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Gaurav Chaudhary
Department of Horticulture, Chaudhary Chhotu Ram (P.G.) College, Muzaffarnagar, Chaudhary Charan Singh University, Meerut, Uttar Pradesh, India

Gir Raj Kishore
Department of Horticulture, Chaudhary Chhotu Ram (P.G.) College, Muzaffarnagar, Chaudhary Charan Singh University, Meerut, Uttar Pradesh, India

Anushree Jatrana
Department of Chemistry, CCS Haryana Agricultural University, Hisar, Haryana, India

Shalini Arora
Department of Dairy Technology, College of Dairy Science and Technology Lala Lajpat Rai University of Veterinary & Animal Sciences, Hisar, Haryana, India

Devesh Pratap
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh India

Corresponding Author:
Gaurav Chaudhary
Department of Horticulture, Chaudhary Chhotu Ram (P.G.) College, Muzaffarnagar, Chaudhary Charan Singh University, Meerut, Uttar Pradesh, India

Effect of LDPE packaging and chemical treatments on dry matter content of Guava (*Psidium guajava* L.) fruit during storage

Gaurav Chaudhary, Gir Raj Kishore, Anushree Jatrana, Shalini Arora and Devesh Pratap

Abstract
The present research was aimed to study the combined effect of different chemical treatments and polyethylene wrapping on dry matter content of Guava (*Psidium guajava L.*) fruit. The guava cv. L-49 fruits were treated with chemicals such as calcium chloride, calcium nitrate, gibberellic acid, benzyl adenine and spermine and packed in LDPE100 and LDPE200 bags. The dry matter content of guava fruits was studied at three days of interval during storage at low temperature. SPM was most effective for MG fruits with dry matter content of23.24 (MG-100) and 23.34 (MG-200) on 12th day of storage. For CT fruits, SPM and BA were found to most efficient with dry matter content of 23.33 and 23.96 for CT-100, and 23.14 and 23.37 for CT-200, respectively on 12th day of storage. The combined application of chemicals and polyethylene significantly controlled the increase in dry matter content of guava fruit during storage at low temperature.

Keywords: Guava (*Psidium guajava* L.), post-harvest, dry matter, chemical treatment, LDPE

1. Introduction
Guava (*Psidium guajava* L.) fruit is a member of the Myrtaceae family that originated from Central America, Mexico, and grows in all subtropical areas in the world. The *Psidium* genus consists of approximately 150 persistent leafy shrub species (Pereira *et al*., 2016) [8]. Due to high yield and the variety of products derived from its fruit, the national and international stage in guava cultivation is of great economic significance in many countries around the world (Singh *et al*. 2018) [13]. Guava is grown in over 60 countries, and its worldwide production is estimated to be around 40 million tons (Angulo-López *et al*. 2021) [2].
Guava (*Psidium guajava* L.) was launched in India in the early 17th century and has now occupied an area in India of more than 60,000 acres (Sathe, 2015) [10] in all parts of the country. In the list of guava production all over the world, India is on the top, tailed by China and Kenya, with Brazil and Venezuela also standing out.
Guava is called by various names, including Amrud, Seed Pandu, Peru, Piyara, Koyya, Jamakaya, etc. It is among India's most popular commercial fruit crops and often referred to "The fruit of the poor guy" or "Tropical apple." It is a common tropical and subtropical fruit tree. Guava is thought to be one of the most delightful fruits (Adhau *et al*., 2014) [1]. Due to its exceptional phenolic content and other bioactive components such as lycopene, it has gained the attention of the scientific community in recent years, so much so that some writers consider guava to be a 'superfruit' (Oliveira *et al*., 2020) [6]. It contains the highest concentration of ascorbic acid (up to 228.3 milligram/100 g, fresh weight). Large amounts of essential oils, triterpenes, phenols, flavonoids, saponins, lectins, fiber and pectin as well as fatty acids are also found in guava. It has significant mineral levels, including calcium, phosphorus, iron and vitamins such as niacin, pantothenic acid, thiamin, riboflavin and vitamin A. Guava contains both polyphenolic compounds and carotenoids that give antioxidant property to the fruit making it one of the fruit with highest antioxidant values (Omayio *et al*., 2019, Kafle *et al*., 2018) [7, 4].
Guava fruit shows a climacteric pattern of respiration and ethylene production so is highly perishable in nature and grieves excessive amount of post-harvest loss (Singh *et al*., 2017) [11]. Postharvest treatment of guava fruits for attaining palatability after storage is a major concern for increasing the worldwide utilization of guava fruit.

Various technologies have evolved for improving the shelf life and marketability of horticultural commodities during the past decades, like use of various chemicals, fungicides, growth regulators, retardants, wax coatings, different types of packing materials, modified and controlled atmosphere storage etc. Treatments with various chemicals have been observed as economically viable and potential tool for reducing the post-harvest losses (Singh *et al*., 2017) [12]. However, temperature and relative humidity during storage are also fundamental to obtain a high-quality fruit with good storage potential (Wijewardane *et al*., 2013) [14]. Storage of fruits at low temperature for a definite period is a common practice to delay or retard the ripening. The use of polyethylene film for storage is also preferred nowadays, as it creates a modified atmosphere within the packaging, and reduces the losses related to transpiration and respiration. The packaging of guava fruits in polyethylene film greatly minimize the post-harvest losses and ensure the better quality of fruits during cold storage (Nagaraju *et al*., 2019) [5].
In this paper, combined effect of different chemical treatments and polyethylene wrapping was studied on dry matter content of guava fruits during cold storage. Where, calcium chloride, calcium nitrate, gibberellic acid, benzyl adenine and spermine were used for chemical treatment and LDPE (low-density polyethylene) at 100 and 200 gauge was used as wrapping material.

2. Materials and Methods
The experiment was conducted during the winter season of 2018-19 and 2019-20 in Post-harvest Technology Laboratory, Department of Horticulture, Choudhary Chotu Ram (PG) College Muzaffarnagar Uttar Pradesh. The fruits were collected from Sardar Vallabh bhai Patel University of Agriculture & Technology research farm Meerut, located at the North-West Plains of region Uttar Pradesh. In this experiment, we have used guava cv. L-49 i.e., harvested at green mature stage and color turning stage. All the chemicals used during experimentation and analysis were of analytical grade, purchased from the standard Indian chemical companies, i.e., Sigma, Hi-media and SRL. Low Density Polyethylene (LDPE) bags were locally purchased. The aqueous solution of $CaCl_2$ (2%), $Ca(NO_3)_2$ (2%), Gibberellic acid (GA_3, 200 ppm), Benzyl Adenine (BA, 50 ppm), and Spermine (SPM,100 ppm) were used for dipping the fruit for 5-10 minutes and then packed in LDPE bags at 100 and 200 gauge with 1% ventilation. The control fruits were kept for comparison after dipping it in tap water. The surface of fruit was air dried and thereafter packed in polyethylene film. All the fruits were stored at low temperature (10±2 °C) and 90±5 percent relative humidity. The experiment was laid out in completely randomized design with three replications. The dry matter content was determined by the methods of AOAC 1965.

3. Result and Discussion
3.1 Dry matter content of MG guava fruit
The dry matter content of MG guava fruits at low temperature storage as influenced by post-harvest application of various chemicals and polyethylene film (LDPE 100) is presented in Figure 1. In comparison to control, significant differences dry mattes were recorded with application of different chemicals and packing with LDPE. The data regarding to dry matter for MG fruit dipped in various chemicals and wrapped with LDPE 100 (MG-100) presented highly significant difference for all the treatments in comparison to control. For $CaCl_2$ and $Ca(NO_3)_2$treated fruits, no significant difference was observed in the trend of increase dry matter content. GA_3, BA, and SPM were found to exhibit better efficiency than the calcium based compounds, where the increase in dry matter content was found to be low. Among these, SPM presented the best efficiency with minimum increase in dry matter content during the course of storage. During the initial days of storage (upto 6th day), there was not much difference in the dry matter content for GA_3, BA, and SPM. After 6th day of storage the dry matter content was remarkably increased for GA_3, BA with the maximum value of 25.06 and 24.16, respectively on 12th day of storage, while SPM presented the dry matter of 23.24.In case of control, the dry matter content exhibited slow increase till 3rd day, after that a significant increase was observed with the advancement of storage duration and the maximum dry matter content (29.84) was recorded on 12th day of storage. The increase in dry matter content with the advancement of storage duration may be related to the withdrawal of water from the pulp to peel (Rokib *et al*., 2021) [9]. From above results it was observed that treatment with SPM was most effective in maintaining the palatability of fruit after storage, due to retention of moisture into pulp of fruit. The data regarding to dry matter of MG fruit dipped in various chemicals and wrapped with LDPE 200 (MG-200) is presented in Figure 2.A significant difference was observed for all the treatments in comparison to control. Among the Calcium based compounds the dry matter content observed for $CaCl_2$ and $Ca(NO_3)_2$on 12th day of storage was25.06 and 24.89, respectively. In case of GA_3, BA, and SPM, the dry matter content was found to be 24.06, 23.76 and 23.34, respectively. Among these SPM was found to exhibit the minimum amount of dry matter on 12th day of storage. In the early days of storage, no significant difference was observed between $Ca(NO_3)_2$ and GA_3, and the same was observed between BA, and SPM till 6th day of storage.

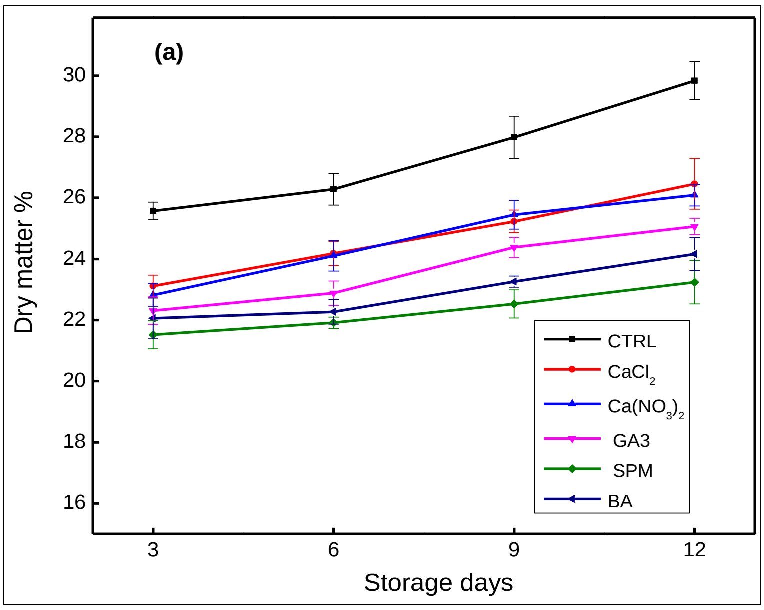

Fig 1: Effect of different chemical treatments and LDPE100-gauge packaging (1% ventilation) on dry matter content of mature green guava fruits cv. Lucknow-49 at low temperature storage, two years pool data (2018-19 to 2019-20)

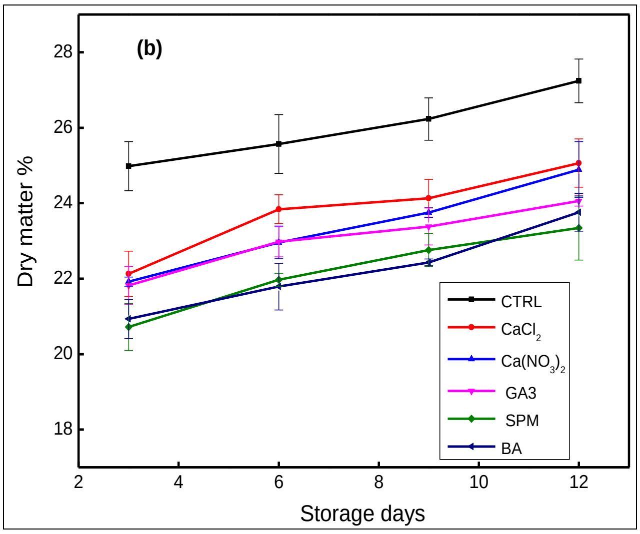

Fig 2: Effect of different chemical treatments and LDPE200-gauge packaging (1% ventilation) on dry matter content of mature green guava fruits cv. Lucknow-49 at low temperature storage, two years pool data (2018-19 to 2019-20)

3.2 Dry matter content of CT guava fruit

Figure 3&4 indicates the dry matter content of CT guava fruits after application of various chemicals and polyethylene film (LDPE 100& LDPE 200) during storage at low temperature. For both CT-100 and CT-200, the interaction between all the treatments and control were found to be significant, but the increase in dry matter was to a higher extent than MG stage guava fruit.

During all the days of storage, SPM and BA were found to exhibit the comparable efficiency with dry matter content of 23.33 and 23.96 for CT-100, and 23.14 and 23.37 for CT-200, respectively on 12th day of storage. While a similar pattern for dry matter content of CT-100 and CT-200was observed for $CaCl_2$, $Ca(NO_3)_2$ and GA_3 towards. The results reveal that treatment of CT guava fruits with different chemicals followed by packing with LDPE-100 & LDPE 200 was found to be less effective in controlling the increase of dry matter content with comparison to MG fruit.

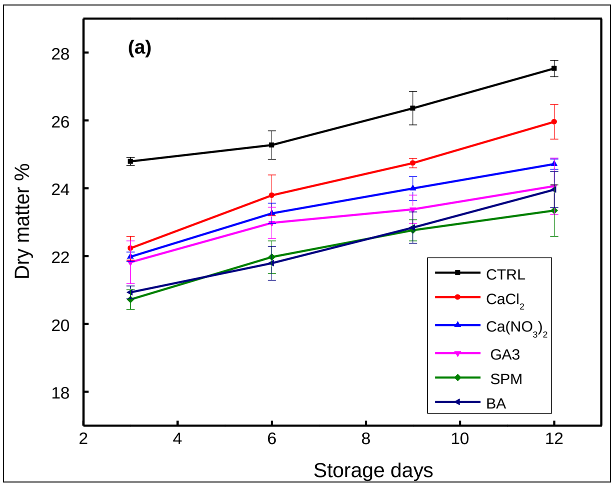

Fig 3: Effect of different chemical treatments and LDPE 100-gaugepackaging (1% ventilation) on dry matter content of color turning guava fruits cv. Lucknow-49 at low temperature, two years pool data (2018-19 to 2019-20)

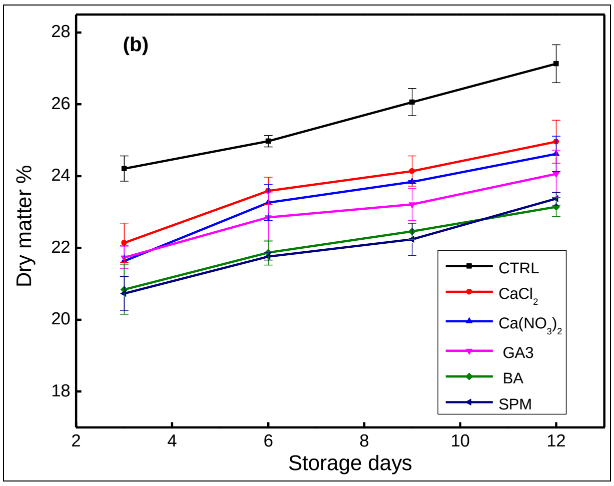

Fig 4: Effect of different chemical treatments and LDPE200 packaging (1% ventilation) on dry matter content of color turning guava fruits cv. Lucknow-49 at low temperature, two years pool data (2018-19 to 2019-20)

4. Conclusion

In this study, Guava fruits at two different stages of maturity (MG and CT) were treated with calcium chloride, calcium nitrate, gibberellic acid, benzyl adenine and spermine and wrapped with LDPE bags with 1% ventilation. It was observed that the combined application of chemical treatments and LDPE packaging was quite effective for controlling the increase in dry matter content during storage. SPM was found to be most effective for MG fruits, where, the dry matter content on 12^{th} day of storage was found to be 23.24 (MG-100) and 23.34 (MG-200). For CT fruits, SPM and BA were found to exhibit the maximum efficiency with dry matter content of 23.33 and 23.96 for CT-100, and 23.14 and 23.37 for CT-200, respectively on 12^{th} day of storage. The results suggested that the treatment of CT guava fruits was found to be less effective in controlling the increase of dry matter content with comparison to MG fruit. Present study reveals that the combined application of chemicals and LDPE can help in retaining the quality of guava fruit during storage at low temperature.

5. References

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