EFFECT OF ADDITION OF SODIUM BENZOATES IN GREEN SUGAR CANE JUICE (Saccharum Officinarum L.) ON THE APPLICATION PULSED ELECTRIC FIELD (PEF) CONTINUOUS SYSTEM

Dina Wahyu Indriani [1], Sumardi Hadi Sumarlan[1], Nurul Dwi Hidayani[2], Arie Febrianto Mulyadi[2]

[1] *Department of Agricultural Engineering, Faculty of Agricultural Technology University of Brawijaya*
[2] *Department of Agricultural Industry, Faculty of Agricultural Technology University of Brawijaya*
Correspondence author : [1]dinawahyu@ub.ac.id

ABSTRACT

Non-thermal pasteurization process using Pulsed Electric Field (PEF) today has been used particularly in processed food products are easily contaminated. One cause contamination of processed products is the high number of microbes in the product example is a green cane juice (Saccarum officinarum) and thus require proper handling process is to conduct non-thermal pasteurization using Pulsed Electric Field (PEF) continuous system. This study aims to reduce the total number of microbes and it maintains the physical and chemical qualities of green cane juice. In this study also added sodium benzoate which serves to inhibit microbial growth and increase shelf life of cane juice. This study uses a Randomized Complete Block design (RCB) with 2 factors that PEF continuous voltage (20, 30 and 30 kV) and the addition of sodium benzoate concentrations (200, 400, and 600 ppm) with 2 replications. Best research results at a voltage of 40 kV and a concentration of 600 ppm sodium benzoate. In this combination had a mean number of total microbes of 4.15 x 106 cfu / ml, TPT at 12.9 ° brix, total cave of 11.61%, a viscosity of 5.5 cp, the color on the brightness value (L *) of 24.1, redness (a *) of 7.1 and yellowness (b *) of 7. The color of the green cane juice controls had no significant difference it showed that PEF continuous system is able to maintain the color of the green cane juice.

Keywords: *Continuous; Green Cane Juice; Pulsed Electric Field; Sodium Benzoate*

1. INTRODUCTION

Fruit drinks that contain enough sugar will lead to ease the growth of microbes, so it takes a pasteurization treatment. The processing of fruit juices generally consist of two methods that the thermal processing and non-termal. In thermal processing (pasteurization) using an ambient temperature of 600-700 C so as to inactivate the enzyme and suppress microbes that can damage the fruit juice. Heat processing can destroy sensory and nutritional quality. Results from the manufacture of cane juice by using a thermal method, the color green cane juice tends to change due to the effects of cooking so that the green color slightly. According to, the sugar is the largest content (75-92%) in the sap from sugar cane consisting of sucrose, glucose and fructose. When heated in the presence of OH- ions, will occur the decomposition process that begins with the formation of organic acids (lactic acid) followed complex compounds which can eventually produce a brown color.

To inhibit the growth of microbes to do the addition of sodium benzoate so menambahan shelf life of the juice. Sodium benzoate in the form of granules or powder is white, odorless and stable in air. Easily soluble in water and slightly soluble in ethanol. Solubility in water at a temperature of 250C for 660g / l with an active form as a preservative by 84.7% in the range of pH 4.

2. MATERIAL AND METHODS

2.1. *Materials*

The tools used in this study is a set of tools Pulsed Electric Field (PEF), autoclave, scales, basins, bottles, measuring tubes, gloves, aluminum foil, knives, cotton, scissors and paper labels. The tools used for the analysis of which is a petri dish, electric cookers, cotton, gauze, bunsen, test tubes, brown paper, plastic, scissors, blue tip, a micropipette and laminar air flow, incubator (brand Bionex).

In this study used some materials were 862 PS sugarcane varieties obtained from green cane juice seller at Jl. Candi Trowulan, Malang, 96% alcohol, distilled water, sodium benzoate, plate count agar (OXOID brand).

2.2. *Methods*

Research using Random Design (RBD) with two factorial ie voltage PEF (20, 30, and 40 kV) and the concentration of sodium benzoate (200, 400, and 600 ppm), then do two repetitions.

2.3. *Analyzed method*

Analyzed using ANOVA. If there is any real difference then do a further test BNT and if the interaction of both factors showed significant difference, then continued with DMRT.

3. RESULT AND DISCUSSION

Characteristics of PS 862 varieties of cane juice used in the study refers to the TPC, TPT, total sugar, viscosity and color. Based on such information, the value of the characteristics of green cane juice.

Table 1. Characteristic value of Sugar cane compare with Related References

Karateristik	Value	Referenc e	Unit
Total Plate Count (TPC)	$6,79X10^7$	$4,25X10^{10}$ *	Cfu/ml
TPT	14,55	16**	^{0}brix
Total Sugar	14,88	-	%
Viscosity	3	2,03**	Cp
Brightness (L*)	23,55	-	-
Redness (a*)	7	-	-
Yelowness (b*)	6,7	-	-

Based on Table 1 value characteristic green cane juice control compared with the literature has significant value. TPC value of green cane juice research have lower scores than the TPC literature, allegedly due to the different treatment of the material. Besides the environmental conditions allow for differences in the value of TPC. Value TPT green cane juice and literature by, has a significant difference. Total TPT study had a lower value for their interval is used between extortion green cane juice with testing the value of TPT.

The viscosity of the green cane juice by, has a value lower than the viscosity value in the research of green cane juice that is equal to 2.3 Cp. This is due to the lapse of time between the green cane juice extortion by testing, because if there is a lapse of time that is long enough texture green cane juice will be more viscous.

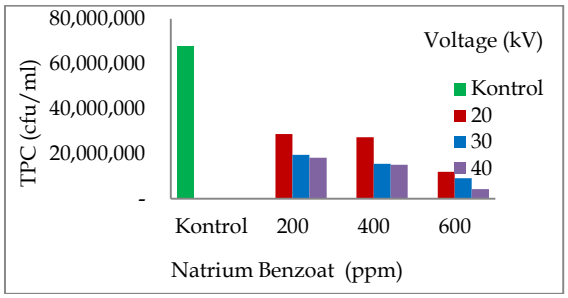

Figure 1. Relationships Graph PEF voltage (kV) and sodium benzoate (ppm) Against Value Average TPC (cfu / ml) Sari Tebu Green

Treatment PEF voltage and the concentration of sodium benzoate lowers microbial significantly ($P < 0.05$), but the interaction of the two are not significantly different ($P > 0.05$).

Table 2. Average Value Total Plate Count (TPC) Green Sugarcane Juice Based difference voltage value PEF

Treatment	Average	Notation (*)
V_1	22.116.667	a
V_2	20.916.667	a
V_3	8.366.667	b

Note : The notation in the table followed by the same letter show no significant difference in the LSD 5%

The highest voltage 40 kV cause greater microbial inactivation capability. According to [7], noted that the reduction of microbes depends on the strength and timing the application of an electric field, the higher the voltage. The greater the ability of inactivation of microbes.

Table 3. Average Value Total Plate Count (TPC) Green Sugarcane Juice Based on Difference Value Concentration Sodium Benzoate

Treatment	Average	Notation (*)
N_1	22.650.000	a
N_2	16.300.000	ab
N_3	12.450.000	b

Note: The notation in the table followed by the same letter show no significant difference in the LSD 5%

The addition of sodium benzoate concentrations of 200, 400, and 600 ppm showed that the higher the concentration would result in a decrease in the number of microbes significantly. According [12], that the effectiveness in inhibiting the growth of microbes is influenced by the concentration of preservatives, which can inhibit the activity of microorganisms in the oxidation produces an enzyme that can destroy vitamin C.

The decrease microbial cane juice is still below the standard of microbial contamination of juice according to ISO 7388-2009, namely ALT 1X104 CFU / ml, whereas in cane juice has the lowest number of microbes 4.15X105 CFU / ml.

Death effectiveness Microbes.

Effectiveness Death Microbes represent the number of microbes after the administration of treatment decrease stress concentration PEF and administration Sodium benzoate. Total microbial control of $6.79X10^7$ cfu / ml. Decrease the lowest microbe at a voltage of 20 kV is equal 1.195X107 cfu / ml. The decrease microbial highest voltage of 40 kV is equal $4.15x10^6$ cfu / ml. The effectiveness of microbial reduction in green cane juice can be seen in Table 4.

Table 4. Decrease Effectiveness Microbe (TPC) tension

Voltage (kV)	TPC (cfu/ml)	Decrease Effectiveness (%)
20	$1.195X10^7$	82.55
30	$9.1X10^6$	86.60
40	$4.15X10^6$	93.89

Table 4 shows the ability of microbial inactivation efficacy on green cane juice by PEF treatment voltage and the concentration of sodium benzoate is pretty good. The decline in total microbial still above the maximum limit of microbial contamination in food according to ISO 7388: 2009 in the juice that is equal to 1X104 cfu / ml. Voltage electricity is one of the main factors affecting the microbial deactivate. Microbial deactivation can be increased with an electric voltage.

Potential Decimal Reduction Time (D)

Potential Decimal Reduction Time (D) is the time in seconds at a certain voltage required to reduce or inactivate almost 90% of the number of microbes (1 log cycle). Great value D depending on the initial microbial count (N0), the number of microbes end (N) and the processing time (t) which can be plotted on the graph below semilogaritmic or in decline.

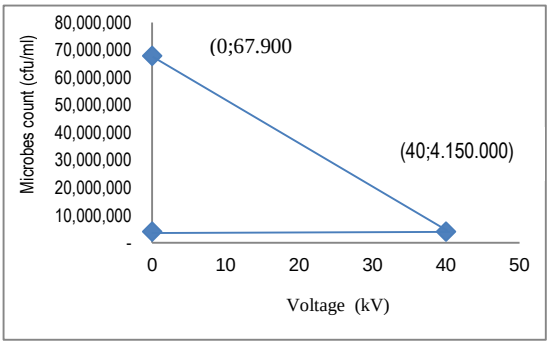

Figure 2. *Potential Decimal Reduction Time Graph*

Figure 2 illustrates the initial microbial count of 6,79X107 cfu / ml of the show at the point (0; 67.9 million), while a decrease of $4,15X10^6$ microbial cfu / ml at a voltage of 40 kV is shown in point (40; 4.15 million) which decreases of 1.21 log cycle. The decrease microbial calculated by the following calculation:

$$\text{The decrease microbial} = \frac{N0}{N} = \frac{67.900.000}{4.150.000} = 16{,}36$$

The decrease microbial = 1,21 *log cycle*

The decline of microbes on green cane juice up to 90% or 1 log cycle is equal to 1.21 log cycle due to the provision of PEF voltage with a combination of sodium benzoate concentration capable of inactivating microbes largely on sugar cane juice green.

The death rate of Microbes

Lethal rates is a microorganism death rate per unit time due to high voltage electric shock on a food. The mortality rate of microbes can be depicted in a graph that is equal to the value of the slope (slope).

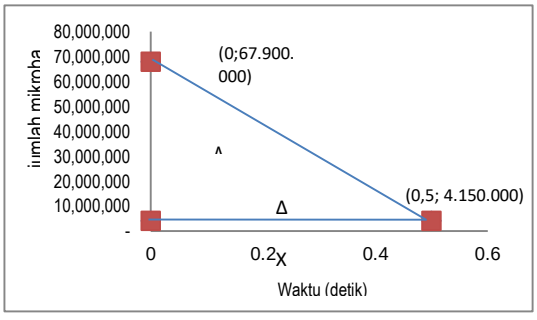

Figure 3. The death rate of microbes

$$Slope = \frac{\Delta y}{\Delta x} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$= \frac{67.900.000 - 4.150.000}{0,5 - 0}$$

$$= 127.500.000$$

$$= 1,275X10^{8} \text{ (cfu/ml)/second}$$

The above calculation can be concluded that through electric shock treatment at 40 kV can inactivate microbes by 1,275X108 (cfu / ml) / sec. Equation graph linear equations models as follows:

$$y - yf = m(x - xf) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Graph through the point (0; 67.9 million) which is the value of N0 as control is established:

$$y - 67.900.000 = - 127.500.000 (x - 0)$$

$$y = 67.900.000 - 127.500.000$$

Conclusion

Interaction PEF voltage and the concentration of sodium benzoate is not significantly different (P> 0.05) of the total plate count (TPC), total dissolved solids (TPT), total sugar, viscosity and color on a green cane juice. PEF voltage and the concentration of sodium benzoate significantly different (P <0.05) reduction in TPC on green cane juice. The best treatment at a voltage of 40 kV and a concentration of 600 ppm of sodium benzoate were able to inactivate microbes by 93.89% or by 1.21 log cycle is 4,15x106 cfu / ml. nillai TTP of 12.9 oBrix, total sugar amounted to 11.61%, a viscosity of 5.5 cp, the color brightness values (L *) of 24.1, redness (a *) of 7.1, and yellowness (b *) amounting to 7.

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