

Research Application Summary

**Morphological and nutritional characteristics of new Papaya Hybrid Fruits**

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**Abstract**

Papaya (*Carica papaya* L.) is a popular and economically important tropical fruit. Its production in Kenya is practiced at both small and large scale. The major challenge is getting good planting materials and producing quality papaya fruits that meet international quality standards. Most producers use imported seeds, or farmer-selections which are of unknown quality. Researchers at Jomo Kenyatta University of Agriculture and Technology (JKUAT) recently developed new papaya hybrids through selection and cross breeding of local germplasms and Solo Sunrise. However, the quality of the new papaya hybrid fruits has not been evaluated. The objective of this study was to evaluate morphological and nutritional characteristics of the new papaya hybrids. The fruits were collected at breaker stage from JKUAT's Block A (research farm). Fruits size (weight, length and diameter), shelf-life and total soluble solid (TSS) content were evaluated. The papaya descriptor (IBPGR) and Standard for papaya (CODEX STAN183-1993) were used in size evaluation and classification. The hand held refractometer was used to determine TSS. Data on shelf-life were evaluated every two days for fruits stored at room temperature ( $25 \pm 2^\circ\text{C}$ ). The data were analyzed for variance (ANOVA) using GenStat software 14th edition and the mean separation conducted at 5% probability level using Duncan's multiple range test (DMRT). The size of the new papaya hybrid fruits was classified as small, medium and large. The fruits shelf-life ranged from 4 to 11 days at room temperature, while the TSS varied from 7.4 to 12.3%. The new papaya fruits presented desirable traits for both the local and international markets. Thus, the new papaya hybrids have the potential for commercial production in Kenya.

Key words: Cross breeding, Kenya, papaya germplasms, shelf-life, selection

**Résumé**

La papaye (*Carica papaya* L.) est un fruit tropical très connu et économiquement important. Sa production au Kenya est pratiquée à la fois à petite et à grande échelle. Le défi majeur est d'obtenir de bons matériels de plantation et de produire des fruits de papaye de qualité qui répondent aux normes internationales de qualité. La plupart des producteurs utilisent des semences importées ou des sélections paysannes dont la qualité est inconnue. Des chercheurs de l'Université d'Agriculture et de Technologie Jomo Kenyatta (JKUAT) ont récemment développé de nouvelles variétés hybrides de papaye grâce à la sélection et le croisement de germoplasmes locaux avec la variété Solo Sunrise.

Cependant, la qualité des nouveaux fruits hybrides de papaye n'a pas été évaluée. L'objectif de cette étude est d'évaluer les caractéristiques morphologiques et nutritionnelles des nouveaux hybrides de papaye. Les fruits ont été récoltés au début du rougissement dans le bloc A de JKUAT (ferme de recherche). La taille des fruits (poids, longueur et diamètre), la durée de conservation et la teneur en matières sèches solubles totales (TSS) ont été évaluées. Le descripteur de la papaye (IBPGR) et la norme pour la papaye (CODEX STAN183-1993) ont été utilisés dans l'évaluation de la taille et la classification. Un réfractomètre portatif a été utilisé pour déterminer le TSS. Les données sur la durée de conservation ont été évaluées tous les deux jours pour les fruits conservés à température ambiante ( $25 \pm 2$  °C). Les données ont été soumises à une analyse de variance (ANOVA) dans le logiciel GenStat 14e édition et la séparation des moyennes effectuée à un niveau de probabilité de 5% grâce au test de Duncan (DMRT). Les tailles des fruits des nouvelles variétés hybrides de papaye ont été classées comme petite, moyenne et grande. La durée de conservation des fruits variait de 4 à 11 jours à température ambiante, tandis que le TSS variait de 7,4 à 12,3%. Les fruits de ces nouvelles variétés de papaye présentaient les caractéristiques désirées par les marchés locaux et internationaux. Ainsi, ces nouvelles variétés hybrides de papaye ont un potentiel de production commerciale au Kenya.

Mots clés: Croisement, Kenya, germoplasmes de papaye, durée de conservation, sélection

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## Introduction

Papaya is from Caricaceae family and originated from tropical America (Nakasone and Paull, 1998). It is distributed throughout Asia and Pacific continents. Currently, it is grown in all tropical and subtropical countries between 32° North and South latitudes but higher commercial production is found between 23° N and S latitudes (Nakasone and Paull, 1998). Papaya fruit ranges in size from 7-30 cm and the shape vary according to the varieties.

The fruits are called pepo like berries due to their melon like (Yogiraj *et al.*, 2014). The fruits from female trees are spherical whereas the shapes of the fruits from hermaphrodite trees are affected by environmental factors that modify floral morphology during early development of the inflorescence (Aikpokpodion, 2012). The green fruits contain an abundance of milky latex while the ripe fruits have yellow-orange coloured skin (Nakasone and Paul, 1998). Papaya fruits have been found to have high economical and nutritional value (Bhardwaj and Nandal, 2015). It is grown for a variety of products including, edible fresh fruits and drinks, jams, candies and dried fruit (Workneh, 2012). The ripe fruits are eaten fresh and the green fruits are cooked as vegetables (Azad *et al.*, 2014). The latex of green fruits contains papain which is proteolytic enzyme and is used in beverage, food and production of chewing gum, chill-proofing beer, tenderizing meat and treating digestive disorders (Rahman, 2013).

Papaya is a very wholesome fruit and it is an excellent source of Vitamin C and A (Wijaya and Chen, 2013). Additionally, papaya has pharmacological and cosmetic application (Elgadir *et al.*, 2014). Papaya is popular and economically important fruit crop in Kenya and it is grown on both small and large scale (Asudi *et al.*, 2010). It is propagated sexually where the farmers collect the fruits of good quality from their orchards and extract the seeds for the subsequent plantings (Teixeira *et al.*, 2007). The importing of seed from some commercial varieties is another alternative source of planting materials. According to Asudi *et al.* (2010), the imported cultivars face many changes associated with open pollination and this results in loss of their identity and compromises fruits quality. Jomo Kenyatta University of Agriculture and Technology (JKUAT) developed new papaya hybrids from

selection and cross pollination of different germplasms collected all over the country, one of them being Solo Sunrise. However, their fruits features have not been evaluated. Thus, the aim of this study was to evaluate fruits size, keeping quality and TSS of the new papaya hybrids.

## Materials and methods

Papaya hybrids developed by selection and crossing of local germplasms (Table 1) and the control (Solo sunrise) were used in the study. They were planted in an open field in a complete randomized block design with new hybrids as main treatments and Solo Sunrise as control. The set-up was replicated three times and the normal agronomic practices were performed. The papaya fruits were collected and evaluated between December 2017 and February 2018 from JKUAT farm. The fruits were harvested at breaker stage from 11 months old female plants. The papaya descriptor was used to evaluate the size of the new papaya fruits (IBPGR, 1988), Standard for papaya (CODEX STAN 183-1993) (2011) was used to classify the fruits. The significance among the papaya hybrid and the control was evaluated with analysis of variance (ANOVA) using the GENSTAT software 14th edition.

**Table 1. New papaya hybrids evaluated**

No	1st parental line	Second parental line	Hybrid
1	Local papaya from Manyani (Man 1)	Solo sunrise	Line 1
2	Local papaya from Voi (Voi 4)	Local papaya from Kilifi	Line 2
3	Local papaya from Voi (Voi 5)	Local papaya from JKUAT farm ( Block A)	Line 3
4	Local papaya from Voi (Voi 5)	Solo sunrise	Line 4
5	Local papaya from Mombasa	Local papaya from Voi (Voi4)	Line 5
6	Local papaya from Kirinyaga	Solo sunrise	Line 6
7	Local papaya from Voi (Voi 4)	Local papaya from JKUT farm ( Block A)	Line 7
8	Local papaya from Manyani ( Man 2)	Solo sunrise	Line 8

## Results and discussion

According to the results (Table 2) there was significance variation in size between the new papaya hybrids and the control. Line 4 and Line 6 had the heaviest and largest fruits. Line 5 and Line 7 showed the highest TSS content of 12.3% . The variation in keeping quality among the new papaya hybrids and the control was also observed. The fruits size classification is very important, it is the main parameter that the consumers take into consideration during purchasing.

Among the evaluated papaya fruits, Line 2, Control and Line 5 showed the highest proportion of small size (fruit weight below 500 g, fruits length below 15 cm and fruit diameter below 10 cm) (Figure 1). Line 7, Line 8, Line 3 and Line 2 had higher percentage of medium fruits size (fruit weight between 500 and 1000 g, fruits length between 15 cm and 25 cm and fruits diameter between 10-13 cm). Line 4 and Line 6 presented the higher percentage of large fruits size (fruit weight greater than 1000 g, fruits length greater than 25 cm and fruit diameter greater than 13 cm) (Plate 1).

**Table 2. New papaya hybrids fruits characteristics**

Treatments	Weight (g)	Length (m)	Diameter (cm)	Brix	Keeping days	Class
Control	544 ±56.3cd	12.3±0.6 e	9.4 ±0.6def	7.7±0.2e	6.0±0.2e	Small
Line 1	430±45.3d	13.8±0.5d	8.5±0.5f	11.2±0.1b	4.0±0.1f	Small
Line 2	813.7± 72.2 bc	16.8± 0.5c	10.5± 0.4cd	11.6± 0.1b	7.0±0.2d	Medium
Line 3	898.5± 62.5b	17.2± 0.5bc	11.4± 0.3bc	8.7± 0.2d	7.0±0.2d	Medium
Line 4	1246.7± 70.3a	21.2± 0.5a	11.9±0.2 b	8.6±0.2d	10.3±0.1b	Large
Line 5	586.7± 58.2cd	16.6± 0.6 c	10± 0.5de	12.3±0.2a	7.0±0.2d	Medium
Line 6	1240.8± 93.9a	18.5± 0.6 b	13.3± 0.6 a	10±0.2c	8.7±0.1c	Large
Line 7	586.3± 36.2 cd	16.5± 0.5c	9.2± 0.4 ef	12.3±0.2a	11.5±0.2a	Medium
Line 8	626.7± 44.9c	17.5± 0.4bc	9± 0.3ef	7.4±0.2e	4.0±0.1f	Medium
LSD	171.9	1.5	1.22	0.5	0.46	
CV %	43.6	17.2	23.1	10.6	12.6	

The values are mean± standard error (S.E).

**Figure 1. Photos showing fruits classification and category**

The study results indicate that new papaya hybrids varied in size, keeping quality and TSS content. Their sizes range varied: small, medium and large fruits but most fell into small to medium size. According to OECD (2003), the fruits size range from 7-30 cm long and vary in mass from about 250 to 3000 g. Rivera *et al.* (2005) placed papaya into two groups, the small fruits weighing below 500g and the big fruits weighing from 500g up to 10kg. Fruit size is the main parameter that determine

the market price and export grade (Riyadi *et al.*, 2007). On the other hand the new papaya hybrids had TSS levels ranging from 7.4% to 12.3% which is within the range of export requirement. The Jamaica Papaya Growers Association indicated that the brix should be at least 12% (Aikpokpodion, 2012). Thus the fruits characteristic of new papaya hybrids showed desirable traits for export and local market.

## Conclusion

The fruits characteristic of new papaya hybrids and the control showed heterogeneity. The differences observed among them was due to different genetic make-up. This study demonstrated that the new papaya hybrids met the quality standard for both local and international markets.

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