

Stabilitation of Strawberry Puree During Processing

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Abstract

During processing of strawberry products like puree were often found of problems such as loss of changed of red colour anthocyanin, formation of brown pigment and loss of vitamin C. The purpose of this research is to determine the best of precise ascorbic acid and sodium acid pyrophosphate (SAPP) concentrations to produced strawberry puree with a good quality. The research was employed by two factors. The first factor is ascorbic acid concentrations, consist of three levels: ascorbic acid 0,5%, 0,75% and 1,0%. The second factors is sodium acid pyrophosphate (SAPP) concentrations, consist of three levels: SAPP 0,04%, 0,07% and 0,1%. The research was designed by factorial randomized block design with two replications. The data were analyzed by variance analyzed when the treatments result gave significantly effect ($P < 0.05$), then continue to least significant different test (LSD). To decided the best treatment, using of indexes efektifitas method. The result of this research showed that the treatment combination of ascorbic acid and SAPP gave significantly effect on anthocyanin content and red colour intensity (a^* value), but gave no significantly effect of total ascorbic acid, total soluble solid (TSS), pH and degree of lightness (L^* value) of strawberry puree. Treatment of ascorbic acid 0,75% gave significantly effect on total soluble solid. The best of strawberry puree was produced by treatment of ascorbic acid 0,75% and SAPP 0,07%.

Keyword: Anthocyanin stability; processing; strawberry puree; quality

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1. Introduction

Strawberries (*Fragaria vesca*) is the fourth most important commodity in the world after the oranges, peaches, and apples, because in addition to being highly nutritious food producers are also useful as raw material for various food industry and beverages [1]. In global potential areas including strawberry producer and Lembang Cianjur (West Java) Batu (Malang), Tretes (East Java), Bedugul (Bali) and Tanah Karo (North Sumatra) [1]. In addition to eating fresh strawberry fruit can also be made jam, jelly, juice and puree and can also be used as a mixture of ice cream, milk or pudding, natural dyes [2] and to health as antioxydants [3].

Strawberry fruit texture is soft and has a very high respiration activity, so quickly overripe and decaying (high perishable food). This becomes the main problems in the utilization of strawberry fruit as raw material for industry continuously. One effort that can be done is by making into refined products. Strawberry processed products which has not been developed in Indonesia today is "pasta strawberry". Advantages puree shapes are more durable, and a smaller volume, so as to facilitate packaging and transport.

The main problems are often found during processing and storage of processed products such as strawberry puree is the loss or changed red colour of anthocyanin, brown formation and loss of vitamin C (ascorbic acid). Strawberry puree color changes are caused by the presence of dissolved oxygen in

materials, metal ions and high levels of water.

Ascorbic acid is synergistic antioxidant which serves as a binder oxygen (oxygen scavenger) [4]. Ascorbic acid reacts with oxygen to form dehydroascorbic acid, thereby reducing the supply of oxygen to the reaction autooxydacy [5]. Sodium acid pyrophosphate (SAPP) acts as a chelating agent that will bind free metal ions such as Cu²⁺ and Fe³⁺ on the material so that the reaction of formation of the metal complex compound-anthocyanin which can cause discoloration can be inhibited [6]. SAPP compounds will bind metals (prooxydant) and form complexes with metal compounds stable [4].

The attractive colors and stable is an important aspect of the quality of the product strawberry, so it is necessary to research conducted on the addition of ascorbic acid and SAPP in the making of strawberry puree, so it can produce strawberry puree with a good quality and have good color stability during processing.

2. Material and Methods

Material

The raw material used is optimally ripe strawberry fruit of local variety obtained from farmers in Malang Selecta. The chemicals used are: ascorbic acid (technical), SAPP (technical), 2,6 dichloro indofenol, HPO₃, ethanol 90%.

Research Methods

This study consisted of two factors, The First factor (I) is Ascorbic Acid Concentration, which consists of three levels of treatment, namely: (A1) Ascorbic Acid 0.5%; Ascorbic acid 0.75%; and Ascorbic Acid (1.0%). The Second Factor (II) is Sodium Acid Pyrophosphate Concentration (SAPP), which consists of three levels of treatment are: SAPP 0.04%; SAPP SAPP 0.07% and 0.1%. Overall there are 9 units of combined treatment and repeated 2 times. The research used a randomized block design (RAK) factorial with two factors [7]. Besides the above treatment also made a control (no treatment) were used as a comparison. This research aims to determine the concentration of ascorbic acid and sodium acid pyrophosphate (SAPP) the right to produce good-quality strawberry puree and has a red color that is stable during processing. Stages of The Research Conducted:

- Optimal ripe strawberry fruits is washed with clean running water and drained.
- Fruits that are already clean sorted by color, shape and size and the level of damage.
- Blanching is done with steam, at a temperature of 100 ° C for 45 seconds.
- After blanching of strawberries, promptly carried removal stalk and leaf manually
- Meat strawberries weighed as much as 300g / sample
- Meat strawberry fruit added with ascorbic acid and SAPP (according to treatment)
- Then crushed in a blender for 2 minutes and is evaporated by using a vacuum evaporator at 40 ° C for 1 hour
- Strawberry puree that produced packed with aluminum foil and than pasteurized at 70 ° C for 15 minutes. Packaging size 12x12 cm. each sample (product) containing 150 g of strawberry puree.

Research Parameters

Parameters research that observed: anthocyanin concentration, total ascorbic acid, total soluble solids (TSS), pH, the intensity of the red colour (a^* value) and Lightness (L^* value).

Data Analysis

Data were analyzed using analysis of variance, if the results of the analysis showed significant effect ($P < 0.05$), than followed by a further test least significant difference (LSD). To determine the best treatment using of effectiveness index methods [8].

3. Results and Discussion

Anthocyanin Concentration

Anthocyanin concentration in strawberry puree between 23.62 mg/kg to 40.91 mg/kg in Table 1. Variance analysis showed that ascorbic acid, sodium acid pyrophosphate (SAPP) concentration and the interaction gave significantly effect ($P < 0.01$) on anthocyanin concentration of strawberry puree that produced.

On the Table 1 showed that between treatment and the control there is significant differently (T-Test 5%) and the average value of anthocyanin concentration that given by the treatments of Ascorbic acid and sodium Acid Pyrophosphate (SAPP) higger 32.46 mg/kg than control 21.90 mg/kg.

Table 1

Average concentration anthocyanin, red colour intency (a^* value) and lightness degree (L^* value) on strawberry puree in ascorbic acid and sodium acid pyrophosphate (SAPP) concentrations variety.

Ascorbic Acid (%)	SAPP (%)	Anthocyanin Concentration (Mg/kg)	Red Colour Intency (a^* value)	Lightness (L^* value)
0.5	0.04	40.91 a	+ 31.90 a	31.65
	0.07	23.62 d	+ 28.10 c	32.70
	0.10	24.91 cd	+ 30.90 ab	32.20
0.75	0.04	38.65 a	+ 30.25 b	31.55
	0.07	38.44 a	+ 30.80 ab	32.35
	0.10	36.18 ab	+ 28.65 c	32.90
1.0	0.04	30.44 bc	+ 30.40 b	32.70
	0.07	35.33 ab	+ 30.25 b	32.60
	0.10	23.62 d	+ 28.70 c	33.55
LSD 5%		6.59	1.34	-
Treatments		32.46 a	+ 29.99 a	32.46
Controls		21.90 b	+ 22.00 b	29.40

Description: The different letters behind the number showed that significantly different ($P < 0.05$).

The highest of average anthocyanin concentration of strawberry puree 40.91 mg/kg produced by 0.5% ascorbic acid and 0.04% SAPP but not significant differently (LSD 5%) with 0.75% ascorbic acid and 0.07% SAPP concentration namely 38.44 mg/kg. otherwise, the lowest anthocyanin concentration were produced by 0.5% ascorbic acid and 0.07% SAPP concentration and 1.0% ascorbic acid and 0.1% SAPP concentration as well.

This is showed that adding of ascorbic acid with level concentration 0.5% to 0.75% and 0.04% to 0.07% SAPP can increased of anthocyanin stability during processing. The addition of ascorbic acid 0.5 to 0.75% can chelated the dissolved oxygens of strawberry puree therefore the oxydation reaction in anthocyanin will be retarded so that the anthocyanin concentration in strawberry puree can be maintained. Ascorbic acid will reaction with oxygen to form dehydroascorbat acid, so decreased oxygen available for autooxydation reaction [5].

The adding of sodium acid pyrophosphate (SAPP) with concentration 0.04 to 0.07% probably can chelated the metal ions that contain in strawberry puree, so that the reaction of anthocyanin oxidation that catalysis by metal ions can be retarded. Phosphate compounds will chelate the metal (prooxydant) and to form complexes compound with metal that stabil [9].

Red Colour Intensity (a* value)

In Table 1 can see that the red colour intensity (a* value) of strawberry puree that gave treatments of ascorbic acid and sodium acid pyrophosphate (SAPP) has significant different (T-Test 5%) with the control (no- treatment). The average value of red colour intensity (a* value) in strawberry puree that given of treatments has higger result +29.99 than control +20.00 (the puree colour of red to brown).

The adding of ascorbic acid 0.5% and SAPP 0.04% produced of strawberry puree with the highest of red colour intensity a* value +31.90 but not significantly different (LSD 5%) with the treatment of ascorbic acid 0.75% and SAPP 0.07% namely a* value +30.80. Ascorbic acid has antioxydant character and can ability to prevent the oxydation reaction that caused of forming brown colour [10]. The addition of sodium acid pyrophosphate (SAPP) during processing can maintain the stability of the product colour that produced [4].

Intensity of Lightness (L* value)

The average value of lightness degree (L* value) of strawberry puree around 31.55 to 33.55 (Table 1). The analisis variance showed that the treatment of ascorbic acid and SAPP and their interactions not gave significantly (P<0.05) effect of lightness degree of strawberry puree. There is significantly different between of the strawberry puree that given of treatment than without treatment (Control). The average value of lightness (L* value) of the strawberry puree by treatment is higher 32.46 than control 20.40 (Table 1).

During processing there is oxydation of anthocyanin pigment that caused by dissolved oxygen and metal ion therefore make the complex coumpoun with red to brown colour. Oxygen can increase the degradation of anthocyanin [9]. The changed of anthocyanin colour is caused by complex reaction between anthocyanin and metal ion [6].

Generally, the treatment of ascorbic acid and sodium acid pyrophospahte (SAPP) concentration can maintain the degree of lightness (L* value) of strawberry puree. The stability of anthocyanin colour can increased by losing of oxygen and metal ion [11].

Total of Ascorbic Acid

Base on Table 2, can see that the total of ascorbic acid on strawberry puree that given of treatment significantly different (T-Test 5%) with the control. The average total of ascorbic acid strawberry puree control (no-treatment) lowest 20.52 mg/100 g comparing than given of treatment namely 75.49 mg/100g. this is caused that ascorbic acid to be destroyed during processing therefore the amount of

ascorbic acid on strawberry puree tend to decreased. ascorbic acid has dissolved character in the water and faster destroyed by warm, light and oxydation. Otherwise, during processing of food will be lose of ascorbic acid 10 to 50% [12].

pH

The average value of pH strawberry puree that given treatment by ascorbic acid and sodium acid pyrophosphate (SAPP) concentration around 3.08 to 3.17. There is tendency that higher of adding ascorbic acid concentration on strawberry puree so the pH of strawberry puree will decrease but base on the significantly different test (LSD 5%) showed that, between treatment of ascorbic acid and SAPP concentration not gave significantly different on pH of strawberry puree. This case probably caused that ascorbic acid is weak acid and SAPP is salt that formed of weak acid, therefore hydrogen ion (H+) that produced is a little, so the pH of strawberry puree not effected by the treatments. The anthocyanin has maximal stability on acid condition (pH 1 to 3.1) [13]. The stability of colour anthocyanin pigment will decrease if the pH increasing (pH>3.1) and get minimum on pH 6 [14].

Table 2

Average ascorbic acid total and ph of strawberry puree on ascorbic acid and SAPP concentration

Ascorbic Acid	SAPP	Ascorbic Acid Total	pH
0.5	0.04	74.29	3.16
	0.07	74.56	3.17
	0.10	74.32	3.14
0.75	0.04	75.38	3.13
	0.07	76.20	3.11
	0.10	75.63	3.16
1.0	0.04	76.09	3.13
	0.07	76.81	3.08
	0.10	76.10	3.11
LSD 5%		-	-
Treatments		75.49 a	3.13 a
Controls		20.52 b	3.48 b

Description: The different letters behind the number showed that significantly different (P<0.05)

Total Soluble Solid (TSS)

The average value of total soluble solid (TSS) strawberry puree that given by treatment of ascorbic acid between 14.02% to 14.22% (see Table 3). Treatment of ascorbic acid gave significant effect of total soluble solid strawberry puree but the sodium acid pyrophosphate (SAPP) treatment not gave significant effects. In Table 3, can see that the higher total soluble solid (TSS) 14.22% produced by treatment of ascorbic acid concentration 1.0%, otherwise the lowest of total soluble solid 14.02% produced by ascorbic acid concentration 0.5%.

Base on least significantly different test (LSD 5%), that the treatment of ascorbic acid concentration 1.0% not significant different with the treatment of 0.75% ascorbic acid concentration but both have significant different with the treatment of 0.5% ascorbic acid concentration. The average value of total soluble solid with the treatment higher 14.15% than the control (no-treatment) 13.60%. the higer added of ascorbic acid concentration, the total soluble solid in strawberry puree tend to increase. This is caused

by ascorbic acid is soluble solid part so adding of ascorbic acid in strawberry puree can increase the total soluble solid of strawberry puree. Ascorbic acid is organic acid that is very easy to dissolve in water [15].

Table 3
Average of total soluble solid (TSS) of strawberry puree on ascorbic acid concentration

Ascorbic Acid (%)	Total Soluble Solid (TSS) %
0.5	14.02 b
0.75	14.20 a
1.0	14.22 a
LSD 5%	0.14
Treatments	14.15 a
Controls	13.60 b

Description: The different letters behind the number showed that significantly different (P<0.05).

Determination of The Best Treatment

In Table 4, showed the analysis of the best treatments determination that the highest total of product value (NP) 1.47 given by treatment of ascorbic acid 1.0% and sodium acid pyrophosphate (SAPP) 0.07% concentration, otherwise the lowest of total product value (NP) 0.31 given by treatment of ascorbic acid 0.5% and SAPP 0.07%.

Base on the least different significant test (LSD 5%), that the product value (NP) 1.47 of ascorbic acid concentration 1.0% and SAPP 0.07% not significant different with the treatment of ascorbic acid 0.75% and SAPP 0.07% product value (NP) 1.41 if comparing with parameters of anthocyanin concentration, red colour intensity (a* value), and total soluble solid (TSS). The highest of anthocyanin concentration and red colour intensity (a* value) produced by treatment of ascorbic acid 0.5% and SAPP 0.04% but not significant different with the treatment of ascorbic acid 0.75% and SAPP 0.07 % concentration.

Table 4
The value of analysis determination of the best treatments

Ascorbic Acid (%)	SAPP (%)	Product Value Total (NP)
0.5	0.04	0.87
	0.07	0.31
	0.10	0.69
0.75	0.04	0.85
	0.07	1.41
	0.10	1.00
1.0	0.04	1.14
	0.07	1.47
	0.10	1.15

Description: The different letters behind the number showed that significantly different (P<0.05)

4. Conclusion

Base on the economic and the quality reasons that the product of strawberry puree that produced with treatment of ascorbic acid 0.75% and sodium acid pyrophosphate (SAPP) 0.07% concentration not different with the treatment of ascorbic acid 1.0% and SAPP 0.07%, therefore, the best treatment on this research is ascorbic acid 0.75% and SAPP 0.07% concentration.

The strawberry puree characteristics that produced by treatment of ascorbic acid 0.75% and sodium acid pyrophosphate (SAPP) 0.07% concentration are anthocyanin concentration 38.44 mg/kg, red colour intensity (a^* value) +30.80, Lightness degree (L^* value) 32.35, ascorbic acid total 76.20 mg/100 g, total soluble solid (TSS) 14.25% and pH 3.1.

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