Original Research Article

Physicochemical and nutritional evaluation of mango purees from 3 departments of the Savanes district during their conservation

ABSTRACT

Mangoes are perishable commodities subject to continuous changes which lead to post-harvest losses. It is therefore necessary to develop conservation methods in order to reduce these losses. Main objective of this study was to evaluate the impact of storage at 4°C and 25°C on the physicochemical and nutritional properties of mango purees from 3 departments (Boundiali, Korhogo and Sinématiali) of the district of savannahs. After stabilization of the purees, the physicochemical and nutritional parameters were determined according to standardized methods. Result of the study revealed fluctuations in parameters during storage. After 4 weeks of storage at 4°C, the moisture content, pH and acidity oscillated between 82.90 – 88.61%, 3.50 – 4.21 and 6.00 – 8.66 meq/, respectively. 100g. As for storage at 25°C after 4 weeks, these parameters varied respectively between 82.90 – 93.23%, 3.21 – 4.21 and 6.00 – 9.10 meq/100g.Residual nutrient contents after 4 weeks at 4 °C were included: soluble dry extract (18 – 13.33 °Brix), reducing sugars (0.35 – 0.89%), total sugars (0.73 – 1 .19%), proteins (3.97 – 5.87%) and vitamin C (6.56 – 11.15 mg/100g). After 4 weeks of storage at 25°C, the variations were as follows: soluble dry extract (18 – 11°Brix), reducing sugars (0.28 – 0.89%), total sugars (0.49 – 1.19 %), proteins (3.97 – 9.40%) and vitamin C (4.86 – 11.15 mg/100g). In view of these results, it would be desirable to keep the purees stabilized at 4°C and 25°C for respectively no more than 4 weeks and 2 weeks in order to contribute to the food security of the Ivorian population.

Keywords: mangoes, conservation, puree, district, nutritive

1. INTRODUCTION

Mango (Mangifera indica L.) is a tropical fruit native to the Indo-Burma region, ranking fifth in global fruit production after citrus fruits, grapes, bananas and apples [1]. According to [2], the mango would be considered the 2nd most cultivated tropical fruit after the banana. Its cultivation represents more than 50% of the volume of tropical fruits grown around the world in 2017 [3]. In terms of regional distribution, it is estimated in 2017 that 75% of global mango production comes from Asia, 15% from Africa and 10% from Latin America and the Caribbean [3].

In West Africa, the mango offers many nutritional benefits and represents an essential source of income [4]. It plays an important role in the economic development of production areas. In Ivory Coast, mango is the third fruit exported behind banana and pineapple, generating more than 16.8 billion CFA francs in revenue in 2021 [5]. Ivorian mango production was estimated at 180,000 tonnes [5]. This production constitutes a substantial source of income for farmers. Ivory Coast's mango exports have increased significantly over the years to reach over 47,500 tonnes in 2021 [5].

Third supplier to the European market, Côte d'Ivoire is also the leading African country exporting mangoes, far ahead of other West African countries [6]. The main producing regions are located around the towns of Odiénne, Boundiali, Korhogo, Sinématiali, Ferkéssedougou and Tafire. There are approximately a thousand varieties grown around the world that differ in size, color, texture and nutritional properties of the fruit [7]. This varietal diversity makes it one of the most popular fruits in many tropical and subtropical regions. The most common varieties are Kent, Keitt, Amélie, Julie, Lippens, Brooks, Palmer.

Nutritionally, it is appreciated for its sweet taste and for its vitamin richness, especially in vitamins A and C and minerals such as calcium, potassium, phosphorus and iron [8].

At the medical level, mango has been designated as a functional food for the prevention and control of metabolic disorders, obesity-related chronic diseases, fatty liver and other comorbidities [9].

Ivorian mango sector is facing considerable losses between the quantity of mango produced and the quantity exported. These post-harvest losses are estimated between 30 and 35% of total production, or between 54,000 tonnes and 63,000 tonnes of mangoes lost after harvest out of a production of 180,000 [5]. To reduce these post-harvest losses, one of the solutions would be their transformation into purees, jams and jellies, nectars and dehydrated products [10]. Processing of mangoes in the form of purees constitutes a way of reducing post-harvest losses and to give added value to the product and conserve production surpluses [11].

These significant losses of mango after harvest can be justified mainly by the difficulty of preserving fresh mango linked to its biochemical composition and by the absence of post-harvest technologies for stabilizing the fruit. In addition, what could be the impact of conservation on the nutritional value of the puree produced?

It is with this in mind that our work aims to evaluate the impact of two conservation methods on the physicochemical and nutritional properties of mango purees of the Kent variety from 3 departments in the north of Côte d'Ivoire.

2. MATERIAL AND METHODS

2.1 Material

2.1.1 Biological material

Biological material used in this study consists of mango of the Kent variety from the departments of Boundiali, Korhogo and Sinématiali.

BoundialiKorhogoSinématiali

Fig. 1. Mangoes from different departments

2.1.2 Chemicals

Chemicals used in this work are analytical grade. Metaphosphoric acid, glucose, sodium hydroxide and phenolphthalein come from Sigma. As for 2,6 dichlorophenol-indophenol (DCPIP), dinitrosalicylic acid (DNS), methyl red and bromocresol green come from Merck. Solvents such as sulfuric acid and acetic acid come from Sharlau.

2.2Methods

2.2.1 Sampling

Samples were collected from three markets in different localities, namely Boundiali (large market, Simpiogo market), Korhogo (large market, disaster market and small Paris) and Sinématiali (large market, ouollo and Fodiolokaha market). Samples collected from the different markets were mixed to constitute the locality sample.

2.2.2 Puree production

Mango puree was obtained according to the method described by [6] modified. Mangoes were sent to the Peleforo Gon Coulibaly University Laboratory in Korhogo in boxes at the rate of one box per location. They were washed and disinfected in 100 ppm bleach water. Subsequently, they were peeled, pitted and diced using a stainless steel knife. Pulp obtained was crushed using a blender (NASCO).

2.2.3 Stabilization of the puree

Stabilization of the puree was carried out according to the method of [12]. To 1 kg of puree were added 10 mL of lemon juice. Mixture obtained was divided into 5 glass jars at a rate of 200 g per jar. Jars were sterilized at 85°C in an autoclave for 10 min. After sterilization and cooling, a jar was used for initial time (T0) analyses. Other four jars were split into two batches of 2 jars. The batches were stored for 4 weeks respectively at room temperature (25°C) and in the refrigerator (4°C). Every 2 weeks, samples were taken for the various analyses.

2.2.4 Physicochemical properties

Moisture, pH and acidity were determined using [13]. Moisture content was determined by the difference of weight before and after drying stabilized puree (10 g) in an oven at 105°C until constant weight. pH was determined as follow: 10 g of stabilized puree was homogenized with 100 mL of distilled water and then filtered through Whatman No. 4 filter paper. pH value was recorded after the electrode of pH-meter was immersed into the filtered solution. For acidity 10 mL of filtrate or nectar have been titrated by NaOH 0.1N in the presence of phenophthalein.

2.2.5 Nutritive properties

Soluble dry extracts of stabilized puree were measured using method **[9].** A drop of stabilized puree was placed on the screen of a refractometer and the value of soluble dry extracts was read directly in its eyepiece.

Total sugars were determined by the phenol method [14]. 0.50 g of stabilised puree was introduced into a test tube containing 0.50 mL of sulfuric acid (12 N). Reaction medium was kept at ambient temperature (25 °C) during 1 hour before boiling it for two hours in a water bath (100 °C). Then, to the boiling medium, were added successively 5.50 mL of distilled water, 10 mL of ethanol (70%), 0.5 mL of zinc sulfate (2 g/100 mL) and 0.5 mL of potassium ferrocyanide (10.6 g / 100 mL). Mixture was filtered and the filtrate was adjusted to 50 mL with distilled water. To 0.2 mL of the filtrate was successively added 0.50 mL of phenol (5%) and 2.50 mL of sulfuric acid. After for 10 minutes at ambient temperature, the mixture is well homogenized and the absorbance was read with a spectrophotometer at 490 nm. Total sugars content was determined using a calibration curve of glucose (10 mg/100 mL) as standard.

Reducing sugars content of Stabilized puree was determined according to [15]. 1 g of stabilized puree is dissolved in 50 mL of warm distilled water. After filtration, the volume is completed at 100 mL. To 1 ml of solution were added successively 0.5 ml of distilled water and 0.5 ml of DNS. After for 5 minutes at ambient temperature, the absorbance was read with a spectrophotometer at 580 nm (1 mg/mL) as standard.

Vitamin C contained in stabilized puree was determined by titration using the method described by [16]. Ten (10) g of stabilized puree were soaked for 10 min in 40 mL of solution of metaphosphoric acid-acetic acid (2%, w/v). Mixture was centrifuged at 3000 rpm for 20 min and the supernatant obtained was diluted and adjusted with 50 mL of bi-distilled water. Ten (10) mL of this mixture was titrated to the end point with dichlorophenol-indophenol (DCPIP) 0.5 g/L.

2.2.6 Statistical analysis

Statistical analyses were performed with Graph Pad Prism software version 8.0.2. The variance analysis (ANOVA) was performed to determine differences between the averages according to method of Turkey at the 5% threshold ($p<0.05$ was considered significant). The results were expressed as averages with standard error on mean (mean ± SEM).

3. RESULTS AND DISCUSSION

Table 1 presents the evolution of the physicochemical properties of the purees during their storage at 4°C and 25°C. Moisture contents are statistically different. Moisture content increases with prolonged storage time. This increase is more accentuated in purees stored at 25°C. After 2 weeks of storage at 25°C, the values vary from 84 to 90.15%; 82.90 to 85.17% and 84.10 to 87.40% respectively for Boundiali, Korhogo and Sinématiali. After 4 weeks of storage at 25°C, Boundiali (93.23%) has the highest content followed by Sinématiali (90.88%) and Korhogo (90.63%). This same trend is also observed during storage at 4°C. On the other hand, after 4 weeks of storage at 4°C, Sinématiali (88.61%) recorded the highest value followed by Boundiali (88.00%) and Korhogo (85.20%). Our results are different from those [17] who recorded constant values of the moisture of the pasteurized pulp of mango of the Karthakolomban variety stored at room temperature for 3 months but coincide with those of [18] who recorded an increase in humidity from 74.50 ± 0.02 to 87.02 ± 0.03% in mango juice stored in the refrigerator (4 °C) for 25 days. This slightness could be explained by various

metabolic processes such as fermentation, packaging preventing moisture loss as well as the absorption of moisture when opening the bottles during analyzes [18, 19].

Concerning the pH, we observe that pH and acidity are statistically identical during storage at 4°C of the different purees unlike storage at 25°C where they remain statistically stable for 2 weeks then vary.Decreases in pH during storage at 4°C are less significant compared to storage at 25°C. After 4 weeks of storage at 4°C, the Sinématiali puree (8.66 meq/100g) is more acidic followed by Boundiali (8.45 meq/100g) and Korhogo (6.05 meq/100g). This slight drop in pH is in agreement with those of [20] who observed a drop in pH from 3.2 to 2.9 after 90 days of storage of plum-based drinks. This drop in pH could be due to the fermentation process which is not completely stopped [21]. Reduction would be beneficial because it would inhibit the growth of microorganisms [22].

Table 1. Evolution of the physicochemical properties of the purees during storage at 4°C and 25°C.

	Moisture %	pH	Acidity (meq/100g)
Boundiali			
0 week	84.00 ± 0.15e	3.83 ± 0,00b	6.28 ± 0.16c
2 weeks 4 °C	86.32 ± 0.36d	3.70 ± 0,08c	8.33 ± 0.30b
2 weeks 25 °C	90.15 ± 0.12b	3.52 ± 0,00c	8.73 ± 0.15b
4 weeks 4 °C	88.00 ± 0.60c	3.52 ± 0,02c	8.45 ± 0.20b
4 weeks 25 °C	93.23 ± 0.55a	3.26 ± 0,05e	9.00 ± 0.02a
Korhogo			
0 week	82.90 ± 0.20f	4.21 ± 0.02a	6.00 ± 0.02d
2 weeks 4 °C	84.49 ± 0.20e	4.03 ± 0.04a	6.04 ± 0.00d
2 weeks 25 °C	85.17 ± 0.26d	3.98 ± 0.01a	6.06 ± 0.10d
4 weeks 4 °C	85.20 ± 0.30d	3.95 ± 0.03a	6.05± 0.05c
4 weeks 25 °C	90.63 ± 0.21b	3.21 ± 0.12e	9.10 ± 0.02a
Sinématiali			
0 week	84.10 ± 0.04e	3.72 ± 0.05c	8.32 ± 0.00b
2 weeks 4 °C	84.67 ± 0.07e	3.60 ± 0.06c	8.66 ± 0.20b
2 weeks 25 °C	87.40 ± 0.13c	3.43 ± 0.01d	8.80 ± 0.00b
4 weeks 4 °C	88.61 ± 0.70c	3.50 ± 0.05c	8.66 ± 0.30b
4 weeks 25 °C	90.88 ± 0.40b	3.29 ± 0.07e	9.05 ± 0.00a

Values in the table are averages of three tests, affected by standard deviations. Statistical differences between these average values at 95% confidence level are indicated in the same column by the different letters a, b, c, d, e and f.

Evolution of the nutritional properties during storage at 4°C and 25°C are shown in Table 2. Soluble dry extract of the different purees are statistically different. After 4 weeks of storage at 4°C, the soluble dry extract of the different purees increased from 15.66 to 13.33°Brix, from 18 to 15°Brix and from 16 to 15°Brix respectively for Boundiali, Korhogo and Sinématiali. As for conservation at 25°C, they varied from 15.66 to 11°Brix for Boundiali, from 18 to 13°Brix for Korhogo and from 16 to 13°Brix for Sinématiali. These results corroborate those of total and reducing sugars which decrease with prolonged storage time. This drop in sugars is more accentuated during storage at 25°C. These slight decreases were also recorded by [23] when storing mango puree at 4 °C (19.42 to 19.28 °Brix) and at 25 °C (15.05 to 13.67 °Brix) for 90 days unlike to those of [24], who instead recorded an increase in sugars in mango purees stored for 2 months at 25°C.This reduction in sugars in our samples could be due to their fermentation due to the pasteurization time which could be insufficient. Unlike sugars, protein levels increase during storage. This increase is greater after 4 weeks of storage at 25°C and 4°C respectively in the purees of Sinématiali (4.02 to 9.70% and 4.02 to 5.87%), Korhogo (3.99 to 8.30% and 3.99 to 5.79%) and of Boundiali (3.97 to 7.94% and 3.97 to 5.11%). This increase could be explained by the production of enzymes by microorganisms during the breakdown of sugars.

Table. 2. Evolution of the nutritional properties of purees during storage at 4°C and 25°C

	Soluble dry extract (°Brix)	Reducing sugars (%)	Total sugars (%)	Proteins %

Booundiali				
0 week	15.66 ± 0.57b	0.49 ± 0.00e	1.10 ± 0,10a	3.97 ± 0,15g
2 weeks 4 °C	14.66 ± 0.28c	0.45 ± 0.03e	0.93 ± 0.03b	4.75 ± 0,15f
2 weeks 25 °C	12.00 ± 0.00e	0.39 ± 0.01f	0.84 ± 0.00c	6.46 ± 0.29d
4 weeks 4 °C	13.33 ± 0.17d	0.35 ± 0,02f	0.76 ± 0,05c	5.11 ± 0,12e
4 weeks 25 °C	11.00 ± 0.00f	0.30 ± 0,02g	0.52 ± 0.08d	7.94 ± 0.05b
Korhogo				
0 week	18.00 ± 0.00a	0.78 ± 0,03b	1.30 ± 0,12a	3.99 ± 0,24g
2 weeks 4 °C	16.00 ± 0.20b	0.63 ± 0,01c	0.97 ± 0,03b	4.32 ± 0,12f
2 weeks 25 °C	15.00 ± 0.00c	0.52 ± 0,02d	0.85 ± 0,02c	5.79 ± 0.10d
4 weeks 4 °C	15.00 ± 0.00c	0.60 ± 0,02c	0.77 ± 0,05c	5.79 ± 0.37d
4 weeks 25 °C	13.00 ± 0.00e	0.37 ± 0,01f	0.53 ± 0,01d	8.30 ± 0,39b
Sinématiali				
0 week	16.00 ± 0.15b	0.89 ± 0,02a	1.19 ± 0,11a	4.02 ± 0.17g
2 weeks 4 °C	15.00 ± 0.00c	0.74 ± 0,06b	0.98 ± 0,06b	4.38 ± 0,07f
2 weeks 25 °C	14.00 ± 0.00d	0.47 ± 0,01e	0.65 ± 0,03c	7.35 ± 0.21c
4 weeks 4 °C	15.00 ± 0.00c	0.57 ± 0,02c	0.73 ± 0,04c	5.87 ± 0.26d
4 weeks 25 °C	13.00 ± 0.00d	0.28 ± 0,03g	0.49 ± 0,01d	9.40 ± 0.15a

Values in the table are averages of three tests, affected by standard deviations. Statistical differences between these average values at 95% confidence level are indicated in the same column by the different letters a, b, c, d, e, f and g.

Figure 2 shows the evolution of the vitamin C content in the purees during storage at 4°C and 25°C. In general, vitamin C levels decrease during storage. After 4 weeks of storage at 4°C, the losses are between 8.69 and 25.34%; 17.48 and 25.65% and 17.16 and 26.86% respectively in Korhogo, Sinématiali and Boundiali purees. As for conservation at 25°C, they are more significant and vary from 21.18 to 53.19% for Korhogo, 28.16 to 44.30% for Sinématiali and from 24.19 to 4581% for Boundiali. Recorded results are similar to those of [25] during the storage of pasteurized mango pulp (8.33 to 33.33%) at 4°C for 20 weeks. These losses can be explained by the influence of certain factors such as pH, temperature and humidity [26]. Residual vitamin C contents in our samples at 4°C and 25°C could cover respectively 1/5th and 1/8th of the daily requirements estimated at 40 mg [27].

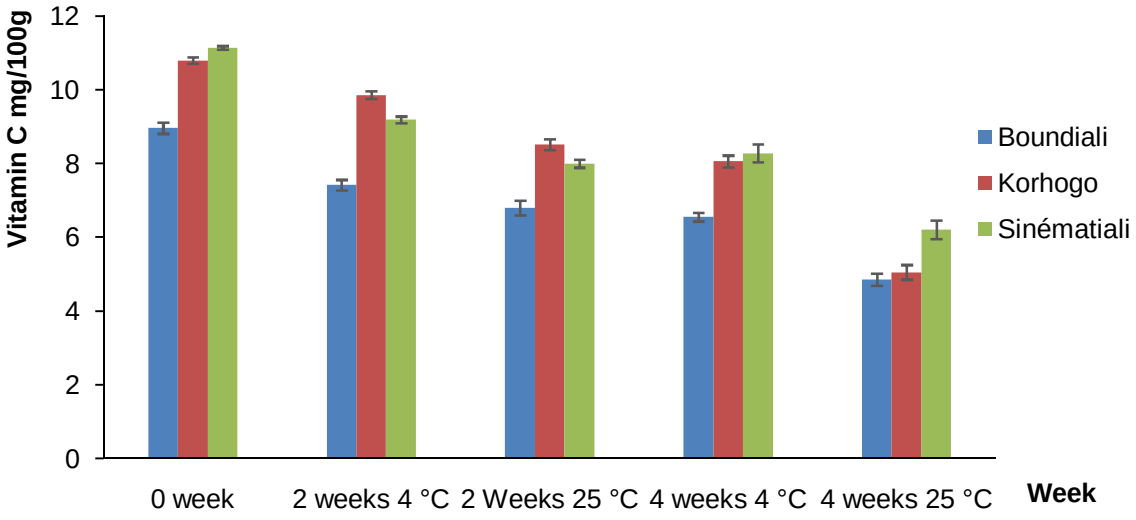

Fig.2. Evolution of vitamin C content during storage at 4°C and 25°C

4. CONCLUSION

This study allowed us to evaluate the physicochemical and nutritional parameters of mango purees of the Kent variety from Korhogo, Boundiali and Sinematiali through their storage at 4°C and 25°C. Storage at 4°C is better than storage at 25°C because it results in less loss of nutrients. Korhogo and Sinématiali purees are the purees which have retained more nutrients. Depending on losses, the storage times for purees that could be recommended would be 4 weeks for storage at 4°C and 2 weeks for storage at 25°C.

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