Effectiveness of *Aloe vera* gel in preserving the organoleptic quality

Abstract

Tomatoes in Ivory Coast suffer enormous post-harvest losses due to the lack of simple, accessible and reliable techniques for long-term storage. To remedy this, this study was conducted to explore the possibilities of using *Aloe vera* in the long-term storage of tomatoes after harvest while preserving their organoleptic quality.Thus, ripe green and red tomatoes from two production systems, namely tomatoes grown with either *Aloe vera* gel or NPK, which are organic and chemical fertilisers respectively, were evaluated. To do this, they were immersed either in *aloe vera* gel or in a mancozeb solution, then dried in the open air before being placed in storage baskets.The parameters observed were the visual appearance of the tomatoes, the time in days taken for the colour change and rotting of the red tomatoes, and finally the sensory analysis of the coated and preserved tomatoes.As a result, the *aloe vera* gel gave the tomatoes a shiny appearance and delayed the colour change from green to red by three (03) days. In addition, the control tomatoes showed 100% rot on the 51st day, while those coated with *aloevera* gel showed 66.66% rot, and by the 60th day the rate was 73.33%.This study showed that the appropriate stage for preserving ripe tomatoes using *aloe vera* gel is when they are red rather than green. Furthermore, sensory analysis showed that red tomatoes coated with the gel had organoleptic qualities that were appreciated by tasters, who found them to be very firm, less acidic and with a better aroma. Thus, *aloe vera* gel increases the market value of tomatoes by giving them a shiny appearance, reducing rapid rotting and preserving their functional properties.Therefore, to extend their shelf life, ripe red tomatoes should be coated with *aloevera* gel.

Key words: Tomatoes, post-harvest losses, preservation, *Aloe vera*, colour change, rotting.

Corresponding author :**RenéPépé NOUFE**

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Introduction

In Côte d'Ivoire, tomatoes are one of the most widely consumed vegetables after onions and chillies (AGRICI, 2016). Annual consumption in all forms is around 105,000 tonnes (Faostat, 2013), while national production in 2020 was 47,283 tonnes, or 45% of total consumption. The remaining 55% is met by imports. This production remains insufficient to meet the needs of the Ivorian population (Soro *et al.*, 2007). This low productivity creates a structural deficit and makes tomatoes one of the most imported market garden crops in Côte d'Ivoire

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(MAHRH, 2011). Outside the rainy seasons, when there is overproduction, tomatoes are rare in the markets. This period of overproduction is also characterised by huge losses due to the lack of storage infrastructure (Kouamé, 2016).As a result, a loss of 5 to 50% in production has been observed (Bancal & Tano, 2019). These losses are physiological in origin, through the loss of dry matter and water loss through transpiration, and microbial in origin, particularly fungal (Akpo, 2022). Thus, any conservation initiative should slow down metabolism and protect tomatoes from diseases and pests (Bancal & Tano, 2019).

Several preservation methods using chemicals have been developed to control post-harvest diseases in tomatoes and extend their shelf life. These methods are used to ensure a profitable market price for producers.However, the application doses of these products are not always respected, and some market gardeners use unconventional chemicals to treat tomatoes (Soro *et al.*, 2008). Furthermore, their application has led to residues in the fruit, which poses a serious problem for public health and the environment (Dorais *et al.*, 2008). It is therefore necessary to find alternative methods that are accessible and beneficial for preservation and for the consumer.The use of natural products such as *Aloe barbadensis* Miller (*Aloe vera*) represents an environmentally friendly alternative to the use of chemicals.

Some researchers have used *Aloe vera* in their work on the post-harvest preservation of various fruits and vegetables. Indeed, the results of Handarini's study (2021) showed that coating chillies with *Aloe vera* gel can maintain their organoleptic quality and slow down weight loss. In addition, Chauhan *et al*. (2011) used *aloe vera* gel to extend the post-harvest storage of strawberries and blueberries. It has also been reported that coating with *aloe vera* gel extends the shelf life and preserves the functional properties of the coated products (Vieira *et al*.,2016). However, no studies have been reported on the use of *aloe vera* gel in tomato preservation in Côte d'Ivoire. Therefore, this study was initiated to explore the possibilities of using *aloe vera* gel in post-harvest preservation and organoleptic quality of tomatoes under ambient conditions.

MATERIALS AND METHODS :

Site of study

This study was conducted at the Agricultural Improvement and Production Laboratory (APA) of Jean Lorougnon Guédé University (UJLoG) located in the department of Daloa (central-western Côte d'Ivoire). Daloa is bounded by longitudes 6.48°W and 6.41°W and latitudes 6.91°N and 6.84°N (Adjiri *et al*., 2018). The climate of this region is sub-equatorial attic with two seasons, namely a dry season and a rainy season. The dry season lasts four months

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(November to February). The rainy season lasts eight months, from March to October. The rainiest months are April, August and September, with an average of 103.58 mm of rainfall per year. The average annual temperature is 26.3°C, with November and May being the driest months, with average temperatures of 26.2 and 27.9°C. The soils in this region are generally ferralitic, moderately leached on dry land and sandy hydromorphic (Zro *et al.*, 2018).

Plant material

Two types of plant material were used in this study. The first consisted of tomatoes of the Cobra 26 variety. These tomatoes, grown on the UJLoG plot, were harvested in August 2024 and then transported to the laboratory for various tests. They were harvested at two physiologically mature stages, namely red and green (Figure 1). These tomatoes came from three production systems and followed all the technical guidelines recommended by the CNRA (2019):

- tomatoes grown with *Aloe vera* gel;
- tomatoes grown with NPK mineral fertiliser ;
- tomatoes grown without gel or mineral fertiliser (control).

The second plant material consisted of gel extracted from the mature leaves of three-year-old *Aloe vera* plants. These plants were grown on the UJLoG experimental plot.

Figure 1: Tomato samples

A: Green tomato; B: Red tomato

Methods

Preparation of solutions used to coat fruit for preservation:

***Aloe vera* solution**

The *Aloe vera* gel was obtained from 2 kg of leaves that were harvested and then transported to the APA-UJLoG Laboratory. The leaves were cleaned with water and detergent to remove all impurities. Then the spines on each side were removed. They were then laid flat on a

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cutting board and the thin layer on the underside was removed with a knife. The exposed gel was carefully scraped off with a spatula, stored in a jar and crushed to obtain a liquid.

Mancozeb solution

The mancozeb solution was obtained by diluting 5 g of the powder in 1000 ml of distilled water. Mancozeb is used in powder form, but since the gel is liquid, this dilution was made to bring it to the same state as the gel. In addition, this product is used by some market gardeners to preserve their products after harvest.

Coating the tomatoes

The coating was applied by completely immersing the tomatoes in the corresponding solution for approximately one minute. The coated tomatoes were then removed and air-dried before being placed in storage containers. The immersion time used in this study was established on the basis of preliminary tests. The choice of these conditions will facilitate its application at an industrial level and the implementation of this process.

Setting up the experimental system

The tomatoes were stored at room temperature in a factorial block design (plastic basket). Each block consisted of red (ripe) or green (unripe) tomatoes stored in the basket and then arranged randomly. In each block, the physiological state of the tomatoes (unripe or ripe) and the type of coating (Table 1) were taken into account.

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Table1 : Table showing the physiological state and production system of tomatoes

	Tomato production system		
	Aloe vera	**NPK**	**Witness**

Coating \ State	green	red	green	red	green	red
Gel	TBV1	TBM1	NV1	NM1	TEV1	TEM1
Mancozeb	TBV2	TBM2	NV2	NM2	TEV2	TEM2
Uncoated	TBV0	TBM0	NV0	NM0	TEV0	TEM0

TEV0: Tomato produced without fertiliser, green and uncoated; TEV1: Tomato produced without fertiliser, green and coated with aloe vera gel; TEV2: Tomato produced without fertiliser, green and coated with mancozeb; NV0: Tomato grown with NPK, green and uncoated; NV1: Tomato grown with NPK, green and coated with gel; NV2: Tomato grown with NPK, green and coated with mancozeb; TBV0: Tomato grown with aloe vera gel, green and uncoated; TBV1: Tomato grown with gel, green and coated with gel; TBV2: Tomato grown with gel, green and coated with mancozeb; TEM0: Tomato produced without fertiliser, red and uncoated; TEM1: Tomato produced without fertiliser, red and coated with aloe vera gel; TEM2: Tomato produced without fertiliser, red and coated with mancozeb; NM0: Tomato produced with NPK, red and uncoated; NM1: Tomato produced with NPK, red and coated with gel; NM2: Tomato produced with NPK, red and coated with mancozeb; TBM0: Tomato grown with gel, red and uncoated; TBM1: Tomato grown with gel, red and coated with gel; TBM2: Tomato grown with gel, red and coated with mancozeb.

Observations and measurements

The observation consisted of carefully examining each batch of tomatoes every three days until the 60th day of storage. At each observation, rotten tomatoes were removed from the batch.

Effect of coating material on the time taken for tomatoes to change from green to red

Only green tomatoes were considered. To this end, the transition time (DV) from green to red for each batch was considered when 100% of the tomatoes had changed colour. It starts at time T0, which corresponds to the start of the trial, and ends at time Tm

$$DV = Tm - T0 \text{ (Tm = 100\% of tomatoes turning red).}$$

Effect of coating on tomato deterioration

The effect of coating on deterioration (DT) was measured by the number of rotten tomatoes during the 60 days of storage. Every three days, tomatoes that had lost their initial appearance were removed (Figure 2).

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Figure 2: Damaged tomatoes removed from the batch

Thus, deterioration was determined based on the number of rotten tomatoes (NTp) over time using the following formula:

$$DT = NTp\ (t)$$

Sensory analysis

The sensory analysis involved resource persons selected at random from the UJLoG population. This population consisted of five teacher-researchers, five students and five restaurateurs. It consisted of tasting sessions that took place on 18 October 2024 at the APA (Agricultural Improvement and Production) Laboratory. The tasting consisted of consuming raw tomatoes cut into slices.The criteria used were in accordance with standard NF ISO 5492-1992, as indicated by Agassounon *et al*. (2012). In this standard, six criteria were evaluated: colour, acidity, aroma, juiciness, fleshiness and skin thickness. This evaluation was scored on a scale of 0 to 10 at the end of the tasting.

Statistical analysis

All data collected was entered using Microsoft Office Excel 2013 software, which was also used to plot the graphs. Then, Statistica version 7.1 software was used for statistical analysis of the data through comparison of means and analysis of variance (ANOVA) using the Student Newman Keuls test to show the existence of a significant difference between the means at the 5% threshold.

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Results and Discussion:

Appearance of tomatoes after coating

Figure 3 shows the ripe green tomatoes after treatment, coated (TV1 and TV2) and uncoated (TVO). Tomatoes coated with aloe vera gel had a bright and shiny appearance (TV1) compared to the control tomatoes (TV0). Those coated with mancozeb showed whitish spots (TV2).

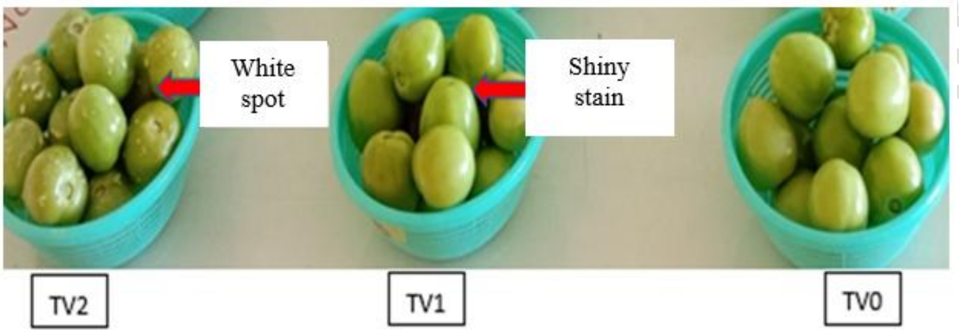

Figure 3: Appearance of tomatoes stored in baskets after coating

TV0: Green tomatoes without coating; TV1: Green tomatoes coated with *aloe vera* gel; TV2: Green tomatoes coated with mancozeb

Effect of coating on the time taken for green tomatoes to change colour

Figure 4 shows the rate at which green tomatoes turn red (ripening) over time. The resulting curves show the acceleration of ripening until it reaches its plateau, which represents 100% red tomatoes depending on the treatment. The first tomatoes began to ripen on the second day with all treatments, but the difference between treatments was in the number of tomatoes. Thus, for the NV2 and TBv2 treatments, 20% of tomatoes ripened, compared to 13.33% for TEV0 and TBV0 and 6.66% for the TEV2, NV0 and NV1 treatments. At the end of the sixth day, the TBV0 and TEV0 treatments reached a plateau, i.e. 100% ripening. The TBV1 treatment took 10 days to reach 100% ripeness. The other treatments had intermediate values.

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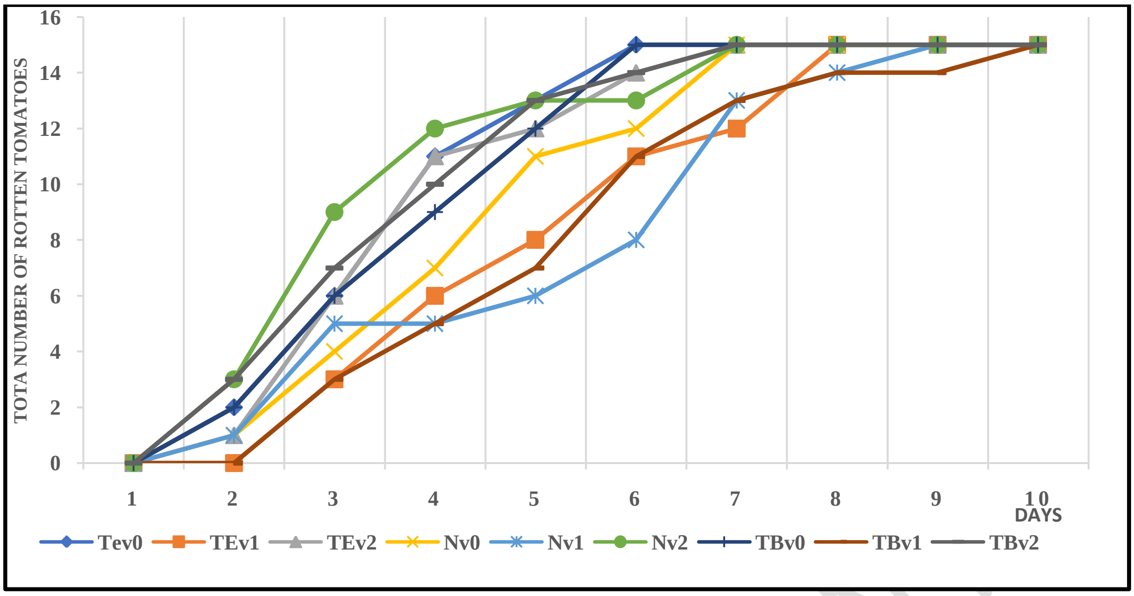

Figure 4: Number of tomatoes ripened as a function of time

TEV0: Tomato grown without fertiliser and not coated; TEV1: Tomato grown without fertiliser, coated with aloe vera gel; TEV2: Tomato grown without fertiliser, coated with mancozeb; Nv0: Tomato produced with NPK and not coated; NV1: Tomato produced with NPK and coated with gel; NV2: Tomato produced with NPK and coated with mancozeb; TBV0: Tomato grown with aloe vera gel and uncoated; TBV1: Tomato grown and coated with gel; TBV2: Tomato grown with gel and coated with mancozeb.

Deterioration time of red tomatoes as a function of time

Figure 5 shows the curves representing the rate of deterioration (rotting) of tomatoes over time and according to treatment. The first signs of rotting began on the sixth day for treatments TEM2, TEM0 and TBM0, with 13.33% of red tomatoes affected, and continued to progress gradually. On the 15th day of storage, rot was observed in the TBM1 and NM2 treatments, with a low percentage of 6.66%. The time taken for 100% of the tomatoes to rot was 51 days for TEM0 and 57 days for TBM0 and NV2. As for the other treatments, after two months or 60 days of storage, the TEM2, TEM1, NM1 and TBM1 treatments recorded 93.33%, 86.66%, 80% and 73.33% rot, respectively.

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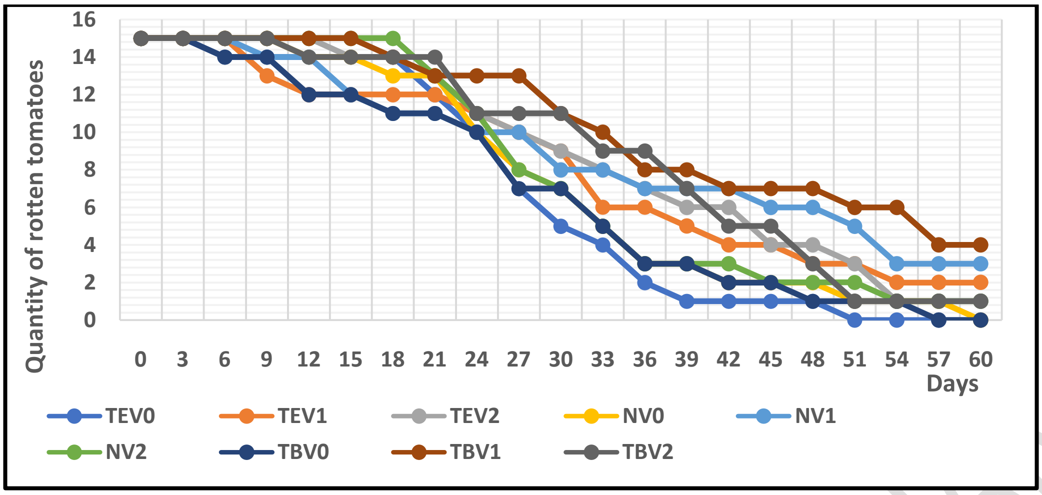

Figure 5: Number of rotten tomatoes over time

TEM0: Tomato grown without fertiliser, red and uncoated; TEM1: Tomato grown without fertiliser, red and coated with aloe vera gel; TEM2: Tomato grown without fertiliser, red and coated with mancozeb; NM0: Tomato grown with NPK, red and uncoated; NM1: Tomato grown with NPK, red and coated with gel; NM2: Tomato grown with NPK, red and coated with mancozeb; TBM0: Tomato grown with gel, red and uncoated; TBM1: Tomato grown with gel, red and then coated with gel; TBM2: Tomato grown with gel, red and coated with mancozeb.

Deterioration time of green tomatoes that have turned red, depending on the weather

Figure 6 shows the decay rate curves for green tomatoes that have turned red, according to time and treatment. The first signs of decay appeared on the 9th day for the NV0 and TBV2 treatments, with 13.33% each, and continued gradually. On the 12th day of storage, the first signs of decay were recorded in the TEV2, NV2 and TEV1 treatments, with a lower percentage (6.66%). The time taken for 100% of the tomatoes to decay was observed on the 48th day for NV0, the 57th day for TEV2 and the 60th day for TBV0. As for the other treatments, two months later, 80% rot was recorded for TBV1, 86.66% for NV2 and 93.33% for TBV2 and NV1.

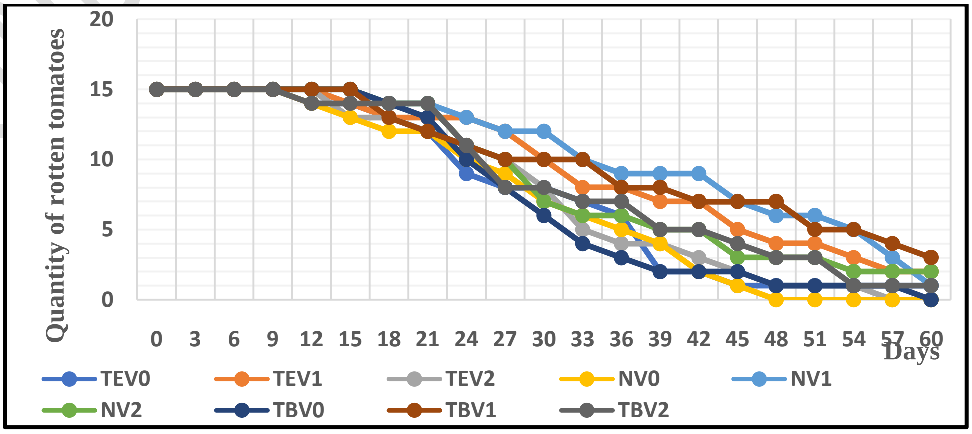

Figure 6: Number of rotten tomatoes over time

TEV0: Control tomato, green and uncoated; TEV1: Control tomato, green and coated with aloe vera gel; TEV2: Control tomato, green and coated with mancozeb; NV0: Tomato grown with NPK, green and uncoated; NV1: Tomato grown with NPK, green and coated with gel; NV2: Tomato grown with NPK, green and coated with mancozeb; TBV0: Tomato grown with aloe vera gel, green and uncoated; TBV1: Tomato grown with gel, green and coated with gel; TBV2: Tomato grown with gel, green and coated with mancozeb.

Sensorial profile of different tomato treatments

Table II shows the average scores for the different tomato treatments after tasting. Sensory analysis showed a variation in scores for sensory parameters between treatments. The TB1 treatment had sensory parameters that were more appreciated by the tasters. It obtained a score of 7.6/10 for colour, an average acidity of 6.4/10, an aroma of 7.2/10, juiciness of 7.60/10, firmness of 7.2/10 and skin thickness of 7/10. In contrast, treatment N0 was the least appreciated, with an overall score of 5.88/10.

Table II : Sensory evaluation of tomatoes after treatment

	Type of tomato production and coating								
Settings	**TB0**	**TE0**	**N0**	**TB1**	**TE1**	**N1**	**TB2**	**TE2**	**N2**
Colour	**5.57**	**6.50**	**5.90**	**7.60**	**5.87**	**5.80**	**6.53**	**6.53**	**6.10**
Acidity	**5.60**	**4.93**	**4.87**	**6.40**	**5.40**	**5.87**	**6.37**	**5.60**	**6.13**
Aroma	**6.93**	**6.53**	**6.20**	**7.20**	**6.00**	**6.40**	**6.40**	**6.40**	**6.33**
Juiciness	**6.33**	**6.67**	**6.00**	**7.60**	**6.40**	**6.67**	**7.00**	**6.87**	**6.30**
Firmness	**6.87**	**6.13**	**6.13**	**7.20**	**6.20**	**6.53**	**6.87**	**6.93**	**6.53**
Skin thickness	**6.67**	**6.47**	**6.20**	**7.00**	**5.93**	**6.27**	**6.20**	**6.27**	**5.73**
Average score	**6.42**	**6.22**	**5.88**	**7.20**	**5.96**	**6.23**	**6.56**	**6.43**	**6.20**

TB0: Tomato grown with gel, without coating, TEO: Control tomato without coating, NO: Tomato grown with NPK without coating, TB1: Tomato grown with gel then coated with gel, TE1: Control tomato coated with gel, N1: Tomato grown with NPK then coated with gel, TB2: Tomato grown with gel then treated with mancozeb, TE2: Control tomato coated with mancozeb, N2: Tomato grown with NPK then coated with mancozeb.

Tasters' assessment of the different tomato treatments:

- TB0: Tomatoes grown with uncoated aloe vera gel were rated as moderately coloured, non-acidic and with an average aroma. The fruit was perceived as very juicy and fleshy with fairly thick skin.
- TE0: the fruit was considered colourful, slightly acidic and with an aroma slightly above average. The fruit is quite juicy with a thick skin and is very fleshy.

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- NO: the tomatoes were moderately coloured, slightly acidic and had an average aroma. The fruit is firm with a fairly thick skin.
- TB1: the treatment produced well-coloured, non-acidic fruit with more aroma than the other production systems. The fruit was also perceived as very juicy, fairly fleshy and with fairly thick skin.
- TE1: tomatoes grown without fertiliser and coated with gel produced moderately coloured, non-acidic fruit with above-average aroma. The fruit was also fairly juicy, quite fleshy and had moderately thick skin.
- N1: the treatment was considered to be moderately coloured, moderately acidic with an average aroma. In addition, the fruit was juicy, not very fleshy with a moderately thick skin.
- TB2: the treatment produced well-coloured, non-acidic fruit with an above-average aroma. These fruits were considered very juicy, fairly fleshy and fairly thick.
- TE2: tomatoes grown without fertiliser and treated with mancozeb were considered to be moderately coloured, slightly acidic and with an above-average aroma. The fruit was juicy, quite fleshy and had fairly thick skin.
- N2: the treatment produced well-coloured fruit that was less acidic with an average aroma. These fruits were also considered juicy and fleshy, with moderately thick skin.

Discussion:-

The commercial quality of tomatoes depends on several factors, including physical, chemical and sensory criteria. Tomatoes must have a bright, uniform colour, a regular shape, appropriate firmness and a pleasant flavour (Ayed & Wesal, 2022). These aspects directly influence consumer acceptance and, consequently, price and marketing.In this study, tomatoes coated with aloe vera gel had a translucent and shiny appearance, which can significantly improve the appearance of tomatoes in the eyes of consumers and boost fruit sales (Shankara *et al.*, 2005). *Aloe vera* contains a sticky, colourless gel from the leaf parenchyma (Changhong *et al.*, 2005) that increases the shine of coated tomatoes. It has the particularity of acting on the fruit by improving its natural shine and consistency due to its antioxidant properties (Rojas-Grau *et al.*, 2007; Namesney & Delgado, 2014).Coating tomato fruits with *aloe vera* also delayed the colour change from green to red in physiologically ripe tomato fruits. According to Bouzonville (2004), the antioxidants contained in *aloe vera* reduce the rancidity of coated products and delay their colouring. Anon (2001) attributes the slowing down of the colour change in fruit due to *aloe vera* gel to a delay and/or reduction in the

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action of ethylene. The gel reduces the rate of ethylene production in fruit. Ethylene is a plant hormone necessary for normal fruit ripening. It triggers a wide range of physical, physiological and biochemical changes that lead to deterioration in fruit quality.

The natural deterioration or senescence of tomato fruits begins with a change in colour from green to red or even orange, depending on the variety. This highly complex process involves the expression of specific genes, the production of ethylene and the acceleration of the respiration process.The total adhesion of the gel to the fruit would reduce their respiration by reducing the fruit's need for oxygen and increasing the CO_2 in their immediate environment, thereby delaying the development of the fruit's colour (Pila *et al.,* 2010). Ethylene and carbon dioxide (CO_2) play important roles in the ripening of red fruits, although their effects are different and sometimes opposite. Ethylene is a plant hormone that stimulates fruit ripening, while CO_2, at high concentrations, can slow or block it.The gel layers on the coated fruits also serve as a protective barrier against microorganisms involved in the post-harvest degradation process, which delays the senescence or rotting process of tomatoes. In this study, the coated tomato fruits were preserved for more than 60 days. *Aloe vera* gel has proven antimicrobial and antifungal properties (Michayewicz, 2013) and other molecules such as aloe-emodin and aleonin are responsible for slowing down fruit rot. *Aloe vera* gel is therefore more effective against microorganisms such as *RhizoctoniaSolani, Penicillium digitatum, P. expansum, B. cinerea* and *A. alternata* (Jasso *et al.,* 2005). These microorganisms are commonly involved in post-harvest degradation of seeds and fruit (Tonessia *et al,.* 2018). Aloeroid, an immunostimulant polysaccharide contained in the gel, is believed to be responsible for this effectiveness.Valero (2020) used *aloe vera* gel to preserve grapes for 35 days, compared to seven days for the control group. Padmaja & Bosco (2014) succeeded in preserving jujube fruit coated with *aloe vera* gel at room temperature for up to 45 days, compared to 21 days for the control group. The protective barrier formed by the gel between the fruit and the environment is thought to slow down the senescence process in coated tomatoes. The *aloe vera* gel creates a layer that closes the pores of the fruit, which are pathways for gas exchange and transpiration.Furthermore, it appears that the gel has powerful antioxidant properties that prevent free radicals from oxidising fruit cells. According to Mengong *et al.* (2021), the antioxidant properties of the gel break the chain of free radical creation, thereby limiting or even stopping cell degradation and ageing. Furthermore, it appears that the gel's effectiveness is due to the presence of molecules such as polyphenols and flavonoids in *aloe vera* (Addou *et al.,* 2020).

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Aloe vera is mainly known for its use in cosmetics and food. Due to its high amino acid content, it is used as a dietary supplement and can be safely consumed with coated products (Aminudin & Nawangwulan, 2014). However, what about its organoleptic impact on coated fruits.Sensory analysis of tomatoes according to different treatments shows that tomato fruits coated with *aloevera* gel have appreciable organoleptic quality. These fruits were also judged by tasters to be very firm and thicker than untreated fruits. This result is similar to those of Athmaselvi *et al*. (2013), who reported higher firmness in tomatoes coated with *aloe vera* gel. Authors such as Ali *et al*. (2010) and Padmaja & John (2014) have reported that coating tomato fruits improves their firmness. The results of this study are also consistent with the report by Padmaja & John (2014), which showed that Aloe-pectin treatment significantly reduces the loss of firmness in tomatoes during storage.With regard to the acidity of tomatoes, treating the fruit with *aloe vera* gel significantly improved it by making them less acidic. This result can be explained by the effect of the gel on the metabolic activity of the organic acid that is responsible for the respiratory process (Echeverria & Valich, 1989). As for the qualitative value of tomato aroma, fruits produced on substrates enriched with *aloe vera* gel and then coated were rated by tasters as having a better aroma. *Aloe vera* gel can preserve the fruity aroma of tomatoes during storage.

Conclusion:

This study evaluated the effectiveness of aloe vera gel on the preservation and organoleptic quality of tomatoes. It was found that coating tomatoes with aloe vera gel gave them a shiny appearance and delayed the colour change of green tomatoes by three days. In addition, tomatoes grown and coated with the gel had a shelf life of more than 60 days, compared to only 48 days for the control tomatoes. Sensory analysis also showed that tomatoes coated with the gel were preferred by tasters based on colour, acidity, aroma and skin thickness. Aloe vera gel therefore prolongs the ripening of tomatoes, reduces rapid deterioration and improves the visual quality of the products. Aloe vera can be said to be a promising bio-preservative. Consequently, these gel-based coatings have a beneficial impact on the quality of tomatoes and reduce food waste.

References:-

1. Adjiri, A., Koné, B., Aka, N., Djabaté, I., Diakité, I. & Brou, D. (2018). Physicochemical characterisation and source of groundwater mineralisation in the departments of Daloa and Zoukougbeu, Côte d'Ivoire. *International Journal of Biological and Chemical Sciences*, 13(4): 2388-2401.

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2. Agassounon, D. T. M., Gomez, S., Tchobo, F., Soumanou, M. & Toukourou, F. (2012). Testing tomato preservation using the immersion dehydration technique. *International Journal of Biology and Chemistry Science*, 6(2) : 657-669.

3. Akpo, F.A. (2022). Development of a method for preserving tomatoes (Solanum lycopersicum) through the application of cold temperatures and plant extracts with anti-ripening and antifungal properties. Joint doctoral thesis from Avignon University and Nangui Abrogoua University, Ivory Coast, 169 p.

4. Aminudin, P. & Nawangwulan, S. (2014). The effect of edible aloe vera gel on the quality and shelf life of cucumbers. Journal of Ecology, 14 (1): 1-12.

5. Anon, N.C. (2001). Determination of variable acidity in fruit and vegetable products, NC-ISO 750, National Standardisation Office, Havana, Cuba, edition 1, 9 p.

6. Anonymous 1 (2020). Using aloe vera to preserve food. Retrieved on 14/08/2021 from https://www.buzz4bio.com.

7. Ayed, A. & Wesal, Y. R. (2022). Tomato Components and Quality Parameters. *A Review*. *Jordan Journal of Agricultural Sciences*, 18 (3): 199-220.

8. Bancal, V. & Tano K. (2019). Study of methods for reducing post-harvest losses in market gardening crops in Côte d'Ivoire. Montpellier: CIRAD, 13 p.

9. Castillo, S., Navarro, D., Zapata, P.J., Guillen, F. & Martinez-Romero, D. (2010). Antifugical efficacy of *Aloe vera* in vitro and its use as a preharvest treatment to maintain postharvest table grape quality. *Postharvest Biology and Technology*, 57(3) : 183-188.

10. Chauhan, O.P., Raju, P.S., Singh, A. & Bawa, A.S. (2011). Shellac and *aloe gel*-based surface coatings to maintain the quality of apple slices. Food Chem. 126: 961–966.

11. Chrysargyris, U., Nikou, U. & Tzortzakis, T. (2016). Effectiveness of *Aloe vera* gel coating in maintaining tomato quality. New Zealand Journal of Crop and Horticultural Science, 44(3): 203-207.

12. Ezeagba, U.J.M. (2023). The use of *Aloe vera* in shelf life extension of fresh fruits. *Eurosian experiment journal of medecine and medical Sciences*, 4 (1) : 1-4.

13. Faostat. (2018). Record high global tomato production. Www.Hortitecnnews. Com Accessed 28 September 2024

14. Handarini, K. (2021). Lidah Buaya (*Aloe vera*) sebagai Edible Coating pada Cabai Merah (*Capsicum annuum*) dan Tomat (*Lycopersicum esculentum*). *Journal Agroscience, 11*(2) : 157–169.

15. Jasso, D., Hermendez, D., Garcia, R. & Angulo, J.L. (2005). In vitro antifungal activity of Aloe vera pulp and liquid fraction against phytopathogenic fungi. *Industrial Crops and Products*, 21 : 81-87

16. MAHRH. (2011). Analysis report on the market gardening module. Phase 2 study report: 2010-2011, Ministry of Agriculture, Hydraulics and Human Resources, 318 p.

17. Mengong, M. H., Ndjoh, J., Nnanga, E., Aka, L.K. & Bengondo, M. (2021). Antioxidant Activity of Aloe Schuerenfurthii and Maintenance of Periodontal Cell Vitality in an Ejected Immature Permanent Tooth, Health Science Disease, 22(12): 71-76

18. Michayewicz, N. (2013). *Aloe vera*, a medicinal plant traditionally and widely used for thousands of years, with numerous therapeutic properties. Miracle plant. Doctoral thesis in pharmacy. University of Lorraine, France, 149 p.

19. Nabigol, A. & Asghari, A. (2013). Antifungal activity of aloe vera gel on the quality of minimally processed pomegranate arils. *International Journal of Agronomie*, 4 : 833-838

20. Namesny, A. & Delgado, A. (2014). Postharvest – Directory of producers, packagers, processors and distributors. Especialistes en Serveis per a la Producció Editorial, SL, Valencia, Spain, pp. 26–41.

21. Nasution, R. S., Yahya, H. & Harahap, M. R. (2019). The effect of carrageenan from red algae (Eucheuma cottonii) from Aceh Province as an edible coating on fruit shelf life. Al-Chimie, 7 (2), 100-112.

22. Padmaja, N. & Don, B.S. D. (2014). Preservation of jujube fruit using an edible *aloe vera* gel coating to maintain quality and safety, Ind. J. Sci. Res. and Tech. 2(3):79-88

23. Paladine, D., Valero, D., Juan, M., Huerts, D.M. &Domigo, M.R. (2014). The addition of rosehip oil enhances the beneficial effect of *aloe vera* gel on delaying ripening and maintaining post-harvest quality in several stone fruits. Biology and Post-Harvest Technology, 2: 23-28.

24. Pila, N., Gol, N. B. & Rao, T. V. R. (2010). Effect of Postharvest Treatments on Physiochemical Characteristics and Shelf Life of Tomato (Lycopersicon esculentum Mill) Fruits during Storage. *American Europeen Journal Agriculture Environment Science*, 9(5) : 470-479.

25. Rojas-Grau, M., Raybaudi-Massilia, R., Fortuny, S., Belloso, O. (2007). Apple puree-alginate edible coating as carrier of antimicrobial agents to prolong shelf-life of fresh-cut apples. *Postharvest Biology and Technology*, 45 : 254–264.

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26. Sangaré, A., Koffi, E.M., Akamou, F.M. & Fall, C.A. (2009). National report on the state of plant genetic resources for food and agriculture. Republic of Côte d'Ivoire. Ministry of Agriculture. State of plant genetic resources for food and agriculture: Second national report, Côte d'Ivoire, 63 p.

27. Shankara, N., van, L.J., Marja, G., Martin, H. & Barbara, v. D. (2005). Tomato cultivation: production, processing and marketing Agrodok 17, Agromisa Foundation and CTA, Wageningen, 105 pp.

28. Tonessia, D. C., Kotchi, V., Gore, B.N., Kouassi, K.D., Soro, L., Soumahin, E.F., Akaffou, D.S., Kouadio, Y.J. & Aké, S. (2018). Sanitary Diagnosis of Cotton Cultivation in the West Central Region of Côte d'Ivoire. *International Journal of Applied Sciences and Biotechnology*, 6(2) : 01-09.

29. Valero, D., Díaz-Mula, H.M., Zapata, P.J., Castillo, S. & Serrano M. (2013). Effects of edible alginate coating on the preservation of fruit quality in four plum cultivars during post-harvest storage. Postharvest Bio. Tech. 77: 1–6.

30. Zirihi, G.N., Soro, S., Kone, D. & Kouadio, Y.J. (2008). Antifungal activity of natural combretum sp extract in vitro on three soil-borne fungal species in tomato crops in Ivory Coast, *review . ivoirian Science and. technology*., 131-142.

31. Zro, F.G.B., Guéi, A.M., Nangah, Y.K., Soro, D. & Bakayoko, S. (2016). Statistical approach to the analysis of the variability and fertility of vegetable soils of Daloa (Côte d'Ivoire). *African Journal of Soil Science*, 4 (4) : 328-338.

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