

## RESEARCH ARTICLE

# Evaluation and consumer acceptance of five tomato (*Lycopersicon esculentum* Mill) cultivars in Northern Region of Ghana

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## ABSTRACT

Tomato (*Lycopersicon esculentum* Mill) is one of the most widely consumed vegetables in the world. It is a major horticultural crop with a global production of 153 million metric tonnes. Many landraces of tomato are used in the Northern Region of Ghana including "Burkina", "Techiman" and "Wosowoso" with "Wosowoso" been the most grown within and around the Tamale Municipality. The seed however, are farmers own seeds and farmers prefer buying those seed because they are relatively cheap compared with the foreign seeds sold on the market. The aim of this study was to evaluate the quality and shelf-life performance of some selected tomato varieties in comparison with the local landrace commonly grown by farmers in the Northern region of Ghana. Seeds of "Wosowoso", Popvriend, Tanga, Tengeru 1997 and Tengeru 2010 were nursed and transplanted onto a land area of 4 x 2 m<sup>2</sup> for each treatment in completely randomized design. All samples performed well agronomically except for Tengeru 97 and 2010 which showed signs of been attached by leaf curl disease. Farmers preferred Tengeru due to the fruit size and ease of seeds extraction regardless of the leaf curl disease. Eighty percent of consumers preferred Tanya for firmness and taste.

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## INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) from the Solanaceae family is fruit vegetable introduced into Western Africa around 1870 by the Europeans. Tomato is a very important vegetable as it is used in almost all meals with a sauce or soup part, and is one of the most widely consumed vegetables in the world. It is a major horticultural crop with a global production of 153 million metric tonnes (FAOSTAT, 2009). According to MoFA (2012), the total land size used for the production of tomato is 44.8 hectares with an average production yield of 7.2 mt/ha in 2012 on rain-fed agriculture. Aside the large area of land used for the production of tomato, tonnes of tomato is imported from neighbouring countries such as Burkina Faso and Togo to meet the demand for tomatoes as more than 60% of tomato production is seasonal and rain-fed dependant. The rain fall pattern is bimodal for the southern part and unimodal for the northern part of Ghana.

Apart from diseases, pests and marketability, one other major concern is the fruit quality of the local varieties currently under cultivation, compared to their exotic varieties. The wild tomato species constitutes potential reservoir of useful genes for useful

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traits and has been greatly used in most breeding programmes (Bai and Lindhout, 2007; Gur and Zamir, 2004). These traits have been mostly incorporated into cultivated tomato through crosses with the wild relative (*Solanum pimpinellifolium* L.). Substantial evidence reveals that some of these traits can be improved through further breeding and selection. However, several varieties with improved fruit qualities developed in the temperate regions are not well adapted to tropical conditions.

Many tomato landraces are grown and used in the Northern region of Ghana including “Burkina”, “Techiman” and “Wosowoso” with “Wosowoso” been the most grown within and around the Tamale Municipality. The seed from “Wosowoso” however, are mostly farmers own seeds and can also be brought at local community markets at relatively lower prices than foreign seeds sold at agro input shops. It is estimated that the yield for Northern and the Upper regions should be between 33,000 – 38,000 kilograms per hectare during the dry season with irrigation and good soil management (Sinnadurai, 1992). “Wosowoso” is disease resistant, can withstands warm weather conditions, requires less fertilization and cultural practices, and produces large fruits with lots of moisture and less dry matter. The high moisture content renders fruits not suitable for storage and preservation such as drying and canning, and deterioration during long transit durations resulting in reduced shelf-life. The objective of the study was to evaluate the quality and acceptance of some selected tomato varieties in comparison with the local landrace “Wosowoso” by farmers and end-users.

## **MATERIALS AND METHODS**

Seeds of “Wosowoso” (often farmers’ own seeds), Popvriend tomato seeds from Holland commonly sold in agro input shops, Tanga, Tengeru 1997 and Tengeru 2010 developed and released by the World Vegetable Center AVRDC from Tanzania were nursed and transplanted onto a land area of 4 x 2 m<sup>2</sup> for each treatment in completely randomized design. Harvested fruits were stored using plastic baskets in a constructed Zero Energy Cooling Chamber (ZECC) as treatment and room storage as control for five days for complete ripening and monitoring of the physical attributes of the fruits. Thirty farmers evaluated the fruits based on the size, firmness, colour, possibility of seed extraction and storability while fifteen traders evaluated the fruits based on size, firmness, colour, taste and storability. The tomato fruits were weighed and weight loss presented as percentage of weight loss compared to the initial weights.

### **Sensory evaluation and Statistical analysis**

Sensory evaluation for tomato fruits was based on aroma, taste, colour, firmness and texture as quality parameters for consumers. Every attribute was evaluated based on five-point hedonic scale from 1-5 (1 = dislike, 2 = fair, 3 = good, 4 = very good, 5 = excellent) by thirty restaurants and eatery joints. Scores of collected data was analysed for variance using Minitab version 16.

## **RESULTS AND DISCUSSION**

Results of the harvested fruits at the pink stage was stored in the ZECC for five days for quality evaluation of the fruits by farmers, traders and consumers.

### **Farmers’ Evaluation**

Farmers preferred Tengeru 97, Tengeru 2010 compared with Popvriend and Tanya base on size, texture and possibility of seed extraction. Popvriend and Tanya although had bright red colour, texture and less moisture was not preferred base on size and difficulty in size extraction (seeds were smaller and appeared immature).

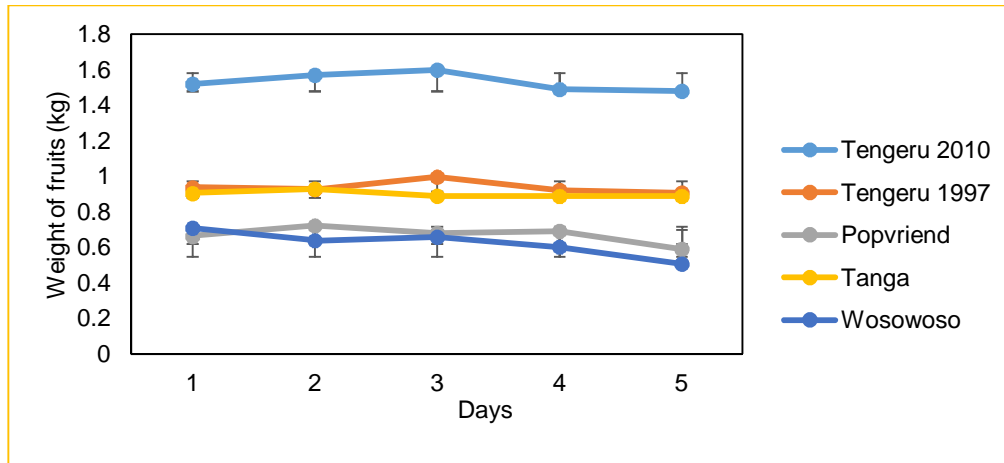


Figure 1: Weight loss percentage of fruits per day

### Colour

All sample fruit colours were preferred by farmers except for Tengeru 97 which exhibited a pinkish colouration from the pink stage through storage for the five days compared with the remaining cultivars which changed from the pink stage to bright red in colour at the completely ripened stage. The colour of tomato fruit is an essential quality parameter of fresh tomatoes for consumers' preference and acceptability, and the determination of the ripening stage (Lopez-Camelo and Gomez, 2004). To ensure an enhanced shelf-life of tomatoes colour changes must be gradual to support chlorophyll degradation with bright red colour (lycopene) (Pek et al., 2010; Dari et al., 2018).

### Size

Farmers preferred all cultivars except for Tanya which was relatively small in size. The attribute of size of fruits too farmers is essential bigger sizes fills packaging containers faster than smaller ones. The agreed standard of packaging materials for sale is volume based and consumers often prefer bigger fruits to small one which directly reflects on volume and taste.

### Texture

Farmers preferred Tanya and Popvriend as against "Wosowoso", Tengeru 97 and 2010 for the firmness as a texture characteristic. Firmness is an attribute which is used to evaluate the shelf-life of tomato fruits. Tengeru 2010 was the most preferred for juiciness compared the remaining samples such as "Wosowoso" which contained more water than solids.

### Storage life

Tanya and Popvriend had a stable storage life using weight loss as a benchmark.

### Weight loss

Storage duration and storage condition directly affects the weight loss of tomato fruits (Kumar et al., 1999; Ndirangu et al., 2017) and influenced by water activity in fruits which is affected by the maturity index, dry matter and physical characteristics of the fruits.

## Physiological losses

The following physiological losses were recorded at the end of the fifth day in storage Tengeru 2010 (25.16%), Tengeru 1997 (12.18%), Popvriend (8.57%), Tanga (10.78%) and “Wosowoso” (39.84%). From the estimated losses, there were significant differences between all samples and losses advanced with duration in storage. Popvriend had lower losses while “Wosowoso” had higher loss percentage. This affirms farmers practices of not harvesting fruits until there is a ready market for produce.

## Seed Extraction

For seed extractability, “Wosowoso”, Tengeru 97 and 2010 were preferred against Tanya and Popvriend which had less seeds and also required extra sieving techniques for seed extraction. All preserved extracted seed were viable for the next cultivation which is a quality trait farmer desire.

## Sensory and Consumer Evaluation

Traders complains of non-sales were due to spoilage of the “Wosowoso” variety which is the commonly grown and also because the “Burkina” variety is available in larger quantities at a relatively cheaper cost compared with the “Wosowoso”. Consumers preferred improved tomato varieties with less water and more dry matter as against the “Wosowoso” fruits.

**Table 1: Sensory analysis on Tomato variety preference**

|          | Tengeru 1997      | Tengeru 2010       | Tanga              | Popvriend          | “Wosowoso”         | LSD   | Fpr (0.05) |
|----------|-------------------|--------------------|--------------------|--------------------|--------------------|-------|------------|
| Taste    | 2.75 <sup>a</sup> | 1.75 <sup>a</sup>  | 2.25 <sup>a</sup>  | 2.0 <sup>a</sup>   | 1.50 <sup>a</sup>  | 1.955 | 0.702      |
| Aroma    | 3.0 <sup>a</sup>  | 2.0 <sup>a</sup>   | 2.0 <sup>a</sup>   | 2.3 <sup>a</sup>   | 1.8 <sup>a</sup>   | 1.965 | 0.706      |
| Texture  | 3.0 <sup>a</sup>  | 2.25 <sup>ab</sup> | 3.0 <sup>a</sup>   | 2.67 <sup>ab</sup> | 1.0 <sup>b</sup>   | 1.593 | 0.069      |
| Colour   | 1.25 <sup>c</sup> | 2.0 <sup>bc</sup>  | 2.75 <sup>ab</sup> | 2.67 <sup>ab</sup> | 2.75 <sup>ab</sup> | 1.246 | 0.051      |
| Firmness | 2.5 <sup>a</sup>  | 3.0 <sup>a</sup>   | 3.25 <sup>a</sup>  | 2.67 <sup>a</sup>  | 2.25 <sup>a</sup>  | 1.482 | 0.605      |

\*Means with different letters in a row are significantly different.

## Taste

Sweet, sour, salty, bitter and umami are the five attributes of taste. Umami can be described as a taste associated with salts of amino acids and nucleotides (Yamaguchi and Ninomiya, 2000). Even though there were no significant differences between samples, there were variations with Tengeru 97, Tanga, Popvriend, Tengeru “Wosowoso” from high to low acceptance in taste.

## Aroma

Aroma compounds are volatile and are evaluated using the nose. Consumers rated Tengeru 1997, Popvriend, Tengeru 2010, Tanga and “Wosowoso” from high to low even though there were no significant differences statistical among samples. None of the samples produced off-flavours which was desirable.

## Texture

There were no statistical difference samples (Tengeru 1997 and Tanga, Tengeru 2010 and Popvriend). There was however, statistical difference between “Wosowoso” compared with the remaining samples. There was no statistical difference between samples even though Tanga was evaluated as the firmest.

## Colour and appearance

Physical characteristics such as wholeness, free from defects, consistency and uniformity in size and shape contribute to the appearance evaluation of fruits (Mitcham et al., 1996; Dandago et al., 2017). There were no statistical differences in colour between Tanga, Popvriend and “Wosowoso” which produce bright red colours compared with Tengeru 1997 and 2010 (pinkish orange) which was significantly different.

## Conclusion and Development Implications

Farmers and consumers preferred the sampled varieties compared with “Wosowoso” which is climate tolerant and disease tolerate due to desirable quality parameters such as taste, size, firmness and shelf-life. Farmers however preferred samples that were bigger fruit sizes and seeds large enough to ease extraction. Consumers preferred samples with bright colours, not small fruit sizes and the sweet taste of fruits. The availability of adaptable improved varieties of tomatoes for production by farmers will encourage consumer acceptance and selection of locally produced tomato which would contribute directly to reducing postharvest losses which is a major setback in the production of the “Wosowoso” landrace.

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