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# Postharvest Management and Value Addition of Grapes *Vitis vinifera* var. Muscat Hamburg

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**ABSTRACT: Grapes (*Vitis vinifera* L.) is a sub-tropical fruit crop, rich in beneficial anti-oxidants, vitamins, minerals and micronutrients. As grapes are highly perishable, the postharvest management plays an essential role in increasing the shelf life. Hence, research was taken up by keeping grapes under cold and ambient storage conditions during 2022-23. The freshly harvested grapes *Vitis vinifera* var. Muscat Hamburg was treated with EFF (0%, 2.5%, 5.0%, 7.5%, 10.0%) for 10 mins and stored under ambient (28°C±2°C, RH 60±10%) and cold storage (12°C±2°C, RH 90±5%) conditions and the physiological characters were evaluated. The EFF at 2.5% concentration recorded the minimum physiological loss in weight (1.31%), higher firmness (3.28 N) with increased shelf life of 21 days at cold storage, while nine days shelf life under ambient storage condition. The EFF treated fruits had low TSS (18.1°Brix), indicating improved fruit quality during cold storage as against TSS of 19.3°Brix at ambient storage. Overall, the results clearly indicates that the EFF treated and shrink wrapped grape var. Muscat Hamburg showed delay in ripening process and had an extended shelf-life.**

**Keywords:** EFF (Enhanced Freshness Formulation) - Grapes–Postharvest management- Shrink wrap- Storage.

## INTRODUCTION

Grapes (*Vitis vinifera* L.) occupy more land in the world than any other single fruit and account for almost half of total production of fruits in the world. Among the fruit crops grown in India, grapes productivity shares 15.8 % with a production of 17.37 lakh MT. Among major grape growing states, Maharashtra ranks first with an area of about 0.90 lakh ha (83.5 %),with a production of 21.60lakh MT. Tamil Nadu ranks third (1.8 %) with a production of 0.47 lakh MT over an area of 2,800 ha, after Karnataka (11.7%). Major grape growing regions in Tamil Nadu rest with Theni, Dindigul & Coimbatore districts (NHB, 2014).

Approximately 17 to 20 percent of the grapes grown in India are dried for the production of raisins. Of the grapes grown, 78% are used for table purpose, while the remaining 2 percent are utilized to make juice and wine. Inadequate postharvest management accounts for 20 to 30% of the loss of grape berries, which are highly perishable in nature. Berries can be stored for four to six days under normal circumstances. Under carefully monitored, the shelf-life of grape berries can be increased to two to three months. For the purpose of maintaining freshness, quality, and reducing berry decay, table grapes can be stored very well in the cold at 0°C shortly after harvest (Sharma and Adsule 2007). Grape postharvest loss has been estimated in India by several employees, which ranges from 8.23% to 16% nationwide. According to the current estimate of 8.23%, India is losing roughly 223 thousand tonnes of grapes every year. Maharashtra, Karnataka, Tamil Nadu and Mizoram are the significant grape growing states. Maharashtra has the highest productivity in the nation during 2021–2022, accounting for more than 70% of the nation's total production. With a 25% share in 2021–22 (3rd Advance Estimate), Karnataka will be the second-largest producer of grapes. The production of grapes will occupy 161.91 thousand hectares, or 2.30% of the total area used for fruit production in 2021–2022. Additionally, the nation is a significant exporter of grapes (Sharma *et al*., 2018). Hexanal is a naturally occurring six carbon aldehyde compound produced in the lipoxygenase pathway and released from plants during tissue damage (Rajesh *et al*., 2020). It is an important precursor for the formation of six carbon alcohols and esters, with an important role in extending fruit freshness by inhibiting the enzyme phospholipase-D (Brown *et al*., 1990; Jandus *et al*., 1997). Polymer

plastic film is the main component of shrink film, often known as shrink wrap. Heat causes it to shrink tightly over the material it is covering.

Polyethylene, polypropylene, and polyolefin are frequently used shrink films. Individual and tray-wrapped fruit's shelf life is extended by polyolefin films at room temperature, and water loss is reduced during prolonged cold storage. The individual shrink wrapping is to prevent moisture loss (Singh *et al*., 2005).

## MATERIAL AND METHODS

A Laboratory research was conducted at Horticultural College and Research Institute, Periyakulam, Theni district during March 2023, to evaluate the influence of EFF & Shrink wrapping on storage of freshly harvested grapes *Vitis vinifera* var. Muscat Hamburg. The treatments include dipping of grape bunches in five different concentrations of EFF @ 0%, 2.5%, 5.0%, 7.5%, 10.0%. The 10 treatment combinations in the experiment were set up in a 2-factor Factorial Completely Randomized Block Design (FCRD) with three replications. The particulars of the treatment are as follows:

**Factor 1:** EFF (concentration 0, 2.5, 5.0, 7.5, 10.0 %) dip for 10 min

**Factor 2:** Storage conditions (S)

$S_1$: Ambient Temperature storage(28-30°C±2°C)

$S_2$: Cold Storage (12°C±2°C)

| **Wrapping material used after EFF dip treatment was Shrink film (SW).** | | | |
|---|---|---|---|
| **Treatment** | | **Storage** | |
| $T_1$ | EFF@ 0 % + SW [Control] | Ambient (28-30°C±2°C) (AS) | Cold (12°C±2°C) (CS) |
| $T_2$ | EFF@ 2.5% + SW | | |
| $T_3$ | EFF@ 5.0% + SW | | |
| $T_4$ | EFF@ 7.5% + SW | | |
| $T_5$ | EFF@ 10.0% + SW | | |

To study physiological and biochemical changes during storage of the fruits under cold and ambient, observations of the fruit samples were recorded at three days interval

**Physiological loss in weight (%)**. The physiological loss in weight of fruits was assessed at three days interval and calculated using the formula given below and expressed in percentage.

$$\text{PLW (\%)} = \frac{\text{Initial weight (g)} - \text{Final weight (g)}}{\text{Initial weight (g)}} \times 100$$

**Fruit firmness (N).** The firmness of the fruits was measured with the help of digital penetrometer [Model: FT 011 (0.4 to 11 lbs)] and the fruit firmness was expressed in Newton (N).

**Total Soluble Solids (°Brix).** With the use of digital refractometer, an LED was allowed to pass light through a prism in contact with the fruit juice sample. An image sensor determines the critical angle at which the light is no longer refracted through the sample and the TSS of the fruits was calculated in terms of degree brix.

**Shelf life (days).** Shelf life of the fruits was determined by recording the number of days the fruits remained in marketable condition without spoilage in each treatment during storage and expressed in days.

**Statistical analysis.** The data collected were statistically analysed under factorial completely randomized block design (Panse and Sukhatme 1967). The significance of the mean differences between the treatments was determined by computing the standard error and critical difference.

## RESULTS AND DISCUSSION

### Physiological characters

**Physiological loss in weight (%).** The results showed under cold storage condition, the maximum physiological loss in weight (11.0%) was observed in treatment $T_1$ (Control) and the minimum physiological loss in weight (1.31%) in treatment $T_2$ (EFF @ 2.5%), 21 days after storage as presented in Table 2. Under ambient condition, the physiological loss in weight was 25.5% in $T_5$ (EFF @ 10.0%), followed by 29.5% in treatment $T_4$ (EFF @ 7.5%), while the maximum physiological loss in weight (38.5%) was observed in treatment $T_1$ (Control) on 9$^{th}$ day of storage and the results are presented in Table 1. The reduction in weight loss in cold storage might be due to the maintenance of firmness of fruit by EFFdip treatment along with shrink wrapping, which decreased the enzyme activity responsible for disintegration of cellular structure and the gaseous exchange. Similar findings have been reported by Aradhya *et al.* (2006).

**Firmness (N).** Firmness of the fruit is an important characteristic that is used to determine stability and it is predominantly determined by cell wall composition and structure. In cold storage condition, the maximum firmness (4.53 N) was recorded in $T_2$ (EFF@2.5%) and the results are presented in Table 4and the minimum firmness of 3.16 N was recorded in $T_1$ (Control: EFF @ 0%). The EFF treatment along with shrink wrapping under cold storage has been known to delay the softening of fruits and improves the fruit quality. Whereas under ambient storage, the maximum firmness (3.27 N) was observed in $T_2$ (EFF@ 2.5%) and the minimum firmness (3.06 N) was observed in treatment $T_1$ (Control: EFF @ 0%) as presented in Table 3. Similar findings have been reported by Tsomu and Patel (2014).

**Total Soluble Solids (° Brix).** The minimum TSS (18.4°Brix) was recorded in $T_2$ (EFF@ 2.5%), which was followed by 19.7°Brix in $T_5$ (EFF@ 10.0%) and the maximum TSS (20.7°Brix) was observed in $T_1$ (Control) under ambient storage as presented in Table 5. In cold storage condition, the minimum TSS (18.1°Brix) was recorded in $T_2$ (EFF@2.5%) and the maximum TSS (19.7°Brix) was recorded in $T_1$ (Control) and the results are presented in Table 6. Similar findings have been reported by Sudha *et al*., (2007).

**Table 1: Effect of EFF& Shrink wrapping on physiological loss in weight (%) of freshly harvested grapes *Vitis vinifera* var. Muscat Hamburg under ambient & cold storage.**

| Treatments | Mean Physiological loss in weight (%) | | | | | | Mean |
|---|---|---|---|---|---|---|---|
| | 3 DAS | | 6 DAS | | 9 DAS | | |
| | AS | CS | AS | CS | AS | CS | |
| $T_1$ | 7.45 | 3.03 | 28.5 | 3.43 | 38.5 | 3.80 | 14.1 |
| $T_2$ | 5.25 | 0.37 | 20.3 | 0.39 | 38.4 | 0.75 | 10.9 |
| $T_3$ | 6.45 | 2.34 | 21.2 | 2.91 | 34.2 | 2.97 | 11.6 |
| $T_4$ | 4.78 | 1.14 | 19.5 | 1.09 | 29.5 | 1.45 | 9.57 |
| $T_5$ | 3.56 | 0.35 | 15.5 | 0.71 | 25.5 | 0.76 | 7.73 |
| **Mean** | **5.50** | **1.44** | **21.0** | **1.70** | **33.2** | **1.94** | **10.7** |
| **SE (d)** | 0.142 | 0.116 | 0.546 | 0.059 | 0.915 | 0.038 | 0.302 |
| **CD (p=0.05)** | 0.317 | 0.259 | 1.216 | 0.260 | 2.040 | 0.086 | 1.193 |

*AS: Ambient Storage; CS: Cold Storage

**Table 2: Effect of EFF & Shrink wrapping on physiological loss in weight (%) of freshly harvested grapes *Vitis vinifera* var. Muscat Hamburg under cold storage.**

| Treatments | Mean Physiological loss in weight (%) | | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|
| | Cold storage (12ºC ± 2 °C) | | | | | | | |
| | 3 DAS | 6 DAS | 9 DAS | 12 DAS | 15 DAS | 18 DAS | 21 DAS | |
| $T_1$ | 3.03 | 3.43 | 3.80 | 5.30 | 6.60 | 9.30 | 11.0 | 6.06 |
| $T_2$ | 0.37 | 0.39 | 0.75 | 0.78 | 0.80 | 0.82 | 1.31 | 0.74 |
| $T_3$ | 2.34 | 2.91 | 2.97 | 3.33 | 3.9 | 4.06 | 4.45 | 3.42 |
| $T_4$ | 1.14 | 1.09 | 1.45 | 1.87 | 1.88 | 1.91 | 2.20 | 1.64 |
| $T_5$ | 0.35 | 0.71 | 0.76 | 1.11 | 1.14 | 1.49 | 1.82 | 1.05 |
| **Mean** | **1.44** | **1.70** | **1.94** | **2.48** | **2.86** | **3.52** | **4.17** | **2.58** |
| **SE (d)** | 0.116 | 0.059 | 0.038 | 0.075 | 0.104 | 0.093 | 0.056 | 0.077 |
| **CD(p=0.05)** | 0.259 | 0.260 | 0.086 | 0.168 | 0.232 | 0.207 | 0.126 | 0.191 |

**Table 3: Effect of EFF & Shrink wrapping on firmness (N) of freshly harvested grapes *Vitis vinifera* var. Muscat Hamburg under ambient and cold storage.**

| Treatments | Mean Firmness (N) | | | | | | Mean |
|---|---|---|---|---|---|---|---|
| | 3 DAS | | 6 DAS | | 9 DAS | | |
| | AS | CS | AS | CS | AS | CS | |
| $T_1$ | 4.25 | 4.94 | 3.75 | 4.83 | 3.06 | 4.65 | 4.24 |
| $T_2$ | 3.95 | 5.23 | 3.75 | 5.11 | 3.27 | 5.01 | 4.38 |
| $T_3$ | 4.18 | 5.18 | 3.78 | 4.90 | 3.20 | 4.59 | 4.30 |
| $T_4$ | 4.58 | 4.96 | 3.85 | 4.77 | 3.11 | 4.63 | 4.31 |
| $T_5$ | 4.56 | 5.20 | 3.79 | 4.92 | 3.09 | 4.87 | 4.40 |
| **Mean** | **4.30** | **5.10** | **3.78** | **4.91** | **3.15** | **4.75** | **4.33** |
| **SE (d)** | 0.123 | 0.027 | 0.099 | 0.036 | 0.048 | 0.060 | 0.065 |
| **CD(p=0.05)** | 0.276 | 0.062 | 0.222 | 0.081 | 0.109 | 0.134 | 0.147 |

*AS: Ambient Storage; CS: Cold Storage

**Table 4: Effect of EFF & Shrink wrapping on firmness (N) of freshly harvested grapes *Vitis vinifera* var. Muscat Hamburg under cold storage.**

| Treatments | Mean Firmness (N) | | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|
| | Cold storage (12ºC ± 2 °C) | | | | | | | |
| | 3 DAS | 6 DAS | 9 DAS | 12 DAS | 15 DAS | 18 DAS | 21 DAS | |
| $T_1$ | 4.94 | 4.83 | 4.65 | 3.73 | 3.52 | 3.28 | 3.16 | 4.05 |
| $T_2$ | 5.23 | 5.11 | 5.01 | 4.85 | 4.71 | 4.64 | 4.53 | 4.86 |
| $T_3$ | 5.18 | 4.90 | 4.59 | 4.25 | 3.99 | 3.59 | 3.38 | 4.26 |
| $T_4$ | 4.96 | 4.77 | 4.63 | 4.40 | 4.03 | 3.71 | 3.62 | 4.30 |
| $T_5$ | 5.20 | 4.92 | 4.87 | 4.68 | 4.53 | 4.54 | 4.32 | 4.72 |
| **Mean** | **5.10** | **4.91** | **4.75** | **4.38** | **4.15** | **3.95** | **3.80** | **4.43** |
| **SE (d)** | 0.028 | 0.037 | 0.061 | 0.083 | 0.050 | 0.072 | 0.100 | 0.061 |
| **CD(p=0.05)** | 0.062 | 0.082 | 0.135 | 0.185 | 0.112 | 0.160 | 0.224 | 0.137 |

**Table 5: Effect of EFF & Shrink wrapping on TSS (°Brix) of freshly harvested grapes *Vitis vinifera* var. Muscat Hamburg under ambient and cold storage.**

| Treatments | Mean Total soluble solids (°Brix) | | | | | | Mean |
|---|---|---|---|---|---|---|---|
| | 3 DAS | | 6 DAS | | 9 DAS | | |
| | AS | CS | AS | CS | AS | CS | |
| $T_1$ | 22.5 | 25.2 | 21.5 | 24.6 | 20.7 | 22.7 | 22.8 |
| $T_2$ | 23.7 | 24.7 | 20.7 | 24.3 | 19.7 | 22.5 | 22.6 |
| $T_3$ | 23.3 | 24.4 | 21.3 | 23.4 | 18.9 | 21.4 | 22.1 |
| $T_4$ | 22.6 | 24.1 | 20.4 | 23.5 | 18.7 | 20.8 | 21.6 |
| $T_5$ | 22.2 | 23.7 | 19.5 | 22.7 | 18.4 | 19.9 | 21.0 |
| **Mean** | **22.8** | **24.4** | **20.6** | **23.7** | **18.8** | **21.4** | **21.9** |
| **SE (d)** | 0.471 | 0.325 | 0.332 | 0.307 | 0.259 | 0.292 | 0.331 |
| **CD(p=0.05)** | 1.049 | 0.726 | 0.739 | 0.685 | 0.577 | 0.650 | 0.737 |

*AS: Ambient Storage; CS: Cold Storage

**Table 6: Effect of EFF & Shrink wrapping on TSS (°Brix) of freshly harvested grapes *Vitis vinifera* var. Muscat Hamburg under cold storage.**

| Treatments | Mean Total soluble solids (°Brix) | | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|
| | Cold storage (12°C ± 2 °C) | | | | | | | |
| | 3 DAS | 6 DAS | 9 DAS | 12 DAS | 15 DAS | 18 DAS | 21 DAS | |
| $T_1$ | 25.2 | 24.6 | 22.7 | 21.6 | 20.7 | 19.9 | 19.7 | 22.0 |
| $T_2$ | 24.7 | 24.3 | 22.5 | 21.4 | 20.3 | 19.3 | 18.1 | 21.5 |
| $T_3$ | 24.4 | 23.4 | 21.4 | 20.5 | 19.56 | 18.7 | 18.8 | 20.9 |
| $T_4$ | 24.1 | 23.5 | 20.8 | 19.9 | 18.9 | 18.2 | 18.9 | 20.6 |
| $T_5$ | 23.7 | 22.7 | 19.9 | 19.4 | 18.7 | 17.8 | 18.6 | 20.1 |
| **Mean** | **24.4** | **23.7** | **21.4** | **20.6** | **19.6** | **18.8** | **19.0** | **21.0** |
| **SE (d)** | 0.325 | 0.307 | 0.292 | 0.403 | 0.374 | 0.301 | 0.347 | 0.335 |
| **CD(p=0.05)** | 0.726 | 0.685 | 0.650 | 0.899 | 0.833 | 0.672 | 0.773 | 0.748 |

## CONCLUSIONS

On the basis of this research findings, it can be concluded that EFF treatment has very good effect in extending shelf-life of grapes *Vitis vinifera* var. Muscat Hamburg. Treatment of grape bunches by EFF dip (2.5%), followed by shrink wrapping is found effective for increasing the shelf life with the minimum physiological loss in weight, TSS and with the maximum fruit firmness of grape berries.

## FUTURE SCOPE

Cold storage of grapes after EFF dip treatment followed by shrink wrapping can be an effective postharvest management strategy to reduce loss of harvested grapes both in storage and in transit. Further, keeping the EFF dipped shrink wrapped grapes in corrugated fibre board boxes may further enhance the shelf life and this can be explored.

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**Conflict of Interest**. None.

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