Extending the Storage-Life of Marigold Flowers Cv. 'Calcutta Jambo' using Cold Storage

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Abstract:

An investigation to evaluate the storage-life of Marigold flowers cv. 'Calcutta Jambo' at room conditions and inside cold storage was undertaken by Ecofrost Technologies Pvt. Ltd. Tathawade, Pune, Maharashtra, India during September 2018. Best flowers from a farmer's field at two locations (Yavat, Pune and Kanhoor Pathar (Ahemadnagar), India) were selected based on quality. The effect of cold storage (4°C and 95% RH) on the storage and post-storage life of these flowers was studied. Weight loss increased with increase in storage period. Flowers stored inside cold storage had a storage life of 6 days along with 1.5 days post storage life as compared to 3.0 days for flowers kept in room conditions. Post-storage life was recorded to be 1 day at room conditions for inorganic and organic flowers when taken out from cold room at the end of the day 8 and day 7, respectively.

Key Words: Marigold, Calcutta Jambo, Ecofrost, Cold storage, Temperature, Humidity.

Introduction:

The African marigold (*Tagetes erecta* L.), belonging to the *Asteraceae* family or *Compositae*, is the most commonly grown loose flower and is extensively used in religious and social functions. Marigold comes in different colours amongst which yellow and orange being the most common. Most marigold flowers have a strong, pungent odour and have great value in cosmetic treatment (Jadhav *et al.,* 2014). Burning the herb repels insects and flies. Marigold pigments are sometimes extracted and used as food colourant for human consumption.

Marigold flowers become ready for harvesting in about 2½ months from the date of transplanting. The plant continues to bear flowers for another 2-2 ½ months from the date of the first harvest. Flowers are harvested when they have attained their full size. Harvesting the flowers in the evening along with a portion of stalk is ideal. The average yield of the African marigold (*Tagetes erecta* L.) is 11-18 t/ha (http://www.keralaagriculture.gov.in/pdf/package_2015.pdf).

Marigold is gaining commercial importance as a source of carotenioid pigments. The principal pigment present in the flower is xanthophyll – particularly lutein – that accounts for 80 to 90% in the form of esters of plamitic and myristic acid. Ground blossom meal (petal meal) or extract (usually saponified for better absorption) is added to poultry feed (Bosma *et al*., 2003). These products are traded as "Aztec marigold" or marigold extract as "Adoptinal".

Rapid cooling and maintaining proper temperature are key requirements for managing the vitality of loose flowers. Refrigerated storages provide growers with the capability of extending the storage-life of loose flowers and, therefore, widen the marketing potential of the product. Temperature is considered the most important factor affecting the quality and longevity of flowers (Cevallos and Reid, 2001; Leonard *et al*, 2001; Gul and Sultan, 2007; Shahri et al., 2009; and Shahri and Tahir, 2011). At lower temperatures, flowers have a lower respiration rate and consume stored energy slowly (Van Doorn and De Witte, 1991, Cevallos and Reid, 2001; Shahri *et al.*, 2009).

Organic amendments provide a high input of exogenous organic matter and nutrients for a long period; in contrast, mineral fertilizers, allowed only in conventional farming systems, are highly concentrated in nutrients that are directly available for root uptake in a shorter time. The use of synthetic pesticides (only possible in conventional agriculture) slows down defence mechanisms against pathogens, with the consequence of favouring primary metabolism.

The storage systems play a pivotal role in the preservation of freshness of the produce along with quality. The aim of this study is to extend the storage life of marigold flowers cv. 'Calcutta Jambo' using cold room.

Materials and Methods

Uniform and healthy Marigold flowers (cv. Calcutta Jambo) of organically cultivated in Yavat Village, Daund Taluka in Pune District of Maharashtra State and inorganically cultivated in Kanhoor Pathar Village, Ahmednagar District, Maharashtra State; were used for this study during September 2018. Fully opened flowers were harvested at 9:00 AM and transported within 2 in an air-conditioned vehicle to the farmer field site, Yavat, Pune, where they were immediately prepared for the experiment. At the time of harvesting, ambient temperature was recorded to be 25.6°C. Flowers were kept inside a cold storage unit (Ecofrost) at 4°C and 95% relative humidity as well as in ordinary room conditions to check post storage life of organic and inorganic cultivated marigold cv. "Calcutta Jambo". 6 crates of each location were used for further study. After day 0, day 2, day 4, day 6, day 8 and day 10 of cold storage, the flowers were taken out from cold room and placed at room conditions to determine post storage life. Weight loss for commodity inside cold room was measured for each interval of two days. Weight loss was determined by using a laboratory digital balance.

Observations recorded

Observations regarding weight loss, storage life, and shelf life were recorded, and cumulative data was subjected to statistical analysis.

Results & Discussion

Weight loss of Marigold flowers cv. "Calcutta Jambo" inside cold room of Ecofrost

Table 1A: Weight loss of each crate of Marigold flowers cv. "Calcutta Jambo" inside Cold storage (Kanhoor Pathar Location).

Initial weight, kg	Weight after 2 days, kg	Weight after 4 days, kg	Weight after 6 days, kg	Weight after 8 days, kg	Weight after 10 days, kg
5.27	5.22	5.17	5.15	4.98	4.92
5.53	5.45	5.35	5.29	5.20	5.21
5.58	5.54	5.45	5.34	5.29	5.18
5.44	5.33	5.16	5.15	4.97	4.99
6.24	6.17	6.01	5.87	5.73	5.61
5.95	5.83	5.70	5.67	5.54	5.42

As shown in above table 1A, as weight loss increased with increase in storage period.

Table 1B: Weight loss of each crate of Marigold flowers cv. "Calcutta Jambo" inside Cold storage (Yavat Location)

Initial weight, kg	Weight after 2 days, kg	Weight after 4 days, kg	Weight after 6 days, kg	Weight after 8 days, kg	Weight after 10 days, kg
5.00	4.90	4.76	4.71	4.60	4.53
5.00	4.91	4.76	4.67	4.56	4.49
5.00	4.91	4.73	4.71	4.60	4.51
5.00	4.90	4.76	4.70	4.65	4.51
5.00	4.90	4.77	4.76	4.64	4.57
5.00	4.88	4.71	4.60	4.57	4.47

As shown in above table 1B, weight loss increased with increase in storage period.

Table 2A: Percent weight loss of each crate of Marigold flowers cv. "Calcutta Jambo" inside Cold storage (Kanhoor Pathar Location)

Initial weight loss, (%)	Weight loss after 2 days, (%)	Weight loss after 4 days, (%)	Weight loss after 6 days, (%)	Weight loss after 8 days, (%)	Weight loss after 10 days, (%)
0	0.85	1.80	2.28	5.41	6.55
0	1.45	3.25	4.34	5.97	5.79
0	0.72	2.24	4.30	5.20	7.17
0	2.02	5.24	5.33	8.73	8.36
0	1.04	3.69	5.93	8.18	10.10
0	1.93	4.21	4.63	6.90	8.92

As shown in above table 2A, as weight loss increased with increase in storage period.

Table 2B: Percent weight loss of each crate of Marigold flowers cv. "Calcutta Jambo" inside Cold storage (Yavat Location)

Initial weight loss, (%)	Weight loss after 2 days, (%)	Weight loss after 4 days, (%)	Weight loss after 6 days, (%)	Weight loss after 8 days, (%)	Weight loss after 10 days, (%)
0	2.00	4.90	5.80	8.10	9.40
0	1.80	4.80	6.60	8.80	10.20
0	1.80	5.40	5.90	8.10	9.80
0	2.10	4.80	6.00	7.00	9.80
0	2.00	4.60	4.80	7.20	8.70
0	2.40	5.80	8.00	8.70	10.70

As shown in table 2B, increase in storage period with increased weight loss of Marigold flowers cv. "Calcutta Jambo" inside cold room.

Table 3A: Average percent weight loss of Marigold flowers cv. "Calcutta Jambo" inside Cold storage (Kanhoor Pathar Location)

After 2 days	After 4 days	After 6 days	After 8 days	After 10 days
1.34%	3.41%	4.47%	6.73%	7.82%

As shown in table 3A, 7.82% weight loss observed at the end of 10 days of storage.

Table 3B: Average percent weight loss of Marigold flowers cv. "Calcutta Jambo" inside Cold storage (Yavat Location)

After 2 days	After 4 days	After 6 days	After 8 days	After 10 days
2.02%	5.05%	6.18%	7.98%	9.77%

As shown in table 3B, 9.77% weight loss observed after 10 days of storage. As compared to inorganic produce, organic produce was observed giving more weight loss.

Table 4. Storage-life (days) of Marigold flowers cv. "Calcutta Jambo" inside cold room.

Type of cultivation	Storage life (days) inside cold room
Inorganically cultivated flowers - Kanhoor Pathar location	6
Organically cultivated flowers- Yavat location	6

Storage life inside cold room was recorded as 6 days for organically and inorganically cultivated marigold flowers cv. 'Calcutta Jambo' to obtain post storage life of 1.5 days at room temperature (Table 4).

Table 5A: Post-storage life of inorganically cultivated Marigold flowers cv. "Calcutta Jambo" at room conditions, after taken out from cold room on different days.

Shelf life (Days)	After 2 Days	After 4 Days	After 6 Days	After 8 Days	After 10 Days
3	2.5	2	1.5	1	0.5
3	2.5	2	1.5	1	0.5
3	2.5	2	1.5	1	0.5
3	2.5	2	1.5	1	0.5
3	2.5	2	1.5	1	0.5
3	2.5	2	1.5	1	0.5

Table 5B: Post-storage life of organically cultivated Marigold flowers cv. "Calcutta Jambo" at room conditions, after taken out from cold room on different days.

Shelf life (Days)	After 2 Days	After 4 Days	After 6 Days	After 8 Days	After 10 Days
3	2.5	2	1.5	0.5	0.5
3	2.5	2	1.5	0.5	0.5
3	2.5	2	1.5	0.5	0.5
3	2.5	2	1.5	0.5	0.5
3	2.5	2	1.5	0.5	0.5
3	2.5	2	1.5	0.5	0.5

As shown in table 5A and 5B, post storage life decreased with increase in storage period. In case of, Flowers taken out at room temperature after 10 days from cold room, post-storage life observed as 0.5 days.

The use of low temperature during storage is very important for conservation of these flowers; in addition to inhibiting bacterial and fungal infections as it reduces degradation of certain enzymes and ethylene production, decreases perspiration, rate of respiration (Van Doorn and De Witte, 1991; Cevallos and Reid, 2001; Shahri et al., 2009) and delays the different processes of senescence (Ashrae, 1994).

Table 6: Shelf life (days) of marigold flowers cv. "Calcutta Jambo" at room temperature

Type of Cultivated	Shelf Life (Days)
Organic Cultivated- Yavat Location	3
Inorganically Cultivated- Kanhoor Location	3

Shelf life was recorded as 3 days for both the samples of marigold cv. "Calcutta Jambo" (Table 6). Lairon (2010) confirmed the absence of pesticide residues in organic food and reported a lower content of nitrogen in organic vegetables in comparison to conventional ones. He also highlighted the high level of antioxidants, minerals, and dry matter in organically-grown products. However, conventional products usually result in higher water content. Similarly, concluded that the concentration of total nitrogen was 10% lower in organic crops compared to conventional crops (Caruso *et al.*, 2011; Baranski *et al*., 2014). The low percentage of nitrogen forms was correlated with a high concentration of secondary metabolites (such as phenols and vitamins, which do not contain nitrogen). Also observed higher dry matter content in organically-grown carrots and spinach in comparison with the conventional ones (Bourn and Prescott, 2002).

Conclusion

In conclusion, fully opened flowers of organically and inorganically cultivated Marigold cv. 'Calcutta Jambo' kept at cold storage were seen to keep well and maintaining best quality of the flowers. Storage life was recorded as 6 days inside cold room and post storage life was recorded as 1.5 days in both organically and inorganically cultivated flowers. Flower appearance was good for 10 days inside cold storage, but petal blackening started after 0.5 days at room conditions, when inorganic and organic flowers were taken out from cold room at the end of 10 and 8 days, respectively.

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