Nile Valley University Publications
Nile Journal for Agricultural Sciences (NJAS)
(ISSN: 48 – 60)
Volume 11, NO. 01, 2026
nilevalley.edu.sd

Shelf-Life Investigation for Two Newly Released Tomato Varieties Compared to Introduced one to Sudanese Environment

Amani Ahmed Abd-Elwahid Gabr[1], Ahmed Elgaili Ibrahim[2], Mohamed Suliman Mustafa [3]and Abdelazim Mohamed Ali[4]

1 Faculty of Agriculture, Nile Valley University

Corresponding author: aalgaili03@gmail.com

Received: 8 Jan. 2025 Accepted :4 Nov. 2025 Published: 20 April2026

Abstract

This study aimed to evaluate shelf life for two newly released (Darmali and ZahratElneel) and one introduced (Castle Rock) tomato varieties grown at Hudaiba Research Station Farm, River Nile State, season 2014-2015. They were kept at room temperature (27^{0}C) and under cold storage conditions (10-12^{0}C) to assess their consumable shelf life. The fruit firmness, weight loss, curliness and overall decay components of the fruits were the daily tested parameters. Tomato fruits stored under cold storage showed longer shelf-life than those stored at room temperature. Generally, Castle Rock had longer shelf-life, followed by Dar-mali and ZhratElneel, respectively. The storage life of tomatoes was determined as 1-14 days.

Keywords: *Tomato, Released varieties, Shelf life, Firmness, Deterioration*

دراسة عمرالعرض لصنفين جديدي الاجازة من الطماطم مقارنةً بصنف اخر مُدخَل إلى البيئة السودانية

أماني أحمد عبد الواحد جبر[1]، أحمد الجيلي إبراهيم[2] ، محمد سليمان مصطفى[3] ، وعبد العظيم محمد علي[4]

كلية الزراعة، جامعة وادي النيل

ممثل المولفين : aalgaili03@gmail.com

المستخلص

هدفت هذه الدراسة إلى تقييم مدة صلاحية العرض لصنفين جديدين من الطماطم (دارمالي وزهرة النيل) وصنف مُدخَل (كاسل روك) زُرعت في مزرعة محطة أبحاث الحديبة، بولاية نهر النيل، خلال موسم 2014-2015. حُفظت الأصناف في درجة حرارة الغرفة (27 درجة مئوية) وفي ظروف التخزين البارد (10-12 درجة مئوية) لتقييم مدة صلاحيتها للاستهلاك. شملت المعايير التي تم اختبارها يوميًا صلابة الثمار، وفقدان الوزن، والتجعد، ومكونات التلف العامة للثمار. أظهرت ثمار الطماطم المحفوظة في ظروف التخزين البارد مدة صلاحية أطول من تلك المحفوظة في درجة حرارة الغرفة. بشكل عام، تميز صنف كاسل روك بفترة صلاحية أطول، يليه صنف دار مالي ثم صنف زهرة النيل. وقد حُددت فترة صلاحية الطماطم من يوم إلى 14 يومًا.

الكلمات المفتاحية: *الطماطم، أصناف مُجازة، فترة الصلاحية، الصلابة، التلف*

Introduction

Tomato (*Solanum Lycopersicon L.*) is one of the most cultivated and popular vegetables belonging to the family Solanaceae worldwide. Latin America is believed to be the origin of the crop where it was cultivated as a vegetable centuries ago. In Sudan tomato is a cool season vegetable (MAAW, 2017). However, warm climate cropping needs special precautions by skilled farmers or otherwise to be produced under cooled green houses. The fruit is considered as a valuable nourishment vegetable, rich source of minerals, vitamins, dietary fibers and lycopene. It is consumed in fresh forms as well as processed products and valued for its health benefits. World tomato production was estimated to reach 186 million metric tons in 2022 (FAOSTAT, 2023). China, India, turkey, United States and Egypt are the global leading producing counties (FAOSTAT, 2025). In Sudan, tomato comes second after onion with an estimated production of 633000 metric tons in 2022.

Tomatoes can be divided into two groups; processing tomatoes and fresh consumption tomatoes (Hogberg, 2010). There are also many varieties within these two groups, especially among the fresh tomatoes, apart from classical round tomato, can be with many different sizes, shapes and colours ranging from beef tomatoes to cherry tomatoes. Tomato varieties differ in their characteristics in relation to production environments, consumer preference, whether for fresh consumption or processing, etc. This necessitates their evaluation to meet such requirements (Ketema and Beyene, 2021).

Tomato fruit ripens through climacteric mechanism which is accompanied by a peak in respiration and is regulated by ethylene. Exposure to exogenous ethylene accelerates ripening of green tomatoes (Carrari and Fernie, 2006; Alexander and Grierson, 2002). The ripening process affects physical, chemical, and physiological properties of the fruit. The fruit soften, chlorophylls degraded and carotenoids increased. There is also an increase in the respiration rate, ethylene, organic acids, sugars and lycopene production (Cano *et al.,* 2003). Respiration is a metabolic process that provides energy for plant biochemical processes. It involves oxidative breakdown of organic reserves to simpler molecules (O_2 and H_2O), with the release of energy (Ravindra and Goswami, 2008). These changes start while the fruit is still on the plant and accelerate after harvest and fruit reaches an over-ripe state in a short period of time (Guillen *et al*., 2006). Qualitative attributes, such as texture, generally change with time, as part of the normal metabolism of the product (Tijskens and Evolo, 1994). Most of the physiological, biochemical and microbiological activities contributing to the deterioration of produce quality are largely dependent on temperature (Tano *et al*., 2007). Low temperature is the most important factor in maintaining quality and extending the shelf-life of fruits and vegetables after harvest. However, gas composition of the ambient air also plays an important role. Shelf-life of fresh fruits and fresh-cut fruits may be extended by atmospheres reduced in O_2 and elevated in CO_2, by means of modified atmosphere packaging that slows deterioration and reduces ethylene production and respiration rates. Controlled atmosphere storage or modified atmosphere packaging, combined with low temperature storage, can reduce respiration and ethylene production rates, then retard or slow down changes related to ripening and senescence (Fonseca *et al.*, 2002).

Fruit firmness, is an important parameter to know the minimum pressure required for skin puncture and hence design of suspension system of transport vehicle. In addition, data of post-harvest mechanical properties in fruits and vegetables are important for the adoption and design of several handling, packaging, storage and transportation systems (Singh and Reddy, 2006).

Shelf-life is the most important criteria in fresh marketing of fruits and vegetables. Shelf-life is defined as the period in which a product should maintain a predetermined level of quality under specified storage conditions (Shewfelt, 1986). A number of chemical and physical processes take place in fruits and vegetables during storage.

Since tomato is highly perishable, it suffers several postharvest losses during storage, transportation, and marketing (Ben *et al*., 1986). Tomato fruits shelf-life is calculated by counting the days required to attain the last stage of ripening, but up to the stage when fruit remained still acceptable for marketing.

Hardenburg *et al*. (1986) and Ball (1997) stated that low temperature storage is the most efficient method to maintain quality of most fruits and vegetables due to its effects on reducing respiration rate, transpiration, ethylene production, ripening, senescence and rot development. Ball (1997) and Schuelter *et al*. (2002) stated that temperature plays an important role in maintaining post-harvest quality and shelf-life of tomato fruits. However, optimal storage temperatures depend on the maturity stage of the tomatoes.

Maul *et al*., (2000) reported that red tomatoes can be stored at 7°C for a number of days, although tomatoes stored at 10°C were rated lower in flavor and aroma than those held at 13°C. They also concluded that ideal conditions for ripening are 19 to 21°C with 90 to 95% relative humidity. Castro *et al*. (2005) mentioned that ripe tomato can be stored at a temperature of 10-15°C and 85-95 relative humidity for longer periods. Similarly, Dragan and Tomaz (2006) stated that, though tomato fruits can be stored at ambient temperature for a period of up to 7 days, they, at lower temperature showed more stability, greater storage life and acceptable weight loss.

Fruit firmness is considered to be a good indicator of fruit maturity for determining the shelf-life of products (Beaulieu and Gorny, 2001). Fruit firmness is also affected during storage. However, mature fruits with greater firmness have longer shelf-life (Zdravkovic *et al*., 2010). Storage at low temperature is a common practice to retard softening of fruits and vegetables. However, accelerated softening of tomato can occur at low temperature due to chilling injury (Jackman *et al.*, 1992). Cold temperature will cause tomatoes firm texture to turn pulpy (Adegoroye *et al*., 1989; McDonald *et al*., 1999). Decay organisms can enter through such breaks in the skin. However, Ressureccion and Shewfelt (1985) established that tomato should not be stored in the refrigerator; as refrigeration will reduce its flavour by approximately 30%. The flavour of tomatoes is largely determined by the sugar and acid composition of the fruit (Moretti *et al*., 1998).

The colour of a ripe tomato is determined by the ratio of two pigments, lycopene and β-carotene (Hobson and Grierson, 1993). The colour changed in fruit corresponds to a fall in chlorophyll and an increase in carotenoids synthesis (Pretel *et al*., 1995). Storage at over 27 °C reduces intensity of red color.

Quality of most fruits and vegetables is affected by water loss during storage, which depends on the temperature, relative humidity and storage time (Perez *et al*., 2003). Varieties respond differently in terms of weight loss, and the best vapor heat treatment condition should be determined for each variety to reduce weight loss and prolong shelf life (Castaneda *et al*., 2010). Mallik *et al*. (1996) reported that tomato fruits showed the lowest physiological weight loss (7.7-9.7%) after 6 days of storage under ambient condition. However, Akand *et al*. (2015) found that different varieties exhibited a significant influence on shelf-life of tomato at different storage conditions. The loss of water can lead to wilting and shriveling, which both reduce market value and consumer acceptability (Ball, 1997). According to Znidarcici and Pozrl (2006) weight loss of tomato fruit is closely related with the temperature. Tomato fruit stored at lower temperatures have an acceptable weight loss and more stability and greater storage life than fruit stored at higher temperatures. Weight losses of 8-6% affects the visual appearance and texture of the fruits and causes a reduction of marketability of the fruits (Haffner *et al.*, 2002). Kader (2002) stated that products must lose about 5 % of their fresh weight before visual appearance is affected. This is likely due to the high temperature, which melted the wax to such an extent that it ran off and was lost and caused major injuries to fruit tissues.

Acid concentration in the fruit is also temperature dependent. Concentration of acid linearly reduced when temperature increased and then went up again when fruit stored at 15°C (Islam *et al*., 1996). However, tomato cultivars with high pH are not suitable for processing.

Goojing *et al*. (1999) reported that 78.2 and 47.5% of rotting can be found in red ripen and mature harvested fruits, after three weeks of storage at 15-20°C, respectively.

Apart from physical quality, serious losses also occur in the essential nutrients, vitamins and minerals.

This study aimed to evaluate the shelf life for two newly released (Dar-mali and ZahratElneel) and one introduced (Castle Rock) tomato varieties grown at Hudaiba Research Station Farm, River Nile State

Material and Methods

Fresh, fully ripped tomato fruits from three varieties; Castle Rock, Dar-mali and ZahratElneel, were collected from Hudaiba Research Station Farm, River Nile State, season 2014-2015. Hundred fruits selected randomly from each cultivar.

Tomato fruits were submitted to different storage temperatures and evaluated for their quality. The tomatoes stored at room temperature (27^0C) and those stored at lower temperatures (10-12^0C) showed gradual change in their intensity of measured parameters with storage time. The fruit firmness, weight loss, curliness and overall decay components of the fruits were recorded daily. The storage life of tomatoes was determined as 1-14 days.

Fruit shelf-life was determined in terms of fruit firmness, curliness, weight loss% and decay according to the methods applied by Jan *et al*. (2012) and Parker and Maalekuu (2013) with some modifications. Tomato fruits varieties under investigation were stored at room temperature (about 27^0C) and in refrigerator (10-12^0C) for 1-15 days. Quality parameters; fruit weight loss, fruit firmness, curliness and decay were evaluated.

Fruit firmness was determined by feeling how hard or soft the fruit was. The fruits were rated on a scale of 1-5 with;

5-4= very firm

4-3= firm

3-2= soft

2-0 = very soft

Five fruits in each variety were separated for weight loss test. The initial weight of each fruit was noted daily with the help of electronic balance. The average loss of weight was calculated at day's intervals. The weight loss (%) was calculated as:

$$\text{Weight loss \%} = \frac{\text{Weight of fresh fruits} - \text{Weight after interval}}{\text{Weight of fresh fruit}} \times 100$$

Fruit curliness was determined visually. The fruits were rated on a scale of 1-4;

1-2= non
2-3= very little
3-4= little
4 to above= much

Fruit decay was determined by the visual observation. Development of spots on the fruit's skin and softening and rotting of fruits were rated on a scale of 1-4;

1-2= non
2-3= very little
3-4= little
4 to above = much

Results and Discussion

Fruit weight loss

Weight loss% depends on water loss mainly and it is important because it affects the visual appearance and texture of the fruits and causes a reduction in saleable weight (Jones, 1999).

The weight loss of tomatoes was almost linear at both storage temperatures. The weight loss appeared after 4 days in all varieties. After 7 days Dar-mali and ZhratElneel lost about 18.5% (in average) while Castle Rock lost 14.7% (Fig.1a). At cold storage, weight loss goes slowly compared with storage at room temperature (Fig.1b.), after 7 days Dar-mali and ZhratElneel loss was about 4.5% fruit weight but Castle Rock loss was 3.3%. Results showed higher weight loss in ZhratElneel than in Dar-mali and Castle Rock, respectively. The high level of moisture in ZhratElneel render it to be more perishable and hence requires to be handled with much care to minimize losses. Storage at lower temperature tended to increase tomato longevity.

Fruit firmness

Fruit firmness of the three tomato varieties showed a progressive decline during storage at room temperature and at cold storage (Fig 2 a-b). The decline occurred earlier at room temperature mostly after 7 days storage. The decrease in firmness observed earlier in ZhratElneel, followed by Dar-mali and Castle Rock, respectively. Zdravkovic *et al.* (2003) established that Castle rock variety had greater firmness that causes long shelf-life of its mature fruit.

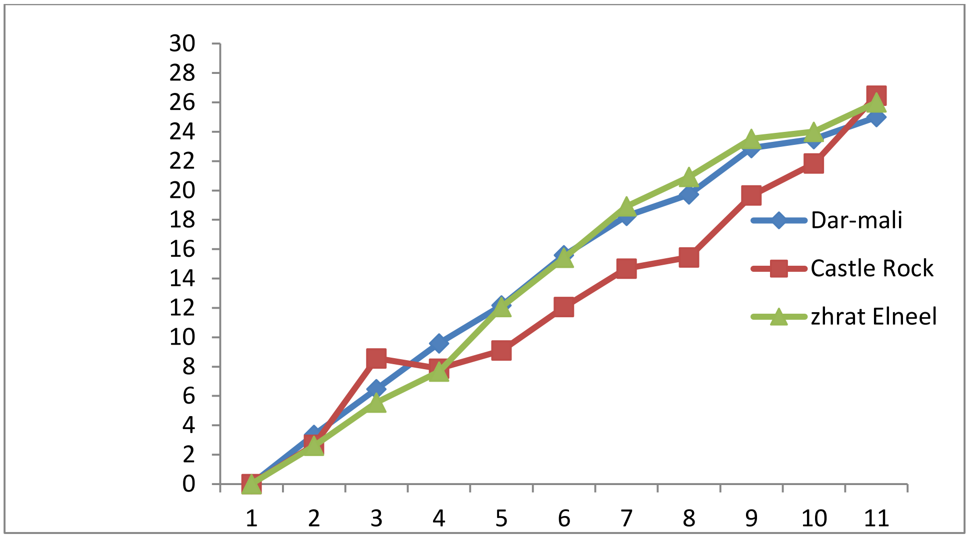

Fig.1a. Tomato fruits weight loss (%) at room temperature

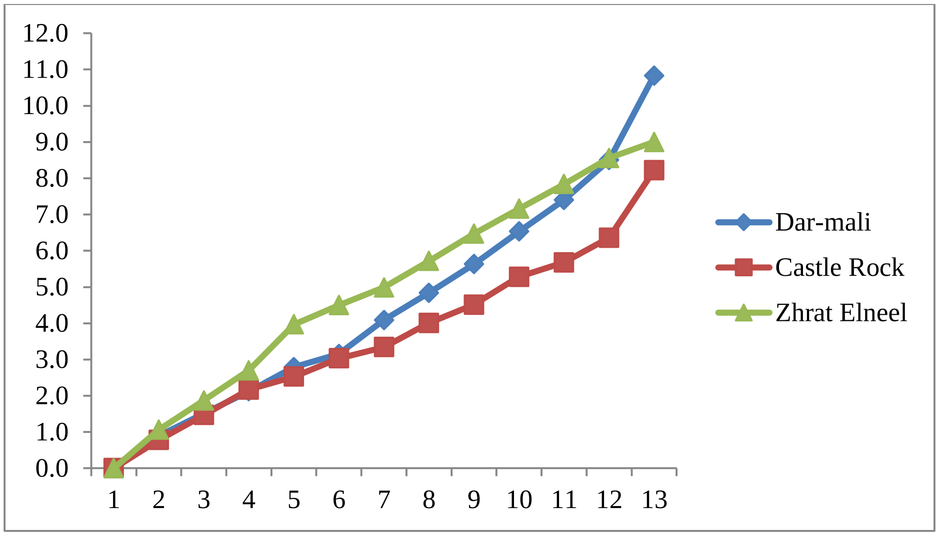

Fig.1b. Tomato fruits weight loss (%) at cold storage

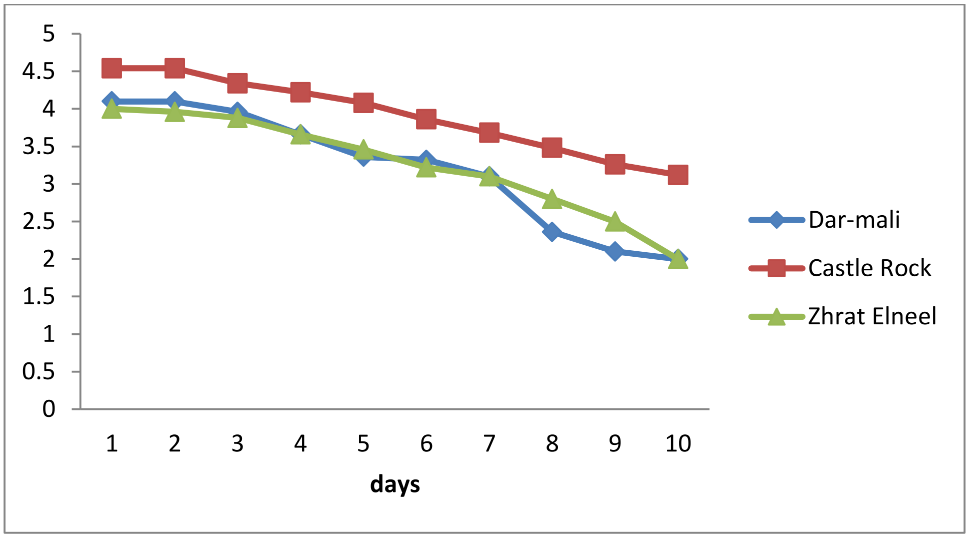

Fig.2a Tomato fruits firmness during storage at room temperature

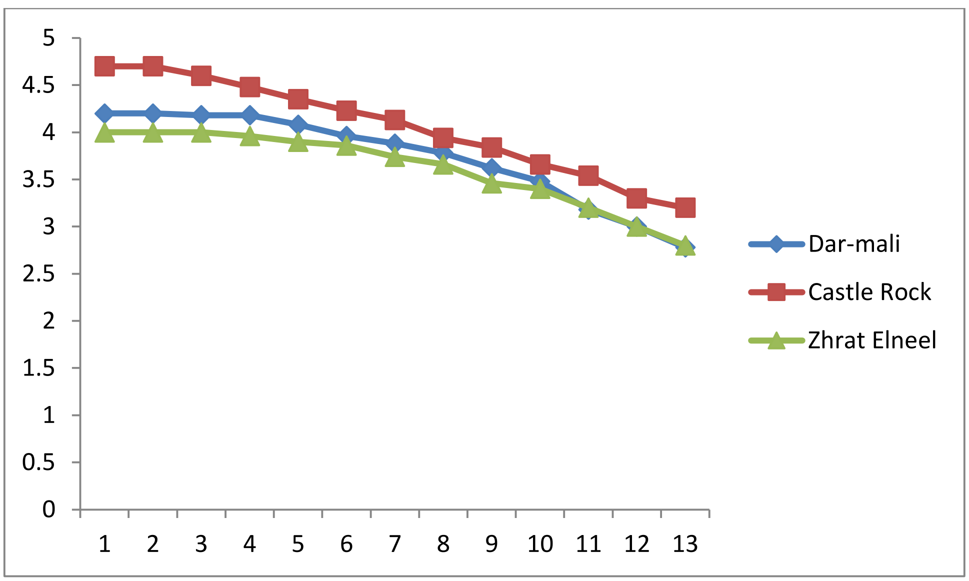

Fig2b: Tomato fruits firmness during cold storage

Fruit curliness (shriveling)

Fruits curliness was observed earlier during the storage of tomato at room temperature than at cold storage conditions. However, under both storage conditions, Castle Rock showed no tendency to shrivel and sustain its natural good appearance for the first 7 days. Dar-mali and ZhratElneel shriveled earlier with sharper decline after 2 days at room temperature and after the 4th day at cold storage conditions (Fig3a and b).

4.2.4 Fruit overall decay

After seven days of storage at room temperature rotting was very little in Dar-mali and ZhratElneel tomato varieties, while Castle Rock showed no rotting until the ninth day (Fig. 4 a.). Under cold storage conditions, the decay or rotting is not found in the three tomato varieties until the 9th day (Fig.4 b.).

Generally, the shelflife results showed that Castle Rock had a better keeping quality, followed by Dar-mali and ZhratElneel, respectively. The higher rate of decay in ZhratElneel variety could be attributed to its higher moisture content (95%).

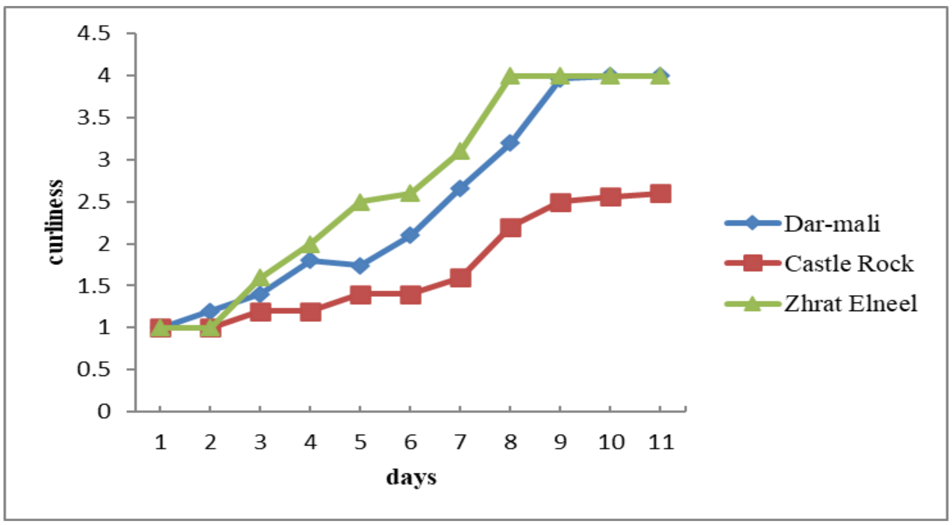

Fig.4a. Tomato fruits curliness at room temperature

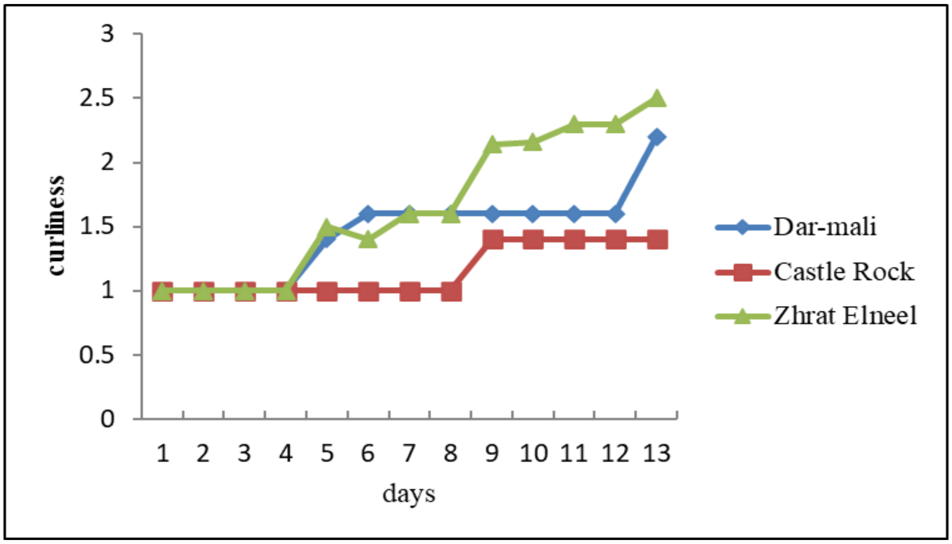

Fig.4b. Tomato fruits curliness at cold storage

Conclusion

Three tomato fruit varieties; Castle Rock, Dar-mali and ZahratElneel were evaluated for the shelf-life at room temperature and under cold storage conditions.

In term of fruits shelf-life, fruits stored under cold storage showed longer shelf-life than those stored at room temperature. The percentage of decay, weight loss, fruit softening, fruit curling gradually increased with storage time. Generally, the shelf life results showed that Castle Rock had longer shelf-life, followed by Dar-mali and ZhratElneel, respectively.

References

Adegoroye, A.S.; Jolliffe, P.A.; Tung, M.A. (1989). Texture characteristics of tomato fruits (*Lycopersicon esculentum*) affected by sunscald. Journal of Science and Food Agriculture, 49: 95-102.

Akand, M. H.; Khairul, H.E.M. M.; Islam; P. M. S.; Newaz, M. S.C.; Ferdous, M.J. (2015). Effect of organic manures on assessment of shelf life of tomato varieties (*Lycopersicon esculentum Mill*.) International Journal of Applied Research, 1(5): 94-97.

Alexander, L; Grierson, D. (2002). Ethylene biosynthesis and action in tomato: a model for climacteric fruit ripening. J Exp Bot 53(377):2039-55.

ASNS (2004). American Society for Nutritional Sciences. 2004.

Ball, J.A. (1997). Evaluation of Two Lipid-based Edible Coatings for Their Ability to Preserve Postharvest Quality of Green bell peppers. M.Sc. Thesis, Blacksburg, Virginia, 89 p.

Beaulieu, J.C.; Gorny, J.R. (2001). Fresh - Cut fruits. In: Gross, K.C.; Saltveit, M.E.; Wang, C.Y. (Eds.), The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stocks. USDA Handbook 66. USDA, Washington, D.C. pp. 1-49.

Ben, Ruth; Arie ; Susanlurie (1986). Prolongation of fruit life after harvest. In: Handbook of Fruit Set and Development, Eds., Shaul, P. Monselise, CRC press

Cano, A.; Acosta, M.; Arnao, M. (2003). Hydrophilic and lipophilic antioxidant activity changes during on-vine ripening of tomatoes (Lycopersicon esculentum Mill). Postharvest Biology and Technology, 28: 59–65.

Carrari, F.; Fernie, A.R. (2006). Metabolic regulation underlying tomato fruit development. Journal of Experimental Botany, Vol. 57, No. 9,1883–1897

Castaneda, J.L.; Garcia, J; Corrales, S. T. T.; Leon, T. C. (2010). Effect of saturated air heat treatments on weight loss reduction and epicuticular changes in six varieties of cactus pear fruit (*Opuntia spp.*). Journal of the Professional Association for Cactus Development, 12: 37–47.

Castro, L.R.; Vigneault, C.; Charles, M.T.; Cortez, L.A.B. (2005). Effect of cooling delay and cold-chain breakage on 'Santa Clara' tomato. Journal of Food and Agriculture Environment, 3: 49-54.

Dragan, Z.; Tomaz, P. (2006). Comparative study of quality changes in tomato cv. 'Malike' (*Lycopersicon esculentum Mill*.) whilst stored at different Temperatures. Acta agriculturae Slovenica, 87 – 2

ERS (2005). United States Department of Agriculture. Economic Research Service (ERS). Briefing Room. Tomatoes: Background.

FAOSTAT (2023). Core Production data database. Food and Agriculture Organization of the United Nations.

FAOSTAT (2025). Core Production data database. Food and Agriculture Organization of the United Nations.

Fonseca, S. C.; Oliveira, F. A.R.; Brecht, J. K. (2002). Modeling respiration rate of fresh fruits and vegetables for modified atmosphere packages: a review. Journal of Food Engineering, 52 (2): 99-119

Goojing, L.; Zhaihao, X.U.; Dhai, D.; Shov, W.; Li, G.J.; Xu, Z.H.; Dai, D.I.; Shou, W.I. (1999). The effects of cultivars electrical conductivity and harvest date on the storability of cherry tomato grown in soil less culture. Acta Agriculturae-Zhejiangensis 11 (1):17- 22

Guillen, F.; Castillo, S.; Zapata, P.J.; Martinez-Romero; D.; Serrano, M.; Valero, D. (2006). Efficacy of 1- MCP treatment in tomato fruit. 2. Effect of cultivar and ripening stage at harvest. Postharvest Boilogy and Technology, 42:235-242.

Haffner, K.; Rosenfeld, H.J.; Skrede, G.; Wang, L. (2002). Quality of red raspberry *Rubus idaeus L*. cultivars after storage in controlled and normal atmospheres. Postharvest Biology and Technology, 24: 279-289.

Hardenburg, R.E.; Watada, A.E.; Wang, C.Y. (1986). The Commercial Storage of Fruits, Vegetables, and Florist, and Nursery Stocks. Washington, Agriculture Handbook 66,130 p.

Hobson, G.E.; Grierson, D. (1993). Tomato. In: Biochemistry of Fruit Ripening (Seymour, G.B., Taylor, J.E. and Tucker, G., eds.). Chapman and Hall, London, pp. 405-442.

Hogberg, J. (2010). European Tomatoes. MSc thesis. Environmental Department, Swedish Institute for Food and Biotechnology, Sweden.

Islam, M.S.; Matsui, T.; Yoshida, Y. (1996). Effect of carbon dioxide enrichment on physico-chemical and enzymatic changes in tomato fruits at various stages of maturity. Sci Hortic-Amsterdam 65:137-49.

Jan, I.; Abdur Rab, A.; Muhammad, A. ; Ali, A. (2012). Response of Apple cultivars to different storage durations. Sarhad Journal of Agriculture, 28(2): 191 95.

Jones, J. (1999). Tomato Plant Culture: in The Field, Greenhouse, and Home Garden. CRC Press. Boca Raton, FL 1-30.

Kader, A.A.; Kasmire, R.F.; Mitchel, G.; Reid, M.S.; Somer, N.F;Thompson, J.F. (2002). Postharvest Biology and Technology: An Overview: Postharvest Technology of Horticultural Crops pp. 39-47.

Ketemann, W.; Beyene, D. (2021). Adaptability study and evaluation of improved varieties of tomato (*Lycopersicon esculentum L*.) under irrigation for their yield and yield components in east Wollega, western Ethiopia. Int. J. Adv. Res. Biol. Sci. (2021). 8(7): 118-125.

Liu, J; Van Eck, J; Cong, B.; Tanksley, S.D. (2002). A new class of regulatory genes underlying the cause of pear-shaped tomato fruit. Process National Academic Science,99:13302–13306.

MAAW (2017). Ministry of Agriculture and Animal Wealth, Nile state, Sudan. Annual Report.

Mallik, S.E.; Bhattacharja, B.B. (1996). Effect of stage of harvest on storage life and quality of tomato. Environ. Ecol. 14 (2):310-303

Maul, F.; Sargent, S.A.; Sims, C.A.; Baldwin, E.A.; Balaban, M.O.; Huber, D.J. (2000). Recommended commercial storage temperatures affect tomato flavor and aroma quality. J. of Food Science, 65(7):1228-1237.

McDonald, R.E.; Mccollum, T.G.; Baldwin, E.A. (1999). Temperature of water treatments influences tomato fruit quality following low temperature storage. Postharvest Biology Technology, 16: 147-155.

Moretti, C.L.; Sargent, S.A.; Huber, D.J.; Calbo, A.G.; Puschmann, R. (1998). Chemical composition and physical properties of pericarp, locule and placental tissues of tomatoes with internal bruising. J. of American Society Horticulture and Science, 123: 656-660.

Parker, R.; Maalekuu, B.K. (2013). The effect of harvesting stage on fruit quality and shelf-life of four tomato cultivars. Agriculture and biology Journal of north America, 4(3): 2151-7517.

Perez, K.; Mercado, J.; Soto-Valdez, H. (2003). Effect of storage temperature on the shelf life of Hass avocado (Persea americana). Food Sci. Tech. Int., 10(2): 73-77.

Pretel, M.T.; Serrano, M.; Amoros, A.; Riquelme, F.; Romojaro, F. (1995). Noninvolvement of ACC and ACC oxidase in pepper fruit ripening. Postharvest Biology and Technology, 5: 295 302.

Ravindra, M.R; Goswami T.K. (2008):Modelling the respiration rate of green mature mango under aerobic conditions. Biosystems Engineering. 99, (2): 239-248

Ressureccion, A.V.A. and Shewfelt, R.L. (1985). Relationships between sensory attributes and objective measurements of postharvest quality of tomatoes. Journal of Food Science, 50: 1242- 1245.

Schuelter, A.R.; Finger, F.L.; Casali, V.W.D.; Brommon, S.H.; Otoni, W.C. (2002). Inheritance and genetic linkage analysis of a firm-ripening tomato mutant. Plant Breed, 121:338-342.

Shewfelt, R.L. (1986). Postharvest treatment for extending the shelf life of fruits and vegetables. Food Technology, 40: 70-80.

Singh, K.K.; Reddy, B.S. (2006). Post-harvest physico-mechanical properties of orange peel and fruit. J. Food Engineering. 73:112-120.

Tanksley, SD (2004). The genetic, developmental, and molecular bases of fruit size and shape variation in tomato. Plant Cell.;16 Suppl:S181-9.

Tano, K; Oul, M.K; Doyon, G.; Lencki, R.W.; Arul, J. (2007). Comparative evaluation of the effect of storage temperature fluctuation on modified atmosphere packages of selected fruit and vegetables. Postharvest Biology and Technology 46; 212–221.

Tijskens, L.M.M.; Evelo, R.G. (1994). Modelling colour of tomatoes during postharvest storage. Postharvest Biol. Technol. 4; 85-98.

Zdravkovic, J.; Markovic, Z; Damjanovic, M., Zdravkovic, M.;Dordevic, R. (2003). The expression of the ringene in prolongated tomato fruit ripening (*S.Lycopersicon*). Genetika, 35 (2): 77-85.

Zdravkovic, J.; Pavlovic, N.; Zdenka, G.; Zdravkovic, M.; Cvikic, D. (2010). Characteristics important for organic breeding of vegetable crops. Genetika, 42(2): 223-233.

Zdravkovic, J.; Pavlovic, N.; Zdenka, G.; Zdravkovic, M.; Cvikic, D. (2010). Characteristics important for organic breeding of vegetable crops. Genetika, 42(2): 223-233.

Znidarcici, D. and Pozrl, T. (2006). Comparative study of quality changes in tomato cv. Malike (*Lycopersicon esculentum Mill*.) whilst stored at different temperatures Acta Agriculture Slovenica, 87: 235 – 243.