"Mitigation of Postharvest Loss in Solanum Lycopersicum L. Through Application of Biopolymeric Coatings"

Dr. Alvikar Annapurna R.

Department of Botany, Vivekanand College Kolhapur, (An Empowered Autonomous Institute) (416003), Maharashtra, India

DOI: https://dx.doi.org/10.51244/IJRSI.2026.130200143

Received: 03 February 2026; Accepted: 09 February 2026; Published: 14 March 2026

ABSTRACT

The formulation of a bio-based coating employing mucilage powders integrated with protein–lipid complexes presents a novel strategy for postharvest preservation of tomato (*Solanum lycopersicum*). Mucilage fractions extracted from *Parkia biglandulosa*, *Bombax ceiba*, *Spathodea campanulata*, and *Muntingia calabura* exhibited significant hydrocolloidal properties that directly influenced water dynamics within the fruit tissues. Experimental application of these coatings to tomato fruit resulted in enhanced physiological indices, including total water content, relative water content, cellular succulence, and osmotic potential. These parameters are closely associated with maintenance of cellular turgor, which serves as a critical determinant of postharvest freshness and visualappeal.

Turgidity preservation, achieved through mucilage-mediated modulation of osmotic balance and water retention, reflects the efficacy of the coating in mitigating postharvest desiccation. Tomato fruits treated with varying concentrations of the mucilage complex displayed a marked reduction in moisture loss, delayed softening, and improved structural integrity throughout the storage period. Consequently, shelf-life extension was observed, along with superior retention of textural and physiologicalattributes.

The valorization of mucilage polymers sourced from waste floral, foliar, and fruit biomass of roadside avenue species further underscores the ecological and economic potential of this approach. Beyond offering a biodegradable and non-toxic alternative to synthetic coatings, such utilization addresses the dual objectives of waste reduction and sustainable crop management. Thus, mucilage-basedediblecoatingsrepresentapromisingfrontierinpostharvest biology for maintaining the market quality of tomato fruits during handling, storage, and distribution.

Keywords: Shelf-life physiology (Post Harvest Physiology), Cellular solute concentration (Osmotic Potential), Plant water status indicator (Relative water content), Fleshy texture (Succulence).

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is an important fruit vegetable belonging to the family **Solanaceae**. The plant is native to South and Central America, particularly the Peru–Ecuador region, but is now cultivated worldwide. It is a herbaceous annual crop with a fleshy berries as fruits. The fruit is typically red at maturity due to the presence of lycopene pigment and contains flattened, hairy, pale- yellow seeds. (Beneke *etal.*,2009).Tomato fruits are notable for their high water content, constituting about 93–95% of the fresh weight. This high level of moisture is responsible for the juiciness, freshness, and firmness of the fruits. (Bewley, *etal.*,1994). According to Adams (2004) succulence in tomato mainly arises from the pericarp and locular tissues, where mucilage and pectic substances hold water and contributeto the fruit's juicy nature while excessive postharvest water loss causes shriveling, softening, and reduced market value (Adams, 2004).

Physiologically, water in the tomato plant is essential for photosynthesis, nutrient transport, transpiration, osmotic regulation, and maintaining cellular turgidity, its succulence, nutritional quality, and consumer appeal (Ahuja, *etal.*,2010).

MATERIAL AND METHOD

Tomato fruits were coated following the method of Carlin *et al*., (2001). Absolute alcohol, rapeseed oil, and mucilage powders from *Parkia biglandulosa*, *Bombax ceiba*, *Spathodea campanulata*, and *Muntingia calabura* were dissolved and combined with a corn zein solution containing potassium metabisulfite, ascorbic acid, and benzoic acid. Tomatoes were immersed in 500 ml of the coating solution, gently shaken, dried for 30 min, and stored at room temperature and 10°C for 1, 2, 4, 8, and 12 days (Arvanitoyannis, I.; Psomiadou, E. and Nakayama, A. (1996). Dry weights were recorded on the 1st, 4th, 8th, and 12th day to calculate water content, relative water content, succulence, and osmotic potential using standard methods (Weatherley, 1965; Klug & Ting, 1978; Slatyer, 1955; Janardhan & Krishnamoorthy,1975).

RESULTS AND DISCUSSION

A biopolymeric coating was applied using mucilage powders incorporated with protein– lipid complexes. Mucilage extracted from *Parkia biglandulosa*, *Bombax ceiba*, *Spathodea campanulata*, and *Muntingia calabura* significantly enhanced fruit water potential, relative water content, tissue succulence, and osmotic adjustment in tomato (*Solanum lycopersicum* L.), thereby sustaining cellular turgor and maintaining cell wall integrity—key physiological determinants of postharvest freshness. Application of varying concentrations of the coating optimized tissue hydration, reduced transpiration-driven water loss, and maintained osmotic homeostasis, resulting in extended postharvest longevity. Utilization of mucilage as a natural polymer, derived from waste flowers, leaves, and fruits of avenue plants, constitutes a physiologically informed strategy for mitigating postharvest senescence, preserving fruit structural integrity, and minimizing water-stress–induced deterioration during storage and transport.

REFERENCE

1. Adams, J.B.(2004) Raw materials quality and the texture of processed vegetables. *Texture in Foods.* vol.2: *Solid Foods. Ed. D. Kilcast. Cambridge*, Woodhead Publ. Ltd, 342-363
2. Ahuja, M., M. Kumar and M. Yadav, (2010). Evaluation of mimosa seed mucilage as bucoadhesivepolymer.*YakugakuZasshi*, 130: 937-944
3. Arvanitoyannis, I.; Psomiadou, E. and Nakayama, A. (1996). Edible films made from sodium caseinate, starches, sugars or glyserol. Part 1. *Carbohydrate Polymers*, **31**(4): 179-192.
4. Bewley, J.D. and Black, M. (1994). Seeds: Physiology of Development and Germination. Plenum Press, New York.
5. Beneke CE, Viljoen AM, Hamman JH (2009) Polymeric Plant-derived Excipientsin Drug Delivery. *Molecules* **14**: 2602-2620.
6. Carlin, Gontard, N., Reich, M. and Nguyen-The, C. (2001). Journal of Food Science, 66(9): 1385 Kluge, M. and Ting, I. P.(1978). Crassulacean Acid Metabolism. Analysis of an Ecological
7. Adaptation. Springer-Verlag, Berlin.
8. Slatyer, R..O. (1955). Studies of the water relations of crop plants grown under natural rainfall in Northern Australia. Aust. J.Agr.Res.,6:365.
9. Janardhan, K., P. V. Murthy, K. Giriraj and S. Panchakshariah (1975). A rapid method for determination of Osmotic potential of plant sap. Curr.Sci., 44: 390.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue II February 2026

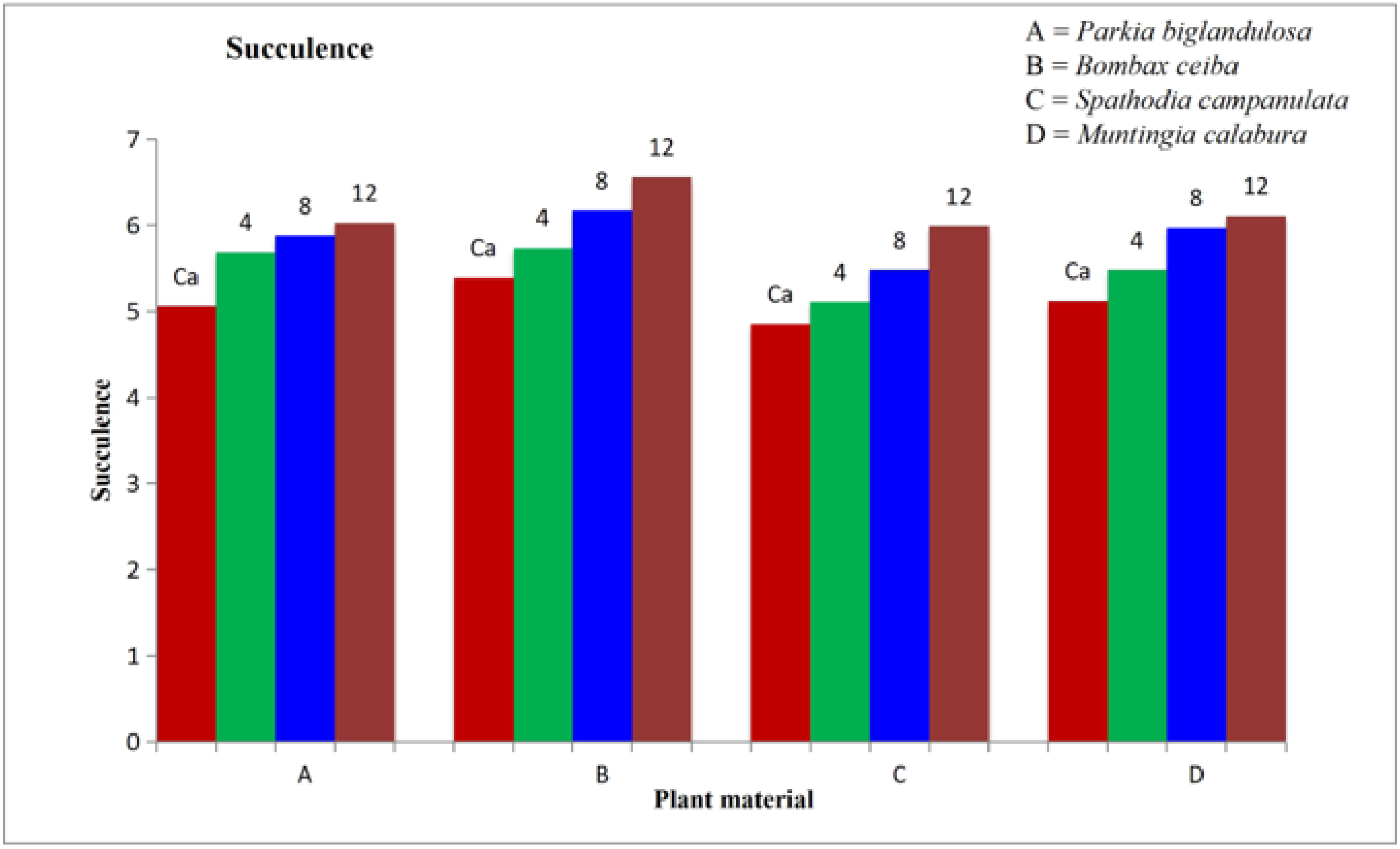
TableNo:1. Effect of Mucilage extract on Tomato fruit stored in Refrigerator at low temperature

Treatment EC(mS cm^{-1})	***Parkia biglandulosa***				***Bombax ceiba***				***Spathodia campanulata***				***Muntingia calabura***			
	Control	4	8	12	Control	4	8	12	Control	4	8	12	Control	4	8	12
Water content (% of D.W.)	512	568	584	612	558	589	635	678	483	512	538	592	499	527	572	603
Relative Water Content (%)	53	61	72.09	76	65	78	82	89	45	54	67	71	58	62	67	73
Succulance	5.06	5.69	5.88	6.03	5.39	5.74	6.17	6.56	4.85	5.11	5.48	5.99	5.12	5.48	5.97	6.11
Osmotic potential	-10.01	-10.13	-10.29	-11.20	-11.44	-11.78	-11.89	-12.18	-10.16	-10.22	-10.56	-11.21	-11.20	-11.36	-11.68	-11.99

TableNo: 2. Effect of Mucilage extract on Tomato fruit stored at room temperature.

Treatment EC(mS cm^{-1})	***Parkia biglandulosa***				***Bombax ceiba***				***Spathodia campanulata***				***Muntingia calabura***			
	Control	4	8	12	Control	4	8	12	Control	4	8	12	Control	4	8	12
Water content (% of D.W.)	416	488	518	584	484	503	565	612	445	489	504	549	438	478	511	569
Relative Water Content (%)	34	45	59	68.3	56	62	76	81	36	44	52	65	48	52	61	69
Succulance	4.12	4.28	4.60	5.16	4.18	4.60	5.11	5.59	4.36	4.88	5.12	5.61	4.88	5.16	5.48	5.91
Osmotic potential	-9.03	-10.1	-10.14	-10.59	-10.68	-11.20	-11.78	-11.90	-10.3	-10.19	-10.44	-10.69	-10.78	-11.12	-11.27	-11.47

Fig. no. 1. Effect of Mucilage extract on Water content in Tomato fruit stored in Refrigerator at low temperature.



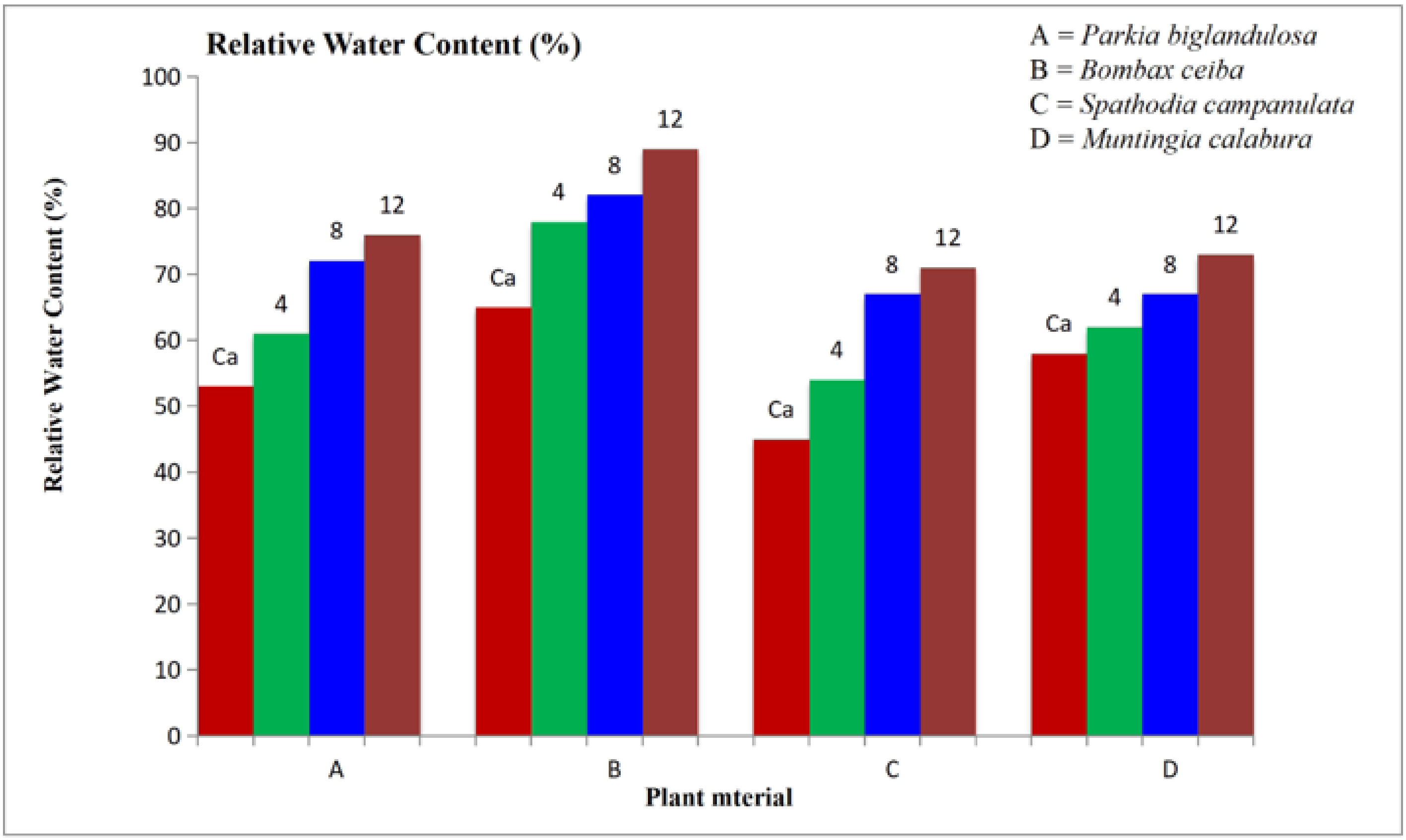


Fig. no. 2. Effect of Mucilage extract on Relative water content in Tomato fruit stored in Refrigerator at low temperature.

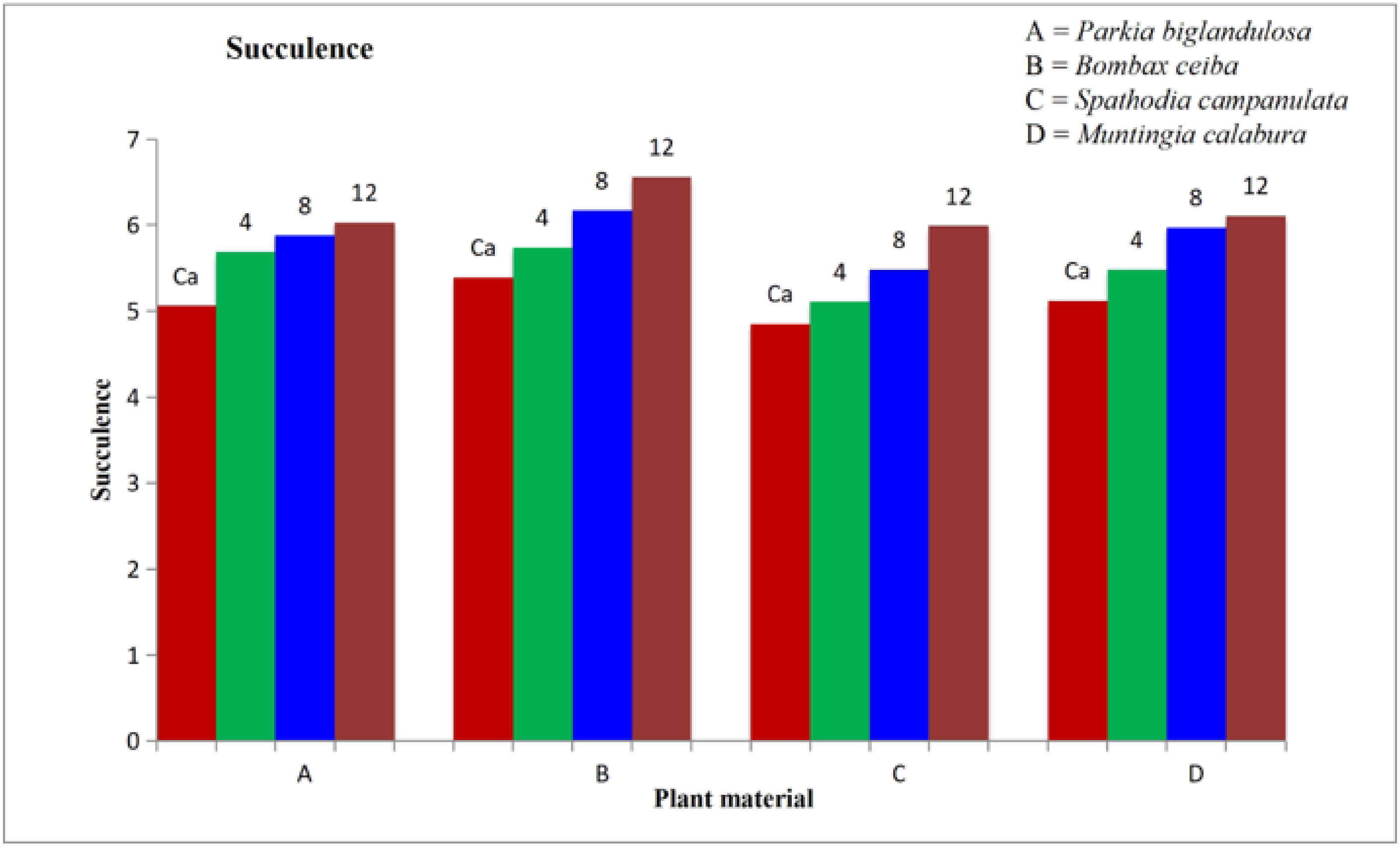


Fig. no. 3. Effect of Mucilage extract on Succulence in Tomato fruit stored in Refrigerator at low temperature.

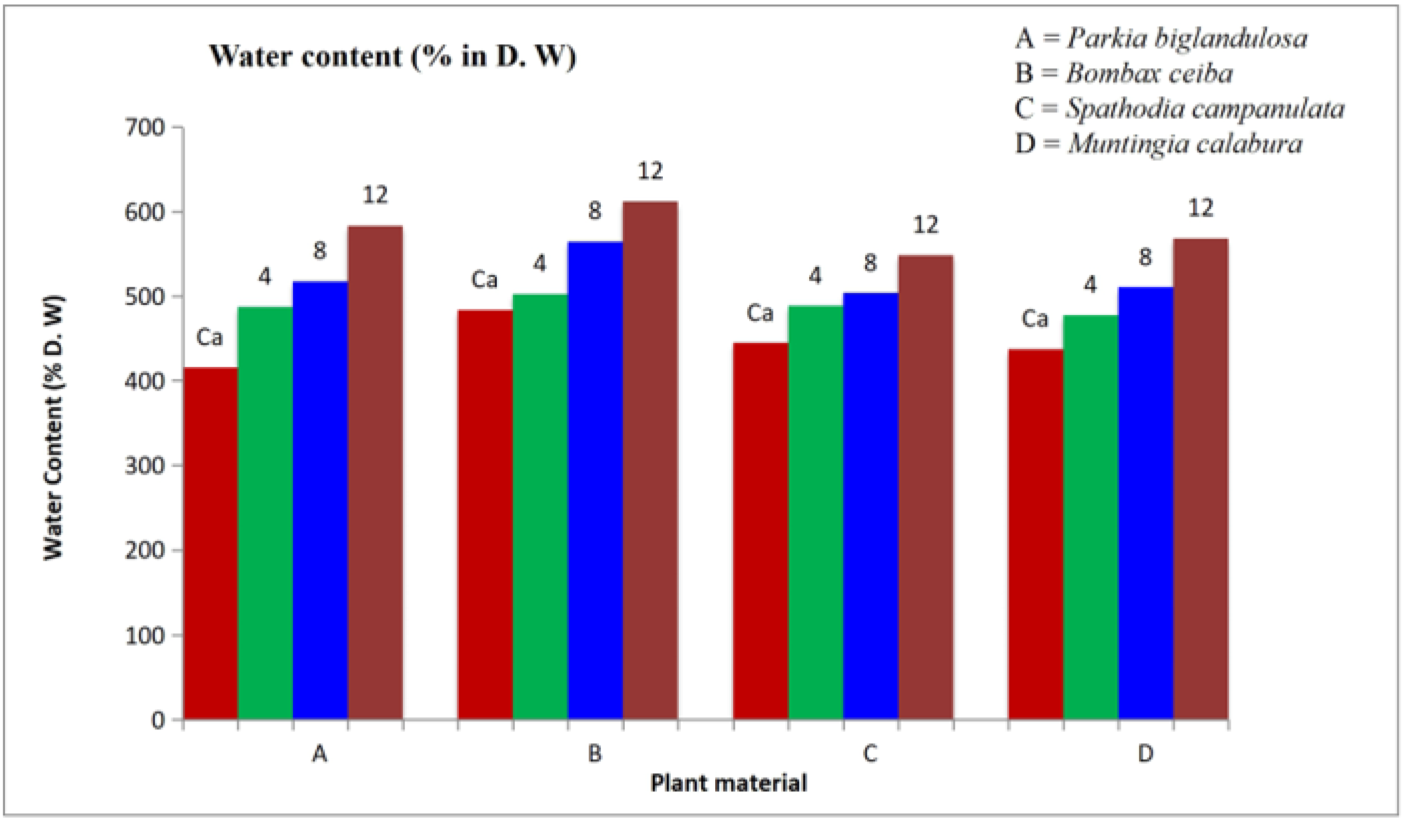


Fig.no. 4. Effect of Mucilage extract on Water content in Tomato fruit stored at room temperature.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue II February 2026

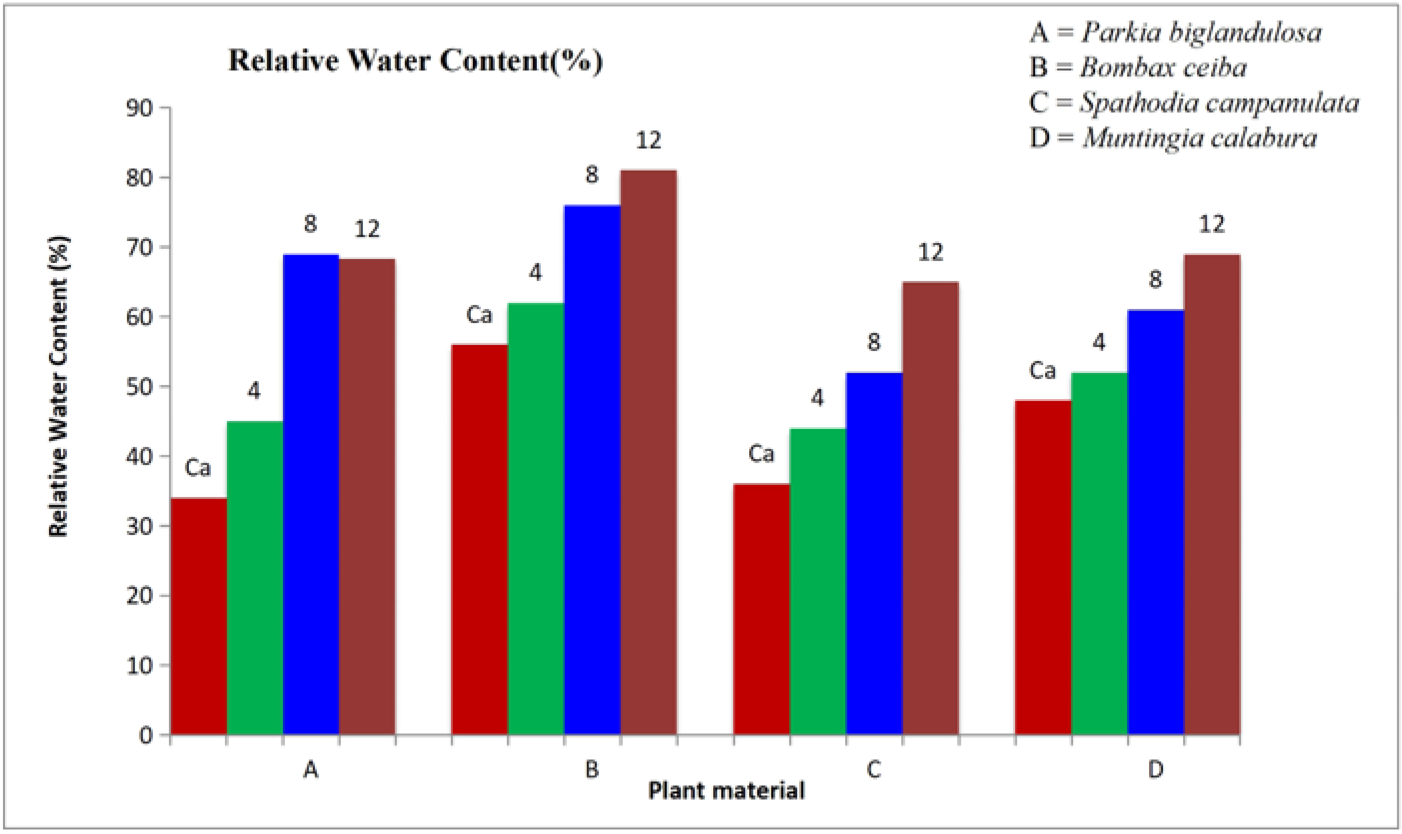


Fig. no. 5. Effect of Mucilage extract on Relative water content in Tomato fruit stored at room temperature.

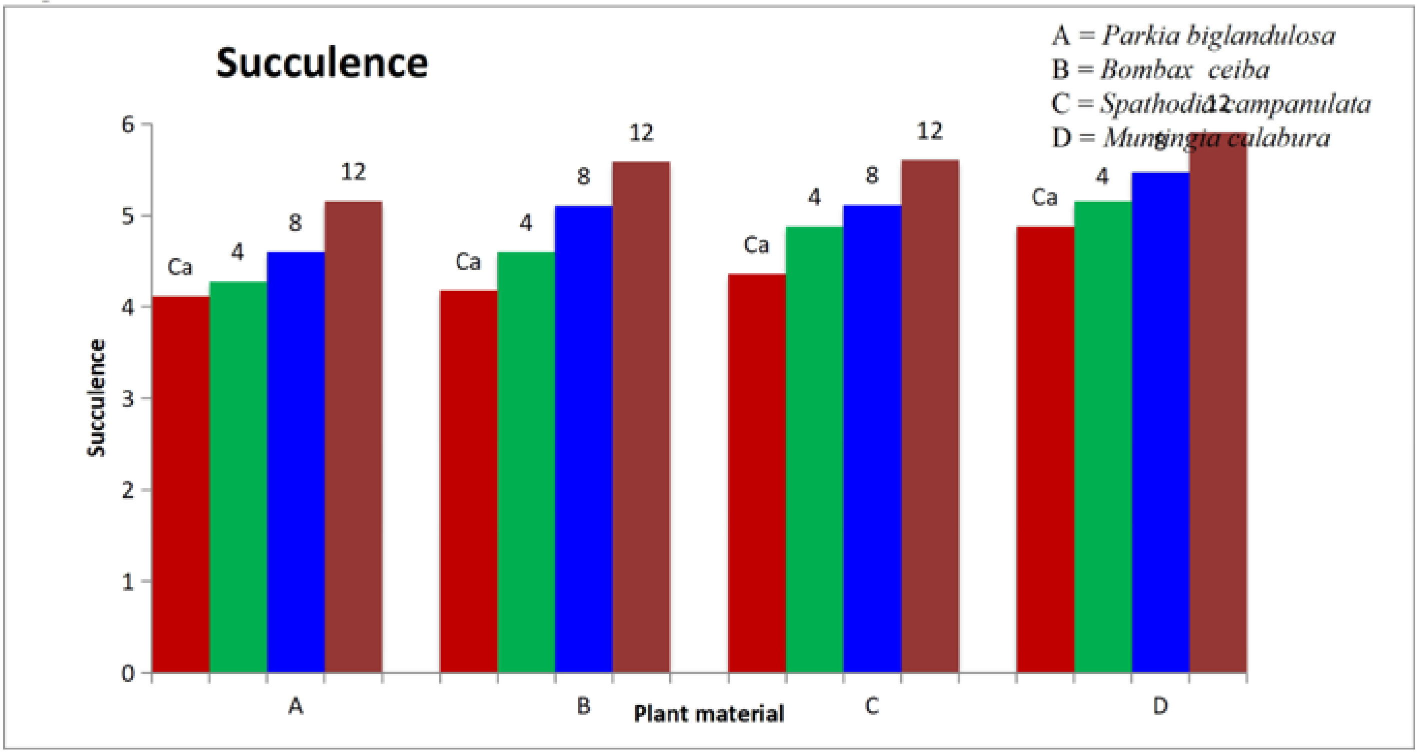


Fig. no.6.Effect of Mucilage extract on Succulence in Tomato fruit stored at room temperature.