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Chemical properties and morphological characteristics some genotype papaya (*Carica papaya* L.) in Aceh province

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Abstract

Papaya is one of the fruit commodities that has various properties, especially in the health sector. Health nutrients that affect the content in papaya are chemical properties. The chemical and morphological characteristics of the fruit in papaya experience many changes during the maturity process. This study aims to determine the chemical and morphological properties and organoleptic tests on some papaya genotypes. The design used was Randomized Completely Design with non-factorial pattern. The research treatment of papaya genotype was 6 levels, namely (USK 7 x USK 6), (USK 6 x USK 7), (USK 4 x USK 7), (USK 7 x USK 4), (USK 1 x USK 7), (USK 6 x USK 4) with 3 replications for the analysis of chemical properties, morphology and organoleptic tests. The results showed that each genotype had a very significant effect on the chemical and morphological characteristics of papaya. USK 1 x USK 7 is the best genotype that can be used as a superior new variety because it has a sweet taste with dissolved solids total is 9.83° Brix, the color of fruit pulps is red and bright, has medium size, and USK 6 x USK 4 has good vitamin C level is 77.04%.

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Introduction

Papaya is a fruit commodity that has various functions and benefits as a fresh fruit and has good nutritional content. Papaya is usually harvested in green conditions but already in a mature physiological phase, this level of maturity is strongly influenced by its marketing objectives. Marketing is very much determined by the quality of papaya, the very important quality of papaya is the chemical content (Manenoi and Paul, 2007; Ali *et al.*, 2011). The chemical and morphological properties of fruit on papaya experience many changes during the maturity process and after harvesting will determine the quality of the fruit for consumption by consumers. Every 100 g of papaya fruit consists of 86.6 g of water, 0.5 g of protein, 0.3 g of fat, 12.1 g of carbohydrates, 0.7 g of fiber, 0.5 g of ash, 204 mg of potassium, 34 mg of calcium , 11 mg of phosphorus, 1 mg of iron, 74 mg of vitamin A, 0.003 mg of thiamine, 0.5 mg of niacin, and 0.004 riboflavin and 0.075 g of vitamin C (Reninda, 2006). Ripe papaya also contains carotenoids, vitamins, proteins and polysaccharides (Waghmare and Annapura, 2013).

The quality of the fruit that deserves consideration includes appearance, texture, shape, nutritional content and safety is one of the factors that influence consumer tastes. Consumer preference in buying and choosing papaya fruit is also influenced by the morphological properties of the fruit (Serry, 2011; Muzdalifah, 2012), such as the size, aroma and color of fruit flesh. Fruit quality parameters that show differences in fruit maturity levels are starch content, dissolved solids total, hardness, acidity and fruit skin color which are organoleptic tests (Rafikasari, 2006). Organoleptic is testing that using human senses as the main tool for measuring the acceptance of the product.

Materials and methods

This research was conducted at Papaya Saree Garden, Lembah Seulawah Subdistrict, Aceh Besar District and Laboratory of Food Analysis, Laboratory of Agricultural Products Processing Technology, and Laboratory of Horticulture, Agriculture Faculty, Syiah Kuala University. The research was conducted from April to May 2017.The tools used in this study are: Refractometer, Penetrometer, Erlenmeyer, petri dish, oven, measuring flasks, blenders, refrigerators, calipers, analytic scales, knives, scissors, stationery and digital cameras.

The materials used are papaya fruit with a maturity level of 75-80% that has been harvested from the research garden in Saree Aceh Besar District using genotype USK 7 x USK 6 (V_1), USK 6 x USK 7 (V_2), USK 4 x USK 7 (V_3), USK 7 x USK 4 (V_4), USK 1 x USK 7 (V_5), USK 6 x USK 4 (V_6).Other ingredients used in this study are iodine solution, starch solution, filter paper, label paper, plastic bags, newspapers, cardboard, and insulation.

Harvesting of papaya fruit is done in the morning using a knife. The fruit harvested was papaya fruit with a yellow tinge maturity of 75-80%. Then sorting is done directly in the field by choosing papaya fruit that has a uniform size and shape. The total number of fruits harvested in total is 36. Each fruit is labeled according to the type of genotype. To avoid damage to fruit during transportation, papaya fruit is packaged by using newspaper and put into cardboard, then the fruit is transported to the Agricultural Technology Technology Laboratory, Faculty of Agriculture, Syiah Kuala University, Banda Aceh. After arriving in the laboratory, the papaya is cleaned from dirt so that the peel is clean and not attacked by pests and diseases that attach to the fruit peel. Papaya fruit used was genotype of USK 7 x USK 6 (V_1), USK 6 x USK 7 (V_2), USK 4 x USK 7 (V_3), USK 7 x USK 4 (V_4), USK 1 x USK 7 (V_5), USK 6 x USK 4 (V_6)obtained directly from the papaya garden, Saree Aceh Besar District as many as 36 pieces. The harvested papaya fruit is then arranged and stored at room temperature of 28 ° C until 100% ripe.

Observation parameters

Chemical properties

Moisture content (%) (Apriyantono *et al.*, 1989): Water content analysis was carried out by using the oven method.

The principle is to vaporize free water molecules (H_2O) in the sample. The difference in weight before and after drying is the amount of water that evaporates. The procedure for analyzing the water content is as follows: Dry the empty cup in an oven at 105 ° C for ± 15 minutes then weigh, weigh the 5 g sample in a known petri dish, then dry the sample in an oven at 105 ° C for 5 hours, after that the sample is lifted and cooled in a desiccator for ± 15 minutes then weighed, then heated again in the oven for 30 minutes then cooled in a desiccator and weighed. This treatment is repeated until a constant weight is obtained. Weight reduction is the amount of water evaporated from the material with the following calculations:

$$\text{Water content (\%)} = \frac{\text{Initial weight} - \text{final weight}}{\text{initial weight}} \text{ x } 100\%$$

Dissolved solids total (°Brix): Dissolved solids total are reflection of sweetness, which also shows the degree of aging and maturity, where sugar levels increase in line with the maturity process (Sjaifullah, 1997). This parameter done by using refract meter. Fruit flesh is crushed until the filtrate is obtained and then dripped on the refract meter lens. The number indicated on the refract meter shows the level of total dissolved solids (°Brix) obtained from the sample.

Vitamin C (%) (Apriyantono *et al.*, 1989): The sample used was papaya fruit with a maturity level of 100%, taken 100 g of sample and crushed using a blender until juice was obtained, weighed 30 g of fruit juice, put in 100 ml of flask and added distilled water to the mark and shake, then filtered using filter paper to separate the filtrate and take as much as 25 ml of filtrate with a pipette and put it in a 125 ml Erlenmeyer, add 2 ml of 1% amylum solution and titrate with 0.1 N iodine standard. Vitamin c content can be calculated as follows:

$$\text{Vitamin C (mg/100g)} = \frac{V \times 0{,}88 \times P \times 100}{S\ (g)}$$

Information: V = ml Iod 0.1 N solution, P = dilution, S = sample weight, 0,88 as cobart acid for 1 ml Iod 0.1 N solution I

Fruit hardness (mm/g/second): Measurement of fruit hardness is done by using a penetrometer. Penetrometer is used in a way on the surface of the fruit pressed using the tool so that the hardness value of the fruit is listed on the device.

Morphological properties

Fruit length (cm): Length measurement is done by measuring the fruit from the base to the end of the fruit using a ruler. Fruit weight (kg): Fruit weight measurement is done by weighing papaya fruit that has been harvested using analytical scales.

Fruit diameter (cm): Fruit diameter measurement is done by measuring the fruit circumference in the middle part of the fruit by using calipers.

Color measurement is determined based on digital data with the level of light intensity of red, green, and blue (RGB) taken with the camera. The RGB value of the papaya genotype is then converted to the values L, A, and B with the equation:

X = 0,607R + 0,174G + 0,201B

Y = 0,299R + 0,587G + 0,114B

Z = 0,066G = 1,117B

The conversion equation used to determine L,A, and B is:

$$L = 25\left[\frac{100\ Y}{Y_0}\right] - 16$$

$$A = 500\left[\left(\frac{X}{X_0}\right) - \left(\frac{Y}{Y_0}\right)\right]^{\frac{1}{3}} \qquad \frac{1}{3}$$

$$B = 200\left[\left(\frac{Y}{Y_0}\right) - \left(\frac{Z}{Z_0}\right)\right]^{\frac{1}{3}} \qquad \frac{1}{3}$$

With value X_0= 98,071; Y_0= 100; Z_0 = 118,225

With the conversion equation, the value of L shows the brightness of [L =

100 (white) and L = 0 (black)], the value of a indicates that the color red is positive, gray if 0, and green is negative. Whereas the value of b shows yellow if positive, gray if 0, and blue if negative.

Organoleptic test

Organoleptic Test was conducted by sensory assessment method. The United States Food Technology Institute (IFT, 1975) states that sensory

assessment is a discipline that is used to stimulate, measure, analyze and interpret reactions to characteristics of food and ingredients if they are "judged" by the senses of seeing, smell, taste, touch and hear. The sensory examination method is usually done using human senses, such the eyes, nose, mouth, eyes and ears.

This test was conducted on 15 panelists. Papaya fruit is given to each panelist, namely papaya fruit with a maturity level of 100%. This test aims to find out the differences in a product that consumers can recognize and influence their preferences and acceptance. All fruit genotypes will be tested on each author simultaneously.

The parameters tested are taste, texture, aroma, color, and overall acceptance of the fruit. Data collection is done by filling out the questionnaire on the organoleptic test form.

Statistical analysis

The design used was was Randomized Completely Design with non factorial pattern with 3 times repeated, 1 factor studied is fruit genotype and consists 6 treatment levels, namely: V_1 = USK 7 x USK 6, V_2 = USK 6 x USK 7, V_3 = USK 4 x USK 7, V_4 = USK 7 x USK 4, V_5 = USK 1 x USK 7 dan V_6 = USK 6 x USK 4, which are: USK = University of Syiah Kuala, USK 1 = Carisya, USK 4 = Callina, USK 6 = Carmida, USK 7 = Dapina.

If the ANOVA test shows a real effect, then proceed with the Tukey Test at the 5% level (Tukey $_{0.05}$). The formula of Tukey test is:

$$\text{Tukey}_{0.05} = q\,(db\ galat, p) \times \sqrt{\frac{KTGalat}{r}}$$

Information

Tukey $_{0.05}$= Tukey Test at the 5% level, q = table value at the 5% level, p = number of treatments, KTG= middle squre of galat(error), r = number of repeat.

Results and discussion

Chemical properties of papaya genotype

Genotype has a very significant effect on the chemical properties of papaya fruit, that are dissolved solids total, vitamin C and fruit hardness. Papaya fruit which has the highest total dissolved solids, vitamin C and highest fruit hardness are each in the genotype (USK 1 x USK 7), (USK 6 x USK 4) and (USK 7 x USK 4) (Table 1).

Table 1. The average value of some pepaya genotypes.

Treatments	Moistute Content(%)	PTT(°Brix)	Vitamin C (%)	Fruit hardness (mm/g/second)
USK 7 X USK 6	93,67^{b}	5,35 ^{ab}	74,43 ^{b}	2,53 ^{abc}
USK6 X USK 7	91,31^{a}	9,33 ^{c}	63,83 ^{a}	2,41 ^{ab}
USK 4 X USK 7	91,56^{ab}	5,28 ^{ab}	63,48 ^{a}	2,60 ^{bc}
USK 7 X USK 4	91,85^{ab}	4,85 ^{a}	63,70 ^{a}	2,94 ^{d}
USK 1 X USK 7	90,71^{a}	9,83 ^{c}	74,32 ^{b}	2,26 ^{a}
USK 6 XUSK 4	91,21^{a}	6,50 ^{b}	77,04 ^{b}	2,81 ^{cd}
Tukey (0,05)	2,35	1,31	3,14	0,29

Description: The number followed by the same letter in the same column is not significant in Tukey test 0.05.

The difference in sweetness, vitamin C and fruit hardness is strongly influenced by environmental factors. This is in accordance with the opinion of Muttaqin (2003) and Rosa (2004) which states that the weight of fruit is negatively correlated with PTT fruit content. In addition, environmental factors also affect the percentage of PTT fruit content and Muchtadi and Sugiyono (1992) added that differences in vitamin C content were caused by different genotypes, cultivation factors, climatic conditions before harvest, harvesting methods and differences in picking age. Genotypes have a significant effect on the chemical properties of papaya fruit on fruit moisture content, where the highest water content is found in the genotype (USK 7 x USK 6).

Morphology of papaya genotype

Genotype has a very significant effect on the morphology of papaya fruit, fruit length, fruit weight, fruit diameter, and color of fruit flesh. The longest papaya fruit is in the genotype (USK 1 x USK 7), this is probably because in the genotype the papaya fruit comes from hermaphrodite flowers so it produces longer fruit compared to the fruit of other genotypes. The heaviest papaya fruit and fruit with the largest diameter is genotype (USK 6 x USK 7) (Table2).

Table 3. The average value of organoleptic test on papaya.

Treatments	Taste	Textur	Aroma	Color	Overall Acceptance
USK 7 X USK 6	13,63^{b}	19,82^{bc}	16,23^{a}	15,23^{b}	19,70^{c}
USK6 X USK 7	13,47^{b}	18,63^{b}	18,03^{b}	19,98^{d}	22,47^{e}
USK 4 X USK 7	9,40^{a}	19,33b^{c}	16,33^{a}	14,60^{b}	16,09^{e}
USK 7 X USK 4	10,43^{a}	21,31^{d}	16,63^{a}	12,50^{a}	18,23^{a}
USK 1 X USK 7	22,37^{c}	15,97^{a}	16,57^{a}	22,87^{a}	22,00^{b}
USK 6 XUSK 4	14,37^{b}	20,07^{cd}	18,20^{b}	17,00^{c}	18,03^{d}
Tukey (0,05)	1,29	1,24	0,61	0,94	0,46

Description: The number followed by the same letter in the same column is not significant in Tukey test 0.05.

According to Yon (1994) classifies the size of papaya fruit based on the heavy version of fruit from the Research Institute of Fruit Crops divided into three types of size categories, namely small fruit that has a weight ranging from 300-700 g, medium fruit weighing 800-1500 g, and fruit- large fruits ranging from 2000-4000 g.

The size of the most popular papaya fruit by consumers is the size of the medium fruit, so that papaya fruit from the results of this study already has a size that is in accordance with consumer demand. The highest L value (brightness) in the genotype (USK 1 x USK 7), and the highest value of the value (redness) and b (yellow), namely in the genotype (USK 6 x USK 7).

Organoleptic testing of papaya genotype

Organoleptic test is a test of food ingredients based on its preferences and willingness to use a product. Organoleptic assessment, also called sensory assessment or sensory assessment, is a method of assessment that has long been known and still very commonly used.

According to Astuti (2008) in her research to determine the characterization of physicochemical properties and flavor description of papaya fruit can be done through physical, chemical and sensory analysis. Some physical analyzes include color analysis, texture (hardness) and percentage of edible portion. Fruit images and color of papaya pulp are shown in Figs 1 and 2.

Genotypes have a very significant effect on taste, texture, aroma, color, and overall fruit acceptance. According to Winarno (2004) taste is one of the factors that influence a person's acceptance of a food or product. Feelings arise as a result of chemical stimuli that can be received by the sense of taste or tongue.

Acceptance of panelists to taste is influenced by several factors, including chemical compounds, temperature, concentration, and the interaction of other flavor components. Papaya fruit that has the sweetest fruit flavor and the brightest fruit color is the genotype (USK 1 x USK 7). Papaya fruit which has the softest fruit texture and fruity aroma is each in the genotype (USK 7 x USK 4), (USK 6 x USK 4). (Table 3).

Kartika *et al.* (1988) states that texture has an important influence on papaya fruit such as from the level of softness, tenderness, hardness, and so on. The overall fruit acceptance test is an assessment of all the

quality factors observed including shape, outer texture, inner texture, outer color, inner color, taste, aroma and color. This test aims to determine the level of panelists' acceptance of a product.

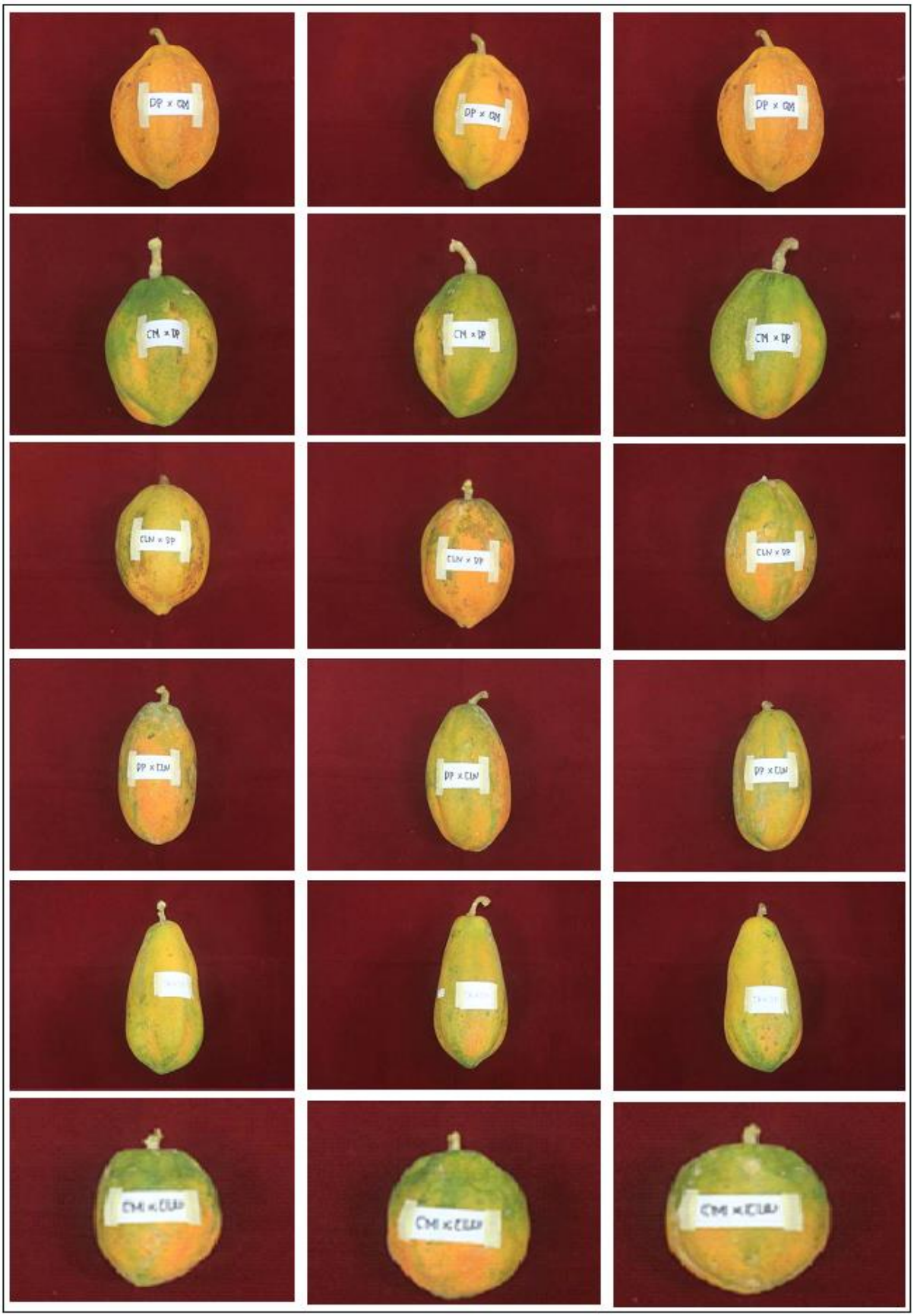

Fig. 1. Color on the outside of papaya.

The best results are found in the genotype (USK 7 x USK 6) and (USI 1 x USK 7), this probably because the genotype has the best morphological and chemical properties and fruit quality that is suitable for the taste and acceptable to consumers.

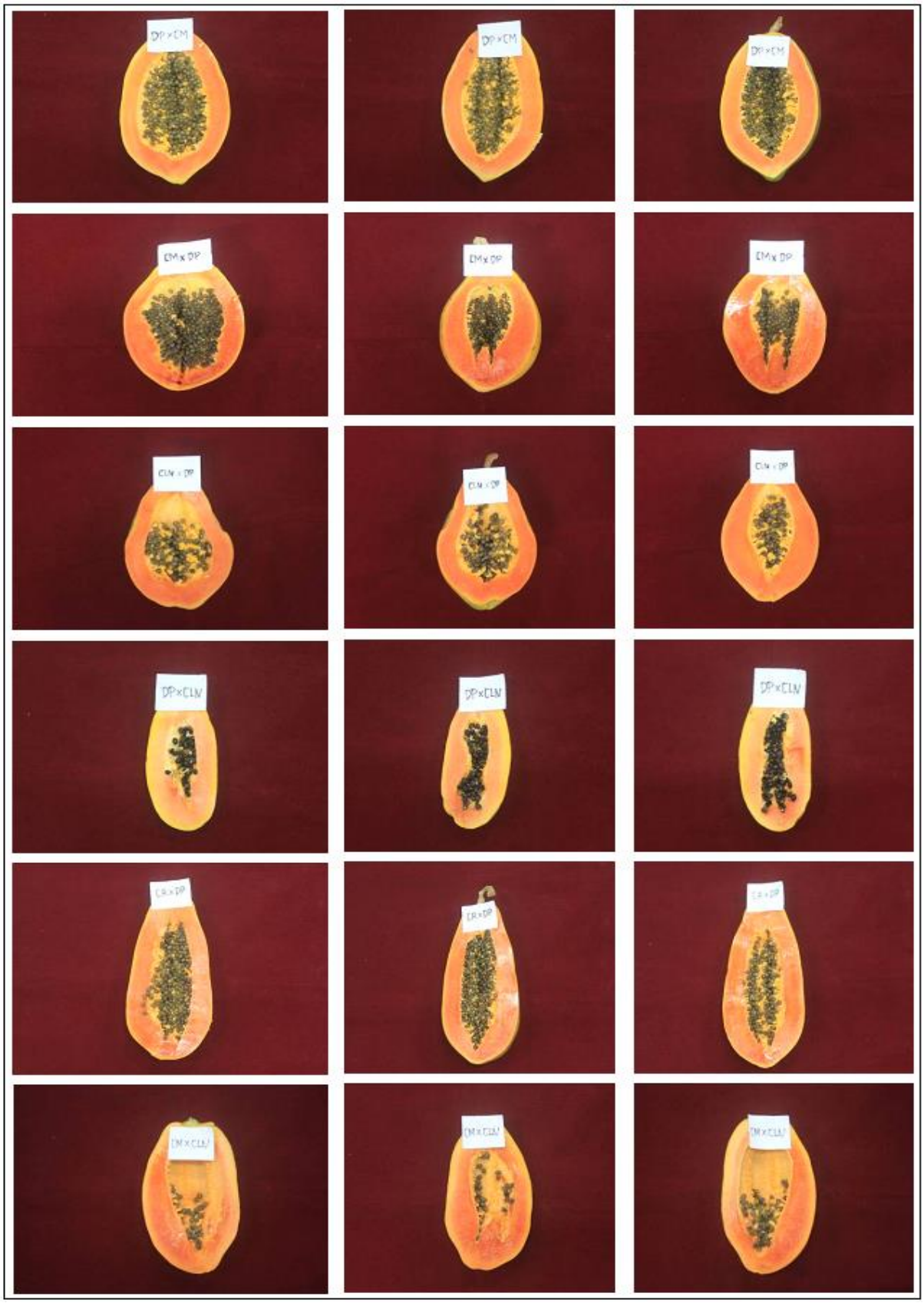

Fig. 2. Color on the inside of papaya.

Conclusion

Each genotype of papaya has different morphological and chemical characteristics that are strongly influenced by several factors, one of which is genetic factors and environmental factors. Genotype (USK 1 x USK 7) is the best fruit that can be used as a new superior variety because it has PTT fruit flavor 9.83 sweet ^{o}Brix, red and bright pulp color, medium sized fruit, and has good vitamin C levels.

The suggestion for this study is that further research is needed such as testing protein content, fat content, and ash content.

References

Ali A, Muhammad MTM, Sijam K, Siddiqui Y. 2011. Effect of chitosan coating on physicochemical characteristic of Eksotika II papaya (*Carica papaya* L.) fruits during cold storage. Food Chem. **12,** 620-626.

Apriyantono A, Fardiaz D, Puspitasari NL, Sedarnawati Budiyanto S. 1989. Food Analysis. Bogor Agricultural University Press, Bogor.

Astuti. 2008. Characterization of Chemical Physical Properties and Description of Papaya Fruit Flavor (*Carica papaya* L) Genotype IPB-3 and IPB-6C. Faculty of Agricultural Technology Bogor Agricultural University, Bogor.

Hutabarat OS. 2006. Study of Reduction of Chilling Injury Symptoms of Tomato at Save at Low Temperature. Thesis. Bogor Agricultural University, Bogor.

IFT. 1975. Minutes of Sensory Evaluation Div. Business Meeting at 35th Ann. Meet., Institute of Food Technologies, Chicago.

Kartika H, Pudji, Wahyu S. 1988. Guidelines for Food Sensory Testing. Universitas Gajah Mada, Yogyakarta.

Manenoi A, Pauli RE. 2007. Papaya fruits softening, endoxylanase gene expression, protein and activity. Physiol. Plant. **131,** 470-480.

Muchtadi TR, Sugiyono. 1992. Food Science. Department of Education and Culture. General of Higher Education. Inter-University Center for Food and Nutrition, IPB.

Muttaqin T. 2003. Evaluation of some Morphological Characteristics 19 Papaya Genotype (*Carica papaya* L.) Breeding Results Balitbu Solok: Thesis. Faculty of Agriculture Bogor Agricultural University, Bogor.

Muzdalifah. 2012. Study of consumer preference to local fruits in Banjarbaru City. J. Agrides. **02,** 297-309.

Rafikasari I. 2006. Age quotient and papaya fruit quality (*Carica Papaya* L.). Essay. Horticulture Study Program, Faculty of Agriculture, Bogor Agricultural University, Bogor.

Reninda D. 2006. Physical and chemical characteristics of papaya fruit in three ages of fruit picking. Essay. Horticulture Study Program, Faculty of Agriculture. Bogor Agricultural University, Bogor.

Rosa M. 2004. Morphological performance and quality of papaya from four populations of papaya in Bogor. Essay. Department of Agricultural Cultivation, Faculty of Agriculture. Bogor Agricultural University, Bogor.

Serry NKH. 2011. Postharvest handling of Solo papaya fruits harvested at different maturity stages. American-Eurasian. J. Agric Environ Sci. **11(2),** 205-210.

Soekarto S. 2002. Organoleptic Assessment for Food Industry and Agricultural Products. Bharata Karya Aksara, Jakarta.

Sjaifullah. 1997. Instructions for Choosing Fresh Fruits. Print 2nd. Self-Helping Spreader, Jakarta.

Waghmare Annapura. 2013. Combined effect of chemical treatment and/or modified atmosphere packaging (MAP) on quality of fresh cut papaya. Posharvest Biology and Trchnology. **85,** 147-153.

Winarno FG. 2004. Food and Nutrition Chemicals. PT. Gramedia Pustaka Utama, Jakarta.

Yon RMD, Serrano EP. 1994. Handling Systems. P 105-110. In Yon, R.Md. (Ed.). Papaya: Fruit Development, Postharvest Physiology, Handling and Marketing in ASEAN. ASEAN Food Handling Bureau. Kuala Lumpur, Malaysia.