ABSTRACT

COMPARATIVE STUDY OF EDIBLE COATINGS FOR FRESH-CUT FRUITS: ANTI-BROWNING EFFECT AND QUALITY ASSESSMENT

Yessy N. Lauwa, Filiana Santoso, Yonathan Asikin
Swiss German University, BSD City, Tangerang, Indonesia

This study was conducted to assess the effectiveness of natural edible coatings prepared from ascorbic acid, honey, chitosan, carrageenan and *Aloe vera* performed on fresh-cut fruits (pear and starfruit) with respect to the anti-browning effect and quality parameters of the fruits. Evaluations were conducted during 3 days storage at 25°C for physicochemical characteristic, microbiological assay and organoleptic test. The research showed that the application of all edible coatings could maintain the fruits' texture and reduce weight loss. Ascorbic acid was the best anti-browning agent which was able to reduce 6.34% and 2.29% of color changes loss in pear and starfruit samples, respectively; while chitosan proved to be not suitable for maintaining the color. This result was in accordance to the analysis of polyphenol content in pear fruits. Based on microbiological assay, all tested edible coatings could substantially decrease the growth of microorganism. Furthermore, in this research chitosan, a well-known anti-browning agent, was found to exhibit a high potency as antimicrobial agent. It showed the highest inhibition activities against all microorganisms tested compared to other edible coatings. In pear samples, it could decrease mold growth by 1 log CFU/g. In starfruit, chitosan could reduce the number of bacteria by 3 log CFU/g and that of mold by 1 log CFU/g. In the sensory evaluation, pear coated with carrageenan and starfruit coated with ascorbic acid achieved the highest acceptance level. The least favorable samples were chitosan coated pear and *Aloe* coated starfruit.

Keywords: edible coating, pear, starfruit, anti-browning, antimicrobial

COMPARATIVE STUDY OF EDIBLE COATINGS FOR FRESH-CUT FRUITS: ANTI-BROWNING EFFECT AND QUALITY ASSESSMENT

Filiana Santoso, Yessy Natalia Lauwa, Yonathan Asikin
Faculty of Life Sciences, Swiss German University, EduTown, BSD City, Indonesia
Email address: filiana.santoso@sgu.ac.id

ABSTRACT
This study was conducted to assess the effectiveness of natural edible coatings prepared from ascorbic acid, honey, chitosan, carrageenan and *Aloe vera* performed on fresh-cut fruits (pear and starfruit) with respect to the anti-browning effect and quality parameters of the fruits. Evaluations were conducted during 3 days storage at 25°C for physicochemical characteristic, microbiological assay and organoleptic test. The research showed that the application of all edible coatings could maintain the fruits' texture and reduce weight loss. Ascorbic acid was the best anti-browning agents; while chitosan proved to be not suitable for maintaining the color. This result was in accordance to the analysis of polyphenol content in pear fruits. Based on microbiological assay, all tested edible coatings could substantially decrease the growth of microorganism, with chitosan as the most potent antimicrobial agent. Furthermore, in the hedonic test pear coated with carrageenan and starfruit coated with ascorbic acid achieved the highest acceptance level.

INTRODUCTION
Fresh-cut fruits are highly favored due to the convenience and mostly because of their nutritive value. Unfortunately, the quality of the fruits deteriorates easily in relatively short time. Some conventional preservation methods, such as cooling and canning, have been employed and, to some extent, were proven to be effective. However, the need of preservatives that are safe, cost-effective and of natural source is still emerging and aimed to find alternative spoilage inhibitor other than the commonly used chemical preservatives and anti-browning agents like ascorbic acid. *Aloe vera*, chitosan, carrageenan and honey are examples of potential natural edible coatings that could prolong the freshness of fresh-cut fruits and at the same time delay the browning process. On top of that, Aloe vera and honey would be able to enhance the nutritional value of fruits. The primary purpose of this research is to prepare *Aloe vera* fresh gel and to find the best formulation of edible coatings derived from *Aloe vera*, carrageenan, chitosan, and honey to be used as natural preserving and anti-browning agents for fresh-cut fruits.

EXPERIMENTAL METHOD
The raw materials used for the research were *Aloe vera* leaves, pears, and starfruits. They were obtained from local market in Serpong. The research was divided into two sequences, which were the preliminary and primary research. The preliminary research was intended to investigate the best method for the research. This includes the formulation for making the edible coating from *Aloe vera*, chitosan and carrageenan, to determine the best concentration of anti-browning agents and the coating method for the fresh-cut fruits. The primary research was aimed to prepare the samples with various types of edible coatings and anti-browning agents followed by the physicochemical and microbiological analyses.
Pears and star fruits used in the experiment were sorted to have more or less uniform size. Then, they were washed with distilled water to remove dirt. The pears were then peeled, cored and cut into similar size wedges. The star fruits were also cut at both tips and sliced with similar size. Next, the fruits were dipped in the edible coatings and anti-browning solutions which already prepared before. They were dipped for about five minutes and let dry for about one hour. After that, they were put on the Styrofoam and wrapped with polyethylene. The fruits were then observed at day 0, day 1, and day 3.

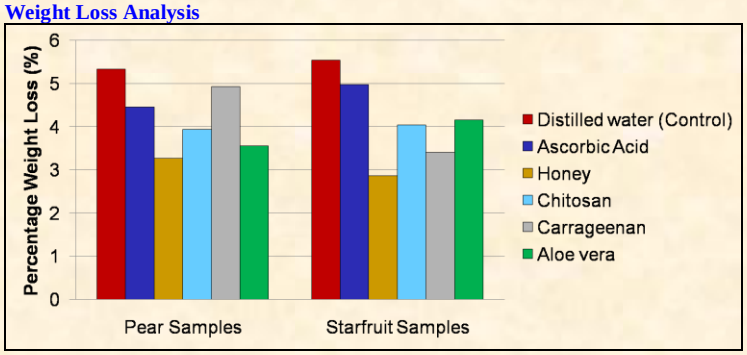
RESULT AND DISCUSSION
Weight Loss Analysis


Figure 1: Percentage Weight Loss within 3-Day Storage

In this analysis, honey treated sample showed to be effective in reducing the weight loss of pear and starfruit samples. Ascorbic acid which is used commonly in the industry did not show much decrease of weight loss percentage. Control sample exhibited the highest percentage of weight loss indicating that after 3 days the uncoated fruits did not contain as much water as coated samples. Overall, the application of edible coatings was effective in preventing the weight loss because it acts as a barrier to prevent the evaporation of water and gas or known as respiration process in fruits [1].

Texture Firmness Analysis
Texture firmness was analyzed using rheometer (CR300, Sun Scientific Co. Ltd, Japan). The lower the firmness value, the softer the texture of the fruits is. In pear samples, the texture firmness value decreased slightly for control and ascorbic acid samples, while the other samples hardly experienced changes compared to day 0. The significant decrease of the firmness value was seen on day 3 for all samples. And for starfruit samples, the texture firmness value was quite similar on day 0. On day 1, the firmness value decreased slightly. After the starfruits were cut, they became riper because of oxidation reaction resulting in softer texture. On day 3, the firmness value of all samples increased. It was caused by the fact that on day 3, the starfruits lost much water and visibly became wrinkled, thus making the texture of the starfruits harder. Chitosan was the best in terms of maintaining the texture firmness of pear and starfruit samples.

Color Changes during Storage
Chromameter (CR10, Minolta, Japan) was used for the measurement of color. Figure 1 showed that ascorbic acid was the best in maintaining the loss of color changes for both fruit samples. While chitosan failed to prevent the color loss in pear samples. Edible coatings were not effective in maintaining color in starfruit samples.

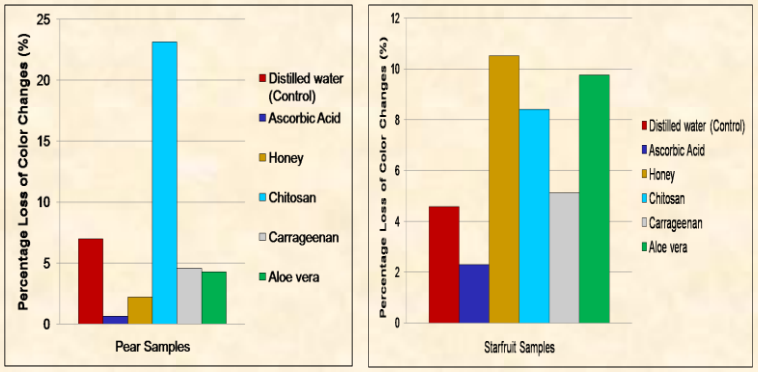


Figure 2: Percentage Loss of Color Changes within 3-Day Storage

pH and Total Soluble Solid (TSS)
Chemical analysis includes pH and TSS analysis. The pH value of both fruit samples did not change substantially. The changes were observed on day 3 in pear samples when the pH value of all samples decreased. The decreasing pH value was assumed to be caused by the increase in total acid that was due degradation of protein and sugar when the respiration process occurs [2]. In general, the application of the edible coatings in starfruits did not influence the pH value.
TSS shows the total amount of sugar contained in fruits. The TSS of treated and untreated samples on day 0 was similar, except for honey coated samples which show higher TSS. It is due to the honey itself, which contains glucose and fructose, thus, increasing the amount of TSS in the sample. Overall, the TSS of all samples slightly increased within the storage time.

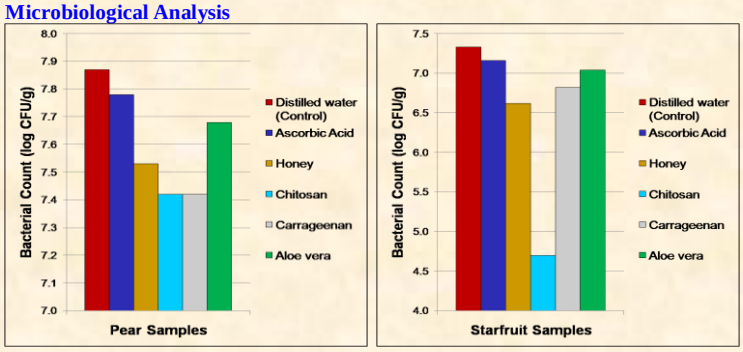
Microbiological Analysis


Figure 3: Bacterial Plate Count on Day 3

From the figure shown, all coating samples are effective in inhibiting the bacterial count compared to uncoated one both in pear and starfruit samples. The most effective antibacterial agent is chitosan followed by carrageenan and honey.
The mold count was also conducted and chitosan was again the best coating in inhibiting the growth of mold both in pear and starfruit samples. *Aloe* treated sample was the second best. Other coated samples were also shown to delay the growth of mold. Hence, the application of edible coatings in pear samples was effective in reducing the mold growth.

Sensory Analysis
The three attributes observed in this analysis were color, texture and taste. The best score for color and texture were given to carrageenan coated pear samples. For the taste, ascorbic acid obtained the best score due to its sour taste and additionally increased the fresh taste of the pear samples. *Aloe* coated sample scored the least compared to other samples. Panelists reported there was strange taste and bitter for the *Aloe vera* coated sample. For the three attributes, ascorbic acid coated sample was the highly likable by the panelists, on the other hand, Aloe coated sample was the least favorable.

CONCLUSION
The use of honey, chitosan, carrageenan and *Aloe vera* as natural edible coatings in freshly cut fruits was overall potential. In terms of physical analysis, the application of edible coatings was proven to reduce weight loss and maintain texture firmness of the fresh-cut pears and starfruits. The best anti-browning agent was ascorbic acid and it was in agreement with the result of polyphenol loss. In chemical analysis, the application of edible coatings did not affect the total soluble solid and pH values of tested fruits. In microbial assessment, the treated samples exhibited less bacterial and mold count compared to control. Chitosan was the best coating solution in inhibiting the microbial growth. Ascorbic acid was overall favorable for color, texture and taste in the sensory evaluation.
In this research, chitosan, a well-known anti-browning agent, was found to exhibit a high potency as antimicrobial agent. It showed the best inhibition activities against all microorganisms tested compared to other edible coatings.

REFERENCES
[1] Valverde, J.M., D. Valero, D. Martnez-Roma, F. Guilln, S. Castillo and M. Serrano. Novel Edible Coating Based on *Aloe vera* Gel To Maintain Table Grape Quality And Safety. *Journal of Agricultural and Food Chemistry*. 2005. 53 (20).
[2] Mardiana, K. Pemanfaatan Gel Lidah Buaya Sebagai Edible Coating Buah Belimbing Manis (*Averrhoa carambola* L.). *Skripsi Fakultas Teknologi Pertanian*. Bogor: Institut Pertanian Bogor, 2008.