Physical Damages of Tropical Fruits: Case Study of Mangoes, "Duku" (*Lansium parasiticum)*, Avocado and Banana Fruits

Yuwana and Evanila Silvia

Department of Agricultural Technology, Faculty of Agriculture, University of Bengkulu, Bengkulu, Indonesia

ABSTRACT

Fruits are important horticultural products for human sustenance. Tropical region produces high variety of fruits species. Fruits are naturally produced for local consumption and processed products. Most of tropical fruits are cultivated in developing countries. Due to lacks of knowledge of fruits growers, limited fruit harvesting and handling facilities, long distance between production fields and fruit markets/destination, and fruits are perishable in mature, these horticultural products are prompted to physical damages. This becomes constraint in promoting purpose. This paper describes physical damages of several tropical fruits hopping that the presented information is useful for growers, government and fruits traders.

Key words : description, physical damage, tropical fruit

INTRODUCTION

Fresh fruits are major source of vitamins and minerals for human being. Demand of fruits grows year by year due to increases in population, education level, people income, and the need for good health. In Indonesia, the production of fruits is fostered to meet national consumption and export for foreign exchange by both extensiveand intensive efforts. National fruits production was 17,631,255 tons in 2014 which were dominated by bananas, mangoes, oranges, pineapple and salak (Statistics Indonesia and Directorate General of Horticulture, 2015) while the production of Bengkulu Province was only 90,023.9 tons in 2013 which were mainly consisted of durian, bananas and oranges (BPS Bengkulu Province, 2015). Fruits are usually produced for fresh consumption and processed products. Although fruits production is abundant, to meet the National demand, Indonesia still imports this commodity. In 2014 541,617 tons were purchased from foreign countries (Agricultural Quarantine Board R.I., 2015).

Fruits are perishable product and most tropical fruits in developing countries are cultivated by growers. Some problems encountered during fruit harvesting, handling and distribution are suspected to be the cause of pure quality of tropical fruits. Among the important problems are lacks of knowledge of fruit's growers, limited harvesting and handling facilities, long distance between production fields and fruit markets/destination, and fruits are perishable especially ripe fruits. These problems lead the fruits to suffer physical damages. Harvesting provokes fruit to impact and shear among each others, between fruits and surfaces of harvesting equipment and facilities, and between fruits and the ground which may produce physical damages. Handling interact between fruit and handling equipment such as sorting equipment, sizing equipment, fruit boxes and containers which may also result physical damage. During transport,physical damage of fruits may occur when fruit impacts or shears to containers surfaces due to vibration or shock produced by vehicles. Road condition and distance between field of cultivation and market/destination will influence the severity of damages. Physical damage contributes to product losses in both quality and quantity.

Most common mode of physical damages in fruits is bruising. Bruising mechanism in fruits and its application for harvesting and handling practices has been intensively explored by researches. Static and dynamic loadings on fruits have been instrumented to find relation between mechanical factors to measured bruising. Bruising indices, such as bruise susceptibility, have been introduced (Ruiz-Altisent and Moreda, 2014). Effect of orchard management and harvest date was related to bruise susceptibility (Opara, 2007). Mechanical theories have been employed to predict bruising quantitatively (Yuwana, 2013).Discrete Element Method (DEM) was used to predict bruising in respect to ripeness, acoustic stiffness, fruit temperature, radius of curvature and harvest date (Zeebroeck *et al*., 2006; Zeebroeck *et*

al, 2007). Characteristics of bruising have also been specifically studied is respect to certain phenomena and commodities. Ahmadi *et al*. (2010) observed the effect of impact and fruit properties on the bruising of peach and found that lowering the temperature and increasing the radius of curvature and acoustic stiffness would reduce the bruise damage of the peach fruit. Shafie *et al*. (2015) investigated the storage time, temperature, and impact region to pomegranate bruising and concluded that higher fruit temperature, firmness, and peel thickness reduced bruise damage to the pomegranate fruit, and storage time and increased radius of curvature increased the bruise volume and bruise area, respectively.

Based on the above reviewed literature physical damages would be easily studied when dimension of damage could be measured. In facts not all modes of damages can be quantified. So that study of physical damage by description is still relevant to be carried out. This article presents the results of field's observation aiming to describe physical damages of mangoes, duku (*Lansium parasiticum*), avocado and banana.

MATERIALS AND METHODS

Fruits utilized for experiments were mangoes (Mangi feraindica :varieties : "Mangga Indramayu", "Mangga Bengkulu", "Mangga Madu"), duku (*Lansium domesticum* Corr), avocado (*Persea americana* Mill) and banana (*Gros Michel*).

Physical damages only suspected caused by external forces, such as impact, compression and shear (not by diseases or physiological disorder) were explored in this experiment. These damages may occur when fruits make contact with various surfaces, such as fruits themselves, equipment, boxes and container, wall and floor of storage, other facilities, during harvesting, handling and distribution.

Representative damage fruits samples from four species were selected. In general, physical damages were observed from two sides: outside and inside. Outside observation was conducted by describing damage of intact fruit while inside observation was carried out by sectioning the damage part from its center. Damages from these two perspectives were then described in detail.

Mangoes were observed for two physiological stages: ripe mango (ready for consumption), "ManggaIndramayu variety","Mangga Bengkulu variety" and Magga Madu variety, and mature mango (freshly harvest), "Mangga Madu variety". Damaged ripe mango samples werecollected and selected from retail shops while fresh mango samples were collected from harvested mangoes. Samples of duku, avocado and banana fruits were taken from retail shops.

During experiment, intact damage at the surface of fruit was observed in detail. This observation was finished by taking picture of the damage. This damage was then sectioned through its center and the affecting tissue was described. Picture of damage tissue was documented.

RESULT AND DISCUSSION

Profile of damage ripe mango was "Indramayu variety" was presented in Figure 1. From the outside damage of ripe mango was not quite visible unless the deformation of damage's surface was observed. Deformation occurred at the damaged part of the fruit. There was no significant change in color of the skin tissue but this affected area was little bit moist. When the damage part was sectioned, the damage tissue could not be distinguished from surrounding tissues. Based on these facts, attention must be given during inspection of physical damage on ripe mango fruits for quality assessment.

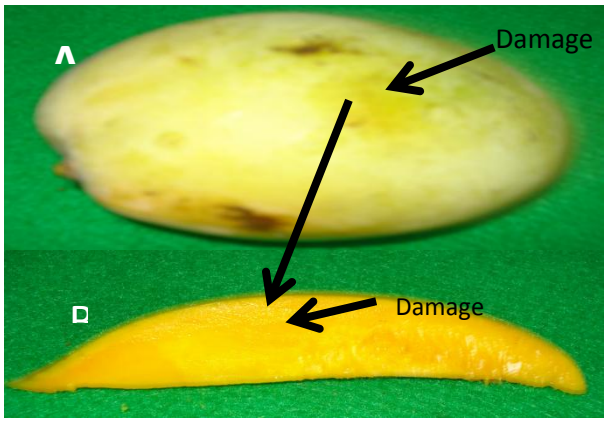

Figure 1. Physical damage of Mangga Indramayu variety

Different mode of physical damage in ripe mango was observed on Mangga Bengkulu variety as shown in Figure 2. Due to strong force, fruit suffered severe damage in the form of cut (A) or multi cut (B) for stronger force rather than bruise. Sectioning across the cut (C), destroyed juicy affecting tissues were observed. The damage of inner tissues was more severe than the damage of tissues near the fruit skin. It might happen because the strength of skin was significantly higher than the strength of flesh.

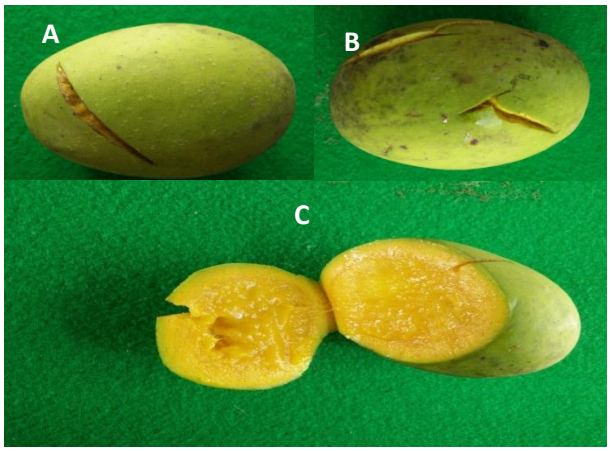

Figure 2. Physical damage of Mangga Bengkulu variety

Similar evident was found in Mangga Madu variety as depicted in Figure 3. Devastative damaged tissues were found in entirely zone near the core of fruit.

Figure 3. Physical damage of Mangga Madu variety

Damage on fresh mango fruit was presented in Figure 4. Colliding on hard ground's surface from several meters drop height during harvesting the fruit suffered serious damage in the form of multiple cuts. These cuts penetrated into the flesh up to the surface of fruit seed. Although the damage was tragic but there were no significant different colors between damage tissues and intact tissues in this area.

Figure 4. Physical damage of fresh Mangga Madu variety.

Based on the above facts it could be concluded that physical damages in mango fleshes were not easily detected from the affected tissues. Majority physical damages in duku appeared as bruising. Figure 5 showed difference between good fruits and bruised fruits.

Figure 5. Good and bruised Duku fruits

Bruised fruits could be identified from changing color of fruit skin from light yellow to dark brown. In some cases shrinkage of skin was found as indication of dehydrated zone of this area. As a function of storage the bruised zones spreadth as illustrated in Figure 6.

Figure 6.Spreadth bruised zones

When the fruit was loaded by strong compression, they turned to be blown up and depending on the severity of damage, flesh might come out of skin as demonstrated in Figure 7.

Figure 7. Physical damages in Duku fruits

Damage in avocado was illustrated in Figure 8. Damage area appeared as bruise although it was not easily detected from the outside of fruit. When the bruise was sectioned the affecting area was clearly distinguished from the change in color of damage tissue. Because of rigidity of skin, it recovered after loading and damaged tissue beneath the surface of skin manifested as a hole.

Figure 8. Physical damage of Avocado

Physical damage in banana was easily identified from both outside and inside, as indicated by Figure 9. From the outside damage could be detected from black in color of fruit skin while from the inside damage could be observed from dark in color of affecting tissues. Severity of damage was revealed in the darkness of tissue colors.

Figure 9. Physical damage of banana

CONCLUSIONS

Physical damages in tropical in tropical fruits varied by fruits species and intensity of external loads. Physical damage in mangoes varied from bruise to flesh cut but the affecting tissues were not easily observed. Damage in Duku fruits could be bruise, cut skin or blown up skin. Bruising duku could be easily identified from the change of skin color of affecting area. Damage in avocado was not easily detected from outside but it was easily found when the damage was sectioned. Damage in banana was clearly manifested by dark skin and flesh colors. The darkness of skin and flesh colors revealed the severity of damage.

REFERENCES

Statistics Indonesia and Directorate General of Horticulture, 2015.Production of Comodities.BPS - Statistics Indonesia and Directorate General of Horticulture.

Agricultural Quarantine Board R.I, 2015. Import of Commodity.Agricultural Quarantine Board R.I.

Ahmadi, E., H.R . Ghassemzadeh, M. Sadeghi, M. Moghaddam, S.Z. Neshat, 2010.The effect of impact and fruit properties on the bruising of peach. Journal of Food Engineering 97(1) : 110-117.

BPS Bengkulu Province, 2015.Production of Comodities.BPS- Bengkulu Province.

Opara, M.L. 2007.Bruise susceptibilities of 'Gala' apples as affected by orchard management practices and harvest date. Postharvest Biology and Technology 43(1) : 47-54.

Ruiz-Altisent and Moreda, 2014. Fruit, mechanical properties and bruise susceptibility. Encyclopedia of Earth Science Series : 318-321.

Shafie, M.M., A. Rajabipour, S. Castro-Garcia, F. Jimenez-Jimenez, H. Mobli. 2015. Effect of fruit properties on pomegranate bruising. Int. Journal of food Properties 18(8) : 1837-1846.

Yuwana, 2013.Bruising : Mechanical Damages of Agricultural Products. First Edition Pertelon Bengkulu, Indonesia, 122 pages.

Zeebroeck, M.V., E. Tijskens, E. Dintwa, J. Kafashan, J. Loodts, J. De Baerdemaeker, H. Ramon, 2006. The discrete element mothod (DEM) to simulate fruit impact damage during transport and handling : Case study of vibration damage during apple bulk transport. Postharvest Biology and Technology 41(1) : 92-100.

Zeebroeck, M.V., V.V. Linden, P. Darius, B. De Ketelaere, H. Ramon, E. Tijskens, 2007. The effect of fruit factors on the bruise susceptibility of apples. Postharvest Biology and Technology 46(1) : 10-19.