Malays. Appl. Biol. (2020) 49(4): 247–251

EFFECTS OF KAFFIR LIME PEEL EXTRACT AND GINGER EXTRACT ON THE POSTHARVEST QUALITY OF TOMATO

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Accepted 27 November 2020, Published online 25 December 2020

ABSTRACT

Harvested tomatoes are very sensitive to changing environments and rough handling techniques. This practice becomes a major challenge to the sellers either for fresh market or long-distance market to maintain the quality and prolong its shelf life. Fungal disease and mechanical injuries due to improper handling practice will deteriorate the fruits, thus reducing the customer's acceptability and its market value. This study was aimed to provide a low-cost technique by evaluating the potential of aqueous kaffir lime peel extract (KLE) and aqueous ginger extract (GG) in maintaining the quality of tomatoes. For this purpose, healthy tomatoes at stage 5 were dipped in 20% GG, 25% KLE and 50% KLE before incubated at room temperature. The data on postharvest parameters namely weight loss, firmness, total soluble solids (TSS), and lycopene content were recorded at two days intervals. The results show that 25% KLE and 50% KLE recorded a good promising agent to maintain the quality of tomatoes. Also, treatment of tomatoes with 50% KLE can significantly preserve the weight, firmness, TSS, and lycopene content of the fruits. None of the tomatoes treated with 20% GG showed significant results in this study. The output of this study will provide important information on the potential of KLE and GG in prolonging the shelf life of tomatoes.

Key words: Tomatoes, kaffir lime peel extract, ginger extract, post-harvest parameter

INTRODUCTION

Tomato is a very perishable crop and has a shorter shelf life. Improper handling and preservation methods along the supply chain can lead to various fungal infections which reduce the quality of the fruits. In cold conditions, a chilling injury may occur and caused several symptoms such as blemishes, disease infection, inhibition of color development, or ripening. During the ripening process, tomatoes change color, flavor, and texture. Kaur *et al*. (2006) reported that interaction between sugars and acids will determine its sweetness, sourness, and overall flavor intensity in the tomatoes. As it ripens, lycopene content in the tomatoes will increase followed by changes of color which determine the eating quality (Ereifej *et al*., 1997).

Tomatoes can easily ripe and deteriorate faster at room temperatures between 20 to 25°C which leads to mold decay and other post-harvest diseases. According to Tournas and Stack (2001), some molds may produce mycotoxins and are considered unfit for consumption. In current practice, the harvested tomatoes will undergo a cleaning and disinfecting process using synthetic chemical products to avoid any incidence of food-borne illness that can be transmitted to consumers (Arah *et al*., 2016). Several types of chemicals have been used to disinfect the fruit before grading and packaging to reduce the occurrence of postharvest disease. However, the application of these synthetic chemical products has been questioned that may concern the health. The prolonged use of it may cause high toxicity and can cause accumulation in the food chain that might destroy useful microorganisms in it (Satish *et al*., 1999). The application of natural products to replace synthetic chemicals is a need to control the post-harvest disease which considered being environmentally safe for the fresh produces and the environment. Also, they are less expensive and non-toxic to human health. Therefore, this study is to

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evaluate the potential of kaffir lime peel extract (KLE) and ginger extract (GG) as a treatment agent associated with the cleaning process of tomato. This study will provide important information on fungal species usually associated with postharvest losses of tomatoes. Application of these extracts as a treatment agent will help many producers in lowering the cost of the post-harvest process, reduce the marketable loss due to deterioration of tomato quality during handling and storage.

MATERIALS AND METHODS

Preparation of aqueous extract

A total of 500 g of kaffir lime peel and 250 g of ginger were washed thoroughly under tap water, blotted dried, and macerated with 500 mL distilled water in a Waring blender for 15 min. After that, the solution was filtered through a double-layered muslin cloth and stored overnight at room temperature before filtered using a Whatman No. 1 filter paper. Then, the extracts were adjusted to 20% ginger extract (GG), 25% kaffir lime peel extract (KLE), and 50% KLE. All extracts were autoclaved at 121°C and kept until used.

Application of plant extract on tomato

Healthy tomatoes at stage 5 which were free from diseases were washed and air-dried before dipped in the plant extracts mixed with 1% gelling at different concentrations. The dipping process was conducted at room temperature with forced air-drying until a thin film layer was formed. Then, all the fruits were weighed before arranged in a tray and stored at room temperature (27°C ± 2°C) with 70–90% RH. Uncoated fruits were used as controls and stored under the same conditions. At two days interval, the post-harvest parameter such as weight loss, total soluble solids (TSS), firmness, and lycopene content was evaluated.

Determination of weight loss

The weight loss of tomatoes was measured at every two days interval by using a portable weigh balance. Percentage of weight loss was calculated as follow:

$$\text{Percentage of weight loss} = \frac{\text{Initial weight-final weight}}{\text{Initial weight}} \times 100$$

Determination of total soluble solids (TSS)

Total soluble solids (TSS) was measured using a small amount of extracted fruit juice by using a refractometer. The reading of total soluble solids concentration was determined by dropping the tomato fruit pulp solution on the prism of the refractometer.

Determination of firmness

The firmness of the tomato was determined by using a texture analyzer (TA-TX), Texture Technologies Corp, USA. The tomato's firmness was measured by using a texture analyzer equipped with a P2/N needle probe that interfaced with a computer and was expressed in force record in Newton (N). The reading of the tomatoes was taken three times to determine the firmness of each fruit.

Determination of lycopene content

Lycopene from tomato fruits was extracted by weighing 750 mg of tomato sample. Then, it was homogenized in 20 mL of acetone with 1 g of magnesium oxide and grind with a pestle. The extract was transferred into a 50 mL centrifuge tube then the mortar and pestle were rinsed with a further 20 mL of acetone. The extract was centrifuged at 2000 rpm for 5 min. Decant the supernatant into a 50 mL volumetric flask and make up the volume using 100% acetone. The absorption of the tomato extract was determined using a different wavelength with UV Spectrophotometer. The total concentrations of carotenoids were calculated and recorded.

Statistical analysis

The results were analyzed for statistical significance (p=0.05) using two-way ANOVA by SPSS statistical software (SPSS 20.0 for Windows). Tukey's test was used for pairwise comparison of the mean values.

RESULTS AND DISCUSSION

Figure 1 shows the percentage of weight loss in tomatoes dipped in 20% ginger extract (GG), 25% kaffir lime peel extract (KLE), and 50% KLE. The percentages of weight loss in tomatoes were gradually increased as the day of incubation time increased. The weight loss in tomatoes indicated that the fruits were undergoing deterioration and degradation processes which will affect the shelf life of the tomatoes. According to Ahmed *et al*. (2017), the weight loss of tomatoes will be occurred at the senescence stage due to metabolic degradation of the cell wall and low water retention capacity.

On day 8, the highest percentage of weight loss was observed in control fruits which recorded 21.85% of weight loss. Only tomato fruits dipped in 25% and 50% KLE showed significantly lower weight loss as compared to the control. A lower percentage of weight loss in tomato fruits dipped in KLE showed its ability to prolong the shelf life of tomatoes stored at ambient temperature. These results suggested that 25% KLE and 50% KLE had good structural continuity for coating the fruits and

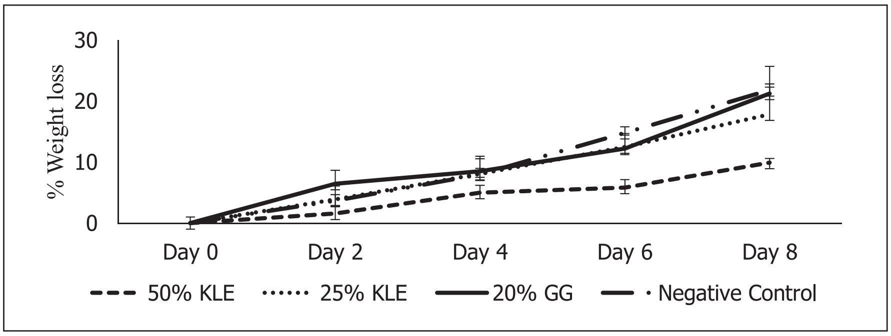

Fig. 1. Percentage of weight loss in tomatoes dipped in ginger (GG) and kaffir lime extract (KLE) during eight days incubation period.

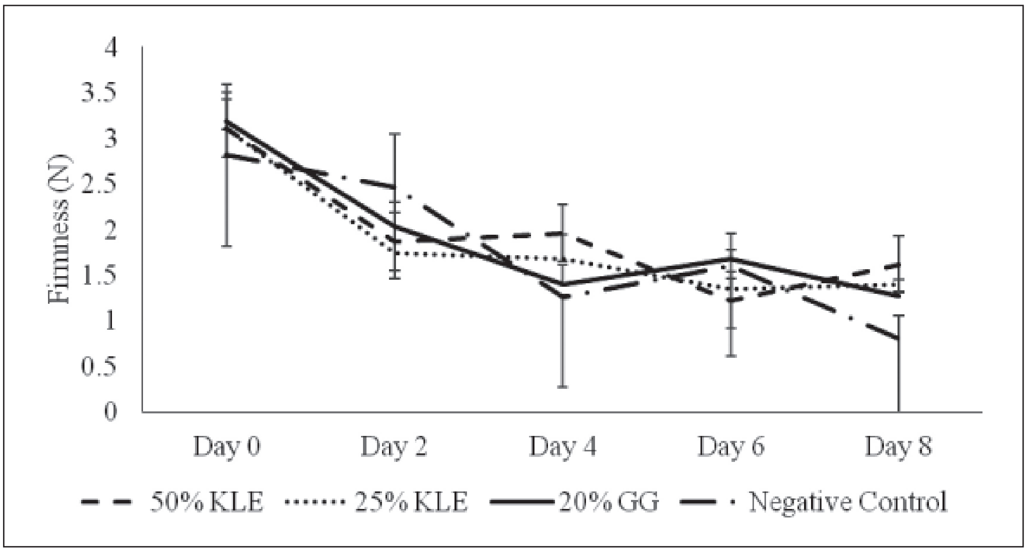

Fig. 2. The firmness of tomatoes dipped in ginger (GG) and kaffir lime extract (KLE) during eight days incubation period.

delays the senescence process. By dipping the tomatoes in KLE, it may enhance the protective barrier within pectin to minimize the moisture loss of the tomatoes. Ullah (2009) also agreed that tomatoes dipped in plant extracts will retard the respiration and transpiration rate which are known to be the major cause of weight loss.

According to Tijskens and Evelo (1994), other important quality attributes for fresh tomatoes is the texture which is influenced by flesh firmness and skin strength. Therefore, it is a major challenge to prevent the softening of the tomato flesh during storage and its ripening process. In this study, the highest firmness value was observed in tomatoes dipped in 50% KLE followed by 25% KLE, 20% GG, and control (Figure 2). Only tomatoes dipped in 50% KLE and 25% KLE showed significantly higher firmness as compared to the control fruit. The highest value of firmness in tomato fruits dipped in 50% KLE (1.62 N) was suggested due to the ability of the extract to form a barrier on the tomato fruits and reducing the water vapor transmission rate.

The firmness of a tomato is closely related to its surface appearance which depends on its color, shape, and sense of touch during purchasing. The ability of the fruit flesh to withstand compressive force is essential in determining fruit maturity and quality. According to Brummel (2006), the cell wall of hydrolytic enzymes will cause tissue softening during fruit ripening thus reduced the intercellular adhesion and eventually lose the firmness of tomato. Based on the data, untreated tomato showed the lowest firm, easily wilt, shriveled which was agreed with the result obtained by Paul *et al*. (1999). The loss of firmness during the storage period was normal behavior during the maturation of tomato fruit due to an increase in the ethylene concentration that encourages the formation of the cell wall solubilizing enzymes (polygalacturonase) that is responsible for fruit softening (Jaramillo *et al*., 2007). Also, metabolic processes such as transpiration and respiration will increase as the storage time increase (Batu, 2004).

For total soluble solid, tomatoes dipped in 50% KLE showed the highest value of total soluble solids (TSS), followed by fruits dipped in 25% KLE, 25%, control, and 20% GG (Figure 3). Only fruit dipped in 50% KLE and 25% KLE showed significantly higher TSS value as compared to the control fruit. The increase of TSS in all the tomato fruits were related to hydrolysis of starch and other polysaccharides to the soluble form of sugar. According to Giovannoni (2004), an increase in TSS of tomatoes was related to changes in the cellular wall especially pectin and hemicelluloses. The conversion of starch to sugar during ripening is the major reason for the continuous rise in TSS during the ripening process. The ripening process in tomatoes was affected by the rate of ethylene production which caused changes in fruit sugar content and organic acid metabolism. Plant with higher sugars content has more free organic acids and less hydrogen ion concentration as compared to the plants with low sugars. According to Eskin (2000), starch accumulated in green tomatoes will start to drop with the onset of the ripening process which directly increases the TSS.

During storage, the green pigment of chlorophyll degrades and carotenoids were synthesized during ripening in tomatoes (Liu *et al*., 2009). The results of this study show that the lycopene content was increased as the day of incubation time increased (Figure 4). On day 8, only tomatoes dipped in 50% KLE recorded significantly higher lycopene content as compared to control. A study conducted by Yahia (2009) reported that tomato fruits stored at ambient temperature had increased respiration rate thus has higher ethylene accumulation. This process might be related to the degradation of chlorophyll and the accumulation of lycopene content at the end of the storage.

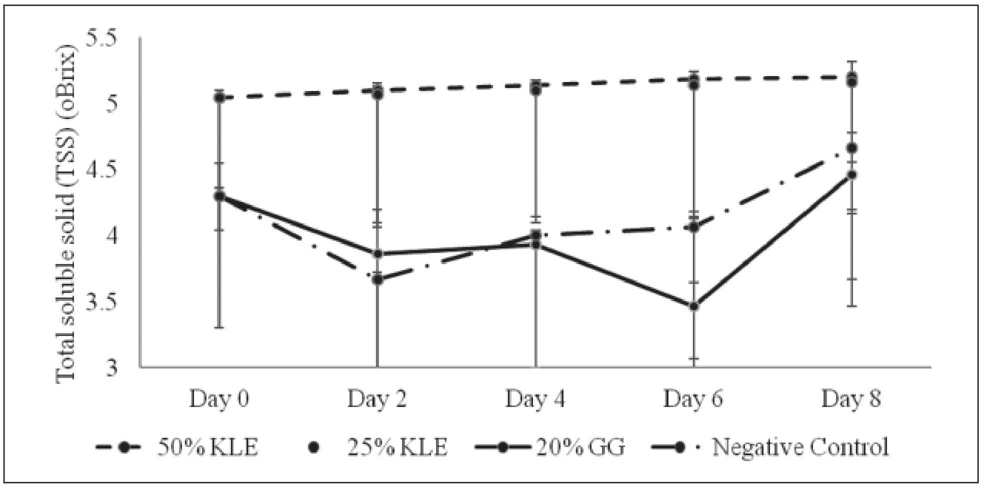

Fig. 3. Total soluble solids (TSS) of tomatoes dipped in ginger (GG) and kaffir lime extract (KLE) during eight days incubation period.

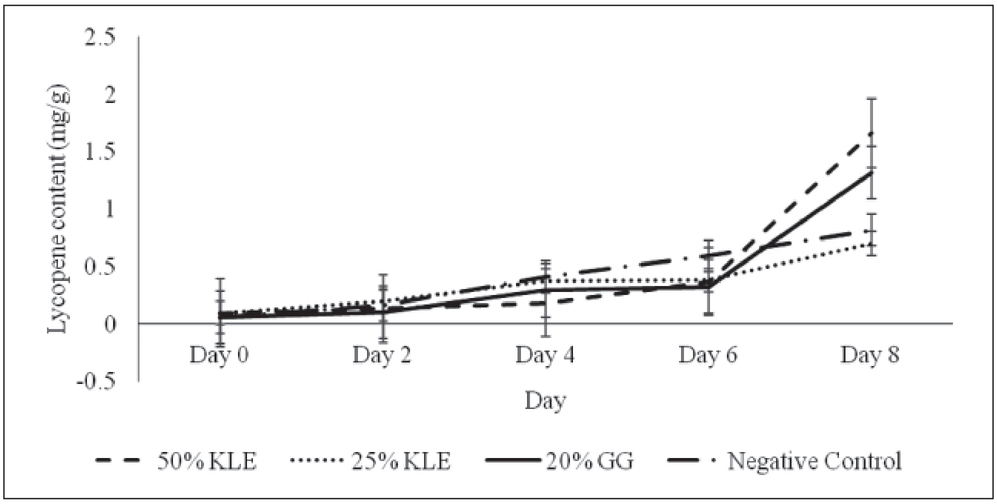

Fig. 4. Lycopene content of tomatoes dipped in ginger (GG) and kaffir lime extract (KLE) during eight days incubation period.

CONCLUSION

Tomatoes are highly perishable fruits and have a short storage life. Deterioration of tomatoes during handling, transportation, or storage has become the main issue for marketable losses which may change the fruit's appearance, reduce its marketing value and its shelf life. In this study, tomatoes dipped in 50% KLE showed a good promising as a treatment agent. It can reduce weight loss, retain the firmness, increase the TSS, and has higher lycopene content when stored at ambient temperature. Therefore, the application of this natural extract to replace synthetic chemicals is a need to which is less expensive, non-toxic to human health, and reduce the occurrence of post-harvest disease in tomatoes under storage.

ACKNOWLEDGEMENTS

The authors are grateful to the sponsor of this research, Universiti Malaysia Terengganu. Our gratitude also goes to all staff for their technical support.

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