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Sensory acceptance and qualitative analysis of fruits in papaya hybrids

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ABSTRACT

Over the last three years, Brazil has been ranked among the three largest producers of papaya. This study aimed to evaluate the acceptance and commercial standard of papaya fruits according to their sensory traits and provide information about the organoleptic and qualitative aspects of the fruit. Ten papaya genotypes grown in Linhares-ES were investigated, arranged in a randomized block design with four replications. Ten fruits from each genotype were randomly collected from each replication, which totaled 40 fruits per genotype. The fruit harvest was performed at stage 1 of maturation. The following genotypes were assessed: hybrids UC13, UC14, UC15 and UC16, from the 'Solo' group; hybrids UC03, UC10 and UC12, from the 'Formosa' group; and 'Golden', 'Calimosa' and 'Tainung 01', which were used as controls. The sensory evaluation of the genotypes was carried out in full balanced design by 50 evaluators. When submitted to sensory analysis, the hybrids showed high performance compared to the controls of each group. Traits such as aroma, flavor and overall impression were crucial in the selection carried out by the appraisers of the hybrids assessed. The hybrids UC10, UC12, UC14 and UC16 were the most accepted and preferred, respectively, in purchase intention.

Key words: *Carica papaya* L., Solo group, Formosa group, Heterotic group.

INTRODUCTION

Papaya is one of the main tropical fruits produced and consumed in the world, especially in Brazil, which is the second largest world producer and exporter (FAO 2013). Papaya is the fifth most consumed fruit in Brazil, with per capita values ranging from 1.85 kg in 2002 to 2.05 kg in 2008 (Silveira et al. 2011).

Papaya is rich in a number of minerals, vitamins and proteins with high biological value. According to Wall (2006), papaya has an average of 51.20 mg of vitamin C per 100 g of fresh fruit, a value close to that found in orange (53.20 mg 100 g^{-1}) and strawberry (58.90 mg 100 g^{-1}).

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Despite its growth trend, papaya consumption in Brazil is still relatively low, compared to many other fruits. However, it has potential to increase in all social strata. According to Monidini (2010), only 15% of the Brazilian population, on average, considering different ages and regions of the country, eat the recommended daily amount of fruits and vegetables.

When selecting a certain fruit, consumers take into account traits such as fruit taste and appearance, which can be regarded as a standard of fruit quality and are decisive in customer satisfaction. Several studies on the sensory perception of consumers about fresh fruit and / or fruit derivatives affirm that sensory and nutritional quality parameters are fundamental for the perception of customer satisfaction (Neves and Lima 2010, Padilha et al. 2010, Berilli et al. 2011, Viana et al. 2012, Oliveira et al. 2013).

Sensory analyses to determine the levels of acceptance of cultivars are not usually performed in papaya, perhaps due to the small number of cultivars and hybrids developed for the Brazilian market. In crops such as pineapple (Berilli et al. 2011), banana (Matasuura et al. 2002), melon (Miguel et al. 2010), strawberry (Resende et al. 2008) and grape (Mascarenhas et al. 2013), sensory parameters are largely employed to determine the quality of the product.

Santana et al. (2004) assessed twelve promising papaya genotypes through sensory and physicochemical evaluations and found that the genotype CMF031 was the most accepted, with higher values for soluble solids (°Brix) and ascorbic acid. It can be considered the most appropriate, with good potential for fresh fruit market and industry. Other studies on the crop have been reported, such as the assessment of papaya jelly mixed with araçá-boi (Viana et al. 2012) and the acceptance of cereal bars with the addition of papaya seeds (Shigematsu et al. 2012). On the other hand, discussion about other fruits, as mentioned above, can help identifying response patterns in fresh papaya assessment.

The present work aimed to assess the sensory attributes and aspects of fruit quality in pre-commercial papaya hybrids and estimate the correlation between sensory attributes and aspects of fruit quality, in order to identify the relationship between this correlation and consumer preference.

MATERIALS AND METHODS

The assessments were conducted in ten papaya genotypes grown in Linhares-ES, (19º23’28”S, 40º04’20”W, alt 33 m), arranged in a randomized block design, with four replications. Ten fruits were randomly collected from each genotype in each replication, totaling 40 fruits per genotype. The fruit harvest was performed at stage 1 of maturity, which corresponds to up to 10% of yellow fruit peel. The following genotypes were assessed, hybrids UC13, UC14, UC15 and UC16, from the ‘Solo’ group, which have small fruits, ranging between 0.4 and 0.7 kg, known as ‘papaya’ or ‘Hawaii papaya’; and hybrids UC03, UC10 and UC12, from the ‘Formosa’ group, which have large fruits, between 1.0 and 2.5 kg, both from the breeding program developed by the Universidade Estadual do Norte Fluminense Darcy Ribeiro – UENF in partnership with the Caliman Agrícola S.A. Company, named UENF/Caliman Program. The hybrids ‘Tainung 01’, from the ‘Formosa’ group, ‘Calimosa’, from the Formosa x Solo intergroup, and the cultivar ‘Golden’, from the ‘Solo’ group were used as controls.

After the harvest, the fruits were immediately packaged in cardboard boxes and transported to the LTA (Laboratory of Food Technology), at the sensory analysis sector of the UENF, in Campos dos Goytacazes-RJ. Then, the fruits were stored in a chamber to ripen at 25°C and relative humidity of 80%. The fruits were kept in the chamber until being used for sensory assessment, at stage six of maturity, when between 71% and 85% of the fruit peel is yellow and ideal for consumption.

The samples were prepared with mature fruits, ready for consumption, peeled and cut into slices of 5 x 2.5 cm, each weighing about 10 g. The apical and basal portions of each fruit, 5 cm each, were discarded. The portions of the samples were coded with three random digits and served in white plastic plates on acrylic trays.

The sensory evaluation of the genotypes was performed in a complete balanced design (Macfies and Bratchell 1989) by 50 appraisers. All genotypes were tasted by the appraisers, 60% of whom were female and 40% male, at ages ranging from 18 to 25 (42%), 26 to 35 (54%) and 36 to 45 years (4%). Among the evaluators, the level of appreciation of fresh papaya was 36% (I appreciate it moderately), 50% (I appreciate it very much) and 14% (I highly appreciate / love it).

The samples of papaya were offered to evaluators at two stages over a period of two days of testing. On the first day, each evaluator received five samples coded with a random three-digit number. On the second day, each evaluator received six samples. The first one, the "dummy sample", is a replication of the last sample evaluated on the previous day of test. The evaluators used this dummy sample only to simulate the sense of continuity during the assessment of the genotype.

Aroma acceptance, flavor, texture and the overall impression were assessed in individual cabins, under red light, by a 9-point mixed structured hedonic scale (Peryam and Girardot 1952): 1: I extremely disliked / hated it; 2: I disliked it very much; 3: I disliked it moderately; 4: I slightly disliked; 5: I neither liked / nor disliked it; 6: I slightly liked it; 7: I liked it moderately; 8: I liked it very much; and 9: I extremely liked / loved it. Evaluations were conducted for Purchase intent (PI1) regarding the overall impression of the genotypes already evaluated in the cabin. In addition, evaluations were carried out in the laboratory, under white light for fruit external appearance, followed by the intent of purchasing it (PI2), and the internal appearance of fruits cut in half, lengthwise, followed by the intent of purchasing it (PI3). The 5-point mixed structured scale (Meilgaard et al. 2006) was used for internal and external fruit appearance and purchase intentions (PI1, PI2, PI3), 1: I certainly would not buy it; 2: I would possibly not buy it; 3: I might buy/not buy it; 4: I would possibly buy it; and 5: I would certainly buy it.

Nine variables were evaluated for the qualitative characterization of the fruits, including five physical variables: fruit length – FL, measured in millimeters from one end of the fruit to the other using a digital caliper, average of five fruits in the plot; fruit diameter – FD, measured in millimeters at the median region of the fruit; pulp thickness – TP, measured from the center of the fruit cavity to the edge of the shell, using a digital caliper, measured in millimeters; and fruit firmness and pulp firmness (FF and PF) - measured from the average puncturing of three equidistant points in the peel and pulp of the fruit, respectively, with the aid of a manual penetrometer, expressed in Newtons; and four biochemical variables: titratable acidity (TA) measured in g ml^{-1}, soluble solids (SS), ratio between titratable acidity and soluble solids (SS/TA) and total sugar (TS) measured in g ml^{-1}. The biochemical variables were evaluated based on the preparations of sample pulp, by the methodologies described in AOAC (1997). All these variables were evaluated in the UENF post-harvest laboratory.

The averages of the acceptance of sensory variables were compared by the Tukey test ($p < 0.05$), and the data of the physical and biochemical variables were subjected to the analysis of variance by the F test ($p < 0.01$) to verify the significance of the treatments, and the means were compared by the Tukey test ($p < 0.05$) (Santana et al. 2004). For the sensory data, it was calculated the frequency distribution of the responses. Both procedures were performed using the SAS Studio software system (SAS Institute, Cary, NC, USA).

The averages of the sensory variables were used to evaluate the formation of similarity groups between the genotypes assessed through the principal components technique (PC), using the GENES software system, version 2013.5.1 (Cruz 2013). The Pearson correlation coefficients between the sensory, physical and biochemical variables were estimated, and their significances were tested by the *t* test ($p < 0.05$) using the GENES software system (Cruz 2013).

RESULTS AND DISCUSSION

Table I shows the comparisons of the means for the sensory variables. A significant difference was found by the Tukey test ($p < 0.05$) for all sensory traits assessed, which indicates a different response of the hybrids according to the analysis of the evaluators.

Overall, considering the set of variables analyzed, the hybrids UC14 and UC16 (Table I) presented the highest levels of acceptance among all genotypes assessed, even surpassing the reference control for the hybrids from the 'Solo' group, the variety 'Golden'. The control 'Tainung 01' achieved the worst overall performance for acceptance of sensory attributes, in contrast to the hybrids UC12 and UC10, from the 'Formosa' group, (Table I), the most well accepted of this group. Among the controls, the hybrid 'Calimosa' presented the best averages for acceptance for all traits assessed.

Some differences were found between hybrids UC14 and UC16, from the 'Solo' group (Table I), but they were almost always in the same average group for total traits, which demonstrates similar sensory behavior. Among the hybrids assessed, UC13 (Table I) showed the worst behavior, only compared to the control 'Tainung 01', except for the traits external and internal appearance, in which UC13 presented behavior consistent with its group, thus exceeding the control 'Golden'.

The sensory acceptance profile can also be analyzed by the principal component analysis. The principal component (PC) technique transforms a set of original data into a new set of data with equivalent size, but with properties of great interest for joint data analysis, such as independence between variables. These components are linear combinations of the variables, estimated in such a way to retain the maximum variation in the first components. Thus, they are associated to reduced data in divergence analysis (Cruz et al. 2013). Several authors have used the principal components to reduce the mass of data in sensory analysis, including in cakes (Padilha et al. 2010), grape (Mascarenhas et al. 2013), acerola (Neves and Lima 2010) and papaya jam (Viana et al. 2012), in order to jointly assess the set of traits investigated.

The first two principal components accumulated 92.70% of the variation present in the mass of data (Table II), thus exceeding the threshold of 80% suggested by Cruz et al. (2013) as appropriate for the interpretation of diversity from the principal components.

Figure 1 shows the diagram with the plotting of the scores based on the principal components for the sensory acceptance variables assessed in this study.

Three cohesive groups can be observed by the projection of the principal components. Group I consist of highly similar genotypes of UC14 and UC16, which can also be proved by the average data presented in Table I. Group II, besides the control 'Calimosa', gathered hybrids UC3 and UC10, from the 'Formosa' group, which are also very similar in their sensory averages, as well as group III, with hybrid UC15, from the 'Solo' group, and the triple hybrid UC12. The other groups IV, V and VI, formed by 'Golden', UC13 and 'Tainung 01', respectively, were isolated from

TABLE I
Averages of sensory acceptance and purchase intentions attributed by consumers (n = 50) to papaya hybrids and controls.

Genotype	Acceptance[1]						Purchase intention[1]		
	Aroma	Flavor	Texture	OI	ExtAp	IntAp	PI1	PI2	PI3
UC03	6.94ab	7.20a	7.14a	7.12a	6.50ac	7.10ab	4.00a	3.86a	3.84a
UC10	6.24abcd	6.99ab	7.08a	6.76ab	6.20bc	7.16ab	4.04a	3.36a	3.92a
UC12	5.80cde	5.78cd	6.34ab	6.02bc	6.66ac	7.26ab	3.04bcd	3.56bcd	4.14bcd
UC13	5.50de	5.02de	5.26cd	5.10cd	6.60ac	7.66ab	2.58cd	3.62cd	4.46cd
UC14	6.90ab	6.86abc	7.00a	6.96ab	6.86ab	7.80a	4.06a	3.98a	4.56a
UC15	6.16bcd	6.00bcd	5.94bc	6.06bc	6.56abc	6.80bc	3.12bc	3.84c	3.94bc
UC16	7.00a	6.94ab	7.24a	6.94ab	7.18a	7.66ab	4.10a	4.32a	4.52a
'Golden'	6.50abc	6.58abc	6.86ab	6.64bc	4.46d	5.64d	3.64ab	2.32ab	3.04ab
'Calimosa'	6.60abc	7.10a	7.20a	6.96ab	6.50abc	6.16cd	3.76b	3.78b	3.60b
'Tainung 01'	5.24e	4.62e	4.78d	4.88d	5.80c	4.48e	2.34d	3.12d	2.22d

[1] Means with same letters in the same column do not differ significantly ($p < 0.05$) according to the Tukey test. ExtAp: External appearance. IntAp: internal appearance. 1: I extremely disliked / hated it; 2: I disliked it very much; 3: I disliked it moderately; 4: I slightly disliked; 5: I neither liked / nor disliked it; 6: I slightly liked it; 7: I liked it moderately; 8: I liked it very much; and 9: I extremely liked / loved it. (Peryam and Girardot 1952). PI1: purchase intent assessed during tasting.; PI2: purchase intent evaluated together with external appearance.; PI3: purchase intent evaluated together with internal appearance.; 1: I certainly would not buy it; 2: I would possibly not buy it; 3: I might buy/not buy it; 4: I would possibly buy it; and 5: I would certainly buy it (Meilgaard et al. 2006). OI: Overall impression.

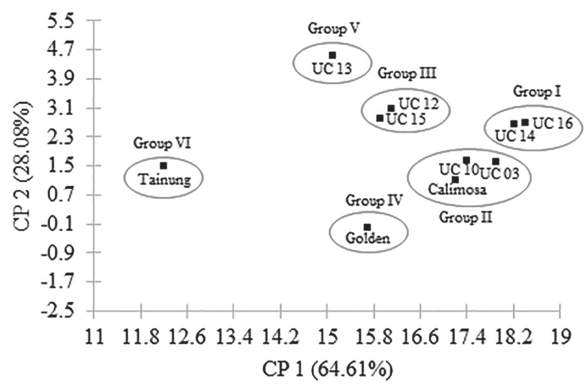

Figure 1 - Projection of the scores for the first two principal components (92.70%) from sensory data.

the other genotypes and showed behavior similar to that already described.

In addition to diversity estimates, the principal component technique provides information about the variables that contributed most to difference (Cruz et al. 2013). Among the variables evaluated, PI2 showed the highest load associated with the last eigenvectors. In other words, it contributes with 7.65% to diversity between hybrids (Table II). Overall, this datum shows that evaluators consider that the external appearance of the fruit is similar for all hybrids. Such information is very important, since, in most cases, fruit selection on supermarket shelves depends solely on external appearance.

Table II presents the estimates of the eigenvalues associated with the principal components and the estimates related to the relative importance of the traits. PI1 (13.83%) showed the highest contribution to divergence followed closely by OI (13.01%). The lowest contributions were observed in PI2 (7.65%) and ExtAp (7.67%). However, Table II reveals that the sensory attributes contributed in a very controlled manner to the grouping of the hybrids. In such cases, the exclusion of any of these variables is not recommended in further analysis, since both contribute in a balanced way to estimate distances (Bilodeau and Duchesne 2002, Rossini et al. 2012, Cruz et al. 2013).

In papaya, fruit quality is usually associated with parameters such as fruit firmness, soluble solids, the amount of sugars, among others (Oliveira and Godoy 2006). In this work, nine traits were measured in the hybrids, when they were ready for consumption, at the 5th ripening stage, to assess the quality of the commercial fruits of the new hybrids under assessment (Table II).

Table III shows the analysis of variance for the physical and biochemical traits evaluated. It can be immediately observed that only three traits showed significant differences among the hybrids: fruit length, fruit diameter and pulp thickness.

In papaya, in the case of hybrids as diverse as those evaluated, differences between them are almost certain, but it must be pointed out that the assessment was conducted at the sixth stage of maturation (ready for consumption), which differs very much from the period when papaya is usually assessed, between the stages of maturation zero and one.

Table IV shows the averages for the physical and biochemical traits assessed. According to the analysis of variance shown in Table III, only FL, FD and PT presented statistical difference. The averages for FF, as described herein, which range between 12.70 and 32.29, and for PF, between 4.88 and 17.30, in this specific case, are not terms of comparison for fruit firmness, since they only reflect the condition of fruit ripening stage. Reference values for fruit firmness in papaya are around 100 and 80 Newtons, for FF and PF, respectively (Pinto et al. 2013a, b). Pulp thickness, on the other hand, is an excellent indicator of the quality of fruits, since the greater the thickness, the more the content of fruit pulp. Table IV shows that the hybrids UC13, UC14, UC15 and UC16, from the 'Solo' group, are well superior to the control 'Golden', which is also true for the hybrids UC12 from the 'Formosa' group, compared to the hybrid 'Tainung 01'.

Sensory attributes in fresh papaya fruits are not easily found in the literature. In Brazil, we found only three reports of the evaluation of papaya acceptance in the formulation of mixed fruit jams (Viana et al. 2012), the conservation of the pulp taste by the effect of the hydrostatic pressure application (Shinagawa et al. 2013) or the changes in parameters related to taste, such as the ratio between soluble solids and titratable acidity by irradiation used in some types of phytosanitary treatments (Camargo et al. 2007). Therefore, the lack of studies on papaya acceptance prevents a direct comparison of the results. Only the comparison of the controls is used. On the other

TABLE II
The relative importance of the traits (Sing method) and estimate of eigenvectors associated to the principal components.

	Relative Importance		Eigenvectors			
	S.j	S%	CP	Av	Av %	Cumulative %
Aroma	11.0568	12.33	CP1	3.613254	64.6156	64.6156
Flavor	11.3395	12.65	CP2	1.570491	28.085	92.7006
Texture	11.5603	12.89	CP3	0.318741	5.70002	98.4006
OI	11.6658	13.01	CP4	0.048906	0.87458	99.2752
PI1	12.3972	13.83	CP5	0.019362	0.34625	99.6214
ExtAp	6.88	7.67	CP6	0.012328	0.22045	99.8419
PI2	6.875	7.65	CP7	0.006183	0.11057	99.9525
IntAp	9.108	10.16	CP8	0.00246	0.04399	99.9964
PC3	8.749	9.76	CP9	0.000199	0.00356	100

OI: Overall impression.; PI1: purchase intent assessed during tasting.; ExtAp: external appearance.; PI2: purchase intent evaluated together with external appearance.; IntAp:. Internal appearance.; PI3: purchase intent evaluated together with internal appearance.

hand, a correlation analysis between the sensory, physical and biochemical variables assessed can help interpreting the results obtained (Fig. 2).

The correlation coefficient between the physical variables FL, FD and TP, Fig. 2, shows statistical significance, with high magnitude, ranging from 0.88 (FL x FD), 0.89 (FL x TP) to 0.91 (FD x PT). The correlations involving physical characters that refer to the qualitative aspects of the fruits are well known in papaya (Silva et al. 2007, Oliveira et al. 2010, 2012) and are consistent with those described herein for the variables investigated. Variations in length, diameter and thickness of fruit pulp are usually positively associated.

No significant correlation was observed between FL, FD and PT and the variables FF and PF, which corroborates that these traits do not change according to the type of fruit, either big or small. On the other hand, PF showed high negative correlation (-0.65) with SS. This correlation cannot be easily explained, although it is already known that, in papaya, the loss of firmness due to advanced ripening stage is caused by the decomposition of cell walls via the activity of some hydrolytic enzymes such as cellulase and β-galactosidase (Gallon et al. 2009, Pinto et al. 2013). This, in turn, due to the decomposition of the cell walls, increases the sugar levels in the cell. Besides, according to Yao et al. (2012), it can explain the magnitude and direction of the correlation observed between PF and SS (-0.65). A similar result for this correlation (-0.81) was described by Oliveira et al. (2012), but the authors did not explain the origin of such correlation.

The content of SS and TA showed correlation only for the TSS/TA ratio with magnitude of 0.66 (SS x SS/TA) and -0.82 (TA x SS/TA), which is quite numerically logic. Correlations presenting similar magnitude and orientation were described by Oliveira et al. (2010) for SS x SS/TA (0.50) and for TA x SS/TA (-0.38).

The content of total sugars (TS), on the other hand, showed no relation even with SS. This may have occurred because the analyses were conducted in an advanced state of ripening, and the genotypes possibly had already reached the limit values for these traits. The data in Tables III and IV corroborate this assumption, since there is no significant difference between the hybrids evaluated for the aforementioned traits.

Otherwise, the biochemical variables (TA, SS, SS/TA, TS) were expected to present some

TABLE III
Analysis of variance of the fruit qualitative variables.

S.V.	F.D.	M.S.								
		FL	**FD**	**PT**	**FF**	**PF**	**TA**	**SS**	**SS/TA**	**TS**
Block	3	181.11	1.028	0.066	105.01	170.48	0.0006	2.553	2037.12	0.357
Hybrids	9	6970.71**	665.81**	0.306*	336.62	63.47	0.0009	0.832	821.52	5.623
Waste	27	449.30	82.27	0.064	200.54	98.30	0.0009	0.702	1017.97	3.017
Average		199.14	108.14	25.6	27.11	8.55	0.098	10.95	117.92	9.05
CV%		10.64	8.38	9.88	32.21	35.13	31.44	7.65	27.05	19.17

FL: fruit length (mm).; FD: fruit diameter (mm).; PT: pulp thickness.; FF: fruit firmness (N).; PF: pulp firmness (N).; TA: titratable acidity (g ml^{-1}).; SS: soluble solids (ºBrix).; SS/TA: ratio between total soluble solids and titratable acidity.; TS: total sugars (g ml^{-1}).; * and **: statistically significant values.

	FL	FD	PT	FF	PF	TA	TSS	TSS/TA	ACT	Aroma	Flavor	Text	OI	PI 1	ExtAp	PI 2	IntAp	PI 3
FL	1	0.88**	0.89**	-0.38	-0.09	0.31	0.31	0.06	0.12	-0.43	-0.18	-0.21	-0.25	-0.19	0.21	0.07	-0.19	-0.24
FD		1	0.91**	-0.18	0.13	0.40	0.34	-0.11	0.18	-0.18	0.00	-0.08	-0.05	0.04	0.55	0.42	0.25	0.19
PT			1	-0.15	-0.05	0.10	0.07	0.15	0.15	-0.41	-0.28	-0.28	-0.32	-0.24	0.48	0.34	-0.05	-0.03
FF				1	-0.06	-0.17	-0.07	0.01	-0.34	-0.33	-0.46	-0.35	-0.42	-0.40	0.19	0.07	0.46	0.46
PF					1	-0.35	-0.65*	-0.02	0.27	0.20	0.23	0.31	0.23	0.12	0.20	0.23	0.01	0.13
TA						1	0.54	-0.82**	-0.44	0.04	0.24	0.15	0.13	0.25	-0.02	-0.03	0.25	0.19
TSS							1	0.66*	0.15	-0.02	0.19	0.15	0.16	0.20	-0.17	-0.24	0.18	0.04
TSS/TA								1	0.38	-0.26	-0.31	-0.26	-0.26	-0.32	-0.17	-0.24	-0.44	-0.44
ACT									1	0.23	0.28	0.33	0.33	0.19	0.37	0.34	0.22	0.19
Aroma										1	0.92**	0.90**	0.94**	0.93**	0.20	0.38	0.42	0.42
Flavor											1	0.99**	0.99**	0.97**	0.13	0.27	0.38	0.36
Text												1	0.98**	0.96**	0.12	0.24	0.41	0.40
OI													1	0.93**	0.13	0.27	0.38	0.37
PI 1														1	0.165	0.29	0.44	0.42
ExtAp															1	0.97**	0.69*	0.71*
PI 2																1	0.66*	0.69*
IntAp																	1	0.98**
PI 3																		1

Figure 2 - Pearson´s correlation coefficient among the sensory and qualitative variables of fruits. Text: Texture.; FL: fruit length (mm).; FD: fruit diameter (mm).; PT: pulp thickness (mm).; FF: fruit firmness (N).; PF: pulp firmness (N).; TA: titratable acidity (g ml^{-1}).; TSS: total soluble solids (ºBrix).; TSS/TA: ratio between total soluble solids and titratable acidity.; OI: overall impression.; PI1: note on purchase intent assessed in the overall impression.; ExtAp:. Note on the external appearance of whole fruits.; PI2: note on purchase intent assessed from ExtAp.; IntAp:. Note on the internal appearance of fruit cut in half.; PI3: note on purchase intent assessed from IntAp.

TABLE IV
Averages of the fruit qualitative variables.

Genotypes	Physical					Biochemical			
	FL	FD	PT	FF	PF	TA	SS	SS/TA	TS
UC 03	191.97c	108.87b	25.0ab	22.51a	5.00a	0.101a	11.34a	115.21a	10.72a
UC 10	272.38a	131.67a	28.5a	19.69a	4.88a	0.135a	11.85a	101.21a	8.37a
UC 12	215.81bc	112.72ab	26.9a	29.85a	11.19a	0.077a	11.17a	140.53a	11.39a
UC 13	187.75c	108.90b	26.2a	23.36a	7.59a	0.110a	10.72a	101.59a	7.77a
UC 14	169.54cd	108.02b	25.3ab	24.37a	5.78a	0.092a	11.02a	125.88a	8.85a
UC 15	177.99cd	100.01bc	23.2ab	28.85a	7.91a	0.105a	11.02a	106.85a	8.74a
UC 16	176.74cd	108.27b	25.5ab	32.29a	17.30a	0.092a	10.31a	113.33a	8.90a
'Golden'	128.89d	79.48c	19.4b	27.62a	8.32a	0.095a	10.97a	121.30a	7.99a
'Calimosa'	219.43bc	110.47ab	26.5a	22.70a	12.62a	0.095a	10.37a	112.62a	9.58a
'Tainung 01'	251.01ab	113.53ab	29.2a	20,46a	5.27a	0.085a	10.70a	141.27a	8.30a

FL: fruit length (mm).; FD: fruit diameter (mm).; PT: pulp thickness (mm).; FF: fruit firmness (N).; PF: pulp firmness (N).; TA: titratable acidity (g ml^{-1}).; SS: soluble solids (ºBrix).; SS/TA: ratio between total soluble solids and titratable acidity.; TS: total sugars (g ml^{-1}).

correlation with the sensory attributes, particularly SS/TA, which indicates fruit ripening. However, it did not occur (Table IV). The data presented do not lead to an immediate conclusion about the level of the relationship between the biochemical variables mentioned and the sensory attributes.

The main sensory attributes correlated to each other showed that aroma had positive and high magnitude correlation with flavor, texture and overall impression (0.92, 0.90 and 0.94), respectively. Similar behavior was found for flavor, with texture and overall impression (0.99 and 0.99), respectively; and between texture and overall impression (0.98). These correlations show that the attributes flavor and aroma are closely linked to the taster's sensation of satisfaction, expressed in the overall appearance of the samples under analysis. It must be pointed out that no correlation was observed between flavor and total soluble solids and sugar content, as mentioned above. On the other hand, there was high correlation between aroma and flavor (0.92) (Fig. 2).

In papaya, the aromatic compounds seem to play an important role in the perception of the sensory attributes of the fruit. More than 300 volatile compounds have been identified in papaya (Pino 2014), but with a wide range of compositions in the different cultivars (Franco et al. 1994). Among these compounds, the most cited are linalool, with floral and sweet notes, and oxide-linalool, with green and bitter notes. Almora et al. (2004) mentioned benzyl isocyanate with striking odor in cv. 'Maradol' papaya, with strong notes of green. This odor decreases sharply during fruit ripening, which induces the activity of other compounds, mainly butanol and 3-methylbutanol at full ripe stages of the fruit. According to Wijaya and Chen (2013), papaya flavor results from a complex interaction between sugars, organic acids and volatile compounds, which may vary according to the cultivars studied and the season when evaluation is performed. The mentioned authors believe that the volatile compounds present in the hybrids assessed are important for the sensory perception of taste, although the present work did not use any methodology to corroborate it. Franco et al. (1994) associated the presence of linalool in varieties of papaya from the 'Solo' group to the taste of nectar (sweet), and to notes of green, associated with the bitter flavor in varieties from the ‘Formosa’ group. In Table I, the highest average for aroma occurred exactly in a cultivar from the ‘Solo’ group, UC16 (7.0), and the lowest, in a cultivar from the ‘Formosa’ group, ‘Tainung 01’ (5.24).

Purchase intentions PI1, PI2 and PI3 were highly correlated to OI, ExtAp and IntAp (0.93, 0.97 and 0.98), respectively. These figures indicate that purchase intent is largely driven by the first impression consumers have of the fruit and in this case, a healthy and beautiful fruit. If consumers had the chance to taste the fruit before purchase, they would surely have a favorable attitude towards taste, given the positive correlation and high magnitude between flavor and PI1 (0.93).

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