

*Full Length Research paper*

# Enhancing postharvest qualities in tomato value chains; the impact of cultivar types as quality indicator

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This research investigated several postharvest quality parameters of five (5) highly recommended tomato cultivars (Akoma, Cal. J, Royal, Pectomech and Power) in Ghana. Fruits harvested at the pink colour stage were evaluated after ten (10) days' storage under an average temperature of 26.85°C and relative humidity of 84.55%. The findings shown significant difference ( $p < 0.05$ ) among cultivars Royal, Pectomech, Akoma, Cal. J and Power in fruit general appearance, weight loss, firmness, decay, pericarp thickness, total soluble solids, dry matter and fruit shelf life. Cultivar Royal performed better in all the postharvest qualities studied than any other cultivar. However, with the exception of Total Soluble Solids, the findings revealed insignificant differences ( $p > 0.05$ ) in postharvest quality traits studied between cultivars Royal and Pectomech. Even though Power fruits performed poorly in postharvest qualities studied, the result indicated insignificant difference ( $p < 0.05$ ) in general appearance, fruit weight loss, pericarp thickness, total soluble solids, dry matter between cultivar Power and Cal. J. With exception of fruit general appearance and fruit pericarp thickness, the findings revealed insignificant differences ( $p > 0.05$ ) among cultivars Akoma and Cal. J in all postharvest quality traits studied. While fruit decay in cultivars Royal, Pectomech and Cal. J revealed a significant relationship with pericarp thickness, shelf life, the fruit decay in Akoma and Power showed significant correlation with only fruit shelf life. For better postharvest quality performance, this research advocates the adoption of cultivars Royal and Pectomech in tomato value chain operation in Ghana.

**Key words:** Postharvest, losses, quality, tomato, cultivars, value chain, Ghana.

## INTRODUCTION

The unceasing changes in quality of food products throughout the entire value chain to the points of final consumption and the wide distance between important nodes in the food value chain (Aiello, et al., 2012) have raised the interest in food value chain research. Postharvest losses in fruits and vegetables have become a major undermining factor to achieve sound food security in the globe. Even though postharvest losses

among the various fruits and vegetables vary across different geographical locations, earlier research have pegged global food losses between one (1) to fifty (50) percent from the production to consumption nodes of their value chain (Cappellini and Ceponis, 1984; Kantor et al. 1997; Kader, 1992). Among the horticultural crops that need much attention in the food value chain due to its perishability rate is fresh tomato. Tomatoes have become almost an obligatory ingredient in the daily diets of people across all regions. This is because it is low in fat, calories, cholesterol-free and a good source of fiber, vitamins A and C,  $\beta$ -carotene, lycopene (provide protection against a broad range of epithelial cancers)

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and potassium (Kabelka et al., 2004). Tomato (*Lycopersicon esculentum* Mill.) is one of the major horticultural crops widely grown in many parts of the globe (Srinivasan, 2010). Its global production is estimated to be over 120 million metric tons (F.A.O. 2007) yet due to its perishability rate and susceptibility to mechanical damage during handling and transportation (Bani et al., 2006) most tomatoes do not get to the end user or they do with poor quality. To mitigate these problems, most countries allocate huge financial resources to import tomato products to supplement their demand. For instance, a report revealed Ghana's importation of tomato paste increased from 3,300 tons in 1998 to 24,740 tons in 2003, an increase of 650 percent (FAO, 2006). Though postharvest losses in fruit and vegetable value chain are alarming, to our knowledge research to mitigate these losses is limited. When postharvest losses are not controlled, participant/actor runs into financial loss and their business collapses. Earlier research confirms finance as a major resource to control firms' power (Yongyi et al. 2013). In some cases, alarming postharvest losses of tomato could cause fatalities among the participants/actors due to their inability to repay the financial loan. Tomato has more varieties sold globally than any vegetable crop (Sacco, 2008). The quality of fruits and vegetables in its value chain could be highly linked to the ability of the cultivar to maintain certain postharvest qualities such as lower weight loss (water loss), fewer fruit cracks, decay incidence, longer shelf life, among others (Maalekuu et al., 2004; Smith et al. 2007). Among the quality traits of fruits and vegetables are general appearance, weight loss, fruit decay, pericarp thickness, fruit firmness, dry matter, total soluble solids and shelf life. The General appearance of fruits is highly influenced by the fruit's colour as well as the presence and magnitude of defects. General appearance plays an important role in making marketing decisions (Kays, 1999; Batu, 2004). In most marketing systems, weight loss of fruits and vegetable product determines its market value. According to Perez et al. (2003), quality of fruit is highly influenced by degree of weight loss during storage under specific environmental conditions. Wilson et al. (1999) indicate that weight (water) loss is the principal cause of fruit softening and shriveling. The moment opportunistic pathogens engulf bruises, cuts and punctures of fruits they often can surround the rest of the fruits (Sergeant et al., 1998). Fruits and vegetables vary in their innate resistance to decay; those crops that have active wound-healing processes are more resistant (Niklis et al., 2002). Pericarp tissue is a key component of both processing and fresh market cultivars (Artherton and Rudich, 1986). Pericarp thickness does not influence only fruit appearance, handling and storage, but also plays a prominent role in fruit cracking (Seske, 1995). The firmness is a criterion often used to evaluate fruit quality. Fruit firmness is considered to be the principal characteristics of fruit quality, harvest maturity and storage and shelf life (Dobrzanski and Rybezyski, 1998). Fruit firmness is related to the likelihood of bruising when fruits are subjected to certain influence during handling (Lesage and Destain, 1996). High quality fruits have a firm appearance, uniform and shiny colour, without signs of injury, shrivelling or decay (Sargent and Moretti, 2002). Dry matter

content in fruits has become an important quality trait in tomato because major components of tomato taste such as sugars and acids, are more concentrated in tomato dry matter (Auerswald et al., 1999; Loboda and Chuprikova, 1999). Fruit eating quality can be correlated to a number of variables, including dry matter content (Walsh et al., 2004). Previous research revealed a high correlation of consumer acceptance of fruits with high soluble solid concentration (SSC) in many commodities (Kader, 1994). Tomato fruits contain about seven percent solids (Norman, 1992). Fruit shelf life is a period which starts from harvesting and extends up to the start of rotting of the fruits (Mondal, 2000). The shelf life of fruit is an important quality trait from a producer's and distributor's point of view. Fruits shelf life allows the determination of risks arising from the loss of commercial value of fresh fruit in trade turnover (Radajewska and Borowiak, 2002). Ghana can boast of numerous tomato cultivars. Among the highly recommended tomato varieties in Ghana are the Roma VF, Pectomech, Pectomech VF, Tropimech, Royal, Rio Grande, Cal J, Wosowoso, Laurano 70 and Power (MoFAIR 2008). However, participants/actors in the tomato value chain currently face challenges in distinguishing the cultivars based on their postharvest quality performance. Cultivar differences could influence postharvest losses of fruit and vegetables (Maalekuu et al., 2004). However, to our knowledge, no research has assessed the potential postharvest qualities of major tomato cultivars grown in Ghana. Hence, this research adopts sound scientific methodologies to evaluate the postharvest quality traits of five tomato cultivars (Royal, Pectomech, Cal.J, Akoma and Power) under similar environmental conditions. The contributions of this research to the literature on tomato value chain management are in three major folds. First, by categorizing tomato cultivars grown in Ghana based on several postharvest harvest qualities, the chains' participants/actors could choose and trade in best postharvest performance cultivars. Secondly, the results of this research could guide tomato breeders in improving postharvest qualities of tomatoes. Thirdly, the result will be served as a guide for decision making bodies/government officials to outline new policies and regulations to control postharvest losses in the tomato industry. The next section elaborates the methodologies adopted in this research. The results of the study are in section 4. Section 5 discusses the findings. Finally, section 6 concludes the study and highlight future research.

## MATERIALS AND METHOD

### Field Description

The field experiment (sandy loam soil) is located at latitude 6° 43'N and Longitude 1° 36' N within the rainfall pattern of the forest zone of Ghana with an average rainfall of 645mm during the research period. Soil samples were randomly collected from different cores at 0-15cm and 15-30cm for analyzed for the contents of organic carbon (1.10% and

**Table 1.** Means of fruit quality parameters as influenced by tomato cultivar types.

Cultivar	GA	WL (g)	FF (N)	FD (%)	PTK (g)	DM (g/cm <sup>2</sup> )	TSS (Brix)	SL (Days)
Akoma	3.98a	3.32b	3.36a	8.10b	3.65a	0.26b	3.45b	8.23b
Cal J	3.33b	3.33bc	2.99a	7.79b	2.33b	0.19b	3.11b	6.93b
Pectomech	4.01a	2.43a	3.37a	6.17a	3.67a	0.34a	3.59b	10.11a
Power	3.31b	3.56c	2.39b	10.67c	2.25b	0.21b	3.23b	6.38c
Royal	4.03a	2.27a	3.43a	6.10a	3.70a	0.36a	4.05a	10.20a
CV %	2.3	2.1	2.5	4.6	4.1	3.1	1.5	3.6

**NB:** Figures with the same alphabets are insignificantly different from each other

General Appearance (GA), Weight loss (WL), Fruit Firmness (FF), Pericarp Thickness (PTK), Fruit Decay (FD), Dry Matter (DM) Total Soluble Solids (TSS) and Shelf Life (SL).

0.70%), organic matter (1.94% and 1.28%), total nitrogen (0.13%, 0.09%), exchangeable potassium (0.51 cmol/kg and 0.21 cmol/kg), Calcium (5.23 cmol/kg and 4.21 cmol/kg), Magnesium (1.31 cmol/kg and 1.89 cmol/kg), Available Phosphorus (231 and 132) and pH. 6.50 and 5.34 respectively. A Complete Randomized Block Design involving 5 cultivars with three (3) replications was adopted. Seedlings of the cultivars 'Akoma, Cal.J, Royal, Pectomech and Power were transplanted three weeks later (after they had been watered well) to the field which had been lined and pegged using a plot size of 3m x 4m and planting distances of 60cm x 75cm and 0.9 meters between and within rows.

### Cultural practices

All appropriate cultural practices including staking irrigation, pests control (with cypadem 43.6% EC), an organophosphate insecticide at 36g cypamethrin plus 400g dimethoate per litre in the form of emulsifiable concentrate at dosage rate of 0.6-1 litre/ha), hand weeding control, fungi control (with sundomil 72% WP, containing metalaxyl 8% and mancozeb 64% per kilogram) in the form of wettable powder at 250-350g in 100 litres of water four(4) spray at 10-14 days' intervals were timely performed. Fruits at the pink stage were harvested (calyx attached) from plants marked or tagged in the field at three different harvests each in the morning within a month and two weeks from each plot and immediately placed under shade to maintain fruits temperature. Fruits were quickly transported to the laboratory where sorting and grading were carefully done and homogeneous colour developments were selected for further studies on qualitative parameters.

### Laboratory Description

Tomato cultivars Akoma, Cal. J, Royal, Pectomech and Power fruits stored for ten (10) days at 26.85°C and

85.75% RH were evaluated for postharvest quality parameters such as General Appearance, Weight Loss, Firmness, Decay, Pericarp Thickness, Dry Matter, Total Soluble Solids and Shelf Life. Sixty (60) pots containing ten (10) fruits from each plot were set up in the laboratory for each harvest in a complete randomized design and stored for ten (10) days at an average temperature of 26.85°C and relative humidity of 85.75%).

### DATA COLLECTED

Fruit General Appearance (GA) scored by overall quality was based on the fruit general acceptability to the consumer. It was measured subjectively on an 8-point hedonic scale where 0 = poor (extremely defective), 2 = fair (defective), 4 = good (moderately defective), 6 = very good (slightly defective), 8 = excellent (not defective) (Cabrera and Saltveit, 1992). Weight loss (WL) of fruits was determined as a percentage of initial weight to the final weight during the storage period. Statistically express as,  $WL = \frac{WL_1}{WL_2} * 100$  where WL = weight loss,  $WL_1$  = initial weight loss,  $WL_2$  = final weight loss. Fruit firmness (FF), fruit firmness was determined with a fruit an effigy Penetrometer (Kitinoja and Husein, 2005). A circular portion of the peel of diameter about 2 cm was removed before applying the plunger of the firmness tester in order to eliminate the effect due to the peel, and firmness was expressed in Newtons (Batu, 1998). Pericarp thickness (PTK), high precision digital veneer caliper was used to measure (mm) pericarp thickness from three (3) discs of 10 mm in diameter taken at the equatorial region of five fruits. Fruit Decay (D) was recorded as soon as fungal mycelia appeared on the calyx or peel of the fruit. Decay was expressed as the percentage of the total number of fruits stored. Dry matter (DM) was measured by taking three (3) discs of 10 mm in diameter in the equatorial region of fresh fruits and oven dried at 105 degree Celsius until the constant dry weight and expressed in gram per square centimeter (g/cm<sup>2</sup>) (AOAC 1990). Juice from the cultivars

Fruits were squeezed onto Abbe's hand refractometer recommended by the Association of official Analytical chemists (Anonymous, 1984) to determine the Total Soluble Solids (TSS). Shelf life (SL) was observed from the start of harvesting and extended up to the start of rotting of fruits (Mondal, 2000).

Data collected were analyzed using analysis of variance (ANOVA) with statistical package - GENSTAT discovery edition 3.0. Means were separated by Lsd test at 5% and Correlation was analyzed with statistical package SPSS edition 18.

## RESULTS

### Impact of cultivar difference on fruit General Appearance

Fruit general appearance is the first criterion that influences customers purchasing abilities. The results revealed that, the fruits general appearance of cultivars of Royal (4.03), Pectomech (4.01), Akoma (3.98) were significantly ( $P < 0.001$ ) better than the general appearance of the fruits of cultivars Cal J. (3.33) and Power (3.31) respectively. However, insignificant difference was obtained in general appearance between the fruits of cultivars Power and Cal. J as well as general appearance among fruits of Royal (4.03), Pectomech (4.01), Akoma(3.98)respectively(Table 1).

### Impact of cultivar difference on fruit Weight Lost

The analysis of variance indicated significant differences ( $P < 0.001$ ) in fruit weight lost among the cultivars evaluated. Fruit weight lost recorded in cultivars Royal (2.27g) and Pectomech (2.43g) were significantly ( $p < 0.01$ ) lesser than weight loss recorded in cultivars Akoma (3.32g), Cal. J (3.33g) and Power (3.56g) fruits respectively. Even though fruits of cultivar Akoma (3.32g) lost lesser weight than fruits Cal. J (3.33g) and Power (3.56g) respectively, the difference in weight loss among Akoma (3.32g) and Cal. J was insignificant ( $p > 0.01$ ). However, Akoma (3.32g) fruits recorded significantly ( $p < 0.01$ ) lesser weight than Power fruits (3.56g). In addition, insignificant difference ( $p > 0.01$ ) weight loss was observed between cultivars Power (3.56g) and Cal. J (3.33g) (Table 1).

### Impact of cultivar difference on fruit Firmness

The analytical results revealed that, fruit firmness differs among cultivars. Fruit firmness were significantly ( $p < 0.001$ ) higher Royal (3.42N) and Pectomech (3.37N) than Cal. J (2.99N), Akoma (3.36) and Power (2.39) While insignificant difference ( $p > 0.01$ ) as observed among the fruit firmness of Cal. J (2.99N) and Akoma

(3.36N), the fruit firmness of cultivar Power (2.39 N) was significantly ( $p < 0.001$ ) lower than fruit firmness of Cal. J (2.99N) and Akoma (3.36N) respectively (Table 1).

### Impact of cultivar difference on fruit Decay

The evaluation of the impact of tomato cultivars on postharvest fruit decay revealed that, fruit decay is influenced by tomato cultivar differences. Highly significant differences ( $P < 0.001$ ) were observed among the cultivars. Fruits decay in cultivars Royal (6.10%) and Pectomech (6.17%) was significantly ( $p < 0.001$ ) lower than the decay rate in cultivars Power (10.67%), Akoma (8.10), Cal. J (7.99%) respectively. Cultivar Power recorded significantly ( $p < 0.001$ ) the highest decay incidence rate (10.67%) than decay in cultivars Akoma (8.10), Cal. J (7.99%). The analysis revealed insignificant differences ( $p > 0.01$ ) among decay rate in cultivars Akoma (8.10) and Cal. J (7.99%) (Table 1).

### Impact of cultivar difference on fruit Pericarp Thickness

The test for fruit pericarp thickness of tomato cultivars indicated highly significant differences ( $P < 0.001$ ) among the cultivars. Royal fruits (3.70mm),Pectomech (3.67mm)and Akoma (3.65 mm) recorded significantly different ( $p < 0.001$ ) fruit pericarp thickest from the fruits of Power (2.25mm) and Cal. J (2.33 mm). However, insignificant differences ( $p > 0.01$ ) of fruits pericarp thickness were observed among cultivars Royal (3.70mm), Pectomech(3.67mm) and Akoma (3.65mm) as well as the fruit pericarp thickness between Power (2.25mm) and Cal. J (2.33 mm) (Table 1).

### Impact of cultivar difference on fruit Dry Matter

Royal fruits recorded the highest dry matter of  $0.36 \text{ g/cm}^2$  followed by fruits from Pectomech ( $0.34 \text{ g/cm}^2$ ),Akoma( $0.26 \text{ g/cm}^2$ ), Power ( $0.21 \text{ g/cm}^2$ ) and Cal J ( $0.19 \text{ g/cm}^2$ ). Though the dry matter content among Royal ( $0.36 \text{ g/cm}^2$ ) and Pectomech ( $0.34 \text{ g/cm}^2$ ) were insignificant ( $p > 0.01$ ) different from each other, Royal ( $0.36 \text{ g/cm}^2$ ) and Pectomech ( $0.34 \text{ g/cm}^2$ ) dry matter contents shown significantly different ( $p < 0.001$ ) from dry matter of Akoma ( $0.26 \text{ g/cm}^2$ ), Power ( $0.21 \text{ g/cm}^2$ ) and Cal J ( $0.19 \text{ g/cm}^2$ ) cultivars. Nonetheless, insignificant differences were observed between fruits harvested from Akoma ( $0.26 \text{ g/cm}^2$ ), Power ( $0.21 \text{ g/cm}^2$ ) and Cal J ( $0.19 \text{ g/cm}^2$ ) respectively (Table 1).

### Impact of cultivar difference on fruit Total Soluble Solids

Our results revealed that the cultivar type influence Total Soluble Solids differently. Total Soluble Solids produced by cultivar Royal (4.05 Brix) were significantly ( $p < 0.001$ )

**Table 2.**Correlation of Postharvest Quality Traits in Tomato.

Cultivar Power	General (GA)	Appearance	Weight Loss (WL)	Fruit (FF)	Firmness	Fruit (FD)	Decay	Pericarp (PT)	Thickness	Dry (DM)	Matter
GA	-										
WL	-0.65**		-								
FF	0.60*		-0.65**	-							
FD	-0.55*		0.64**	-0.61**		-					
PT	0.67**		-0.65**	-0.64**		-0.61		-			
DM	0.60		-0.66**	0.63**		-0.50		0.63**		-	
SL	0.57		-0.61**	0.67**		-0.78**		-0.65**		0.60**	

\*, \*\*, = P < 0.05, P<0.01 respectively.

higher than all other cultivars studied. Even though, cultivar Power (3.23 Brix) recorded the least Total Soluble Solids, The Total Soluble Solids of cultivar Power (3.23 Brix) revealed insignificant difference between the Total Soluble Solids of Pectomech (3.59 Brix), Akoma (3.45 Brix) and Cal J (3.11 Brix) (Table 1).

#### Impact of cultivar difference on fruit Shelf Life

The shelf life of the fruits of cultivars Royal (10.20 days) and Pectomech (10.11 days) recorded significantly (P<0.001) the longest shelf life among the cultivars. Also, the results of the shelf life of Akoma (8.32 days) and Cal J (6.93 days) were significantly different (p<0.001) from the shelf life of a cultivar Power (6.38 days) fruits (Table 1). However, insignificantly different (p>0.05) was observed among the shelf life of Akoma (8.32 days) and Cal J (6.93 days) (Table 1).

#### Correlations

Except for the strength in degree of the significant levels (1%or 5%) of the associations, the trends of fruit quality parameters' correlation seem to be similar among the cultivars. General appearance correlates significantly with fruit weight loss, fruit firmness, fruit decay and fruit pericarp thickness of cultivars Royal, Pectomech, Cal.J, Akoma and Power. However, none of the studied cultivars general appearance correlates significantly with fruit dry matter or fruit shelf life respectively (Table 2&3).Weight lost in cultivars (Royal, Pectomech, Cal.J, Akoma and Power)significantly (p<0.001) correlates with fruit firmness, decay,pericarp thickness, dry matter and shelf life(Table 2&3).Similarly, the result revealed strong and of fruit firmness with decay, pericarp thickness, dry matter and shelf life in all the cultivars studied(Table 2&3). Whiles fruit decay of cultivars Royal, Pectomech and Cal.J revealed strong and significant relationship with fruit pericarp thickness, shelf life, fruit decay in Akoma and

Power only showed significant correlation with fruit shelf life respectively(Table 2&3).Pericarp thickness of all the cultivars (Royal, Pectomech, Cal.J, Akoma and Power) significantly (p<0.001) influence the dry matter content and the shelf life of tomatoes. The correlation results also revealed significant association of fruit dry matter with shelf life among all the cultivars studied (Table 2&3).

#### DISSCUSION

Wholesalers, retailers and final consumers' keenness to purchase fresh tomato fruits are highly influenced by postharvest quality performance. Therefore, by growing cultivars that have high postharvest qualities, producers can be rest assure of attracting customers. In addition, during unexpected situations such as fluctuation in demand and supply as well as unreliable logistics services, participants/actors in the tomato value chain operating with the highest postharvest quality cultivars could minimize losses in their chain.

Differences in postharvest quality traits of tomato cultivars studied might have been caused by the genetic makeup of the individual cultivars. The highest general appearance in Royal (4.03) most likely was due to the lowest weight loss (water loss) through respiration which could lead to fewer shrivelling or shrinking and moderately maintaining fruit firmness in comparison to the fruits of Cal. J and Power. Earlier research revealed that, fruit general appearance of fruits is affected mainly by fruit firmness and weight loss (Keys, 1999). Fruit general appearance relates negatively to weight (water) loss. The weight loss reduces fruit firmness and increases shriveling, which is an important criterion for assessing fruit general appearance qualities.

Weight loss is one the important postharvest quality attributes of tomato. The significant lowest weight loss recorded in cultivars Royal, Pectomech and Akoma might be an indication of probably having relatively lower water loss rate than fruits of Ca I J and Power. The ability of

**Table 3.** Correlation of Postharvest Quality Traits in Tomato.

Cultivar	General Appearance (GA)	Weight Loss (WL)	Fruit Firmness (FF)	Fruit (FD)	Decay	Pericarp (PT)	Thickness	Dry Matter (DM)
Royal								
GA	-							
WL	-0.73**	-						
FF	0.62*	-0.79**	-					
FD	-0.59*	0.70**	-0.67**	-				
PT	0.77**	-0.67**	-0.72**	-0.58*	-			
DM	0.43	-0.78**	0.67**	-0.45		0.81**		-
SL	0.40	-0.72**	0.81**	-0.89**		-0.62**		0.62**
Pectomech								
GA	-							
WL	-0.65**	-						
FF	0.59*	-0.63**	-					
FD	-0.61*	0.60**	-0.60**	-				
PT	0.67*	-0.55**	-0.68**	-0.59*	-			
DM	0.30	-0.67**	0.61**	-0.52		0.65**		-
SL	0.47	-0.70**	0.78**	-0.78**		-0.73**		0.55**
Cal. J								
GA	-							
WL	-0.55*	-						
FF	0.51*	-0.55**	-					
FD	-0.60*	0.58**	-0.63**	-				
PT	0.56**	-0.62**	-0.67**	-0.60*	-			
DM	0.48	-0.65**	0.59**	-0.56		0.68**		-
SL	0.46	-0.60**	0.69**	-0.70**		-0.70**		0.63**
Akoma								
GA	-							
WL	-0.70**	-						
FF	0.66*	-0.65**	-					
FD	-0.61*	0.68**	-0.61**	-				
PT	0.58**	-0.64**	-0.67**	-0.53	-			
DM	0.40	-0.71**	0.67**	-0.56		0.76**		-
SL	0.45	-0.68**	0.78**	-0.82**		-0.64**		0.60**

\*, \*\*, = P < 0.05, P < 0.01 respectively.

fruits of Cal J and Power. The ability of cultivars to regulate water loss during respiration which is a principal cause of weight loss difference in fruit after harvest (Keys, 1999) might have caused the differences in weight loss of tomato cultivars studied. Previous research indicates that pepper cultivars differ in fruit weight, (water) loss rate during storage (Bosland, 1993; Smith *et*

*al.*, 2007). There is an indication that, increase in weight loss in tomato fruits irrespective of cultivar type could directly soften fruit firmness. Weight (water) loss has been revealed as the principal cause of fruit softening (Wilson *et al.*, 1999).

Genetic background and differences in fruit weight loss might have caused the difference in fruit firmness observ-

ed among cultivars Akoma, Pectomech, Cal. J, Power and Royal. Genetic background plays a differential role in fruit firmness (Bosland, 1993). In addition, differences in weight loss rate recorded by individual cultivar types might have influenced the difference in fruit firmness. Previous research on pepper found a pronounced decrease in fruit firmness to be associated with increased weight loss during prolonged storage (Lownds *et al.* (1994). Similarly, the differences in genetic make-up of the individual cultivar types studied could have varied ability to resist decay pathogens of the cultivars. This might have caused the significant difference observed among the decay rate cultivars studied. An earlier work found pepper cultivar types as the key influencing factor of fruit decay (Maalekuu *et al.*, 2004).

Pericarp thickness is an important tomato quality attribute which is highly associated with several postharvest quality attribute such as fruit firmness, fruit defect, and weight loss. Cultivar difference might have caused the differences in fruit pericarp thickness observed in this current study. The thickest pericarp thickness recorded in cultivar Royal, Pectomech, Akoma, might have been partly caused by the reduced in weight loss in cultivars Royal, Pectomech, Akoma, than cultivars Power and Cal. J respectively.

High dry matter of the tomato has also been reported to affect fruit taste positively because the major components of tomato taste; sugars and acids, are more concentrated (Auerswald *et al.*, 1999), which fits well with consumers' demand for high quality produce (El-Saeid *et al.*, 1996). The highest dry matter recorded in cultivars Royal and Pectomech than cultivars Akoma, Power and Cal J. could also be due to appreciable lowest weight lost recorded cultivar Royal and Pectomech. This could have led to lower water loss (lower respiratory) rate in cultivar Royal and Pectomech which resulted in lower in loss of fruit dry matter (Opara and Tadesse, (2000). The highest dry matter content in cultivar Royal fruits might have influenced the highest total soluble solids in Royal fruits (4.05% Brix) than total soluble solids in cultivars Akoma, Pectomech, Power and Cal. J fruits. Fruits with high dry matter content usually have higher total soluble solids as well as better taste and flavour (Hao, *et al.*, 2000b). Fruit shelf life during storage is an important feature from a producer's and a distributor's point of view, allowing the determination of risks arising from the loss of commercial value of fresh fruits in trade turnover (Radajewska and Borowiak, 2002). Variations observed in fruit shelf life among the cultivars studied might have been caused by variations in genetic makeup of the individual cultivar's ability to reduce weight loss (water loss), maintain high fruit firmness, high pericarp thickness among other factors that can affect the shelf life of fruits.

## CONCLUSION

### Conclusion and Future Research

Cultivar types can influence the postharvest performance of tomato (*Lycopersicon esculentum* Mill.) fruits. Royal and Power, on an average ranked best and least

respectively, among the cultivar types evaluated on several postharvest quality parameters. The fruit weight loss of tomato cultivars negatively influences fruit firmness, general appearance and shelf life on tomato cultivars in the current study. Fruit firmness affects the fruit shelf life and fruit decay positively and negatively respectively. Pericarp thickness of fruits affected fresh pericarp weight, dry matter, shelf life and total soluble solids on tomato cultivars in the current study. To maintain better postharvest qualities along tomato supply chain in Ghana, this current research advocates the participants in the chain to adopt tomato fruits of cultivars Royal and Pectomech in their operations since they performed significantly better than fruits of cultivars Akoma, Cal J. and Power respectively. From the evidence of the results of this research, it will prudent for tomato breeders to re-breed tomato cultivars Akoma, Cal J. and Power to improve their postharvest qualities in fruit weight loss, firmness, decay, pericarp thickness, total soluble solids, dry matter, and shelf life.

Future research to evaluate postharvest quality parameters, excluding those in this studied can improve literature on tomato postharvest issues in Ghana. Also assessing postharvest losses along the entire tomato value chain could broaden the literature on value chain management in Ghana.

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