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Effect of mango shelf life on sensory properties of puree produced in Côte d'Ivoire

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Abstract

Background: Since mango is a highly perishable fruit, post-harvest losses limit its use and cause huge losses in earnings for producers and exporters in Côte d'Ivoire. Mango processing should make it possible to reduce post-harvest losses, while offering new ways of exploiting the fruit.

Aim: It is against this backdrop that this study was carried out, with the aim of contributing to the development of mangoes produced in the north of Côte d'Ivoire.

Methodology: In practice, purees were produced from mangoes of the Kent variety preserved for 6, 8 and 9 days. Two sensory tests were then carried out, one focusing on the consumer and the other on the product.

Results: As a result of this study, the puree produced from mangoes kept for 10 days was the most preferred by amateur tasters; although expert tasters found that the intensity of its sweet taste was not significantly different from that of the puree produced from mangoes kept for 8 days.

Conclusion: These results suggest that, to produce puree from Kent mangoes, it would be advisable to keep them for 8 to 10 days, after picking at physiological maturity.

Keywords: Mango; Quality; Puree; Organoleptic; Conservation

1. Introduction

The mango (*Mangifera indica L.*) is a tropical fruit originating from the Indo-Burma region, whose world fruit production ranks behind that of citrus fruits, grapes, bananas, apples and watermelons (FAO, 2020; Labaky, 2020; Koffi, 2021). There are around a thousand varieties grown around the world, differing in size, colour, texture and nutritional properties (Djioua et al., 2010). This varietal diversity makes it one of the most popular and widely grown fruits in many tropical and subtropical regions (Liguori et al., 2020). Climacteric fruits such as mango are also appreciated for their sweet taste and are an excellent source of nutrients, particularly vitamins A and C, minerals (calcium, potassium, phosphorus and iron) and dietary fibre (Mamiro et al., 2007; Maldonado-Celis et al., 2019; Aymalo, 2023).

In Côte d'Ivoire, agriculture has always been the backbone of the economy. Indeed, Côte d'Ivoire is the leading exporter of mangoes in Africa and remains the third largest supplier to the European market, behind Brazil and Peru, exporting around 14,000 tonnes a year. As the second most important fruit exported by Côte d'Ivoire, after bananas and before

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pineapples, mangoes contribute 4% of the country's GDP and 10% of its agricultural GDP (Pugnet, 2024). However, according to Konan (2020), Côte d'Ivoire processes only 2% of its national production, exports only 10% to the European market and 40% of its production rots because of fruit diseases and lack of preservation facilities. Moreover, seasonal mango production leads to huge post-harvest losses of up to 40% for Côte d'Ivoire and other West African countries (Arnoldus et al., 2011; Koffi, 2021). All these difficulties are likely to hamper the development of this sector. However, agricultural raw materials are processed to preserve and add value, in line with developments in food technology. Thus, processing fresh mango to obtain products such as mango puree, crisps, dried mango slices, mango wine, chutney, pickles, mango preserves in syrup, candied mangoes, mango paste, frozen or deep-frozen mangoes, etc. would be an alternative to solve the problem of post-harvest losses facing the mango sector (Traoré-Kanté et al., 2017; Aymalo, 2023). The aim is to make a significant contribution to agricultural development and at the same time meet the objectives of sustainable development. It was with this in mind that the present study on the effect of mango shelf life on the sensory properties of the puree produced was initiated.

2. Materials and methods

2.1. Biological material

The biological material used consisted of mangoes (*Mangifera indica* L.) of the Kent variety (Figure 1) harvested in Côte d'Ivoire and exported to Europe by the company SODIPEX SARL. This company specializes in the packaging and export of tropical fruit, particularly fresh mangoes. It collects mangoes from orchards in the Poro region, capital of Korhogo, in the north of Côte d'Ivoire, 635 km from the city of Abidjan. It then packs them in cartons at one of its two packing stations in Korhogo's industrial zone (Figure 2).

Figure 1 Mangoes of the “kent” variety

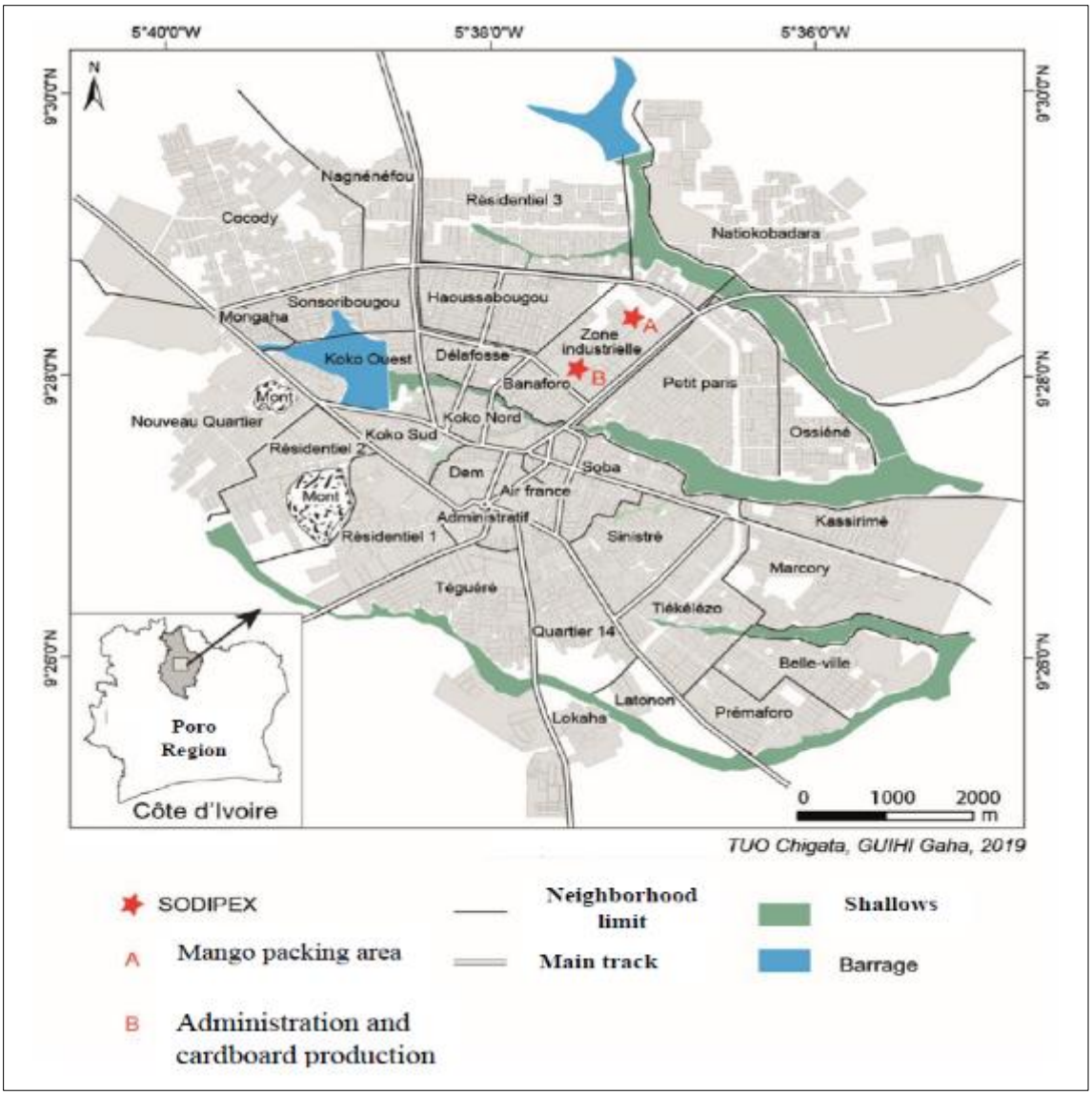

Figure 2 Geographical location of SODIPEX SARL stations in Korhogo

3. Methods

3.1. Conservation of mangoes

As soon as the mango crates arrived at Station A, twenty (20) crates were randomly selected from a group of more than fifty crates. Five (5) pieces of fruit were taken from each crate and marked to identify them. A total of one hundred mangoes were selected at random, and the selected fruit were at approximately the same stage of ripeness. A batch of twenty-five (25) mangoes was placed in a basket with a lid, then stored at room temperature, away from the sun and humidity. On the 6 th, 8 th and 10 th days of storage, five (5) mangoes were taken for the preparation of the puree.

3.2. Preparation of the mango purée

The puree was prepared from mango pulp. First, the five mangoes were washed in tap water with a small amount of bleach, a hydro chlorinated disinfectant, and then rinsed in drinking water. Using a stainless-steel knife, the mango skins and pits were separated from the pulp, which was recovered and then cut into small portions. The pulp was then ground to a purée using a NASCO blender (Model BL1008A-CB, SOCIAM, Abidjan, Côte d'Ivoire). For sensory analysis, all the purée obtained was conditioned, pasteurised in boiling water at 100°C for 2 min (Figure 3) and cooled to room temperature. The first two purée preparations were suitably labelled and then stored at -18°C in a freezer until the last puree preparation on the ^{10th} day when the sensory analysis took place.

Figure 3 Packaging (left) and pasteurization (right) of mango puree

3.3. Sensory analysis of the puree

The sensory analysis consisted of carrying out two tests, one focusing on the consumer and the other on the product.

3.3.1. Consumer-oriented test

This was a consumer preference ranking test. The panel consisted of 60 untrained students from Peleforo Gon COULIBALY University, recruited on the basis of their availability and having no particular knowledge or experience of mango puree. The test was conducted in a tasting room of the same type as those recommended for sensory analysis (AFNOR NFV 09-105). P1, P2 and P3 designate purees produced from mangoes kept for 6, 8 and 10 days, respectively. These three types of samples were homogeneously placed in identical containers coded with random three-digit numbers. Each sample had a different code number. They were presented in six possible orders: P1-P2-P3; P1-P3-P2; P2-P1-P3; P2-P3-P1; P3-P1-P2 or P3-P2-P1. As there were 60 tasters, the order of presentation of the samples was organised so that ten tasters received the samples in each of the six possible orders. The samples were presented simultaneously to each taster, who assessed them one by one. Each taster ranked the coded samples according to the pleasure they experienced, giving each sample a different rating even if it seemed comparable. The most preferred sample was rated 1, the next most preferred was rated 2 and the least preferred was rated 3. Figure 3 shows a copy of the report card that was completed during the ranking test.

3.3.2. Product-oriented test

This was a ranking test of the perceived intensity of the product's sweet taste. The panel was made up of 15 expert tasters from SODIPEX-SARL, five women and ten men. The tasters were selected on the basis of their availability and had no aversion to the product. Their sensory acuity, motivation and ability to describe a product were also selection criteria. This panel was briefed on the purpose of the tests and the nature of the products being tested, then trained in sensory analysis. This test took place under conditions (tasting room, presentation of samples, etc.) that were virtually identical to the previous test. The three types of samples were presented simultaneously and randomly to each taster following a blind distribution (coded samples). The tasters were allowed to taste the samples as often as necessary to make the necessary comparisons between them. Each expert taster ranked the samples presented simultaneously in order of decreasing sweetness intensity, without allowing ties. The sweetest sample was rated 1, the next sweetest 2 and the least sweet 3. Figure 4 shows an example of a report card for ranking intensity.

3.4. Statistical treatment of data

For the processing of the sensory analysis data, the total of the rankings assigned to each sample was calculated. The differences between all possible pairs of the total rankings were compared with the critical value of the Friedman test (appendix 1), for $p < 5\%$ and for the numbers of samples and tasters that participated in the ranking test. When the difference between the pairs of the total rankings was greater than the critical value read, the pairs of samples were significantly different. Otherwise, their difference was not significant.

Name: …….....

Date: ……..

Taste each of the mango puree samples in order. Give the most preferred sample a rating of 1, the next most preferred sample a rating of 2 and the least preferred sample a rating of 3. Do not give the same rating to two samples.

Code	Ranking by rank
…….	……
…….	……
…….	……

Figure 4 Bulletin for the mango puree preference ranking test.

Name: …….....

Date: ……...……

Taste each of the mango puree samples and assess the sweetness intensity for each sample.

Do the assessment in the following order, from top to bottom, then put the samples in order of sweetness intensity. Give the sweetest sample a rating of 1, the next sample a rating of 2 and the least sweet sample a rating of 3. Do not give the same rating to two samples.

Code	Rank assigned
…….	……
…….	……
…….	……

Figure 5 Bulletin for the sweetness intensity ranking test of mango purees

4. Results

4.1. Comparison of the sensory quality of purees produced from mangoes preserved for 6, 8 and 10 days.

Table 1 shows the ranking scores given to each sample by the 60 tasters. P1, P2, and P3 corresponded to the purees produced from mangoes stored for 6, 8, and 10 days, respectively. The differences between the pairs of totals were as follows:

P1 – P3 = 152 – 66 = 86

P1 – P2 = 152 – 142 = 10

P2 – P3 = 142 – 66 = 76

For a risk of error of $p = 0.05$ (60 tasters and 3 samples), the critical value read in the Friedman test table (Appendix 1) is 26. As a result, the preference for P3 mango puree was significantly different from that of P1 and P2 mango purees, whereas the tasters' preference was not significantly different between P1 and P2 mango purees. The panel of amateur tasters found that the P1 and P2 mango purees were less preferred than the P3 mango puree.

4.2. Estimation of sweet taste intensity of purees

The rankings obtained for each sample are presented in Table 2. P1, P2 and P3 corresponded to the purees produced from mangoes kept for 6, 8 and 10 days, respectively. The differences between the pairwise rank totals were as follows:

P1 – P3 = 43 – 20 = 23

P1 – P2 = 43 – 27 = 16

P2 – P3 = 27 – 20 = 7

According to the Friedman test table (Appendix 1), for a risk of error $p = 0.05$ (15 tasters and 3 samples), the critical value is 13. The sweetness intensity of the P1 mango puree was therefore significantly different from that of the P2 and P3 mango purees, while the sweetness intensity of the P2 and P3 mango purees was not significantly different. The panel of expert tasters found that the P1 mango puree was less sweet than the P2 and P3 mango purees.

Table 1 Data from the consumer preference ranking test.

Taster	**Type of puree**		
	P1	P2	P3
1	3	2	1
2	2	3	1
3	3	2	1
4	3	2	1
5	2	3	1
6	3	2	1
7	3	2	1
8	2	3	1
9	3	2	1
10	3	1	2
11	2	3	1
12	2	3	1

13	2	3	1
14	3	2	1
15	2	3	1
16	3	2	1
17	2	3	1
18	3	2	1
19	3	2	1
20	2	3	1
21	2	3	1
22	3	2	1
23	3	2	1
24	2	3	1
25	2	3	1
26	3	1	2
27	3	2	1
28	2	3	1
29	2	3	1
30	3	1	2
31	3	1	2
32	2	3	1
33	2	3	1
34	3	2	1
35	3	1	2
36	2	3	1
37	2	3	1
38	3	2	1
39	3	2	1
40	2	3	1
41	2	3	1
42	3	2	1
43	3	2	1
44	2	3	1
45	3	2	1
46	2	3	1
47	3	2	1
48	2	3	1
49	2	3	1
50	2	3	1

51	3	1	2
52	3	2	1
53	2	3	1
54	3	2	1
55	3	2	1
56	2	3	1
57	3	2	1
58	3	2	1
59	2	3	1
60	3	2	1
Total odds	152	142	66

* Highest rating = 1 = most favourite puree, 3 = least favourite puree.
** P1, P2 and P3 are samples of purees produced from mangoes stored for 6, 8 and 10 days, respectively.

Table 2 Data from sweetness intensity ranking test for mango purees

Taster	**Type of puree**		
	P1	P2	P3
1	3	2	1
2	3	2	1
3	3	1	2
4	3	1	2
5	3	2	1
6	3	1	2
7	2	3	1
8	3	2	1
9	2	3	1
10	3	2	1
11	3	2	1
12	3	2	1
13	3	1	2
14	3	1	2
15	3	2	1
Total ranking by rank	43	27	20

* Highest rating = 1 = highest intensity, 3 = lowest intensity.
** P1, P2 and P3 are samples of purees produced from mangoes stored for 6, 8 and 10 days, respectively.

5. Discussion

It should be remembered here that sensory analysis could be an important tool for the development of food products and for assessing their storage life **(Gimenez et al., 2012)**. The acceptability of P2 and P3 mango purees could be influenced by mango storage time and starch hydrolysis. Indeed, starch undergoes hydrolysis, transforming into sugars, ultimately contributing to the desired ripening quality of the fruit **(Gill et al., 2017)**.

According to **Cadena et al (2013)**, studies conducted with a trained panel can determine how changes during storage affect sensory attributes and consumers can determine how these changes affect the acceptability of the food product. The results showed that the panel of amateur tasters found the P1 and P2 mango purees less preferable than the P3 mango puree. Then the panel of expert tasters found that the P1 mango puree was less sweet than the P2 and P3 mango purees. It should be noted here that the flavour of fruit and vegetables encompasses sensory perception in the mouth, influenced by gustatory factors such as the balance between sweet and sour or acidity and the presence or absence of astringency **(El Hadi et al., 2013)**.

In other words, organoleptic parameters, such as flavour and taste, are the result of compounds that are formed or undergo variations during the ripening **process (Farzana and Baloch, 2014)**. The results obtained are in agreement with those of **Abbasi et al. (2009)**. These authors attributed the change in mango taste to storage time and reported that the mango taste rating increased from 3.54 to 8.42 after four weeks of storage.

In addition, previous work by **Sarrwy et al. (2022)**, revealed that the sensory attributes of mangoes, such as aroma and flavour, showed a consistent and noticeable increase over a 21-day storage period.

Furthermore, these results are in line with those of **Ammara and Dilmi (2018)** who stipulate that the panel of amateur tasters and then the panel of expert tasters-maintained part of their appreciation for sweet juices.

6. Conclusion

Mango is an important source of income for the population in the north of Côte d'Ivoire but preserving mangoes after harvesting remains a national problem. This has led to the transformation of mangoes into other products, hence the initiation of this study, the aim of which was to contribute to the development of mangoes produced in the north of Côte d'Ivoire. However, the puree produced from mangoes kept for 10 days was the most preferred by amateur tasters; although expert tasters found that the intensity of its sweet taste was not significantly different from that of the puree produced from mangoes kept for 8 days. As for the puree produced from mangoes kept for 6 days, it was less preferred and less sweet. These results suggest that, to produce puree from Kent mangoes, it would be advisable to keep them for 8 to 10 days, after picking at physiological maturity.

Compliance with ethical standards

Disclosure of conflict of interest

All authors declare that no competing interests were disclosed..

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