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Chemical Analysis on the Effect of Pulsed Electric Fields in Pineapple Juices Preservation

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Abstract. The application of high voltage electric field for preservation of fruit juices has a promising scope in the food industry. The pulsed electric field (PEF) is an innovative non- thermal technique and free from bio-toxic effects. The technique has a viable solution of the problem yet faced in the food industry to prolong life and preserve and maintain quality with natural properties of the liquid food and beverages. In this study, we have treated the pineapples juice samples by different strengths of pulsed electric field such as 10, 20 and 30kV/cm for 5 minutes in each test. This study used new design of helix treatment chamber with three different lengths of 20, 30and 50cm. In these experiments, all samples were kept in same and normal condition with a temperature around 25-26 C°andthe humidity was between 55 and 65%. Then the observation based on chemical tests such as pH, conductivity, salinity and total dissolved solids (TDS) was recorded for all samples before and after the test. Based on results obtained by chemical parameters suggest that the injection on pulsed electric field of 30 kV/cm by the 50 cm treatment chamber has the best effect on pineapple juices characteristic as compared to the other value. The result of this experiment is encouraging and supportive of the better way for pasteurization the pineapple juices and increasing longevity of pineapple juices.

Introduction

Nonthermal food preservation methods have generated considerable interest in the food industry for their potential to offer an alternative to the traditional thermal processing methods. The electric field may be applied in the form of exponentially decaying, square wave, bipolar, or oscillatory pulses and at ambient, sub-ambient, or slightly above-ambient temperature [1, 2]. The main advantage of this emerging technology is that it is a dry process and the retention of fresh quality attributes is well proven during the preservation process of fruit [3]. Moreover, PEF processing technique offers dry processing which is capable to retain the high quality of food with excellent flavor, nutritional value, and shelf life. The processed food also possesses a satisfactory shelf life at ambient temperature.

In some cases, PEF pasteurized products currently stored using the refrigeration technique (for example, milk), this is necessary for safety (to prevent the growth of spores in low-acid medium. [5, 6]

This study tried to use pulsed electric field with various strengths in order to treat the pineapple juices for five minutes with three different lengths of treatment chamber. According to the chemical results, injection of high voltage pulsed electric field is an efficient way not only to preserve the fruits/juices, butalso to prolong their life [7].

Methodology

Based on the proposed method of this research will be carried out by using designed treatment chamber and developed pulsed electric field generator on pineapple fruit juice. Then, the initial step test designed the helix treatment chamber for applied pulsed electric field on pineapple juices. The important reason for this new design is the increasing treatment time and improved the efficiency of

energy dissipation. Fig 1 shows the treatment chamber wasdesigned in three different lengths 20, 30 and 50 cm. The stainless steel electrode placed in the middle of the helix and the aluminum sheet covered around the treatment chamber for earth.

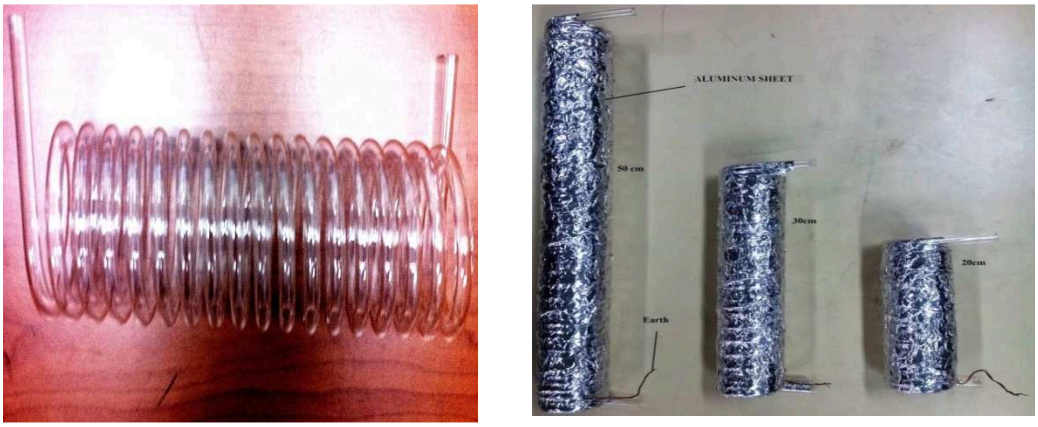

Figure 1: Helix Treatment Chamber Designed

Pulse powers supply another important part of this research. The requirements this processes to supply high pulses at a frequency high enough to permit the processing of foods in a continuous method. The circuit used in this test was coaxial cable. The fig 2 (a, b) has shown the circuit and the schematic of the circuit. The advantage of the double-Blumlein pulsed generator, other than its low cost, compactness and simple construction.

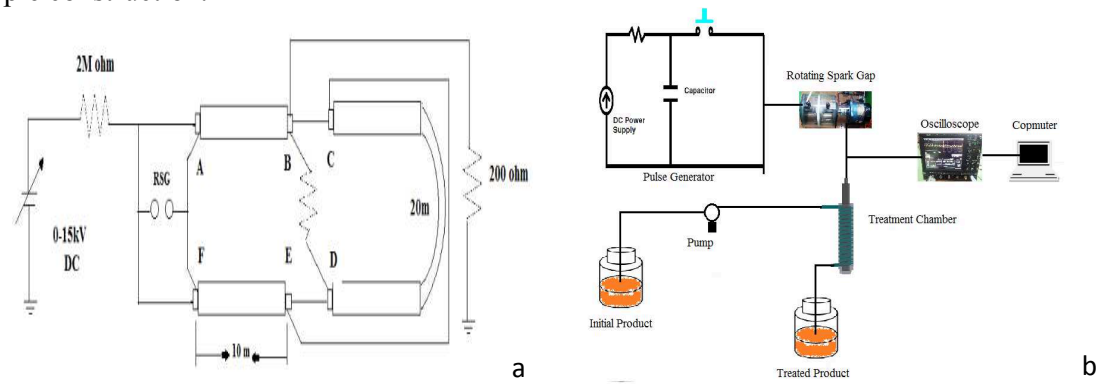

Fig 2: a) Blumlein high voltage cable pulse generator,b) schematic of pulse circuit

In this experiment we focus on a pulsed electric field on pineapple samples. The electric field equation is:

$$E=V/d \quad (1)$$

Where E is the electric field, V is the input voltage and d is the gap. The air gap here is 5mm. It was the distance between the electrode and the aluminum sheet earthing so here was the diameter of the glass tube. Thus, for input voltage of 5, 10, 15 kV the electric field were 10, 20 and 30 kV/cm. Treatment time was 5 minutes for each test [4]. For each of the treatment chamber applied three different ranges of voltage.

The juices, filtered by a paper filter to remove all pulp because the pulp in juices along of discharge and increase the voltage and finally increase the price. The juices pumping to the treatment chamber by a pump. After the test all samples by one non treatment sample keep in the normal and same condition for eight days [8].

Result and discussion

Chemical test on the pineapples sample after pulsed electric field applied to pineapples juice sample and keep in normal condition for eight days. The important chemical parameter pH, conductivity, salinity, and TDS measured and compared all these data together and finally the best result will obtained. The table 1 that follows shows the result of chemical tests on the samples

applied pulsed on 20cm treatment and keep for eight days to prolong the lifetime of juices and could keep for a longer time without any preservatives and the cooling system. Also table 2 and 3 is shown applied voltage on 30 and 50cm treatment chamber respectively.

Table 1: Measurement of chemical parameter values of treated samples for 20 cm treatment chamber

	$N.T^1$	Fresh	10kV/cm	20 kV /cm	30 kV /cm
$C^{\mu s}/_{-cm}$	3127	3164	3119	3128	3130
TDS $^{mg}/_{l}$	2054	2075.5	2054	2059	2091
SAL ppt	1.65	1.74	1.67	1.67	1.69
pH	6.25	5.90	6.13	6.11	6.10

1:Non Treated

Table 2: Measurement of chemical parameter values of treated samples for 30 cm treatment chamber

	N. T^1	Fresh	10 kV /cm	20 kV /cm	30 kV /cm
$C^{\mu s}/_{-cm}$	3127	3164	3137	3139	3145
TDS $^{mg}/_{l}$	2054	2075.5	2061.5	2059.5	2068
SAL ppt	1.65	1.74	1.65	1.67	1.71
pH	6.25	5.90	6.21	6.20	6.17

Table 3: Measurement of chemical parameter values of treated samples for 50 cm treatment chamber

	N. T^1	Fresh	10 kV /cm	20 kV /cm	30 kV /cm
$C^{\mu s}/_{-cm}$	3127	3164	3127	3136	3149
TDS $^{mg}/_{l}$	2054	2075.5	2059.5	2063	2071.5
SAL ppt	1.65	1.74	1.66	1.69	1.71
pH	6.25	5.90	6.22	6.20	6.01

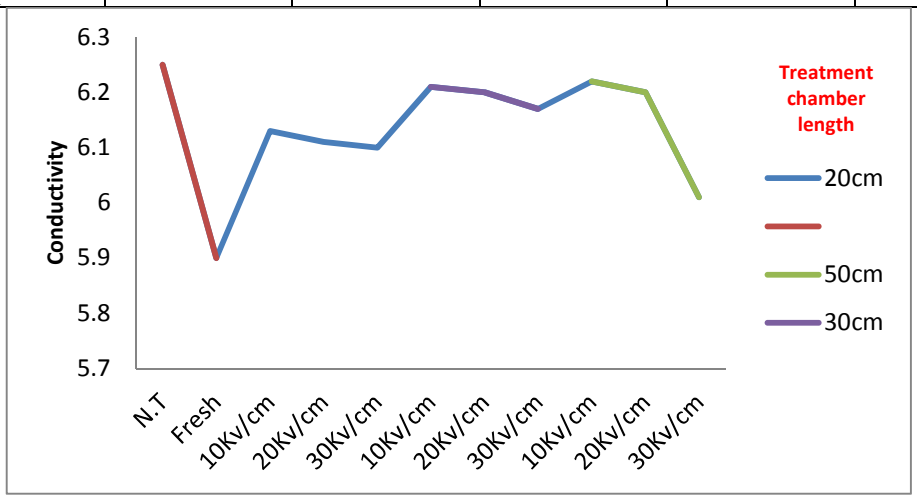

Figure 3: Comparison of conductivity for three different lengths of treatment chamber for three ranges of electric field

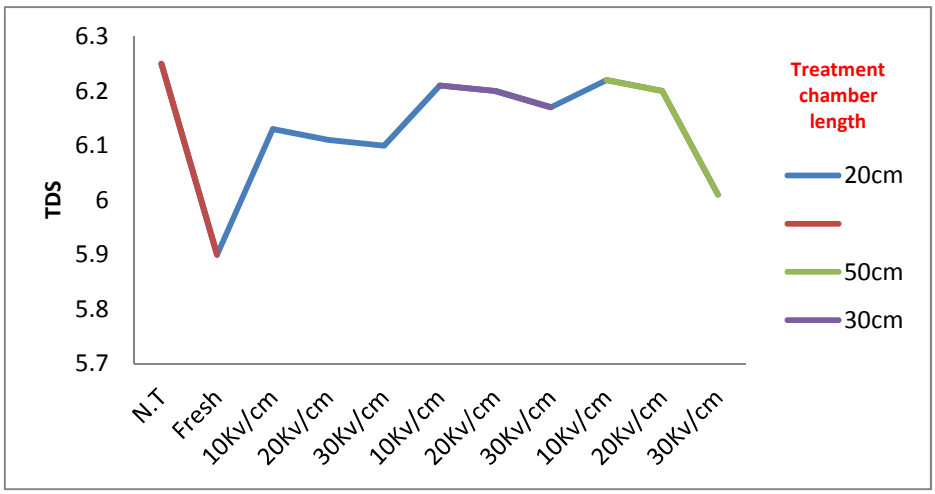

Figure 4: Comparison of TDS for three different lengths of treatment chamber for three ranges of electric field

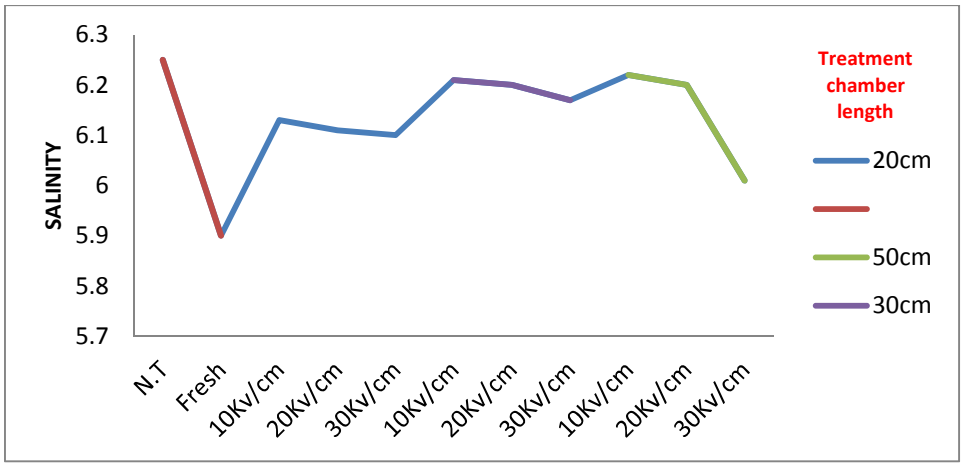

Figure 5: Comparison of Salinity for three different lengths of treatment chamber for three ranges of electric field

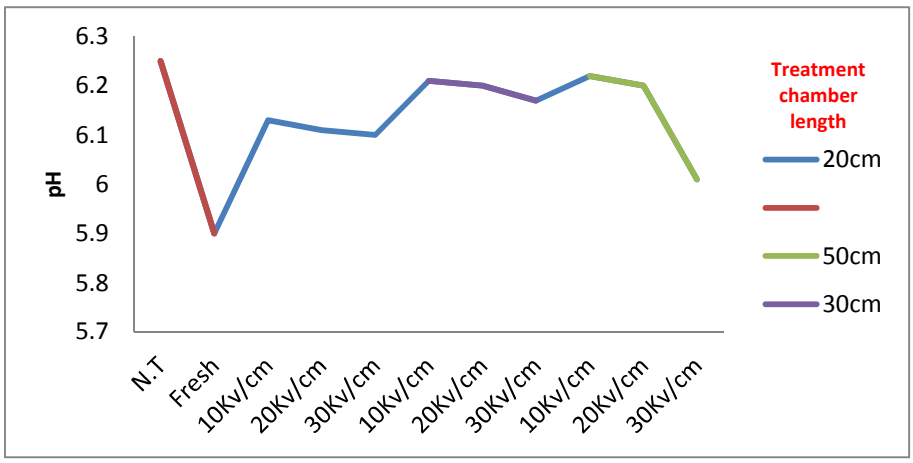

Figure 6: Comparison of pH for three different lengths of treatment chamber for three ranges of electric field

According to the above mentioned tables and graphs and after comparing all results with fresh samples and non-treated samples these points are achieved the 30 kV /cm of 50 cm treatment chamber more effective than the other at total.

Conclusion

In this study, high voltage field treatment is successfully applied to pineapple juice samples to check the preservation characteristics. In this experiment the best results were obtained while using a 30 kV / cm pulsed electric field as compared to other applied high voltage test. It was deduced that after spending eight days the chemical tests performed about the measurement of conductivity, salinity , pH and TDS show that the 30 kV/cm the 50 cm treatment chamber have better effect on pineapple juices as compare to without high voltage stress fresh samples of pineapple juices and non-treatment samples.

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