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Elaboration and characterization of lemon jam

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Abstract - The present work is aiming the transformation of citrus fruits to the elaboration of a jam to basis of whole lemon. The work has focused on the study of the physico-chemical composition, the rheological properties and the microbiological aspect of the product. Thus, it presents richness in soluble sugar and reducer (respectively 24% and 15, 4%), an important content in phenol compounds (542 mg GA/100g) and a wealth in minerals. By against, a low of protein levels (1.27%) and ash (1.28%) has noted. Next to this high value product presented very interesting functional properties (firmness, water retention of power ...), good microbiological stability during the storage period, a positive assessment for tasting and a characteristic color. This product presents an appreciation of sensory quality evaluated by hedonic tests. The result of the work will focus on the improvement on the formulation of the jam.

Keywords: citrus, jam, lemon, physico-chemical characteristics, microbiological stability, sensory quality.

1. Introduction :

Citrus production is widespread around the globe. Improving production is mainly due to the growth of cultivated land under citrus. According to FAO statistics, in 2004, over 140 countries produced citrus. However, the bulk of production is concentrated in the Northern Hemisphere, accounting for about 70% of total production.(FAO 2004)

In Tunisia, the citrus acreage reached 22,000 ha, equivalent to 0.4% of the agricultural area. The plantation growth rate reached 26% compared to the census of 1999. The value of the national citrus production is estimated at 125 million dinars, or 3% of gross domestic product. Citrus supplying the domestic market during months of the year. They are also exported, mainly to France, allowing Tunisia to generate revenues of 22 million dinars through Maltese variety that is considered the most requested for export. Nabeul is the agricultural region par excellence, also called the capital of citrus. It produces three quarters of the national production and devotes 72% of all agricultural land in this activity which is of paramount importance, notably resulted in workshops and scientific meetings dedicated to the promotion of this sector. However, it should be noted that oranges occupy first place in the export of citrus followed by the lemon. This last deserves more attention in order to safeguard and enhance the place it begins to occupy in the international market. (Moufida and Brahim 2003).

The effort of the development of the sector through strategies adopted since independence has led to the increase in commercial production and improves its quality to meet both the local market as global. The quality approach adopted by the Tunisian producer begins by implementing appropriate cultivation techniques. The quality assessment begins with the fruit harvest by picking ripe to storage. (Downing 1996)

The processing of citrus fruit is very limited in Tunisia, it mainly concerns the production of juice, making marmalade and enhancement of co-produced by the extraction of essential oils from the distillation of the flowers and the manufacture of powdered bark (Moufida and Brahim 2003). In this work we are interested in:

(i) Development of a whole lemon-based jam and
(ii) The detection of physico-chemical properties, microbiological and sensorial product.

2. Materials and methods:

2.1. Materials

70kg *Primofiore* variety of lemon Tunisia were collected in January 2014. Various tests were performed by varying a flow diagram of parameters to achieve an appreciable final formulation by the consumer.

2.2. Jam processing

Jam processing was conducted according to procedure described by Downing (1996) Fruits were sorted, washed and ground using a mixer (Hermle, Z323; Wehingen, Germany) at 21 000 × g for 60 s. Jam formulation was 10 kg fruit, 65 % sugar, 4 kg water and 0,2 % ascorbic acid. Ground fruits were heated in a double-jacketed steam kettle at 100 ◦ C for 8 min to inactivate enzymes. Then the mixture is heated to the baking step for 30 min.

Baking followed by measuring brix and the stop is equal to a 65 ° brix. The jam was hot-packed at 85 ◦ C in 100 g glass jars, immediately sealed with metal cover, and inverted for 5 min to sterilize the glass containers. The jars were then returned to normal positions for holding at 50 ◦C. Samples were stored at room temperature. (Downing 1996)

2.3. Chemical analysis of lemon jam

Jam was analyzed for moisture, ash, protein and fat contents as per the standard methods of AACC (2000). Nitrogen content was estimated by Kjeldhal method and was converted to protein using factor 6.25. The amount of soluble dietary fiber (SDF), insoluble dietary fiber (IDF) and total dietary fiber (TDF) was determined according to the gravimetric enzymatic method (Prosky et al. 1988). Starch contentwas evaluated by an enzymatic colorimetric method. Soluble sugars concentrationwas determined by the phenol-sulphuric acid method. (Dubois 1956)

Minerals concentrations were determined after an acid digest of each sample with a nitric/perchloric acid (2:1, v/v) mixture. Aliquots were used to estimate Phosphor concentration by spectrophotometeric methods and Ca, Mg, K, Na, Fe, Cu and Zn by atomic absorption spectrophotometry (Hitachi Z6100, Tokyo, Japan).(AACC 2000)

Total phenols contents were determined by the Folin-Ciocalteu method and measured at 675 nm. (AFNOR 2003)

2.4. Physical characteristics of lemon jam

2.4.1. Color measurement

Color measurements of lemon jam samples were carried out using a Hunter Lab system with a colorimeter (Minolta CR-300, Japan) on the basis of L*, a* and b* values. L* value indicates the lightness, 0–100 representing dark to light, a* value gives the degree of the red–green color, with a higher positive a* value indicating more red. The b* value indicates the degree of the yellow–blue color, with a higher positive b* value indicating more yellow (Sudha et al. 2007)

2.4.2. Water holding capacity (WHC)

For water holding capacity (WHC) determination, 1 g of jam was mixed with 50 ml of distilled water vigorously for 1 min and then centrifuged for 15min at 10,000×g at 20 ◦C. The supernatant was discarded and the tube was kept inverted for 25 min at 50 ◦C. The WHC was expressed as g of water bound per gram of the sample on dray basis (Chen et al., 1988).

2.4.3. Texture Analyzer

Lemon jam was placed on the platform. An acrylic cylindrical probe was used to compress jam sample fo its original height at a speed of 10mm/s. Colors of crust and crumb were measured using the Hunter Lab system with a colorimeter (Minolta CR-300, Japan).(Chen et al. 1988)

2.4.4. Sensory analysis

The organoleptic characteristics of jam were carried out by 25 panelists. The panelists were asked to evaluate the products for crust color, crumb color, grain, texture, eating quality and overall quality (Sudha et al., 2007). The ratings were on 5-point hedonic scale ranging from 4 (like extremely) to 1 (dislike extremely) for each organoleptic characteristic.

4. Results and discussion

4.1. Chemical characteristics of lemon jam

Table 1 summarizes the overall composition of lemon jam. A high mineral content, dry matter polyphenols and pectin content was observed for the product. However, low-fat and protein levels were observed.

This low pH of the jam could be explained by the presence of many organic acids such as malic acid, citric and oxalic. Indeed, the low pH and aw which could prevent the growth of bacteria, can not, prevent the growth of molds and yeasts (El Gerssifi 1998). Acidity is an important criterion for assessing microbiological and sensory qualities jam. This characteristic is derived mainly from the content of organic acids, especially citric acid (Reyes-Aguero et al., 2006). Concerning the activity of the water means the available water content in the product and reflects its fresh state, it is very high and the order of 0.81. Indeed, these values significantly affect the shelf life (FDA 1979, FDA).

Table 1 : Approximate composition of jam

Parameter	Value
pH	2.88
Aw	0.81
Dry matter(%)	63.3
Ash(%)	1.28
Calcium (mg/100gFM)	2823
Potassium (mg/100gFM)	154
Sodium (mg/100gFM)	935,2
Magnesium(mg/100gFM)	189,2
protein (%)	1.27
polyphenols (mg GA/100g)	542
Pectin (%)	53.4

4.2. Physical characterization of lemon jam:

4.2.1.Color measurement

The measured parameters of the color are L*:16, 56 ± 0,137; h°: 89, 12 ± 0, 44.Jam has a stable color over two months of storage and kept a yellow tint.

4.2.2Water holding capacity

For two months of storage, we observed no change in the water holding capacity of jam made from the whole lemon (WHC =22,32g/100gFM (T=0 days) ;WHC=19,96g/100gFM (T=2 months)) .The finished product keeps starting values showing that it is stable over time. So the finished product retains the original values which shows it is stable over time (no syneresis phenomenon).

4.2.3Microbiological stability

Our jam is healthy and has no microbiological spoilage. The high sugar content and their chemical properties ensure the safety of this product. In fact, the results indicate that this jam has good microbiological safety, since the product is free of germs and anaerobic spores sulfito gear boxes, total coliforms, fungal flora, fecal coliforms, staphylococci, yeasts, molds and fungi. The total flora are disappointed thresholds tolerated in acceptable limits (Besbes et al. 2009).

4.2.4.Storability

By performing the test canned, we affirmed according to the French standard NF V 08-401 and NF V 08-402 jam that can be marketable. However, determination of test D.L.C. would be mandatory.

The study of the stability during storage of the lemon jam was determined by analyzing the microbial flora of the samples stored at 55 ° C and 32 ° C for 7 days and 21 days, respectively. The results show that the jam is prepared microbiologically stable, in fact it has no alteration. This could be explained by the following facts:

- The heat treatment during manufacturing pushed jam (cooking, pasteurization)
- The chemical properties of products (acidity, sugar content ...) that limit the growth of bacteria (Raoult 1984).
- The rich in phenolic compounds (Ziouti et al. 1996).

4.2.5.Sensory analysis

The results of the sensory analysis show that substantially only the test sample received a remarkable acceptability (Besbes et al. 2009). Indeed, the results revealed that this product is significant for the majority of tasters (20 person between 25) (Touraitte 1984).

5. Conclusion

In this work, we were interested in the development and characterization of a jam from whole lemon. Initially, the physicochemical characterization of the jam was performed. The results revealed a wealth of soluble sugar, medium fiber, antioxidant compounds know as polyphenols, low ash and protein. Reading microbiological stability of jam the results shows that the product is free of the majority of microbial flora (germs and sulphite-reducing anaerobic spores, total coliforms, fecal coliforms, staphylococcus, yeasts and molds), it meets the standards. The study of the storability shows that our product can be marketable. No change was observed in the water retention capacity of the developed jam .The finished product keeps starting values which shows that it is stable over time (Albagnac et al. 2002).

Sensory analysis jam revealed that this product is significant for the majority of tasters. With less importance to the texture, which was determined by testing the parameters of hardness, cohesiveness, the index of elasticity and adhesion strength of the prepared sample.

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