Levels of farmers’ preferences of papaya trait/varieties/characteristics

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Abstract. Increased awareness on the overall health benefits of fresh fruits and vegetables significantly contributes to Indonesia’s rising consumption. These plants are highly expended, and are particularly cultivated in tropical climate regions. Papaya is described as an important fruit, and is sufficiently nutritional, readily available anytime of the year, and also very affordable. In addition, the country enjoys a wider variety, including Merah Delima, although, lesser information is obtainable about farmers’ preferences, in terms of varietal characteristics, compared to consumers. The purpose of this study was to evaluate the preferences for Merah Delima species and the resulting characteristics required to potentially match the farmers’ demands, using 2019 survey data from East Java, Central Java, Riau, and West Sumatra provinces. Subsequently, 35 small scale papaya farmers were interviewed to obtain necessary information related to the performance and attributes of the selected variety. The results showed major preferences for samples with red meat coloration (87.10%), medium-size range between 0.7 - 1.5 kg (71.43%), sweet to very sweet taste (100%), and hard texture (74.19%), with an oval shape (75%). Varietal characteristics are believed to differ across cultivation zones, depending on the agro-ecosystems and farming processes. Furthermore, the earlier mentioned properties were generally suitable to the farmers’ demands. These findings also serve as important guidance, in order to probe deeper into the development of varieties with relevant traits towards addressing farmers’ specifications.

Keywords: papaya, Merah Delima, preferences, characteristics, variety

1. Introduction
Fruits and vegetables play significant roles in sustaining human health, due to high vitamins, minerals, fibre, and bioactive contents [1] [2]. Based on a study between 2013 - 2017, the plants’ consumption rate in Indonesia appeared reasonably low and was specified at approximately 248.08 grams/cap/day, compared to WHO’s recommendation of 400 grams/cap/day [3]. Currently, there is modification in particular food utilization patterns targeted towards the reduction of carbohydrates, fats, sugars, and replacing with sufficient animal proteins, vegetables, and fruits [3]. Papaya serves as vital alternative, not only comprising high nutrients, low fat and calories, but is also relatively safe for daily consumption. For instance, in 100 grams, about 46 kcal calories, carbohydrates 12.20 g, water 86.7 g, 0.5 g protein, vitamin A 365 IU, vitamin C 78 mg, vitamin B 0.04 mg, calcium 23 mg, iron 1.7 mg, and phosphorus 12 mg, are known to exist [4]. In addition, the presence of carotene bioactive compounds are greatly beneficial as natural antioxidants [5]. Furthermore, carotenoids occur as native pigments with varying coloration of yellow, red, orange, and are also soluble in oil [6].
Papaya develops effectively in several tropical regions across Indonesia, and also demonstrates numerous varieties, including Merah Delima. This specie with emerging and potential varietal characteristics, e.g. superior sweetness, red fruit meat color, and a relatively long shelf life of 7-10 days [7], is typically preferred, although, there is need for further development after ten years of existence, in order to retain or increase consumers’ acceptance.

Furthermore, as the demand are generally visible, less preferential information is available for the farmers as the major seed consumers. These farmers intermediate users, tend to connect to the seed producers, in order to develop the most potential varieties. Also, raw material selection is observed as one of the major significant factors influencing successful specie formation, although certain experiences during sales generally tend to also balance the consumer’s preferences. This study, therefore, investigates papaya preferences of varietal characteristics in production locations to ensure further specie development, in a bid to accommodates the increasing demands.

2. Methods

This paper employs a combination of primary and secondary data. The primary survey was conducted on 35 Merah Delima specie farmers and other varieties, between October – November, 2019 in Riau, East Java, Central Java, and West Sumatra provinces. Census sampling method was applied and the locations were carefully determined on the basis of seed distribution data and available market information. Meanwhile, the secondary data was generated from the Indonesian Fruit Research Institute (ITFRI).

Farmers were selected as the varietal consumer, and also acted as intermediates between seed producers and traders. Furthermore, acquiring farmers’ preferences is important due to associated decision, in terms of seed selection.

In support of the above condition, direct observations were provided by evaluating several fruit criteria, termed total soluble solids (Brix), weight, length, thickness, meat size, circumference, edible portion, sliced shape, skin and meat color, taste, and general texture. The measurement of total levels of dissolved solids involved the use of Atago Brix Refractometer, while RHS Color Chart Sixth Edition was utilized to define the skin color and fruit meat. This chart specifies the standard reference consisting of 920 color to possibly match the fruit and other plant parts, used by horticulturist across the world to describe color differences.

3. Results and Discussion

Evidently, papaya is easily obtained, adaptive, safe to utilize by all ages, and is also very affordable. However, the information related to consumer preferences is highly needed, in an effort to facilitate further desirable traits. Previous research showed the Merah Delima specie in various survey locations in Riau, East Java, Central Java and West Sumatra appears fairly attractive and was able to compete favorably with other varieties. This is due to the number of respondents, based on the plant selection (45.45%). According to [7], Merah Delima variety has also developed in diverse Indonesia regions, including Aceh, North Sumatra, West Sumatra, Riau, Jambi, Bengkulu, Palembang, Bangka Belitung, Lampung, DKI Jakarta, Banten, Central Java, Yogyakarta, East Java, West Kalimantan, East Kalimantan, Central Kalimantan, South Kalimantan, Central Sulawesi, South Sulawesi, North Sulawesi, Manado, Gorontalo, Riau Islands, and Batam. This greatly indicates a substantial fondness for the sample specie by the local farmers and consumers.

3.1. The Level of Preferences Respondents to Papaya

The consumers’ preferences for papaya was essentially influenced by certain criteria, including meat color and taste, fruit size, meat texture, and shape. In addition, the availability level tends to also contribute to the high consumption. Therefore, the product continuity is very important to sustain the ease of access and to avoid losing to other competing varieties.

In East Java and West Sumatra, the favourite stage was almost dominated by the Merah Delima specie (> 61.11%), with abundant availability levels of 66.67%, while the remaining absorbed California Papaya by 25 - 38.89% (Figure 1). This clearly observes California Papaya as a primary competitor, in terms of distribution and preferences. The successful development of Merah Delima variety, in both
provinces (West Sumatra and East Java) demonstrated valuable prospects, and is favoured by most consumers, but was unable to compete with California Papaya, known to be popular for respondents. However, for Riau region, Merah Delima and California papaya preferential states were relatively similar, and approximately 50%. However, the availability was generally 37.5% and 37.5%, respectively, while Central Java dominated by California Papaya (77.77%). The remaining species exist as Merah Delima and other types (Kalina, Orange Lady), due to low productivity level of the Merah Delima Papaya and the small fruit size. Also, the cultivation do not follow the recommended techniques, comprised of fertilization (urea, TSP, KCl), watering, pest and disease control. Consequently, dissemination and development of Merah Delima Papaya in Central Java is expected to be more intensive. This approach was potentially followed by conducting technical guidance when introducing the superiority of the Merah Delima Papaya to instigate farmers’ interest. Meanwhile, as a step to maintain high quality yield in certain locations, including East Java, West Sumatra and Riau, adequate field monitoring becomes paramount.

Figure 1. Respondents’ preference level at various development locations on a) the kind of papaya; b) the availability of papaya

Figure 2. Respondents’ preference level at various development locations on a) papaya fruit color; b) papaya fruit size

Figure 2 showed the entire locations were dominated by a high preference for papaya with red fruit meat (87.10%), with a medium size between 0.7-1.5, estimated up to 71.43%. The interview results with respondents in West Sumatra and East Java, indicated majority of the farmers selected papaya with red meat (100%) and medium-size (66.67-100%). Also, Riau obtained similar tendency in favor of red fruit meat (87.5%), compared to orange fruit meat with medium-sized (87.5%). In Central Java, equivalent trend was observed, but the preferential state for medium and large size was estimated at 50%. Furthermore, the red coloration was caused by the presence of beta carotene compounds [8]. Therefore, higher material content is known to demonstrate excessive red colouration.
Majority of respondents (75%) in the four survey locations preferred oval shape papaya, while in East Java and Riau, 100% estimates were obtained. In West Sumatra, about 75% of consumers also selected the oval structure, while the remaining 25% acquired capsules. Furthermore, Central Java also showed similar trend, with most respondents (58.82%) predominantly selecting oval shape.

Figure 4 revealed the respondents in the entire locations preferred papaya with sweet to very sweet taste (100%), and firm texture (74.19%). Solok and East Java obtained sweetness of > 87.5% with a non-soft texture (100%), but in Riau, papaya with a very sweet taste (62.50%) and sweetness (37.5%), with a hard texture (100%) was preferred. The results from Central Java encountered a different trend, and was dominated with a soft texture of 66.67% and sweet taste (76.92%). According to the interview reports, Merah Delima demonstrated the sweeter taste of meat fruit compared to other varieties, as well as a longer shelf life. Based on [9] [10], the fruit maturity stage determines the level of the chemical properties, including total soluble solids content.

The interview results from several locations also showed most consumers preferred papaya with red meat color (> 75%), medium size (> 50%), sweet to very sweet taste (100%), crust texture (not soft), and oval shape (> 75%). These criterias are possible to employ as references for breeders/researchers, to aid deeper investigations into the development of suitable varieties, including red meat color, hard texture, medium fruit size and the oval structure. Under these circumstances, the papaya produced possibly generates a greater market acceptance, and are also able to compete with the local papaya as well as substitute import opportunities.

3.2. The Characteristic of Merah Delima Papaya

The characteristics of Merah Delima specie of papaya were observed from the physical perspectives, termed appearance (color, size, edible portion, shape), organoleptic (taste, texture, aroma) and nutritional (product nutrient composition). A selection of these criteria are believed to influence the consumer’s or farmer’s acceptance. Based on the observation of three locations, various characteristics of the sample were discovered, and are presented in Table 1.

Figure 3. Respondents' preference level for the shape of papaya fruit in various development locations

Figure 4. Respondents' preference level at various development locations on a) papaya fruit taste; b) papaya meat texture
The selection (West Sumatra, East Java and Banten) was in terms of the consideration as production centres for the Merah Delima sample and the established marketing network. Based on the research results, the varietal characteristics were confirmed to match the preferences of papaya farmers in Riau, West Sumatra, East Java, and Central Java.

Table 1 generally reveals the similar characteristics of fruit weight, length, thickness, circumference, edible portion and shape, in the three locations, but reported different sweetness levels. Fruit weight ranged from 916.1-1,252 g, length 19.6-23.2 cm, thickness 2.1-2.8 cm, circumference 26.6-34.5 cm, edible portion 80.58-83.55%, and is oval. According to [11], thicker papaya meat generated higher edible portion. Based on the level of sweetness (dissolved solids), East Java exhibited the optimum sweetness level of 13.6-14.8 °Brix, followed by Banten at 13.1-14 °Brix, and finally West Sumatra at 11.5-13.6 °Brix. Also, each location acquired different levels of total solids, greatly influenced by agro-ecosystem conditions. According to [8], the sweetness level was strongly affected by environmental humidity, agro-ecosystem conditions and altitude. In addition, the cultivation process significantly contributed to the fruit characteristics. For instance, the sweetness and quantity of papaya production tends to increase by the application of potassium fertilizer [9], [11], [12].

Table 1 shows the observations results of Merah Delima slices from three locations (West Sumatra, East Java and Banten), where 100% of the products were star-shaped, both angular and blunt stars. According to [8], Merah Delima specie acquired a five-pointed star in the fruit cavity and also a red meat color. The other three location properties typically obtained a yellow-orange group 22A skin color, indicating consumption readiness, while the meat color was dominated by orange-red group 32A (vivid reddish-orange) and the edge was 32B (strong reddish-orange), although the taste was sweet fruit meat, with a non-soft texture. This red papaya meat coloration is caused by the presence of beta-carotene compounds, known to eventually change as the fruit ripens. According to [13], beta carotene is very beneficial to the human body as an antioxidant, [14] vision health, cell differentiation, immunity, growth and development of cells, reproduction, prevention of cancer and heart diseases [8]. Therefore, consistent papaya consumption is confirmed very effective in decreasing debris index [15].
4. Conclusion
The interview results of farmers in selected locations showed a higher preference for papaya with red meat coloration (87.10%), medium-size around 0.7-1.5 kg (71.43%), and sweet to very sweet taste (100%). In addition, the fruit’s texture, favoured by respondents, was dominated by the solid texture. Based on the shape, most respondents prefer papaya with an oval structure (75%). These consumer preference criteria serve as the foundation for successive papaya variety development, in order to compete favourably with local species and therefore, substitute fruit importation. Each location observed a different levels of total solids, where East Java demonstrated the highest total solid, with a range of 13.6-14.8. The prevailing indicators are beneficial for breeding programs, to further develop Merah Delima varieties to become sufficiently acceptable, both by farmers and consumers.

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