Cold plasma on papaya minimally processing: an evaluation in the phisico-chemical properties

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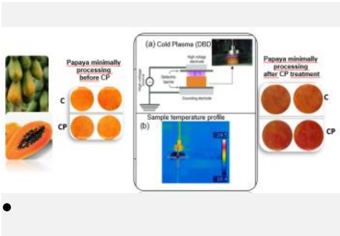

The effectiveness of dielectric barrier discharge cold atmospheric plasma (CP) was evaluated on the physiological process, and quality parameters of minimally processed papaya (Carica papaya L. cv. 'Formosa'), after treatment and during storage at 8 °C (± 1.5 °C) (relative humidity (RH): 85 %) for 10 days. Fresh Cut papaya treated with cold plasma cold plasmas did not accelerate the respiration rate of the CP papaya, maintained the total soluble solids (TSS) and titratable acidity (TTA). Furthermore, the firmness and the In addition, These results showed that DBD-CAP can be used as non-thermal treatment for disinfection and preservation of fresh cut papaya.

Introduction

In Brazil, we have several fruits varieties, with regular growth in the coming years, increasing the demand for fresh fruits. Among the variety of tropical fruits currently available on the market as fresh-cut products, the papaya (*Carica papaya* L. cv. 'Formosa') can be an important alternative due being a rich source of bioactive compounds and vitamins such as A, B, and C. which makes them important in the human diet. In addition, by convenience (read to eat), fresh-cut papaya can be an excellent alternative for consumers, avoiding the peeling and cutting, minimizing the postharvest loss and increasing fruit consumption [1].In general, traditional methods of preserving minimally processed fruits can be using physical or chemical-based preservation and bio preservation technology [2]. However, these techniques can affect the sensory and nutritional quality of foods (Mandal et al., 2018). Thus, non-thermal technology, such as dielectric barrier discharge cold atmospheric plasma (DBD-CP), can be an alternative for fruit presevation due their chracteristics such as reduced processing times, use of air as ionizing gas and ensure product safety. Thus in this work, DBD-CP was used for sanitization and preservation papaya minimally processing.

Material and Methods

Carica papaya L. cv. 'Formosa' in ripening stage 5 (75 – 100 % yellow skin) were purchased from the local market in Florianópolis, SC, Brazil. After washed were manually peeled and cut in cylindrical samples of 2.9 cm in diameter and tackiness 1.2 cm and randomly divided into two groups, a control group (no plasma treatment) and a cold plasma (CP) treatment. For CP treatment, the samples were kept on the electrode gap and, a voltage of 30 kV_{RMS} and frequency of 130 Hz, for 60 s, was performed on 9 samples on both sides. After, all samples (control and plasma) were stored on polystyrene trays covered with stretchable PVC film and kept at 8 °C (± 1.5 °C) and 85 % RH for up to ten day and analyzed at each two days to the soluble solids, pH, respiration rate, weight loss, fimness and color, according [3].

Results and discussion

Respiration rate of the both samples decreased, reaching the equilibrium at 6h (**Figure 1**). For physical-chemical properties, color parameters were express by L* and ΔE, which *L** was lower for CP samples than the control with significant difference ($p \leq 0.05$) immediately after the cold plasma treatment, and during the storage period. Probably due the hardness, observed by the appearance of a thick/firm, whitish layer, from the biochemical reactions. In additon, total color value difference (ΔE) showed significant effect ($p \leq 0.05$) among the samples.

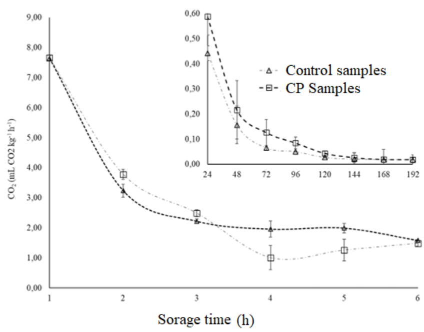

Figure 1: Respiration rate expressed through the CO_2 production of minimally processed papaya for 6 h (8 ± 1.5°C and 85% UR, DBD-CP for 60 s.

Table 1 shown the pH, total soluble solids (TSS), titratable acidity (TTA), and TSS/TTA ratio for papaya (control and treated with CP 60 s) during storage at 8 ± 1.5 °C and RH 80%. For pH there was a significant difference only from the 6th day for CP treated samples. On the other hand, TSS increased, in agreement with an increase in weight loss during the storage (Figure 2), but no significant difference between control and treated. In addition, TSS/TAA ratio is used to express the balance between sweetness and acidity and its perception by consumers. Firmness parameters such as adhesiveness and chewiness did not were influenced by plasma or by the storage period, the adhesiveness on day zero was 1.04 for control and 0.93 for plasma samples. And during the storage the average values were 1.07 and 0.92 kg.s, for control and CP, respectively. The chewiness presents average of the 0.71 and 0.73 kg for control and CP samples, for zero day, and 0.87 during the storage period for CP and 0.78 for control, no significant influence of the treatment or storage ($p \leq 0.05$) was observed. The weight loss increased for both samples and consequent decrease in water activity without a significant difference ($p > 0.05$) after treatment. However, there was a significant difference ($p > 0.05$) during storage (Figure 2). The greater weight loss of the control samples during storage was 18 ± 0.44% may be due to respiratory activity, since the loss of water in minimally processed products occurs due to the consumption of metabolites stored during metabolic activities [4]

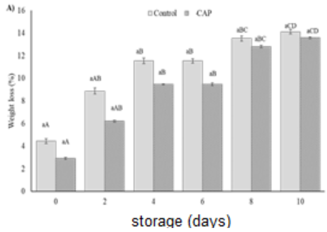

Figure 2: - Effect of cold plasma on weight loss (a) and water activity (b) and control papaya during storage at 8 ± 1.5 °C and 85% RH. Differences in the level of p = 0.05 between days 0, 2, 4, 6, 8, and 10 and between the control and treated groups.

Table 1 - pH, total soluble solids (TSS), total titratable acidity (TTA), and TSS/TTA ratio of minimally processed control and CP treated papayas (60 s) during storage at 8 ± 1.5 °C and RH 85%.

Storage time (days)	Samples	pH	TSS (%)	TTA (%)	Ratio TSS/TTA
0	Control	5.21 ± 0.03^{aA}	8.53 ± 0.07^{aB}	0.054 ± 0.02^{aA}	157.96 ± 1.21^{aA}
	CP	5.13 ± 0.04^{aA}	9.67 ± 0.15^{aC}	0.057 ± 0.01^{aA}	169.65 ± 0.95^{bA}
2	Control	5.13 ± 0.09^{aA}	8.60 ± 0.10^{aB}	0.055 ± 0.02^{aA}	156.36 ± 1.02^{aA}
	CP	4.98 ± 0.03^{aA}	10.67 ± 0.05^{aB}	0.061 ± 0.03^{aA}	174.92 ± 0.86^{bA}
4	Control	5.00 ± 0.07^{aA}	10.50 ± 0.46^{aA}	0.067 ± 0.01^{aB}	156.71 ± 0.75^{aA}
	CP	4.92 ± 0.08^{aA}	10.80 ± 0.28^{aAB}	0.068 ± 0.04^{aB}	158.82 ± 1.05^{aB}
6	Control	4.82 ± 0.03^{aA}	10.67 ± 0.42^{aA}	0.069 ± 0.01^{aBC}	154.64 ± 1.00^{aA}
	CP	4.49 ± 0.08^{bB}	11.06 ± 0.14^{aAB}	0.072 ± 0.01^{aBC}	153.61 ± 0.70^{aB}
8	Control	4.65 ± 0.05^{aA}	10.90 ± 0.36^{aA}	0.070 ± 0.03^{aC}	155.71 ± 0.98^{aA}
	CP	4.44 ± 0.04^{bB}	11.13 ± 0.28^{aA}	0.074 ± 0.04^{aC}	150.40 ± 1.15^{aBC}
10	Control	4.60 ± 0.03^{aA}	10.94 ± 0.16^{aA}	0.071 ± 0.01^{aC}	154.08 ± 0.78^{aA}
	CP	4.42 ± 0.02^{bB}	11.14 ± 0.14^{aA}	0.076 ± 0.02^{aC}	146.58 ± 1.05^{aC}

Conclusions

The plasma operational conditions at 30 kV, 60 s on papaya effectively maintains the attributes quality of minimally processed papaya during cold storage preserveing the product at least for 8 days. This shelf life time is economically viable for market.

Acknowledgments

CAPES, PPGEAL-UFSC

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