Effect of Application Propolis as Biocoating on the Physical and Chemical Properties of Tomatoes Stored at Room Temperature

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Abstract. Tomatoes is considered as one of important horticulture commodities which highly consume by Indonesia consumer. However, this horticulture product is perishable with high rate which reduce quantity and quality of marketable products. One of the method could be used to prevent this problem by application of edible biocoating. In this study, various concentration of ethanolic propolis extract was applied to tomatoes in order to find the effect of propolis coating in tomato preservation and best concentration for application. Tomatoes were grouped into 5 group, namely control group (no coating application), ethanol group (tomato wash with ethanol), and application group (coated with 5%, 10%, and 15% propolis). Variables observed during study were weight change, fruit firmness, total soluble solute, vitamin C, and lycopene. All tomatoes were kept in room temperature for 14 days and observation conducted every 2 days. Result showed that application of 10% propolis as biocoating reduced rate of weight loss and maintained fruit firmness while other variables relatively unaffected by propolis coating.

1. Introduction

Tomato is one of major horticulture commodity in West Java with significant production level and economic value [1]. However, due to their soft skin and their characteristic as climateric fruit, quality of tomatoes rapidly deteriorated which produces weight depreciation, mold development, and loss of attractiveness hence decreasing the economic value [2]. This loss could be prevented through low temperature storage. Unfortunately, not all area in Indonesia has continuous energy supply to enpowered provide power to low temperature storage facilities. Thus it is necessary to develop another preservative strategy which free from continuous need of energy, such as biocoating.

Biocoating is a thin layer that can be consumed and is serving as protection against humidity, oxygen, and solute transition in fruits [3]. Since biocoating mean to be consumed along with fruit, it is necessary to apply natural materials which safe, such as propolis. Propolis is a sticky gummy resinous substance collected by *Trigona* sp., in tropical regions, from the young shoots and buds of certain trees and shrubs. This substance known for having strong anti-bacterial, anti-fungal and anti-viral properties and has been used on various agricultural product for post-harvest protection. Even though it is proven that it can protect some horticulture products, the application of as post-harvest protection in Indonesia is rarely found.

The purpose of this reasearch is to observe effect of application of biocoating made of propolis with concentrations 5%, 10%, and 15% on the physical and chemical properties of tomato fruits in room temperature condition. Changes on physical parameter (weight depreciation and fruit firmness) and chemical (total soluble solid, vitamin C, and lycopene) were recorded every two days for 14 days.

2. Methods

2.1 Tomatoes
Cultivar of tomato used in this study was Warani. All tomatoes were supply by local farm in Ciwidey, West Java which harvested in same day and have same standard based on supplier standard for one day old tomatoes.

2.2 Propolis Extraction
Propolis was originated from local *Trigona* sp. farm in North Bandung. Raw propolis was extracted by ethanolic extraction to obtain highest amount of phenolic compound [4]. Propolis extract then diluted with propylen glycol to obtain 5%, 10%, and 15% solution. Unlike ethanol, propylen glycol disolved beeswax inside the propolis and produced gummy oily solution [5] which easier to be apply as coating material.

2.3 Coating Mechanism
In this study, 90 tomatoes were used as sample. Tomatoes were divided into 5 groups of application. One group was dedicated as control which did not receive any treatment, one group as control positive in which tomatoes was dipped into 70% ethanol, others were treatment group in which tomatoes were dipped into 5%, 10%, and 15% solution respectively.
All tomatoes were kept for 15 days in room temperature (25-27^{o}C) with relative humidity between 75-85%.

2.4 Measurement of Physical and Chemical Properties
Physical and chemical properties were measured every 2 days and variabels measured were weight, fruit firmness, total soluble solid, glucose content, vitamin C, and lycopene.

2.4.1 Physical Properties. Weight of tomatoes measured by digital weight balance while fruit firmness measured by fruit firmness tester.

2.4.2 Chemical Properties
2.4.2.1 Total Soluble Solid and Sucrose Content. Total soluble solid was measured by refraktrometer (Atago) based on Abbe principle and determined by degree brix (^{o}B) [6].

2.4.2.2 Vitamin C Content. Vitamin C content was measured by iodometric titration method [7]. In this method, 10 g sample were collected from each tomato. Sample was grinded and mixed with 30 mL aquadest then filtered with Whatmann paper No. 1. 2 mL of 1% amylum add to solution. Resulted solution then titrated with iodine 0.01 N until the colour of solution change into dark colour, amount of iodine required for this process was measured to calculate Vitamin C content by formulae

$$\boldsymbol{mg\ Vit.C}/_{\boldsymbol{100\ gram}} = \frac{\boldsymbol{vol.iodin\ (ml)x\ A\ x\ fp}}{\boldsymbol{massa\ \ of\ sampel\ (g)}}$$

Whereas
- A is equivalency of 1 ml iodine 0.01 N equal to 0.88 mg ascorbic acid (Vitamin C)
- Fp is dillution factor

2.4.2.3 Lycopene Content. Lycopene content was measured by method of Sharma and Le Maguer [8].

3. Results and Discussion

3.1 Physical Properties

This study showed application of propolis as biocoating able to prevent significant weight loss of tomato and slightly maintained fruit firmness, two component used to determined fruit quality (Fig. 1).

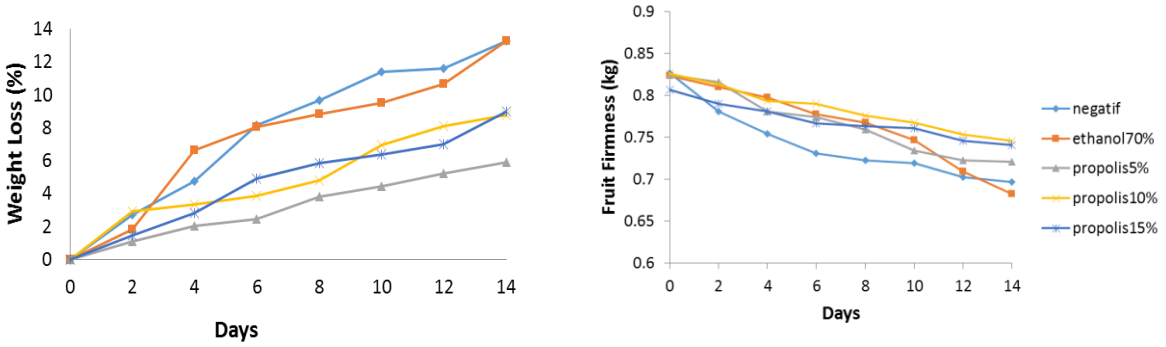

Figure 1. Changes of physical properties of tomato coated with propolis extract.

In general, weight loss of tomatoes coated with propolis were lower than uncoated tomatoes (both control and ethanol application). The lowest weight loss was recorded on tomatoes coated with 15% propolis solution.

Weight loss is main factor determine quality of horticulture products [9]. Most of weight loss caused by water loss from internal tissues. Based on the result, it could be concluded that propolis coat able to prevent water loss through transpiration and respiration [10]. Hydrophobic property of propolis may responsible for prevention of water loss from tomato tissues through transpiration and respiration. Another possibility is propolis coating produced several selective barriers for O_2 and CO_2 which also prevent water loss and maintained fruit weight [11]. This barrier may also reduce pectinase activity through imbalance amount of oxygen and carbondioxide in the fruit tissues [12]. Pectinase is responsible for hydrolisis of pectin and starch, a process that reduce internal cell structure, cell wall composition, and intercelular material which in the end reduce fruit firmness [13][14]. This condition could be found on the tomatoes coated with propolis as the fruit firmness of this group relatively higher than control group (Fig. 1).

3.2 Chemical Properties

This study showed application of propolis as biocoating produced significant higher total soluble solute but not vitamin C and lycopene (Fig. 2).

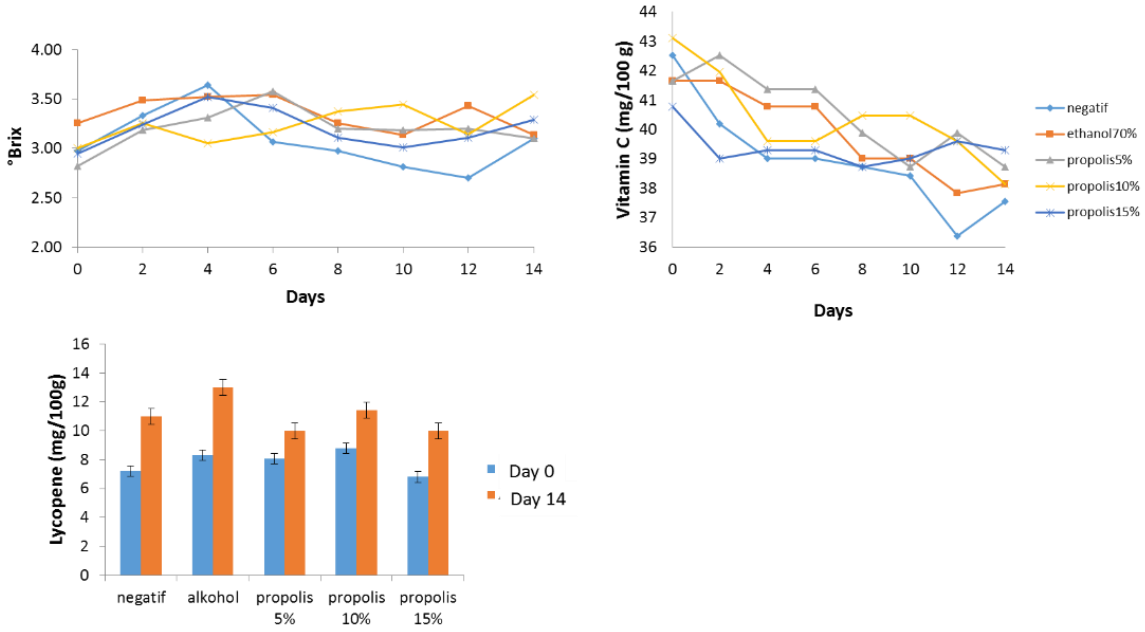

Figure 2. Changes of chemical properties of tomato coated with propolis extract.

Result indicated that all tomatoes coated with propolis had higher total soluble solute than control group (Fig. 2). It seem application of biocoating in tomato reduce respiration rate of fruit which responsible for increasing total soluble solute inside fruit [15].

Interestingly, application of propolis coating did not effected amount of Vitamin C (ascorbic acid) which usually related with TSS [16]. Total vitamin C content of tomatoes of both control and application groups decreased with longer storage period. Eventhough result did not indicated significant different among tomato groups, control group had the lowest vitamin C with highest rate of reduction. Higher amount water and possible imbalance amount oxygen and carbondioxide due to alternation of respiration process may cause fluctuation of Vitamin C content on tomato. Vitamic C is water soluble and could easily oxidate into L-dehydroascorbat [17]. It seem propolis coating reduce respiration rate of tomato thus reduce oxidation reaction of ascorbic acid. Rate of vitamic C reduction also depend on the variety of tomato [18].

On the other hand, lycopene which produces as response to ripening seems not effected by coating at the end of observation. However, differences between early and final lycopene measurement was higher in control and ethanol group (Fig. 2). During ripening process chlorophyll content decreases followed by rapid synthesis of the red pigment lycopene [19]. Different studies have shown that applying various types of coating reduces tomato metabolism, thus increasing shelf life [20][21]. Therefore, application of propolis might slightly reduce metabolism of tomatoes and delaying ripening process.

As conclusion, propolis coating might be used as preservative techniques for tomatoes. However, further studies required to improve effectiveness of propolis as biocoating. In general, 10% propolis is best concentration for application as biocoating.

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