

Original Research Article

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Processing of *Nephrolepis exaltata* with Glycerine to Enhance Shelf Life by Drying

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ABSTRACT

Cut foliage production has been rapidly increased day by day and it's playing an important role in the national income throughout world. *Nephrolepis exaltata*, a popular foliage commonly known as Boston fern normally exhibits longer vase life compared to other ferns. To ensure the availability of the greens for a longer duration a study was conducted on effect of glycerine solutions to enhance the shelf life and extend the longevity of *Nephrolepis exaltata* (L.). This experiment was conducted in the year 2019 with three types of glycerine solution (10%, 20%, and 40%) and with two methods likely full dip and uptake as treatments followed by refrigeration. Usually shelf life of *Nephrolepis exaltata* is 10-12 days, but result from the experiment shows that the shelf life could be enhanced by processing with glycerin (40%) up to 87.33 days with full dip method. The next best treatment comes from 20% glycerine solution, which resulted in shelf life of 46.67 days whereas glycerine solution 10% was effective in uptake method.

Keywords

Foliages, Shelf-life, Processing, Glycerine, Drying

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Introduction

Cut foliage is one of the major components of floricultural crops that have acquired an important position in the local and foreign markets over the world (Abou El-Ghait *et al.*, 2012). Cut foliage constitutes an important part of florist industry everywhere.

Nephrolepis exaltata (L.) is commonly known as sword fern or Boston fern. It belongs to the family Nephrolepidaceae and is native to North, Central, and South America. It is one of the most popular cut foliage. Leaves are hairy with serrated margins. Generally the foliages of *Nephrolepis* having deep green colour with long lasting properties are most

commonly used by the floral industry all over the world (Pacifci *et al.*, 2007; Reid and Jiang 2012). As a consequence, the trade of foliage indicates that India has emerged as one of the top suppliers among the developing countries and has been successful in developing a sustainable market in EU (Ladha and Gunjal, 2011).

In India, a large amount of ferns are grown in Sikkim. A primary survey made by our team revealed that the florists of Sikkim supply the green foliage to Kolkata market, or entire West Bengal and other states, throughout the year. Based on the information from the florists and various flower shop owners of Mallickghat market, Kolkata, it seemed that Boston fern not only has local demand, but bestowed with promising export potentiality also.

Owing to foliage delicacy and tenderness, these are extremely susceptible to mechanical and physical damage during and after harvest. To ensure the availability of the greens for a longer duration, refrigerated storage holds considerable significance (Nowak and Rudnicki, 1990; Bhattacharjee, 1999; Singh *et al.*, 2001). Thus to investigate the effect of glycerine on shelf life of *Nephrolepis exaltata*.

Materials and Methods

Fronds of "*Nephrolepis exaltata*" were harvested early in the morning from experimental plots of AICRP on Floriculture, Mondouri Nadia, West Bengal and that were brought to the laboratory within 2 hours. Then removing the pinnae from the lower third of the fronds and re-cutting to obtain a uniform length of 30cm, It must be ensure that the basal portion of the cut twigs certainly received a uniform dipping of 4.5 cm under solution those are prepared previously. The experiment was carried out by placing only

the stems or dipping the foliages in the glycerine solution for evaluation of keeping quality in normal room temperature and the observations were recorded at 24, 48 and 72 hours interval after that soaking the extra solution from the fronds in bloating paper and stored at a dry place.

Observation recorded

Effective shelf life (days)

Shelf life of fronds was recorded in days. It was determined by hedonic scale acceptability score. When the acceptability score fell below 2 as per hedonic scale the fronds are regarded as commercially unacceptable and up to this day of observation were considered as shelf life and vase life.

Total weight gain (ml)

The total weight gain in cut foliage was calculated by following formula,

Transpiration loss =

Weight of foliage spike at last day - Initial weight of same foliage spike.

Relative fresh weight (RFW) (%)

Relative fresh weight of the foliage was determined just before the immersing of the foliage into the solution and repeated every day until the vase life of the foliage were terminated. The fresh foliage of each foliage was expressed relative to the initial weight to represent the water status of the foliage and it was calculated by following formula,

Relative fresh weight (%) =

$$\frac{\text{Fresh weight on nth day}}{\text{Initial fresh weight}} \times 100$$

Overall acceptability (1-5)

The effect of different temperature on cut foliage were examined by determining the longevity by the day's number till wilting, the general appearance of foliage quality based on scale, ranking from one to four as described by Sangwanankul *et al.*, (2008).

Overall Acceptability	Score
Very Bad	1
Bad	2
Moderate (May be good or may be bad)	3
Good	4
Very good	5

Results and Discussion

Effective shelf life (Days), Total weight gain (Days), Relative fresh weight (RFW) (%), Sensory attributes (Texture, Brittleness, Retention of shape, Colour retention, Overall acceptability)

Data presented in Table: 1 revealed that effective shelf life of Boston fern varied significantly due to different concentration of glycerin. The maximum shelf life of 87.33 days was recorded in ferns dipped in 40% glycerin (T₃) followed by 46.67 days in 20% glycerin (T₂). Whereas minimum effective shelf life of 1.0 day was recorded in control (T₇), where ferns were kept in water for 72 hours in water and afterwards taken out and kept as such. The ideal concentration of glycerine best suited for preservation varied from species to species and method of treatment. In case of Boston fern glycerine 40% was found to be most effective in dip methods whereas glycerine-10% was effective in uptake method.

Maximum weight gain (0.28 ml) was observed in dip methods of 10% glycerin (T₁)

followed by dip methods of 20% glycerin (T₂, 0.21 ml). On the contrary, weight loss was recorded in uptake method of 40% glycerin (0.89 ml.)

As we see in Table 1 after 72 hours, highest percentage of relative fresh weight of 107.44 per cent occurred in 10% glycerin (T₁) followed by 105.69 per cent in 20% glycerin (T₂).

Sensory attributes

Significant differences among the different treatments on the sensory qualities were obtained for the fronds of Boston fern was presented in Table 2.

Texture

Texture of fronds scored best (4.50) in glycerine 40% (T₃) by dip method and least score of (4.00) was recorded in glycerin 10% and 20 % (T₁ & T₂), whereas in uptake method highest score of 3.50 was retained in glycerine 40% (T₆) and least score of 1.50 was noted in control (T₇).

Brittleness

As per the observation recorded by sensory evaluation, brittleness was not observed in in glycerine-10% (T₁), glycerine -20% (T₂) and glycerine-40%(T₃) for fronds leaves, done by dip method and uptake method. However, severe brittleness was observed in control (T₇) samples.

Retention of shape

Retention of shape when the foliages were treated with different treatments pronounced the significant effect on the foliage of *Nephrolepis exaltata*. Maximum points of 5.00 in glycerine-40% (T₃) by dip method and showed minimum points of 2.00 when

kept under control (T7) by uptake method. Shape retention was observed in glycerine-40% (T6) by uptake method and least retention (2.00) in control (T7) by uptake method. Likewise for obtained in glycerine-40% (T3) by dip method and minimum score (2.00) in control (T7) by uptake method.

Colour retention

Retention of colour was recorded, as per Royal Horticultural Colour Chart by panel of judges. Colour of leaves gradually changes after employing of glycerinization. In fronds initially colour of leaves was RHS137A and best retention was obtained to RHS 137C by dip method when treated with 40% glycerine while least retention of RHS199A was observed in glycerine 40% by dip method. For leaves of Boston fern in dip method retained deeper shade RHS199A and all treatments in uptake method retained deep colour RHSN 199A and RHSN 199C respectively, however in control (T7) by uptake method, colour retention (RHS152B) differed from the others to lighter shade.

Over-all acceptability

The over-all acceptability of glycerinized foliages differed significantly with the different treatments for different foliages. In Boston fern, over-all acceptability was highest (4.83) in dip method when glycerine-40% (T3) was used for treatment and showed least (1.63) acceptable in control (T7) by uptake method.

The present study result corroborated with the findings of *Nephrolepis exaltata* preserving plant material with glycol is called glycerinisation. In this technique the internal moisture of plant parts is replaced with solvents like glycol to retain their original texture, shape and colour. The processed part look more natural than air dried leaves, it is less prone to shattering and mechanical

damage and more natural in appearance (Leonard, 1973). Glycerine drying is the most suitable method for drying of foliage (Anonymous, 2001). Glycols are modified alcohols containing two or more hydroxyl (-OH) groups (Morrison and Boyd, 1959). Due to presence of hydroxyl groups, glycols are hydrophilic and have strong affinity for water. This enables many glycols to be used as a humectants or softening agent. Glycols have high boiling point with low viscosity and consequently evaporates at much slower rate than water at a given temperature.

Glycerine (CH₂OH.CHOH.CH₂OH) is a thick syrupy sweetish liquid triol soluble in water and occurs in combination with fatty acid in fats and oil. The effectiveness of treatment in the experiment may be due to glycerine, where the water molecule inside the cell was replaced by the glycerine solution by process of osmosis. Studies in plant cell showed that, turgid cell containing cell sap with certain osmotic concentration when placed in solution of higher osmotic concentration (hypertonic solution) than the cell sap; exosmosis takes place and hypertonic solution try to become isotonic. The solution inside the cell sap is then replaced by the hypertonic solution as reported by Mitra *et al.*, (1997).

Glycerine preserves foliages by replacing the natural moisture present in leaves with a substance that reduces its form, texture and sometimes colour. About 50 % of most plant fresh weight is water but brittleness is usually only the problem if water content falls below 10% percent. At high humidity, all humectants absorb a great deal of water from the atmosphere, and also so proportionally less humectant is required to keep foliage supple. At 90% Relative humidity, glycerol will have a water content of 215 g per g of glycerol. Humectants are absorbed into plant tissues either by transpiration or by immersing the cut foliage in humectants solution.

Table.1 Effect of glycerine on post harvest life of effective shelf life, Total weight gain (g), Relative fresh weight (%)

Treatments	Effective shelf life	Total weight gain (ml)	Relative fresh weight (%)		
			after 24 hrs	after 48 hrs	after 72 hrs
T₁-Full dip @ 10 % glycerine	29.33	0.28	102.87	106.02	107.44
T₂-Full dip @ 20 % glycerine	46.67	0.21	102.50	104.73	105.69
T₃-Full dip @ 40 % glycerine	87.33	0.13	101.08	102.47	103.13
T₄-Absorption @ 10 % glycerine	3.33	-0.11	93.97	94.92	97.44
T₅-Absorption @ 20 % glycerine	1.67	-0.44	90.01	88.66	90.03
T₆-Absorption @ 40 % glycerine	1.67	-0.89	86.06	82.28	79.75
T₇-Control (distilled water)	0.83	-0.27	102.44	95.33	91.99
SE.m (±)	1.58	0.04	0.69	0.94	1.06
CD at 5%	4.82	0.13	2.12	2.86	3.23

Table.2 Sensory evaluation of fronds after glycerinization

Treatments	Scores 1-5				
	Texture	Brittleness	Shape	Colour retention	Overall acceptance
T₁-Full dip @ 10 % glycerine	4.00	4.50	4.50	4.50	4.23
T₂-Full dip @ 20 % glycerine	4.00	4.50	4.75	4.50	4.30
T₃-Full dip @ 40 % glycerine	4.50	5.00	5.00	5.00	4.83
T₄-Absorption @ 10 % glycerine	3.00	2.50	4.00	3.75	3.40
T₅-Absorption @ 20 % glycerine	3.00	2.75	3.75	3.50	3.23
T₆-Absorption @ 40 % glycerine	3.50	3.00	3.50	4.00	3.27
T₇-Control (distilled water)	1.50	1.00	2.00	1.00	1.63



Plate.2 Glycerine dipping method



After 24 hour

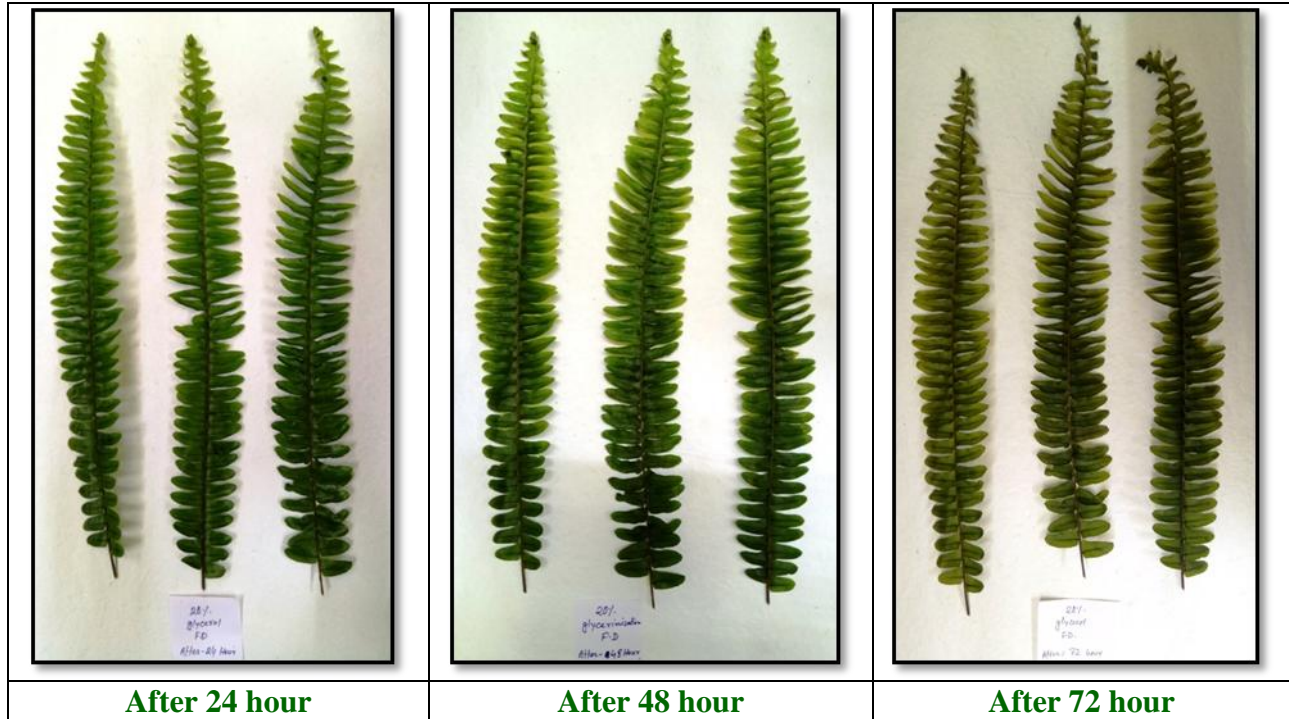


After 48 hour



After 72 hour

Plate.3 10 % Glycerine dip

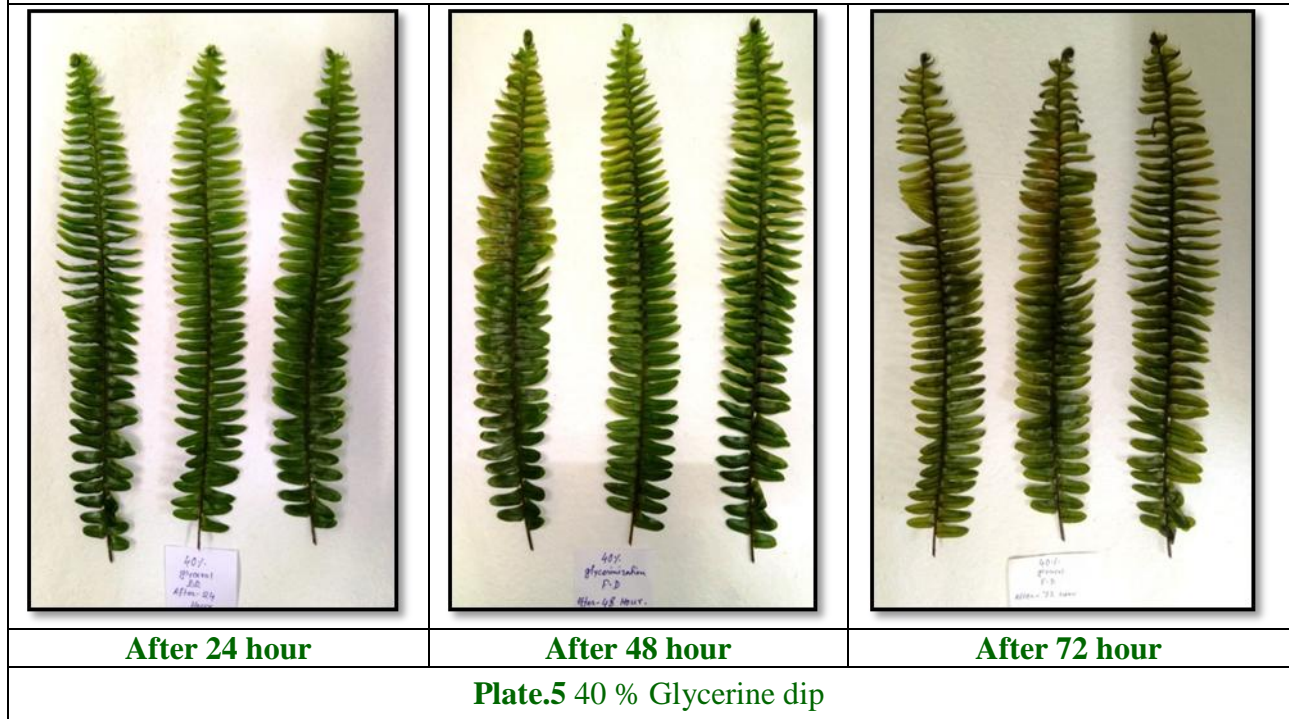


After 24 hour

After 48 hour

After 72 hour

Plate.4 20 % Glycerine dip



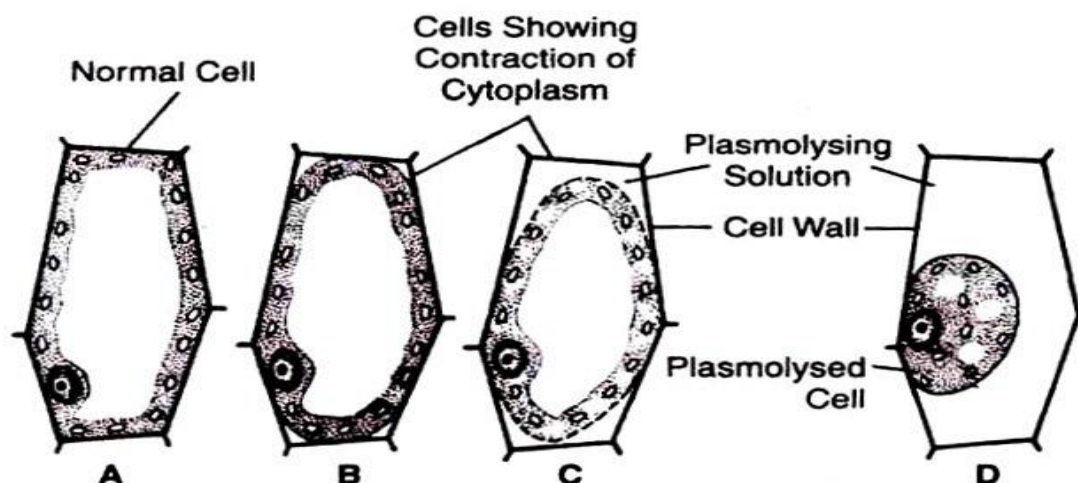
After 24 hour

After 48 hour

After 72 hour

Plate.5 40 % Glycerine dip

Plate.1 A-D=Showing the stages of plasmolysis; A=Normal cell ; B = Incipient plasmolysis ; C=Further shrinkage of the protoplasm and D= Complete plasmolysis



*Source: Mitra *et al.*, 1997

Preserving foliage in glycerine and hot water solution brings them to everlasting category. In glycerine drying the quality of flowers of product found to be good as moisture in flower is replaced by mixture of water and glycerine. It serves as a good source for microorganism so a pinch of antibiotic is needed to prevent microbial growth in the dried specimen. It replaces the water consist of leaves giving them a strong and stable nature. The preserving solution consists of one part of glycerine and two parts hot water along with the addition of chloro-hexidine to reduce bacterial growth. Most foliage preserved by glycerine turns brown but remain pliable. This technique makes the leaves and stem soft, pliable and long lasting so that they may be used over and over.

Barnett and Roger (1996) also found that preservation of foliage with glycerine will retain the shape and makes leaves soft, pliable and long lasting. Secondly Visalakshi and Jawaharlal (2014) studied effect of glycerinisation on fragile leaves and reported that the leaves treated with 30% glycol followed by 30% ethylene glycol were soft,

natural in appearance with minimum moisture loss, maximum colour and shape retention. Treating foliage with glycerine yield unique results, they remain flexible, pliable, indefinitely retain natural shapes and make the dried product last longer (Conder, 1979).

Anitha (2010) reported that silver oak (*Grevillea robusta*) and Thuja (*Thuja orientalis*) were suitable plant materials for glycerine method with low brittleness and good overall acceptance. Vishnupriya (2011) studied the effect of glycerine on different plant species by treating them with different concentrations of glycerine and found that glycerine at 50 % (full dip method) was best with respect to all quality parameters (shape retention, texture, colour retention, brightness, brittleness and overall acceptance).

In conclusion, the experiment was laid out in a Completely Randomized Design consisting of four glycerine concentrations i.e. control (distilled water), 10% glycerine, 20 % glycerine and 40 % glycerine and two method of glycerine application i.e. uptake and full dip method and each treatment taken three

replication for Boston fern. Usable shelf life of *Nephrolepis exaltata* could be enhanced by processing with glycerin (40%) up to 87.33 days by full dip method. The next best treatment was 20% glycerine, which resulted in shelf life of 46.67 days whereas glycerine solution 10% was effective in uptake method.

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