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Effect of glycerine on drying of cut foliage of silver oak (*Grevillea robusta*)

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ABSTRACT

The study was undertaken to evaluate the impact of glycerine on drying process of cut foliage of silver oak (*Grevillea robusta* L.). Two methods of glycerinisation, namely uptake and full dip, were used, and different concentrations of glycerine (10%, 20%, and 40%) were tested. The overall acceptability of dried foliage was assessed, with a higher score indicating better quality. The results showed that full dip method achieved the highest score for overall acceptability (3.36) compared to uptake method. Among concentrations of glycerine, 40% was identified as the optimum for drying process. The maximum score obtained for overall acceptability of dried foliage was 4.98, indicating a relatively high level of satisfaction with quality. Using the full dip method and a glycerine concentration of 40% can result in dried foliage with good overall acceptability. These findings can be useful for improving the drying process of silver oak foliage and enhancing its quality for various applications.

Key Words: Glycerinisation, Dry flowers, Brittleness, Full dip method, Acceptability

Dried or dehydrated plant parts are cost-effective and offer an everlasting charm (Mir and Jana, 2015). Glycerinisation results in flexible and pliable foliage, even though the stems and leaves may turn brown during the process (White *et al*., 2007). Compared to other drying techniques, glycerinisation is considered superior method for drying various types of foliage (Jhanji *et al*., 2018; Mondal *et al*., 2018). It yields fresh-looking results and maintains the flexibility and pliability of plant materials. Therefore, an experiment was conducted on silver oak (*Grevillea robusta* L.) to explore their potential use in creating dry flower products.

MATERIALS AND METHODS

The experiment was conducted at the Department of Floriculture and Landscape Architecture, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, during 2016-17. The experimental design used was a completely randomized design with a factorial arrangement of treatments.

Leaves of *Grevillea robusta* were harvested from mature plants, and leaf samples measuring 15 cm in length were taken for preservation. Two methods of glycerinisation were employed: the uptake method and full dip method. Different concentrations of glycerine (10%, 20%, and 40%) were used. To prevent fungal and bacterial infections on treated leaves, Carbendazim, mancozeb, and Streptocycline were added to glycerine solutions.

The observations and assessments were conducted during the experiment. These included measuring the percentage change in leaf weight (Ranganna, 1977), the percentage change in leaf area, membrane integrity (Leopold *et al*., 1981), chlorophyll content, and quality parameters such as texture, brittleness (Peryam, 1957), and shape retention, and overall acceptance (Vishnupriya, 2011). Sensory evaluation was performed by scoring the observations on a five-point scale ranging from excellent to very poor. The data were analyzed as per (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

The application of glycerine did not have significant effect on change in leaf weight and leaf area. However, foliage treated with 40% glycerine (T_4) showed the best results in terms of weight gain, with a decrease of 10.62%. On the other hand, foliage kept in distilled water (T_1) exhibited highest weight loss of 44.16%. The higher concentration of glycerine in T_4 may have resulted in greater weight gain due to increased uptake and moisture content. Glycerine replaces moisture through capillary action

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when leaves are subjected to the uptake method and through the leaf surface in the full dip method (White *et al*., 2007). (Table 1).

Regarding leaf area, foliage treated with 40% glycerine (T_4) showed the least change in leaf area (1.42%), while maximum change in leaf area (6.07%) was observed when leaves were kept in distilled water (T_1). In the uptake method (M_1), leaves treated with 40% glycerine (T_4) exhibited the minimum change in leaf area (1.72%), while foliage kept in distilled water (T_1) showed maximum change in leaf area (5.56%). In full dip method (M_2), minimum change in leaf area (1.12%) was recorded when treated with a 40% glycerine solution (T_4), and maximum change in leaf area (6.58%) was observed in the control group (T_1), where leaves were kept in distilled water. As leaves lose water, the cellular turgor pressure decreases, leading to separation of cell membrane from cell wall. Eventually, collapse of cell wall results in deformations, folds, and subsequent shrinkage of the leaf (Vicre *et al*., 2004). After a critical point is reached cell wall collapses resulting in deformations, folds, and subsequent shrinkage of leaf (Kramer and Boyer, 1995). Maximum change in leaf area in leaves kept in distilled water may be attributed to high dehydration and shrinkage of leaf tissue. Simultaneous replacement of water loss with glycerine uptake in leaves treated with glycerine resulted in less change in leaf area.

In terms of membrane integrity, foliage treated with 40% glycerine (T_4) using uptake method (M_1) showed better membrane integrity compared to full dip method (M_2), with a leachate percentage of 90.21% and 92.04% respectively. The foliage treated with 40% glycerine (T_4) produced the best results in terms of membrane integrity, with a leachate percentage of 87.63%. In contrast, foliage kept in distilled water (T_1) exhibited a higher leachate percentage (92.84%), which was similar to T_3 (91.63%). The higher percentage of leachate in leaves with greater moisture loss is due to increased cell injury. The damage to cell membranes under conditions of water loss leads to increased permeability and leakage of ions (Bajji *et al*., 2001; Surendar *et al*., 2013).

The leaves treated with the uptake method (M_1) exhibited higher chlorophyll 'a' (1.86 mg/g and 0.85 mg/g), chlorophyll 'b' (2.685 mg/g and 1.350 mg/g), and total chlorophyll (2.376 mg/g and 1.190 mg/g) content compared to leaves treated with full dip method (M_2). When the leaves were kept in distilled water (T_1), they showed higher chlorophyll 'a' content (1.98 mg/g), which was similar to T_2 (1.29 mg/g). When leaves were treated with 10% glycerine (T_2), they exhibited higher chlorophyll 'b' (2.175 mg/g) and total chlorophyll (1.915 mg/g) content. However, when leaves were treated with a 40% glycerine solution, they showed lower chlorophyll 'a' content (1.06 mg/g), while leaves treated with distilled water showed lower chlorophyll 'b' content (1.715 mg/g) and total chlorophyll content (1.512 mg/g).

The chlorophyll content of leaves may vary depending on their age. The addition of glycerol increases the rate of chlorophyll degradation (Lajolo and Marquez, 1982). The minimum change in chlorophyll concentration may be due to minimal water loss, as chlorophyll is an oily pigment. The lower chlorophyll content in leaves treated with glycerine may be attributed to higher dehydration. High dehydration can lead to the decomposition of chloroplasts and the disappearance of thylakoid membranes, resulting in discoloration due to the leaching of pigments. Additionally, the pigments may still be present in the leaves but may have diffused due to senescence (Surendar *et al*., 2013).

The uptake method (M_1) was found to be superior compared to the full dip method (M_2) in terms of brittleness (4.11 and 3.69) and overall acceptance (3.50 and 3.36). However, there was no significant difference observed in texture and shape retention of dried leaves among different glycerine application methods. (Figs 1 and 2).

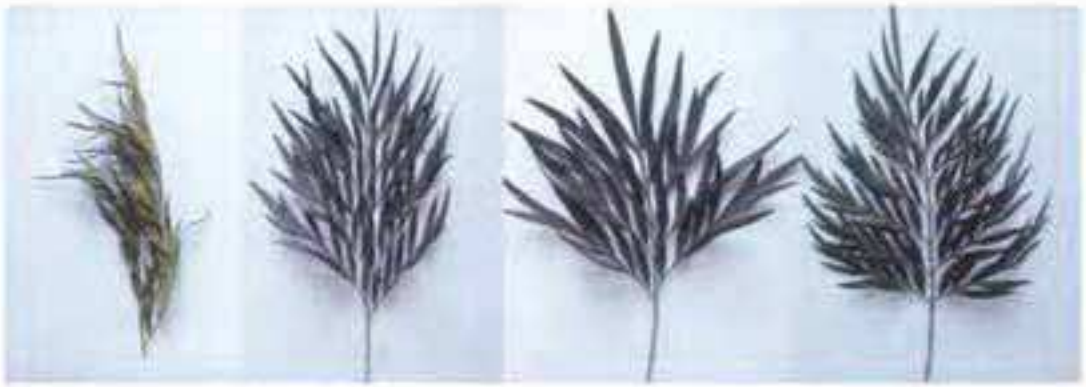
Among different treatments in uptake method (M_1), the foliage treated with 40% glycerine (T_4) obtained the highest scores for texture (4.89), shape retention (5.00), brittleness (5.00), and overall acceptance (4.97). On the other hand, leaves kept in distilled water (T_1) received the lowest scores for texture (1.00), shape retention (1.00), brittleness (3.00), and overall acceptance (1.67). Similar results were observed in full dip method (M_2), where foliage treated with a 40% glycerine solution (T_4) obtained the highest scores (5.00) for texture, shape retention, brittleness, and overall acceptance.

The cut foliage treated with a high concentration of glycerine appeared smooth and glossy, which is consistent with the findings of Day (2000). The treated leaves retained their shape to a great extent, and they were soft, pliable, and long-lasting. Other studies have also highlighted the softness, natural

Table 1: Sensory score (texture, shape retention, brittleness and overall acceptance) for foliage under different methods

Glycerine concentration (C)	Texture (5)			Shape retention (5)			Brittleness (5)			Overall acceptance (5)		
	Method of glycerine treatment (M)											
	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean
T_1 : Control (distilled water)	1.00	1.00	1.00	1.00	1.00	1.00	3.00	2.00	2.50	1.67	1.33	1.50
T_2 : 10% glycerine	3.00	3.11	3.05	1.67	1.78	1.72	3.78	3.00	3.39	2.81	2.63	2.72
T_3 : 20% glycerine	4.78	4.33	4.55	4.22	4.33	4.27	4.66	4.78	4.72	4.56	4.48	4.51
T_4 : 40% glycerine	4.89	5.00	4.94	5.00	5.00	5.00	5.00	5.00	5.00	4.97	5.00	4.98
Mean	3.41	3.36		2.97	3.02		4.11	3.69		3.50	3.36	
$CD_{0.05}$	M	: NS		M	:NS		M	:0.13		M	: 0.05	
	C	:0.14		C	:0.12		C	: 0.19		C	: 0.07	
	C x M	:0.20		C x M	: NS		C x M	:0.26		C x M	: 0.11	

M_1: Uptake method; M_2: full dip method



Control (distilled water) 10% glycerine 20% glycerine 40% glycerine

Fig.1. Leaves treated by uptake method

Control (distilled water) 10% glycerine 20% glycerine 40% glycerine

Fig.2. Leaves treated by full dip method

appearance, minimal moisture loss, and maximum color and shape retention of leaves treated with glycerine (Visalakshi and Jawaharlal, 2014).

Treating foliage with glycerine yields unique results, as it allows the leaves to remain flexible, pliable, and retain their natural shapes indefinitely. Glycerine-dried foliage can be utilized in various applications such as dry flower arrangements, bouquets, and the preparation of greeting cards.

CONCLUSION

The study suggests that the full dip method of glycerine application was better compared to the uptake method. Additionally, the optimal concentration of glycerine for drying the cut foliage was found to be 40%. This concentration resulted in favorable outcomes in terms of texture, shape retention, brittleness, and overall acceptance of the dried foliage.

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