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Effectiveness of Electrolyte Solution on Changes in Apple Fruit Quality

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Abstract: The process of discoloration is an indications of damage in food. In this case, apples are one of the commodities that often experience this events. The cause of the discoloration is the polyphenol oxidase (PPO) enzymes. One possible prevention that can be used to inhibit the discoloration events is by administering ascorbic acid, iodine, and glucose compounds. The purpose of this study was to analyze the color changes in apples after being treated with ascorbic acid, iodine, and glucose. Colour change testing was carried out using immersion in the three solutions. The results obtained from this study was that the treatment of the three solutions for 6 hours, 12 hours, 24 hours, 36 hours, and 48 hours was capable to inhibit the discoloration of the cut apples. Increasing the concentration of ascorbic acid, iodine, and glucose solutions causes an increase in the ability to inhibit the browning reaction. In addition to the concentration factors of the three solutions, soaking time also affects the quantity of color change inhibition.

1. Introduction

Fruits on generally own period save Which short because it is easily damaged (perishable). Especially on fresh-cut fruit, reactions to browning enzymatic occur quicklyt, changing the appearance, texture, and taste of cut fruit. One of the fruit that easily brownsis Apple. Fruits originate from area subtropical Areas the only one is the fruit Apple. Fruit Apple (*Shame sylvestris mill*) is one of the fruits which the Indonesian people like. Fruit Apple Lots cultivated in Poor, East Java.

Apple is known t o containsome vitamins and minerals Which are beneficial for man. One item Apple 5-7 cm in diameter contains vitamins A 900 IU/100 g, *thiamine* 7 mg, *riboflavin* 3*mg, niacin 2 mg, vitamin C 5 mg,* p*rotein* 3 g, energy 58 calories, fat 4 g, *carbohydrates* 14.9 g, *calcium* 6 mg, *iron* 3 mg, *phosphorus* 10 mg, and *potassium* 130 mg. Besides That, fruit Apple rich will contain fibre, *phenol*, And *phytochemicals*. Content chemistry Apple per 100 grams Fruit Composition Content Rate Water (g) 84.05 Vitamin C (mg) 7.34 Content Sour (g) 0.22 pH Fluid Fruit 4.65 *Fructose* (mg) 45.00 *Glucose* (mg) 37.20 *Sucrose* (mg) 45.40.

Fresh cut fruit (*fresh cut fruit*) more No stand long compared to fresh fruit. Various treatments which experience fruit cut fresh like stripping, cutting, and the incision canbother the integrity of the

network and cellshe has. As a result increased *ethylene production*, increased rate of respiration, *degradation of membranes*, lost water, And damage consequence microorganisms. Impact more carry on is happening change enzymatic and reduced shelf life and quality. Meat fruit experience browning with existing process oxidation in a way enzymatic by compound *phenolic polymer*colour chocolate when stored.change colour of fruit Apple influenced by the reaction between oxygen in the air and the *enzyme polyphenol oxidase* (PPO) Which There is in fruit Apple.

When an apple is sliced or bitten, it releases oxygen will about part Which sliced or bitten. When there is oxygen in cells, The PPO enzyme will oxidize the compound phenol in apple tissue. Oxidation is the merger of something substance with oxygen. In the process of oxidation of compound phenol, happen reaction chemistry Which produces substance colour (pigment) melanin. Melanin is a pigment colour dark, this is it why results fromthe reaction of oxidation of fruit apple that makes the colour of the meat fruit Apple changed So browning. Processchange in colour fruit Apple become tanned This is also called *enzymatic browning* (Ashari, 2021). Enzyme PPO No is only contained in the fruit Apple just,

Browning (browning) is a colour change in food substances bright colours become colourful dark (chocolate), especially on fruit- fruit (such as bananas, snakefruit, apples, etc) and on substances Which heated (like sugar). Process *browning* (browning) There are two kinds of, namely: *browning* enzymatic and *browning* Because factor environment. Browningenzymatic happens on fruits Which Lots contain *phenolic substrate*. *Phenolic* compounds with ortho-dihydroxy or trihydroxy types each other close by is substrate Which Good For process browning.

Process browning enzymaticrequires the presence of *the enzyme phenol oxidase* and oxygen Which must relatetosubstrate the. Enzymes Which can catalyze oxidation in the process of browning are known by various names, that as *phenol oxidase, polyphenols oxidase, phenolase or polyphenols* each works in a way Specific to substrate certain.

It happened reaction browning estimated to involve a change fromquinol forms into a quinone. Damage mechanical on fruit cut fresh for example consequence cutting can activate enzyme polyphenols oxidase Which furthermore forms compound melanin which causes the brown color on fruit or vegetables. Among all the factors of the declining quality of fruit cut, browning enzymatic Which is caused by oxidation of phenolic compoundsis a problem big. Deterrent reaction browning shouldselect *anti-browning that* has powergood gas retainers, such as *sucrose, sour ascorbate* and *iodine*.

Colour chocolate This although not dangerous still just reduces the quality product Because consumers do not like it. Anti-browning requires its Power retainer gas Which is good Because in reaction browning is enzymatic Also involves oxygen as a supporting substrate (*co-substrate*). The more A little oxygen Which available in network fruit so reaction browning can minimized.

An electrolyte is something substance Which when dissolved in water will produce a solution Which can deliver current electricity for example solution of sucrose, salt and ascorbic acid(Sutresna, 2016).

Sucrose including *disaccharide* inside consists of components *D-glucose* and *D-fructose*. Formula molecule sucrose is $C_{22}H_{22}O_{11}$. Sugar with heavy molecules 342 g/mol can form crystals free of water with specific gravity I .6 g/ml and a melting point 160°C. High sugar levels (40%-50%) when added to the material food cause water in material food to become bound so that reducing the value of water activity and not being used by microbes immersion on sugar results in the rate sugar in fruit increase And rate water reduction. Circumstances This canhinder the growth of microbesdestroyer (Hasna,

2020).

Salt iodized is the salt kitchen which contains component main. NaCl 94.7%, Water maximum 5% And Potassium Iodate (KIO_3) 30–80ppm.Salt can lower the pH on the surface of fruit apples Which catches the oxygen and can deactivateenzymes that cause browning (Nur, et al., 2016).

Medium-sized lemon only provides around 20 calories. Nutrients in ½ cup or about 100 grams of peeled raw lemon calories contain about 29 calories, water 89%, proteins 1.1 grams, carbohydrates 9.3 grams, sugar 2.5 grams, fibre: 2.8 grams, fat0.3 grams, and various vitamins, like vitamin A, vitamin B6, And vitamin C (Fadli, 2022).

Vitamin C or sour ascorbate issomething compound atom carbon 6 Whichcan late in water. Name chemistry fromsour ascorbate (2R)-2-[(1S)-1,2-*dihydroxy ethyl*]-3,4- *dihydroxy* -2H- *furan* - 5-one *pubchem*. The form main from sourascorbate are *L- ascorbic* And*dehydroascorbic AC ID*. For example, fruitlemons contain very little fatAnd proteins. They especially consist of carbohydrates as much as 10% And water is 88 % -89%. As anti-browning, sour ascorbate has two roles that is as a material marinade (*acidulant*) And as an antioxidant.As an *acidulant*, sour ascorbate causes a decrease in value pH. Matter This causes the enzyme PPO to become inactive (McEvily, 1992). As an antioxidant, sour ascorbate will bond with oxygen from air thereby preventing enzyme oxidation polyphenols oxidase. Matter This can hinder the formation of compound melanin-colored chocolate (Lindley, 1998).

On moment solution sucrose, acid ascorbate, and iodine given to Apple so that material food become stand long For saved And No fast damaged. Therefore this research aims to know the influence of solution sucrose, sour solutions, and solution iodine on the quality physique that is coloured fruit Apples.

Formulation problem study This is b how reaction oxidation happens in fruit apples. Is a solution of lemon, salt and sugar effective in changing the quality of fruit apples? So from the study, expect can know the reaction oxidation Which happens on apples and know solution Which best-administered l solutionlemons, salt, and sugar effective solution to quality change fruit Apple.

2. Research Methodology

The method study used is quantitative that is method theory scientific truth that has been accepted and used as a reference in searching for the truthfurthermore. (Hidayat; 2012)

Jujun S. Suriasumantri in his bookKnowledge in (Ashari, 2021) Perspective Moral, Social, And Political (2000: 6)stated that the methodof Scientific knowledge is a way of acquiring knowledge And compiling body his knowledge based on:

a. Framework thinking Which naturelogical with argumentation Which nature is consistent with previous knowledge that has been successfully arranged;
b. Explain hypothesis Which is a deduction from framework thinking;
c. Do verification to hypothesis intended For testtruth his statement in a wayfactual. Using method experiment.

According to Hadi (1985) study experiment is a study carried out to determine the consequences caused by something treatment given in a way on purpose by the researcher. In line with matter the, Latipun (2002) suggests that a research experiment is a study done by manipulationwhich aims to find out the consequences of manipulation on behaviour individuals observe. Experimental research in principle can defined as amethod systematic to build a

connection Which contains the phenomenonof cause and effect (*causal-effect relationship*) (Sukardi 2011:179). So can concluded that the method experiment is something test done to know the consequence of some treatment.

Hypothesis

a. H1: There is happen reactionto oxidation on the fruit apple.
   H0: No oxidation reaction occurs on fruit Apple.
b. H1: Third solution the effective in changing the quality of apple
   H0: The three solutions are not effective in changing the quality of apples.

Variable Study

The variable study is something attribute or nature or mark from a person, object, organization, or activity Which have variation certain Which determined by researchers to be studied And Then withdrawn the conclusion (Sugiyono, 2016:68). Variable in study This consists of variable independent (independent variable) and variabledependent (variable bound).

1. Variable Free
   Variable free is is variable Which becomes because of the change or emergencedependent (dependent) variable. Variable free Which used in This research is a sucrose solution, iodine, And sour ascorbate.
2. Variable Bound
   The dependent variable is the variable that influences or which becomes a consequence, because of the existence of the independent variable.In the study, This Which becomes the dependent variable is anti-browning on Apple
3. Variable Control
   Variable control is variables Which can do study Which nature compare. In the study, this which becomes variable control is the fruit Apple.

Technique CollectionData

Technique Which will used in the study This is observation and documentation. Technique observationis observation direct which is done by the researcher on an object study. In this research, observations were made by giving a solution of sucrose, iodine, and ascorbic acid to cut fruit apples which taking place to know is the solution that can prevent browning after given influence third solution.

Technique documentation according to Riduwan (2013: 77) states that "Documentation addressed for obtaining data direct from place study, covers book Whichrelevant, regulations, reportactivity, taking pictures, film documentary,data Which relevant". Arikunto (2013:274) opinion that "documentationused to search for data regarding things or variables Which in the form of, notes, transcripts, books, letter news, magazines, inscriptions, meeting minutes, agendas, etc". Can concluded that there exists a Techniquetaking data with documentationthis is for take-proof activity research in the form of photographs as agenda activity which is done by the researcher.

Table 1. Tools and Materials and way making

Tool	Material
Knife : 1 fruit	Apple
Cutting board : 1 fruit	Lemons
Spoon : 3 fruit	Salt
Plate Plastic : 4 fruit	Sugar
Glass Plastic : 3 fruit	
Scales : 1 fruit	
Pipette : 1 fruit	

Table 2. Manufacturing method

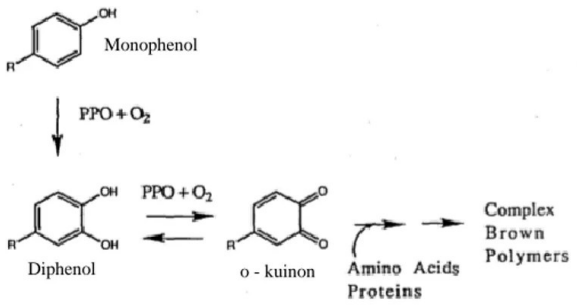
1) Prepare material For make third solution. Put sugar And salt enough in plate plastic.
2) Weigh moreover formerly salt and sugar. After weighing the same about 1 gram, pour salt And sugar Which Already weighedto plate plastic
3) Cut the lemon into two halvesThen lemons Which Already squeezed entered to in plate plastic.
4) Prepare 3 glass plastic Which Already given Name Forknow Name from third solution the.
5) So input salt, sugar, andlemons into the 3 glass plastic Which Already given Name earlier.
6) Prepare glass water Then input
   4 spoon Eat water to 3 glasswhich already contains salt, sugar, etc lemons
7) Stir all solution with spoon Which different different.
8) Prepare fruit Apple Which Already washed clean
9) Cut fruit Apple become 4 parts weighing 35 grams per he interrupted
10) Move it 4 fruit Apple Which Already weighed to plate plastic.
11) Prepare a plastic plategiven Name to 3 solution And plate without solution.
12) Soak 3 fruit cut Apple into the 3 solution Then shut uparound 5 minute
13) After 5 minute soaked and removed3 then cut the apple put on each each plate plastic which has been named 3 solution the
14) So We observation to 4 fruit cut apples around 6 hours, 12 hours,24 O'clock, 36 O'clock , 48 O'clock.

Analysis Data

Sugiyono (2012:148) states that statistics descriptive is statistics used to analyze data with methods describing data which has been collected asexisting without mean makeaconclusion Which applies to general. So based on data study Which obtained analysis data done with method describe or explainresults from the study.

4. Result And Discussion

Browning enzymatic happens Because there is a reaction between the catechol substrate and enzyme PPO on the extract Apple, forming the compound quinone which furthermore forms Picture number 1 explains the brown complex compound calledmelanin. Following is a formation reaction of melanin compounds with catechol substratescontaining diphenol groups in apples such as seen in reaction 1.



Figures 1. Stages reaction on process Browning (McEvilly, 1992)

On an apple Which No uses solution by having an initial weight of 70 and after the experimental weight becomes 21 grams, figure after the experiment the apple turned brown because the moment apples sliced or bitten, oxygen will reach the cut part bitten That, friends. The moment There is oxygen in the cell, enzyme PPO will oxidize compound phenol which is in network Apple. Oxidation is the merger of something substance with oxygen. In the process of compound oxidation phenol, happen reaction chemistry Which produces substance colour (pigment) melanin. Melanin is a pigment colour dark, this is it Why results from reaction oxidation in the apple colour meat fruit Apple changed So tanned.

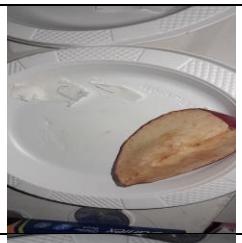
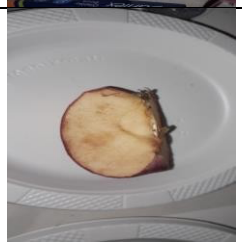
Picture number 2 explains about Apple which is soaked in use solution of lemons with heavy before trial 70 grams and after trial 22 grams, picture after test Apple the colour rather young compared 3 other pictures and also weighs more compared to the other 3 experiments. Due to Lemon containing ascorbic acid. As anti-browning, sour ascorbate has two roles that are as a material marinade (*acidulant*) and as an antioxidant. As an acidulant, sour ascorbate causeshappen decline mark pH. Matter This causes the enzyme PPO to become inactive (McEvily, 1992). As an antioxidant, sourascorbate will bind with oxygen from air-free so prevent oxidation enzyme polyphenols oxidase. Matter This can hinder the formation of compound melanin-colored chocolate (Lindley, 1998).

No	Picture AppleBefore Test	Picture Apple After Test
1		
2		
3		

Figure 2. Experiment on Apples

Figure 3. Fruit Apple after test

Table 3. Observation Results

Name Solution	Time Experiment During 6 O'clock	Time Experiment During 12 O'clock	Time Experiment During 24 O'clock	Time Experiment During 36 O'clock	Time Experiment During 48 O'clock
Solution Lemons					
Solution Salt					
Solution Sugar					
Without Solution					

The picture on number 3 explains apples that have been soaked in the solution salt, picture after test Apple becomes brown and weighs 21 grams. Immersion fruit apple's use of saltkitchen can be an alternative to hinder browning on fruit Apple Because salt can lower the pH of surface fruit Apple Which catches oxygen so that it can inactivate the causative enzymebrowning (Nur, et al., 2016). Although no more effective compared to piecefruit Apple which is soaked in solution lemons.

Picture number 4 explains about apples that have been soaked in the solution sugar with an initial weight of 70 grams and after the test heavy 21 grams, picture after testing the colour also changed turned brown due to soaking sugar in the fruit increase And the rate of water reduce. Circumstances This can hinder *browning* (Hasna, 2020).

From fourth solution used to prevent *browning* more solution effectively is solution lemons Because lemons contain sour ascorbate which causes it to happen decrease in the pH of apples.

5. Conclusion

Based on the results experiment obtainedreaction oxidation on the apple *browning* because exists

a reaction between substrate catechol with enzyme PPO on the extract apples, forming the compound quinoneWhich furthermore forms a compound-complex coloured chocolate called melanin. Whereas solution which most effective For preventing *browning* on apples is the solution of lemons.

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