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Application of the Pulsed Electric Field Method in the Fruit Dragon Red (*Hylocereus polyrhuzus*) with the Study of Electric Voltage and Addition of CMC

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Abstract**—***This study aims to determine the effect of adding CMC and the use of PEF on physicochemical properties (antioxidants, vitamin C, pH, total dissolved solids, colors, and textures) and organoleptic red dragon fruit juice. The materials used are fruits, and CMC with concentrations of 0.5%, 0.7% and 0.9% and pasteurization using PEF with a voltage of 30 kV, 40 kV, and 50 kV. The design of this study uses a Completely Randomized Design (CRD). The results showed that the highest antioxidant activity. The highest IC50 value in fruit juice was obtained from the treatment of 0.5% CMC concentration and 50 kV PEF (129.56 µg / mL) and the lowest (43.10 µg / mL). The highest vitamin C in CMC treatment was 0.90%, ie 8.12 ± 0.17 mg / 100g and the lowest in CMC concentration was 0.50% (5.51 ± 0.68 mg / 100g). The highest pH of CMC concentrations is 0.50g which is 7.4 ± 0.32 and the lowest CMC 0.90% is 5.2 ± 0.35. The highest color intensity in the CMC concentration was 0.50% was 0.8353 ± 0.02 and the lowest CMC concentration was 0.90%, 0.432 ± 0.03. The highest total dissolved solids were found in the CMC concentration of 0.9% and 50 kV PEF was 23.73 0Brix and the lowest was 0.5% CMC concentration and 30kV PEF was 12.10 0Brix. The higher the concentration of CMC, the higher the antioxidant, vitamin C, pH and total dissolved solids. While the color intensity will decrease when the concentration of CMC is higher.*

Keywords— *Dragon fruit, CMC, PEF, concentration.*

I. INTRODUCTION

Fruit Red dragon (Hylocereus polyrhuzus) is also commonly called dragon fruit or thang loy classified as ancient fruit and is a new fruit which is quite popular. Red dragon fruit is one type of fruit that is much favor by the community because it has a distinctive taste that is a unique combination of sweet and sour which is refreshing. Red dragon fruit is famous as one of the sources of beta-carotene is provitamin A which is converted into vitamin A which is very useful in the process of vision, reproduction, and other metabolic processes. The use of red dragon fruit which is high in fiber, antioxidants that are anthocyanin is expected to produce juice that has high health effects because of the antioxidants in red dragon fruit. During storage the juice usually undergoes a deposition that is the separation between the liquid and the solids contained in the drink. To avoid the deposition, a stabilizer is added. The stabilizer used in making red dragon fruit juice is CMC (Carboxy Methyl Cellulose).

The addition of CMC and aims to form a liquid with a stable and homogeneous thickness. Viscostas of CMC solution are influenced by the pH of the solution, the pH range of Na-CMC is 2-10 while the optimum pH is 5 and if the pH is too low, Na-CMC will settle (1). The strength of an electric shock depends on the high voltage pulse applied to the chamber, while the number of pulses depends on the length of time of processing (2). To get an appropriate electric shock for inactivation of microorganisms, it is necessary to adjust the amount of high voltage pulses that can be given to the chamber and also to regulate high voltage pulses. The purpose of using the Pulsed Electric Field tool is to maintain the sensory and shelf life of the red dragon fruit juice. Based on this description, a study was conducted on the Application of the PEF Method to manufacture red dragon fruit juice (Hylocereus contaricensis) by studying the variation of electric discharge and the addition of CMC. This study aims to determine the effect of CMC and Pulsed Electric Field on red dragon fruit juice.

II. METHOD

A. Time and Place

The study was conducted for 7 months, starting in January 2019-July 2019, from the preparation of the material to the analysis of the product. The research was carried out at the Quality Processing and Supervision Laboratory, postharvest and Packaging Laboratory and the Laboratory of Chemical and Biochemical Agricultural Products Department of Agricultural Product Technology, Faculty of Agricultural Products, Brawijaya University, Malang City, East Java.

B. Materials and Research Tools

The raw material used in making red dragon fruit juice is originating from the city of Malang. With the part used in the form of ripe red dragon fruit meat and aquades. The tools used to make juice are blenders, knives, plastic containers, panic, stoves, filter cloths, glass cups, bottles and lids as well as stationery, digital scales, *erlenmeyers*, beaker glasses, funnels, spatulas, pipettes, measuring cups, paper filters, wipes, pH meters, spectrophotometers, hand refractometers, a series of Pulsed Electric Field bottles, Pulsed Electric Field, knives, gloves, *aluminum* foil, cotton, autoclave, washbasins, scissors, measuring tubes, and label paper. The tools used for analysis are pipettes, *micopipets*, petri dishes, cotton, brown paper, measuring tubes, measuring cups, scales, gloves, aluminum foil, test tubes, cotton, blue tips, electric stoves.

C. Experimental Design

The experimental design used in this study was a completely randomized design with 2 factors and 3

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replications. The comparative treatment of red dragon fruit and CMC from this study were: Factor 1 CMC concentrations 0.50%, 0.70% and 0.90%. Factor II variations in electric voltage are 30 kV, 40 kV and 50 kV. The parameters observed in this study were pH analysis, color intensity, total dissolved solids, vitamin C, antioxidants and sensory tests on red dragon fruit juice. The data obtained were processed using analysis of variance. The mathematical model used is as follows:

$Yij = \mu + \tau i + \varepsilon ij$

i = 1, 2, 3, i = treatment

j = 1, 2, 3, 4, 5 j = test

Information :

Yij = Observation response variable

μ = Average value of observations

τi = Effect of i-CMC addition on physical character, pH and taste of red dragon fruit juice.

εij = Effect of trial error from increasing the concentration of the k-i dragon fruit and the quiz ke-j.

Every treatment that shows a real influence, will be tested Duncan (2).

D. Research Procedure

The research procedure was the effect of adding CMC to the red dragon fruit juice into two, namely the preparation of the ingredients and the manufacture of fruit juice.

a. Material preparation

The main ingredient in making fruit juice is red dragon fruit, water. While the tools needed are blenders, knives, mouthpieces, scales, plastic containers, pans, stoves, aluminium foil, pH meters, spectrophotometers, Hand Refractometers, filter cloths, burettes, glass, measuring cups, sterile bottles and lids and stationery.

b. The Process of Making Fruit Juice

The work steps in making this red dragon fruit juice are first 2 kg of red dragon fruit peeled and taken the flesh of the fruit, then cut to a size of 3-5 cm3 and then washed thoroughly using clean running water. Furthermore, the red dragon fruit pieces are mashed using a juicer. After that, dragon juice is pasteurized by using a pulsed electric shock field 30 kV frequency 41.00 kHz for 5 minutes, a 40 kV shock frequency 41.50 kHz for 5 minutes and a 50 kV shock with 42.00 kHz frequency for 5 minutes then bottled. Prepare the material, namely red dragon fruit which is processed before being further sterilized using a pulsed electric field first so as to avoid bacteria and dirt, after that the sample is prepared, and washed and then peeled using a knife, cut into small pieces. Red dragon fruit meat that has been cut, the next process is the destruction of dragon fruit meat using a blender. After that add water. The process of adding water is intended to facilitate the process of destruction. Destruction of red dragon fruit is done until it becomes porridge. The red dragon fruit that is ready is then squeezed using a filter cloth. That way red juice is obtained. The next process is mixing according to treatment with CMC composition with dragon fruit meat by 2 factors and 3 times. then sterilized using a pulsed eletric field. Before the juice is put in a bottle, the bottle is first sterilized and pasteurized using pulsed electric for 5 minutes.

E. Analysis Method

Data analysis of this study used ANOVA General Linear Model and Tukey's advanced test used MINITAB version 3.1.2 software to find out the significant relationship between factors and responses. Sensory data analysis using Kruskal-Willis and Tukey further tests.

III. Results and Discussion

A. Characteristics of Dragon Fruit Juice

Analysis of the physicochemical components of dragon fruit juice, namely antioxidant activity, vitamin C, pH, color intensity, and total dissolved solids. Test the influence of factors and parameters tested using the ANOVA diversity test, and Tukey's advanced test.

a. Antioxidant activity

Figure 1 explains that the IC50 values in this study ranged from 43.103 μg / mL to 129.562 μg/mL. The combination of CMC concentration treatment and PEF stress on antioxidant activity in dragon fruit showed a significant difference as shown in Figure.

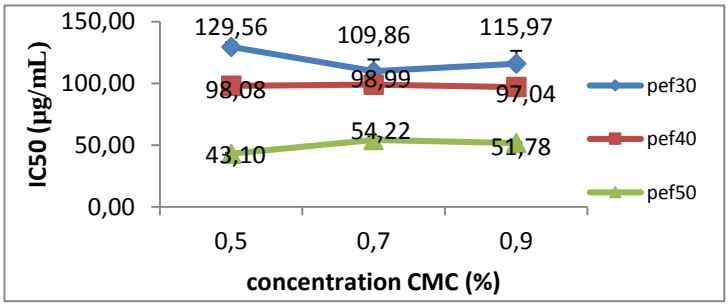

Figure 1. Graph IC50 Effect of Combination of CMC Concentration and PEF Voltage Dragon Fruit Juice

ANOVA diversity analysis results showed that there were interactions of the treatment of the addition of CMC stabilizers and the PEF stress had a significant effect on IC50 levels in the resulting dragon fruit juice. The highest IC50 value in fruit juice was obtained from the treatment of 0.5% CMC concentration and PEF 50 kV that was 129.56 μg / mL and the lowest was 43.10 μg / mL, as presented in Table 1.

Table 1.

Concentration CMC (%)	PEF (Kv)	IC50μg/mL	Notation	BNJ 0,5%
0,5	30kV	129,56±3,95	bc	
0,7	30 kV	109,86±9,61	ab	
0,9	30 kV	115,97±10,35	a	
0,5	40 kV	98,08±0,47	c	
0,7	40 kV	98,99±0,49	c	9,75
0,9	40 kV	97,04±1,26	d	
0,5	50 kV	43,10±0,77	d	
0,7	50 Kv	54,22±2,69	d	
0,9	50 kV	51,78±0,54	d	

Note: The different letter notation contained in the column indicates the real difference.

Table 1 shows that the addition of CMC and the administration of PEF, the higher the concentration of IC50 values decreased and the lower the higher the concentration of

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CMC and the administration of PEF. This is because CMC has a greater role in maintaining the presence of antioxidants in dragon fruit juice. CMC has the ability to capture free radicals higher so that the level of antioxidant damage by free radicals can be inhibited. Stating that the highest antioxidant activity is found in the addition of 0.9% CMC in red dragon fruit juice. Stated that the addition of CMC showed the lowest antioxidant content loss compared with pectin and xanthan. While the role of PEF as pasteurization has no effect. This is probably due to the greater role of CMC in maintaining the presence of antioxidants in dragon fruit juice. The mechanism of PEF in fruit juice pasteurization does not result in a significant loss of antioxidants. This is because the working principle of PEF can activate microorganisms without changing the nutritional value of the product (3).

Stated that PEF is one of the effective methods in activating microorganisms up to 95% without changing color, flavour, and in a short time. Antioxidants in the material will capture free radicals (DPPH) through the mechanism of donation of hydrogen atoms (2). The more DPPH that is captured, the better the antioxidants are in inhibiting oxidative activity (3). That antioxidant power is divided into four levels, namely very strong antioxidant values (IC50 <50 µg/mL), strong antioxidants (IC50 50-100 µ/mL), moderate antioxidants (IC50 101-150 µg/mL) and weak antioxidant (IC50> 150 µg/mL) (4).

b. Vitamin C

Figure 2 explains the vitamin C content in the study ranging from 3.9 ± 0.15 mg / 100g to 8.12 ± 0.17 mg / 100g. With the highest levels of vitamin C produced by dragon fruit juice, the concentration of CMC was 0.9%, while the lowest was dragon fruit juice without treatment. Effect of CMC concentration on vitamin C.

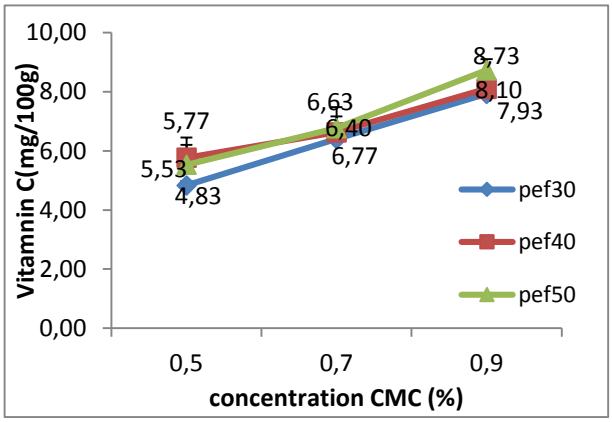

Figure 2. Graph of Vitamin C Levels Effect of Combination of CMC Concentration and PEF Voltage Dragon Fruit Juice.

The results of the diversity analysis showed that the creation of interaction juice with the addition of CMC stabilizers and the administration of PEF did not have a significant effect on vitamin C levels in dragon fruit juice. Significant effects on the level of <5% were found in the addition of CMC stabilizers as presented in Table 2.

Table 2. Average Vitamin C Effects of CMC Concentration on Dragon Fruit Juice

Concentration CMC (%)	PE (Kv)	Vitamin C	Notation	BNJ 0,5%
0,5	30kV	4,83±0,15	a	
0,7	30 kV	6,40±0,46	a	
0,9	30 kV	7,93±0,47	a	
0,5	40 kV	5,77±0,68	b	
0,7	40 kV	6,63±0,85	b	0,22
0,9	40 kV	8,10±0,17	b	
0,5	50 kV	5,53±0,68	c	
0,7	50 Kv	6,77±0,40	c	
0,9	50 kV	8,73±0,38	c	

Note: The different letter notation in the column shows the real difference

The value of vitamin C shows an increase with a higher concentration of CMC, this is related to the condition of the CMC in the juice will be a reaction to the withdrawal of more colloidal particles in the juice. With the withdrawal of these particles, the possibility of free oxygen in dragon fruit juice is low which will cause an oxidation reaction of vitamin C. Similarly, in the research states that the addition of CMC (chitosan) content of vitamin C is higher than the addition of CMC 1.5% rather than 0.5% and 1% in dragon fruit juice (5). Similarly, it states that CMC is able to maintain the content of vitamin C in guava juice because of the withdrawal of particles in the juice that can inhibit free oxygen input which causes oxidation (6). According the higher the concentration of CMC the product will be stable and vitamin C which is easily soluble in water can be bound by CMC so that the damage to vitamin C will be smaller (7).

c. pH

Ph value varies between 5.03 ± 0.32 - 7.50 ± 0.26. The highest acid content at the addition of CMC in the treatment of CMC concentration of 0.9% and the lowest in the treatment of CMC concentration of 0.7% as shown in Figure 3

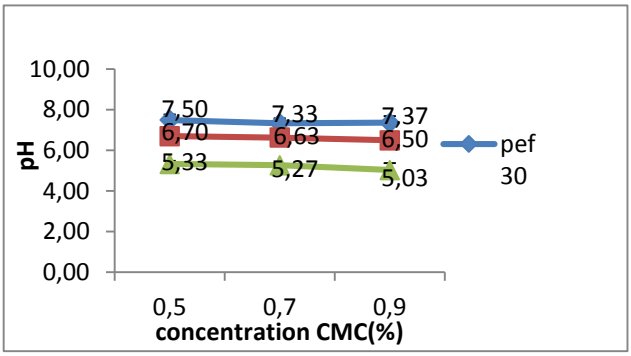

Figure 3. Graph Ph Effect of a Combination of CMC Concentration and PEF Voltage Dragon Fruit Juice

ANOVA analysis results showed that the dragon fruit juice interaction of the addition of CMC treatment and the administration of PEF had no real effect. Significant effect on the 5% level of a single factor adding CMC treatment. The results of further tests with Tukey showed that the treatment of stabilizing CMC increment was significantly different.

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Table 3. Mean Ph Value of CMC Concentration Effect of Dragon Fruit Juice

Concentration CMC	PEF	pH	Notation	BNJ 0,5
0,5	30 kV	7,50±0,26	a	
0,7	30 kV	7,33±0,25	a	
0,9	30 kV	7,37±0,32	a	
0,5	40 kV	6,70±0,40	b	0,35
0,7	40 kV	6,63±0,59	b	
0,9	40 kV	6,50±0,30	b	
0,5	50 kV	5,33±0,15	c	
0,7	50 kV	5,27±0,06	c	
0,9	50 kV	5,03±0,35	c	

Note: the different letter notation in the column shows the real difference.

Table 3 explains the pH value shows the stability during the process of making juice, the pH value becomes neutral. This is due to the administration of different CMC concentrations, the increasing concentration of CMC as a stabilizer will cause the juice to become acidic in dragon fruit pH. This is in agreement states that the change tends to decrease along with the increase in the addition of stabilizers in each treatment due to CMC having a pH of about 3.5-6.5 unstable mixtures of CMC related to its nitrogen content so that the pH of fruit juice decreases (9). Reported that the red dragon fruit has a pH of 5.4. In bayu research, et al. (2012), stated that the use of CMC concentrations of 0.5 g, 0.75 g and 1 g showed a decrease in pH at a CMC concentration of 1% in honey guava juice (10). The addition of CMC will stabilize the pH of the juice with a CMC pH so that the pH value of the juice becomes neutral. Adding CMC as a stabilizer will cause the beverage solution to become acidic. According states that the low pH value in fruit juice, the CMC will precipitate, as a result the ability of CMC to ionize the liquid juice is reduced and can cause ionization and produce in Na^+ which can cause the juice to become alkaline. In addition, the decrease in the pH value of fruit can also be caused by changes in organic acids found in dragon fruit juice such as ascorbic acid which is high in content (10).

d. Color intensity

Figure 4 explains the intensity of the color of dragon fruit juice varies in the range of 0.3181 ± 0.01-0.432 ± 0.03. The color intensity at the addition of CMC was highest in the treatment of CMC concentration of 0.5% and the lowest in the treatment of CMC concentration of 0.9g.

Tukey's further test results showed that the addition of CMC showed a real effect. Color intensity values range from 0.3903 - 0.8416 as presented in Table 4.

The addition of CMC stability of fruit juice intensity. The lower the CMC concentration, the higher the intensity of the color of fruit juice. This is because dragon fruit is a fruit that contains natural dyes namely high anthocyanin pigments. In addition, CMC is colorless so it does not damage the natural color of the dragon fruit. This is in accordance with research (13), states that the color of the mulberry sorbet by using CMC does not have a real effect on sorbet juice, because the natural color of the sorbet is white. Previous research of CMC concentrations of 0.05%, 0.10% and 0.15% did not affect the color of apple cider honey (15). According CMC stabilizers do not smell and color so that CMC does not affect the color and aroma of fruit juices (15). The factors that cause a food material that has a high natural pigment to change after becoming a product can be caused by the chemical content in the material (16).

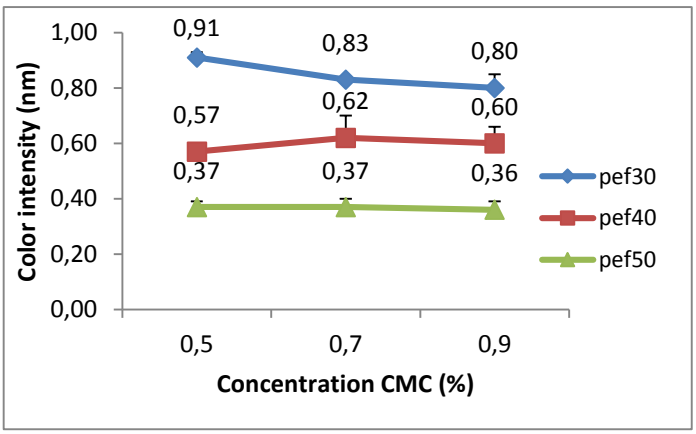

Figure 4. Graphic Intensity Color Effect of Combination of CMC Concentration and PEF Voltage Dragon Fruit Juice.

Table 4. Mean Color Intensity Effect of CMC Concentration of Dragon Fruit Juice

Konsentrasi CMC (%)	PEF (Kv)	Color Intensity	Notation	BNJ 0,05
0,5	30 kV	0,91	a	
0,7	30 kV	0,83	a	
0,9	30 kV	0,80	a	
0,5	40 kV	0,57	b	
0,7	40 kV	0,62	b	0,35
0,9	40 kV	0,60	b	
0,5	50 kV	0,37	c	
0,7	50 kV	0,37	c	
0,9	50 kV	0,36	c	

Note: the different letter notation in the column shows the real difference

e. Total dissolved solids

The total value of dissolved solids varies between 12.10 ^{0}Brix to 23.73. The highest total dissolved solids were found in the CMC concentration of 0.9% and 50kV PEF was 23.73 ^{0}Brix and the lowest was CMC concentration 0.5% and 30kV PEF was 12.10 ^{0}Brix, as shown in Figure 5.

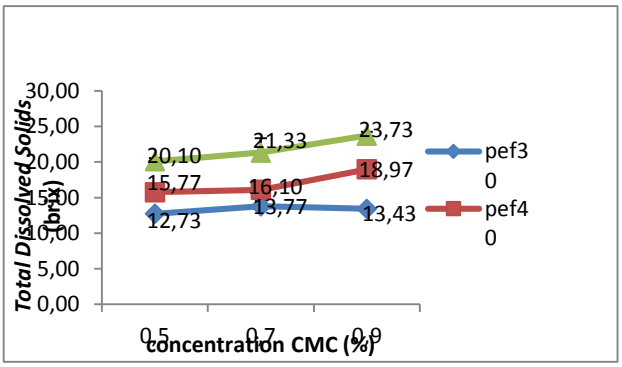

Figure 5. Graph of Total Dissolved Solids Effect of Combination of CMC Concentration and PEF Stress on Dragon Fruit Juice

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Tukey continued test results that the interaction of adding CMC and giving PEF showed differences. Average Total Dissolved Solids.

Table 5. Average Total Dissolved Solids Effect of CMC Concentration and PEF Voltage of Dragon Fruit Juice

Concentration CMC	PEF	Total Dissolved Solids	Notation	BNJ 0,05
0,5	30 kV	12,73±0,51	e	
0,7	30 kV	13,77±0,92	e	
0,9	30 kV	13,43±0,51	e	
0,5	40 kV	15,77±0,68	d	
0,7	40 kV	16,10±0,85	d	0,17
0,9	40 kV	18,97±0,65	d	
0,5	50 kV	20,10±0,44	bc	
0,7	50 kV	21,33±2,03	b	
0,9	50 kV	23,73±0,51	a	

Note: the different letter notation in the column shows the real difference

Table 5 shows that the higher the concentration of CMC stabilizers the higher the total dissolved solids. This is because the total dissolved solids is closely related to the total sugar content of the product, because the total dissolved solids are measured based on the percentage of product sugar. An increase in reducing sugar levels such as glucose, fructose and others can cause an increase in total dissolved. Similarly in the (7) reported that the use of CMC was the highest total dissolved solids at the addition of 1.5% (13,19^{0}Brik) of 1% concentration and concentration. Furthermore the same thing was stated that the use of CMC 7%, 8%, and 9%, the highest total dissolved solids using CMC 9%, the higher the CMC concentration the higher the total dissolved solids of Bligo juice (18). According that fruits contained carbohydrates in the form of simple sugars namely glucose and fructose which are sources of dissolved solids for fruit juice drinks (7). Subsequently (19) the total dissolved solids increased because free water was bound by stabilizers so that the concentration of the dissolved material increased. The more particulates bound by the stabilizer, the total dissolved solids will also increase and reduce the deposits formed. With the presence of a stabilizer the suspended particles will be trapped in the system and not settle by the influence of gravity.

3. Organoleptic Test

A. Hedonic Level of Acceptance of Red Dragon Fruit Juice

The results of the Kruskal-Willis test on the attributes of thickness, color, aroma and appearance showed that the treatment of the combination of CMC and PEF of dragon fruit extract was significantly different. These results indicate that panelists can feel the difference in the intensity of the attributes of the products presented. ANOVA analysis results of further tests showed significant differences in viscosity, color, aroma and appearance. Mean organoleptic values of solid hedonic attributes presented in Table.

- Thickness

In the ANOVA analysis of further tests on hedonic for viscosity attributes showed that in juice the panelists generally chose hedonic fruit juice products at a score of 3.0, it meant rather thick, and a score of 4.0 meant that they liked the treatment of adding 0.5% CMC, 0.7% and 0.9%. This shows that products with the addition of 0.5g, 0.7g and 0.9g CMC and the PEF treatment are products with a high level of viscosity favored by panelists. Fruit juice products with the addition of CMC 0.9% and PEF 50 kV only are preferred by panelists.

- Color

The results of the hedonic test analysis for color attributes showed that in dragon fruit juice most of the panelists chose the hedonic score in dragon fruit juice at a score of 3 (as much as 80%) meaning rather like. In the juice extract treatment 0.9% with PEF 50Kv most of the score 4 (10%). The results show that the 9 different treatment combinations are the products that most panelists like from the color attribute.

- Aroma

The results of the analysis of the hedonic test for the aroma attribute showed that in dragon fruit juice most of the panelists chose the hedonic score of the fruit juice product at a score of 4 (60%) meaning to like. While some of the panelists gave a score of 3 it means rather like. This shows that 9 products with different treatments are the products that most of the panelists prefer the aroma attribute. The average value of panelists' preference for intermittent aromas was between 3.7 (meaning rather like) and 4.45 (meaning close to somewhat like). This shows that products with the addition of 0.9% CMC and 50Kv PEF treatment are the panelists' preferred products compared to other treatments.

- Overall Reception

The results of observations of the hedonic test for the overall acceptance attribute (Table) explained that in dragon fruit juice most of the panelists chose hedonic scores in dragon juice given 0.5% CMC and 0.9% on a score of 4 (as much as 46.7%) means like. This shows that the product with 0.9% CMC addition treatment is a product that is highly favored by panelists compared to other products from the aspect of evaluating overall acceptance. In general, the average score of the panelists' preference level for overall acceptance of the product is around 3 (close to like) and 4 (close to very like).

B. Hedonik Quality of Fruit Dragon Red

Quality hedonic test of the attributes of color, thickness, aroma and taste to determine which attributes are appropriate and which attributes need to be improved for dragon fruit juice products. The results of the Kruskal-Willis test on the attributes of color, thickness, aroma and taste showed that the combination treatment of CMC and PEF of dragon fruit extract was significant. These results indicate that panelists can feel the difference in the intensity of the attributes of the products presented. ANOVA analysis results of further tests showed significant differences in viscosity, color, aroma and appearance. Average hedonic attribute values in Table.

- Color

The results of the analysis of the hedonic test of the product color quality attribute explained that in the dragon fruit juice most of the panelists chose a hedonic score on the fruit juice product at score 3 meaning it was rather purple, meaning that the treatment product added 0.5% CMC in the color rather purple. In dragon juice, the addition of CMC 0.9%, most of the reviewers gave a score of 4 meaning it was purple. The addition of 0.5% CMC juice for most panelists gave a score of 2 meaning it was rather purple. These results show that fruit

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juice with 0.9% CMC treatment and PEF 50 kV are fruit juices that are of a suitable color level compared to others which need improvement of the color attributes.

Table 6. Hedonic Value of Quality Attributes of Color, Thickness, flavor and Taste of Red Dragon Fruit Juice

Concentration CMC (%)	Voltage PEF (kV)	Color	Thickness	Flavor	Teste
0.5	30	2,91±0,53 c	2,21±0,90 e	1,93±0,75 d	1,16±0,79 e
	40	1,86±0,72 d	1,73±0,82 f	2,50±0,74 c	2,41±0,86 d
	50	2,9 6±0,90 c	2,15±0,82 e	2,28±0,84 cd	2,07±0,83 de
0.7	30	2,80±0,10 c	3,33±0,79 d	3,66±0,65 ab	3,56±0,85 b
	40	3,63±0,60 b	3,53±0,79cd	2,05±0,76 d	3,01±0,67 c
	50	3,85±0,78 b	3,90±0,60 abc	3,53±0,72 ab	3,73±0,63 b
0.9	30	3,85±0,65 b	4 ,0±0,55 ab	3,66±0,77 ab	4,16±0,61 a
	40	4,51±0,50 a	3,80±0,51bc	3,30±0,69 d	3,55±0,50 b
	50	4,03±0,71 b	4,21±0, ,61 a	3,90±0,72 a	4,30±0,61 a
BNJ 0,05		0,61	0,63	0,64	0,69

Note: Data is displayed as mean ± standard deviation.
Numbers accompanied by different letters in one column show significantly different results ($p < 0.05$).
Score remarks: 1 = Very not 2. = No 3 = Somewhat 4 = Appropriate 5 = Very appropriate

- Thickness

The observation of the quality hedonic test for the viscosity attribute explained that dragon fruit juice, most of the panelists chose the hedonic score of the fruit juice product at score 2 meaning that it was not thick and score 3 meant that it was viscous in the treatment of adding 0.5% and 0.7% CMC. In dragon juice the addition of CMC 0.9% panelists gave a score of 4 meaning thick. This shows that the addition of CMC products is 0.9% and PEF 50kV is a product with a high level of thickness.

- Flavor

The results of observations of the quality hedonic test for the aroma attribute explained that the juice of the majority of the panelists gave a score of 2 meaning that it was not scented and 3 meaning somewhat flavorful. This shows that the product with the addition of CMC and PEF treatment is a less scented product so it needs to increase the aroma, maybe this is because the ratio of water used is still high compared to fruit juice.

- Taste

The results of observations on the hedonic test of the quality of taste attributes explained that in fruit juice, most of the panelists chose a hedonic score on a score of 3 which means rather sweet. In the addition of 0.5% CMC juice the panelists gave a score of 2 means not sweet. CMC 0.9% panelists gave a score of 4 meaning sweet. This shows the addition of CMC and PEF less sweet fruit juice products, possibly lack of sweetness in fruit juice because there is no addition of stevia or additional sweeteners to dragon fruit juice. The best treatment

Determination of the best treatment uses multiple attributes based on the highest and lowest value parameters. The highest expected parameters are color intensity, total dissolved solids, vitamin C. while the lowest expected values are antioxidants and pH. The physicochemical composition of the best fruit juice combination of CMC concentration and PEF stress is presented in Table.

Table 7. The Best Physical Juice Properties of Fruits

Parameter	Physical-Chemical
Vitamin C (mg/100g)	8,73±0,38
IC_{50} (µg/mL)	43,1±2,41
pH	5,21±0,15
Color intensity	0,3903±0,03
Total Dissolved Solids	23,73±0,51

The best treatment is in the treatment of 0.9% concentration and 50kV PEF voltage. This is because in accordance with the desired expectations that high nutritional content and can be maintained in dragon fruit juice. Furthermore, based on the panelist acceptance value overall the treatment concentration was 0.9% and the PEF 50kV voltage had a score of 4.32 ± 0.53 meaning that the panelists liked dragon fruit juice products.

IV. Conclusions and Recommendations

A. *Conclusion*

The addition of CMC when viewed from the quality value, the CMC discovery has a significant effect on the value of color intensity, total dissolved solids, vitamin C, antioxidants and pH in dragon fruit juice. The higher the concentration added to the juice, the higher the total value of dissolved solids, vitamin C, and antioxidants. The higher the CMC pH value because the lower the pH value so that from the base fruit pH becomes neutral. The use of PEF pasteurization with a pulsed electric pulse on dragon fruit juice, the application of PEF showed no significant effect on the quality value of red dragon fruit juice. The combination of CMC and PEF in general can maintain the quality of red dragon fruit juice. CMC juice extracts 0.9% and PEEF 50 kV are the products that panelists prefer. Quality hedonic for dragon fruit essence, aroma, and taste attribute are attributes that need to be improved in accordance with SNI standard for fruit juice.
Suggestion

B. *Recommendations*

Based on the research results, suggestions for future research to obtain optimal concentrations and optimal stresses of PEF should be done by making juice using RSM.

Beni Patu Londong, Widya Rukmi Putri, and Elok Zubaidah, "Application of the Pulsed Electric Field Method in the Fruit Dragon Red (*Hylocereus polyrhuzus*) with the Study of Electric Voltage and Addition of CMC," *International Research Journal of Advanced Engineering and Science*, Volume 5, Issue 3, pp. 104-110, 2020.

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