and Hongu, 2012). The effects on health especially anemia seem to be the most promising or important in the short term of *panela* products (Jaffé, 2012) and provide a friendly sweetening agent of medicinal value for health (Kiran et al, 2013; Jaswant, Solomon and Dilip, 2013; Sahu and Paul, 1998).

An absence of chemical substances used during the process and freshness are important to evaluate the quality (Ulloa et al, 2010). Faults, foreign materials, toxic and microbial substances do not certify the product (da Silva et al, 2010).

The food quality is given by a set of quantitative and qualitative characters, doing acceptable for the consumers. When the quantity of insoluble solids is reduced, the color and presentation improve. Color in food is a quality measurement and it means the acceptance of a product. These characteristics are obtained through hydrolyzed cane honey. In India, it is used as a classification criteria regarding panela (Guerra and Mujica, 2009).

The quality and availability are associated to the food safety, especially harmless and nutritious food (Niemeyer and Vera, 2008). Any food quality is always harmless, but a harmless food is not always a product of quality, which is undeniable its dual purpose.

According to FAO, **harmlessness** (healthy and safe food) are referred to the existence and control of hazards associated with products which are ready for human consumption through the ingestion of food and medicine which must not provoke hazards to the consumer's health; in spite of the concept about food harmlessness (Engo et al, 2015).

Includes actions, which guarantee the maximum safety of food. Codex Alimentarius states harmlessness as the guarantee of food which must not cause any damage to the consumer when it has been prepared or ingested (OMS, 2007).

Cane honey until its final concentration gets temperatures higher than 105°C, it is rich in inverted sugar and minerals, easy to use and especially harmless (save and healthy) since it is bottled in hot and due to its nature, air-tight containers are used.

II. MATERIALS AND METHODS

The natural clarification process of sugar cane juice was made by using mucilage of Yausabara with a concentration of 100-gram plant with liter of water and incorporation mucilage at 8% juice with a temperature of 90°C (Quezada and Gallardo, 2014b). Use of 0.3 to 60 ppm of aluminum polychloride with flocculants and clarifier magnaflot LT-27 as fining agent reach turbidity values between 53.09 to 93.33 (Prati and Moretti, 2010).

The citric acid was added to 95±1°C; then it is evaporated, cooled, bottled and the hydrolyzed honey is obtained. See figure 1.

The citric acid is used as preservative, antioxidant, and suppressor of the browning in doses of 0.05 to 2% and to brown sugar liquid 0.04% (Priyanka et al, 2016). In order to obtain cane honey or molasses the environment must be stable during 8 until 10 days. Doses of 0.04% are used to avoid crystallization and show an attractive color, 1% of potassium metabisulphite and 0.5% of benzoic acid as preservatives (Jaswant, Solomon and Dilip, 2013).

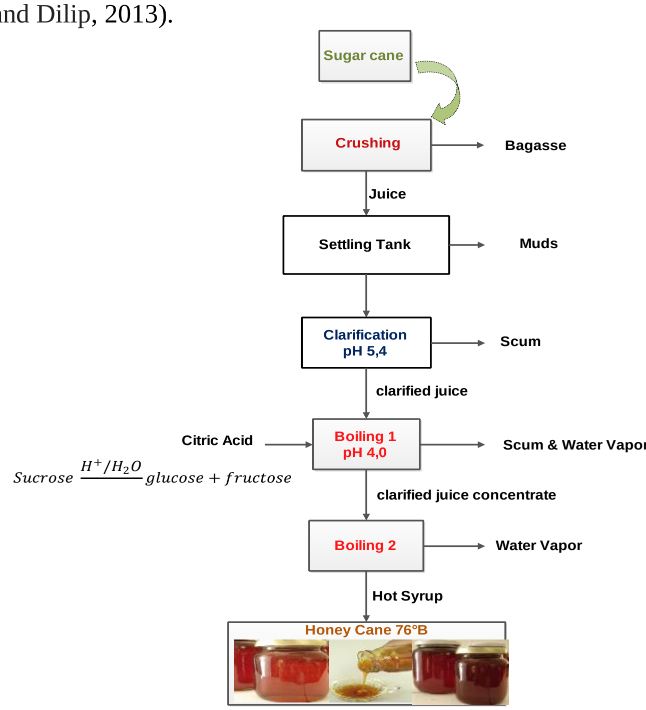

Fig. 1. Process of obtaining cane honey.

It was used an experimental design with factorial arrangement 3^2, taking into account factors such as pH and concentration. The superior level of pH was established according to pH (4.5 to 5.5) of the sugar cane juice (Hugot, 1984; da Silva et al, 2010).

The average and low levels, of pH were measured through invertase-enzyme juice and the average pH 3.91 of bee honey (Rubio, 2015), and the pH of juices invested with enzyme invertase (Solís; Calleja and Duran 2010). The concentration levels were determined according to the cane honey or molasses temperature from 103 to 106°C and belong to 74 y 78 brix (Quezada; Gallardo and Quezada, 2015). See Table 1, the factors: pH=X_1 and concentration (Brix) =X_2

Table 1: Factors, levels and response variables in the product.

Factors	Levels			Response Variables		
	Low	Average	High	Viscosity (Yv)	Flavor (Ys)	Presence of Crystals
X_1	3,5	4	4,5	Sensorial		
X_2	74	76	78			

The response variables were analyzed through a sensorial evaluation by using a panel with 10 tasters for viscosity, flavor, as well as degree of acidity, and presence of crystals after 120 days of having elaborated the product. For the measurement process, a scale of 0 to 10 was used in each case; the high values belong to products widely accepted and the low ones for products scarcely accepted.

III. RESULTS AND DISCUSSION

The data shown (Table 2), mathematical models (Table 3) and 2, 3 and 4 resulting from the evaluation software Statgraphics 4.1.

Table 2: Results of experimental design.

Experiments	X_1	X_2	Yv	Ys	Yc
1	-1	1	0,7	1,9	3,2
2	0	0	9,6	8,6	9,1
3	-1	-1	3,8	2	9,3
4	1	-1	2,1	9,2	7
5	0	1	0,8	8,6	2,9
6	-1	0	9,5	2	9,2
7	1	0	9	8,3	6,8
8	1	1	0,8	8,9	1,2
9	0	-1	2,3	8,8	9,2

Higher values product acceptance responses of the three variables belong to pH and concentrations in their average levels (experiment 2) and pH at its highest level and average concentration (experiment 7). Although the experiment is acceptable to 6, responses variables viscosity and crystal formation, not favor the flavor found in the low (acid product). Similarly, the experiment 9 is acceptable for the response variables flavor and crystal formation, the viscosity of the product is affected by being in the low concentration, namely high fluidity of the product when pouring it, as evidenced in mathematical models (table 3).

Table 3: Mathematical models of response variables

Models
Yv$=9,311-0,35*X_1-0,98*X_2+0,083*X_1\wedge2+0,45*X_1*X_2-7,62*X_2\wedge2$
Ys$=8,489+3,416*X_1-0,1*X_2-3,28*X_1\wedge2-0,05*X_1*X_2+0,267*X_2\wedge2$
Yc$=9,0-1,117*X_1-3,033*X_2-0,95*X_1\wedge2+0,075*X_1*X_2-2,9*X_2\wedge2$

The mathematical model (Yv) for viscosity achieves a high significance about the concentration in relation to the pH. For flavor according to the mathematical model (Ys), the variable, which determines the significance, is the pH. The mathematical model (Yc) for the presence of crystals achieves major significance the concentration variable followed by the pH variable. The last model shows better criteria regarding this study, hydrolyzed cane honey or molasses since it achieves major significance the factors, which were evaluated in average levels and answered to a major level of product acceptance.
Figures 2, 3, and 4 show Pareto diagrams and the graphics about the effects of the variables. Viscosity (figure 2), there is a significant influence about the concentration and it has a better impact in the product acceptance in intermediate values. For flavor (figure 3), achieves significance the pH variable, where the acceptance is major to intermediate and high pH. Finally, for formation of crystals (figure 4), the factors concentration and pH are significant in their order and they correspond themselves, since average levels achieves major acceptance.

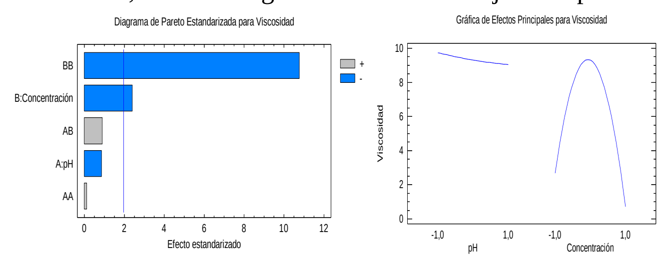

Fig. 2. Performance of pH and concentration of viscosity.

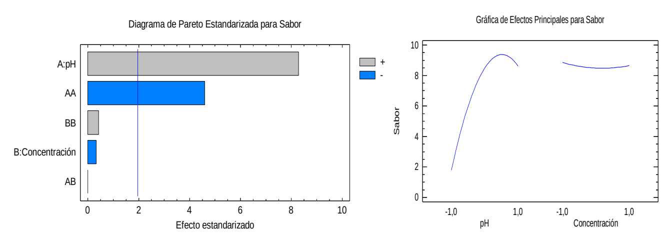

Fig. 3. Performance of pH and concentration of flavor and acidity.

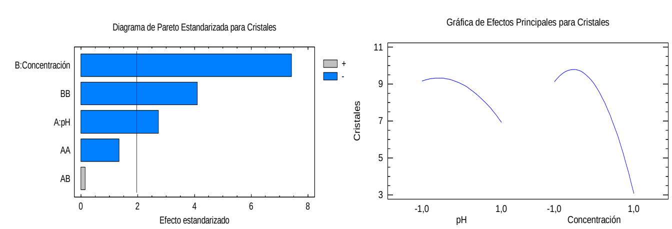

Fig. 4. Performance of pH and concentration of formation of crystals.

When the concentration (brix) and the pH increase, the crystallization in honey is evident, due to an incorrect inversion of sucrose. An adequate combination of the two variables allows stabilizing the product, suppressing the crystallization.

The flavor acceptance (acidity) depends on pH in its average value (4±0, 2) and the adequate concentration of the product (76±0, 5 brix), related to temperature and concentration (106±0, 8 °C).

The citric acid must incorporate superior temperatures to the boiling point (95±0, 5 °C) in clean juice a final clear, and brilliant product is gotten. Below the indicated value, an adequate color is not gotten; the acid is a dye solubilizer. The reddish color is due to a component of phenolic character. They can exist in a free manner or glycosides attached to sugar molecules (Clarke, Blanco and Godshall, 1986). Colored compounds which are formed during the process and they come from the thermal decomposition of sucrose and depleted sugars (Solís; Calleja and Durán, 2010). And regarding degradation of chlorophyll through acids (Prati and Moretti, 2010).

The hydrolyzed cane honey or molasses contains sugars which mostly are represented by soluble solids. The nutritious quality of the product for each 100 grams of food lies in its energy potential with 328.86 kcal, moisture 23.8%, concentration 76 brix and pH 4. Carbohydrates (79,8 %), invert sugar (43,69 %), mineral such as potassium (1056 mg), calcium (136 mg), phosphorous (116 mg), iron (2.62 mg), and magnesium (92, 3 mg). Vitamins: A (3.8 mg), vitamin D (6.5 mg).

Harmlessness, is gotten with the final concentration, which is achieved by the product, when it is bottled with a temperature of 90-±2 °C, it stays steady without affecting its characteristics for more than 3 months. In addition, the presence of microbial load is basically nil and it is adjusted to the standard requirements (NTE-INEN 2 337, 2008).

IV. CONCLUSIONS

The hydrolyzed cane honey or molasses is an alternative of production for diversification and encouragement of the panelero sector, which requires an immediate executive implementation.

Control in all stages of production allows getting a product of quality because of their own characteristics since it is nutritious and harmlessness, compared with other sweeteners they are manufactured in agribusiness.

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