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Preservation of Nepal Ivy (*Hedera nepalensis* K. Koch) Leaves by Drying

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A B S T R A C T

Nepal Ivy naturally grows well in temperate climate of hilly region, while subtropical and tropical plains of country are not most suitable for its growth but people of these places can enjoy the beauty of this plant by drying of its leaves. For standardization and evaluation of best drying techniques for drying of these leaves an experiment was conducted in mid hills of Himachal Pradesh. In this experiment semi mature leaves of hedera were subject to drying in twenty treatment combinations of five embedding materials viz. open drying (E_0), boric acid (E_1), silica gel (E_2), sand (E_3) and saw dust (E_4) and four drying techniques viz. room temperature (D_1), hot air oven (D_2), microwave oven (D_3) and solar drier (D_4) at different temperature level and for varied duration. Standardized temperature level and time duration for drying were recorded in each treatment and then these standardized techniques were evaluated for knowing best drying techniques for this plant. Evaluation of best drying techniques were performed on the basis of evaluation of ornamental parameters of hedera leaves viz. colour, shape, texture and overall ornamental value and best drying techniques have been worked out i.e. (I) embedded drying in silica gel and room temperature for 10 days (II) embedded drying in silica gel and hot air oven at 45°C for 30 hours. (III) embedded drying in boric acid and room temperature for 10 days. It was also observed that dried foliage of hedera can be use in making various dried floral crafts e.g. flower arrangements, wall hanging, swags, greeting cards etc.

Introduction

Hedera nepalensis K.Koch, belongs to the family Araliaceace and commonly known as Nepal Ivy. It is native of Himalayas and North Burma (1). It is an evergreen climber (woody vine), which climbs by aerial rootlets, climber bears linear-lanceolate to heart shaped leaves with 2-4 narrow lobes, which are green mottled with grey green in colour. Inflorescence is drooping corymbose bears yellowish- green flowers of 0.5 cm diameter,

blooming come in July-September. Fruits yellow orange berry, 3 cm diameter and plant generally propagated by cutting and layering.

It thrives well in all temperate region of India and grows well in rich moist soil which having good organic content and found generally in moist shady areas on old trees as climber or cover the ground as creeper. It can be use for covering of walls/ buildings, for topiary and even as indoor foliage plants. But plain areas in subtropical and tropical region of the country are not suitable for growing this plant. Therefore person those living in these areas are unable to see its beauty, but people of these areas can enjoy the beauty of this plant by drying of its foliage. Unlike fresh foliage, dried foliage of hedera retained its beauty for months to years and various dried floral crafts can be made by dried foliage of this plant e.g. flower arrangement in pots/vases, wall hangings, wreaths, swags, greeting cards, weeding cards, dairy covers, mirror decorations etc. Even it is observed that dried floral crafts have good demand in national and international market. Therefore considering these points in view an attempt was made to standardize and evaluate drying techniques for hedera plant, which is growing naturally (wild) in mid hills of Himachal Pradesh.

Materials and Methods

For present study an investigation was conducted in mid hills of Himachal Pradesh and the laboratory work was carried out in the Department of Vegetable Science and Floriculture, CSKHPKV, Palampur, H.P. In the first year of investigation studies were made during main growing season of hedera plant are : Identification of potential areas of growing this plant, ornamental plant parts for drying, best time and ideal stage of collection of ornamental material for drying, for these studies intensive exploration tours were conducted in the mid hills areas of Himachal Pradesh. Ornamental part and Ideal stage of their collection were identified on the basis of morphological and phenological characters of plant, respectively. After these studies an attempt was also made i.e. experiment 'A' for standardization of drying techniques (treatment combinations) in the first year. For this experiment semi mature leaves of hedera were collected from the forest area at identified time and stage and these materials were carrying in herbarium vasculum during exploration tour. After collection ornamental material was prepared for drying by removing infested, distorted and faded parts from them.

Then ornamental material i.e. leaves were subject to drying in twenty different drying techniques (treatment combinations). These treatment combinations consisting five embedding materials viz. open drying (E_0), boric acid (E_1), silica gel (E_2), sand (E_3), saw dust (E_4) and four drying techniques viz. room temperature (D_1), hot air oven (D_2), microwave oven (D_3), solar drier (D_4). For open drying material either hanged on strings or kept openly in vases in different drying techniques and for embedded drying material was embedded in different embedding materials. Aluminum containers were used for embedding in room temperature, hot air oven, solar drier, while glass-ware was used in microwave oven. Three samples of ornamental material (semi mature leaves) were subject to drying at varying temperature level and time duration in all twenty drying techniques (treatment combinations) repeatedly and finally standardized temperature level and time duration were recorded as unit days in room temperature; hours in hot air oven; minutes in microwave oven and light hours in solar drier. Once the leaves are dry, remove the container from the oven/solar drier and leave it at room condition until the desiccant is cool, this time is called setting period i. e. 2-3 hours. After this plant

material were taken out from embedding material and tapping the material with finger slowly, so as to remove the desiccant over and around the foliage.

In first year one more experiment i.e. experiment 'B' were also conducted for standardization of press drying technique of leaves of this plant. For press drying, leaves of this plant were placed sparsely between the folds of rough filter papers (sheets). Then these sheets were kept one above the other and the whole bundle was placed in the herbarium press (plant press) and kept at room temperature for 24 hours after which these were shifted to hot air oven (45^{o}C) for the appropriate duration as advocated by Bhutani (2) and standardized time were noted.

In second year exploration based observations were repeated by intensive exploration tours. After these observations an attempt were also made i.e. experiment 'C' for evaluation of drying techniques and experiment were conducted in factorial CRD design with 20 treatment combinations (mentioned above), 3 replications and 3 samples were used in each replication. In this experiment trips for collection of plant material were repeated and material prepared as previous mentioned method. Then ornamental material i.e. leaves were subject to drying at standardized temperature level and specified time duration in all twenty treatment combinations. After drying fresh as well as dried leaves of hedera were visually judged and compared for different ornamental parameters i.e. colour, shape, texture and overall ornamental value and scores were assigned to these parameters by using a score card (Table 1). First three parameters i.e. colour, shape and texture were simply statistically analyzed by averaging their respective values, while score of overall ornamental value were converted in weighted score by a method advocated by Hamburg (9) and final data were analyzed by using the standard statistical methods. After evaluation of best drying techniques of leaves of hedera. The leaves of this plant were dried in large quantity by using best drying techniques and used in preparing various dried floral crafts.

Results and Discussion

Potential area

On the basis of through survey of the mid hills of Himachal Pradesh, following areas of Himachal Pradesh were found potential for availability of this plant e.g. Churah, Salooni, Dalhousie, Sihunta (Chamba); Kangra, Palampur, Dharmashala, Baijnath, Jaisinghpur (Kangra); Kullu (Kullu) Rampur (Shimla); Kasauli, Arki, Kandaghat (Solan); Dadahu, Raigarh (Sirmaur). Chowdhary and Wadhwa (5) also reported *Hedera nepalensis* in different parts of Chamba, Kangra, Kullu and Shimla district of Himachal Pradesh.

Ornamental part

Green heart shaped leaves were observed as ornamental part of Nepal Ivy, which were also found suitable for drying purpose. These characters of leaves also reported by Bailey and Bailey (1).

Time and Stage of collection

Ideal time for collection of foliage from Nepal Ivy plants, identified between May and July and as in agreement with the finding of Chadha (4). Semi mature leaves, when their lower side showed shining found suitable for its drying.

Standardization of drying techniques

In experiment 'A' different drying techniques (treatment combinations) were standardized for drying of hedera leaves and discussed here. Results of experiment are presented in

Table 2.

Room temperature

Standardized drying techniques in room temperature and different embedded materials were recorded as open drying (E_0)-9 days, boric acid (E_1)- 10days), silica gel (E_2)- 10 days, sand (E_3)-12days, saw dust (E_4)- 9 days.

Orduno and Batazar (12) also reported 15-20 days time for embedded drying at room temperature with sand in rose, gerbera and carnation. It supports standardized duration of room temperature drying in present study.

Hot air oven

Standardized drying techniques in hot air oven and different embedded materials were recorded as open drying (E_0)- 45^{o}C,18 hours, boric acid (E_1)- 45^{o}C,48 hours, silica gel (E_2)- 45^{o}C, 30 hours, sand (E_3)- 45^{o}C, 30 hours, saw dust (E_4)- 45^{o}C, 30 hours. Standardized temperature level and time required for oven drying also supported by Bhutani and Tondon (3).

Microwave oven

Standardized drying techniques in microwave oven and different embedded materials were recorded as open drying (E_0)- 450 wt, 2+2 minutes, boric acid (E_1)- 700 wt, 2+2 minutes, silica gel (E_2)- 700 wt, 2+2 minutes, sand (E_3)- 700 wt, 2+2 minutes, saw dust (E_4)- 700 wt, 2+2 minutes. Study of Westland (14) revealed that in a microwave oven at power level (650 wt.) flower dried in about 7 minutes and flower retain their colour remarkably well. These findings support power level and time for microwave oven drying in present study.

Solar drier

Standardized drying techniques in solar drier and different embedded materials were recorded as open drying (E_0)- 10 light hours, boric acid (E_1)- 30 light hours, silica gel (E_2)- 20 light hours, sand (E_3)- 30 light hours, saw dust (E_4)- 20 light hours. Finding of an experiment conducted by Simalenga *et al.*, (13) shows that in solar drier material can be dried in few hours (8-10 hrs), in spite of open drying, which taken 7-14 days for same drying. These results support standardized duration of solar drying in present study.

Press drying

In experiment 'B' press drying technique was standardized for hedera leaves and result has been presented in Table 2. In this experiment firstly semi mature leaves of hedera were kept in room temperature (D_1) for 24 hours in herbarium press and then shifted to hot air oven (D_2) at 45^{o}C for 48 hours. Press drying technique followed in this experiment also reported by Datta (6).

Table.1 Score card

S. No.	Ornamental Parameters	Points
i	Colour	**5**
ii	Shape	**3**
iii	Texture	**2**
	Overall ornamental value	**10**

Note: These ornamental parameters of dried leaves were compared with fresh leaves and points were assigned accordingly to dried samples of hedera leaves.

Table.2 Standardization of drying techniques of *Hedera nepalensis* K. Koch

Experiment-A

S. No.	Treatment combinations	Standardization of drying techniques	S. No.	Treatment combinations	Standardization of drying techniques
1.	E_0D_1	9 days	11.	E_2D_3	700 wt., 2+2 minutes
2.	E_0D_2	45°C, 18 hours	12.	E_2D_4	20 light hours
3.	E_0D_3	450 wt., 2+2 minutes	13.	E_3D_1	12 days
4.	E_0D_4	10 light hours	14.	E_3D_2	45°C, 30 hours
5.	E_1D_1	10 days	15.	E_3D_3	700 wt., 2+2 minutes
6.	E_1D_2	45°C, 48 hours	16.	E_3D_4	30 light hours
7.	E_1D_3	700 wt., 2+2 minutes	17.	E_4D_1	9 days
8.	E_1D_4	30 light hours	18.	E_4D_2	45°C, 30 hours
9.	E_2D_1	10 days	19.	E_4D_3	700 wt., 2+2 minutes
10.	E_2D_2	45°C, 30 hours	20.	E_4D_4	20 light hours
Experiment-B					
Press drying: D_1 – 24 hours + D_2 (45°C) – 48 hours					

Embedding materials:

E_0 -Embedding material not used (Open drying), E_1-Boric acid, E2-Silica gel, E_3 -Sand, E_4-Saw dust

Drying techniques:

D_1 - Room temperature, D_2 - Hot air oven, D_3 - Microwave oven, D_4 - Solar drier

Table.3 Evaluation of drying techniques of *Hedera nepalensis* K. Koch

Experiment- C

Factors	Ornamental Parameters																			
	Colour					Shape					Texture					Overall ornamental value				
A\B	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean
E_0	2.44	2.66	2.55	2.00	2.41	0.55	0.66	0.55	0.55	0.57	0.44	0.66	0.55	0.55	0.55	3.87	4.36	4.07	3.29	3.89
E_1	3.66	3.11	2.99	2.77	3.13	1.66	2.11	2.22	1.88	1.96	1.77	1.33	1.22	1.55	1.46	7.05	6.44	6.32	5.89	6.42
E_2	3.88	3.66	3.00	3.55	3.52	2.33	2.00	1.88	1.88	2.02	1.10	1.44	1.00	1.44	1.24	7.51	7.29	5.95	6.91	6.91
E_3	1.66	2.33	2.55	2.00	2.13	1.66	1.55	1.77	1.55	1.63	1.44	1.33	1.33	1.66	1.44	4.22	5.15	5.45	4.72	4.88
E_4	1.77	2.44	2.33	2.33	2.21	1.77	1.77	1.66	1.55	1.68	1.55	1.44	1.33	1.33	1.41	4.54	5.36	5.07	4.98	4.98
Mean	2.68	2.84	2.68	2.53	2.68	1.59	1.61	1.61	1.48	1.57	1.26	1.24	1.08	1.30	1.22	5.43	5.72	5.37	5.15	5.41
	A		B		A X B	A		B		A x B	A		B		A x B	A		B		A x B
SEd	0.068		0.060		0.136	0.078		0.070		0.157	0.074		0.066		0.148	0.142		0.127		0.284
C.D. at 5%	0.137		0.123		0.275	0.159		N.S.		0.318	0.149		0.133		0.299	0.287		0.256		0.574
C.V.(%)	6.22					12.24					14.85					6.42				

N.S. = Non-significant

Factors:

A. Embedding Materials - (E_0 –Embedding material not used (Open drying), E_1 - Boric acid, E_2 - Silica gel, E_3 - Sand, E_4 - Saw dust)

B. Drying Techniques - (D_1 - Room temperature, D_2 - Hot air oven, D_3 - Microwave oven, D_4 - Solar drier)

A x B. Interaction - (Embedding material x Drying technique)

Note:

- Values in tables of colour, shape and texture have been given as average of normal score awarded to these parameters out of 5, 3 and 2, respectively.
- Values in table of overall ornamental value have been given as average of weighted score calculated for this parameter on 10 points scale.

Evaluation of drying techniques

Evaluation of drying techniques (treatment combinations) of hedera leaves were conducted in experiment 'C' by evaluating different ornamental parameters of leaves i.e colour, shape, texture and overall ornamental value and results of experiment have been presented in Table 3. Interpretation of these results revealed that.

Colour

Embedding materials, drying techniques and their combinations significantly influenced the colour of hedera leaves. Among embedding material maximum score of colour was obtained in E_2 (3.52), followed by E_1 (3.13) and E_0 (2.41). Silica gel also reported best embedding material for drying by Desh Raj and Gupta (8) in their study. With respect to drying techniques higher score of colour was recorded in D_2 (2.84) followed by D_1 and D_3 with mean score (2.68), while treatment combination were showed maximum score in combination E_2D_1 (3.88), which was statistically at par with $E_2D_2$and E_1D_2 with mean score (3.66) and minimum in treatment combination E_3D_1 (1.66) which was at par with E_4D_1 (1.77).

Shape

Significant effect of embedded materials and treatment combinations and non-significant effect of drying technique were observed on shape of hedera leaves. Within embedding material highest score of shape was recorded in E_2 (2.02), which was at par with E_1(1.96) and followed by E_4 (1.68). With respect to treatment combinations E_2D_1 (2.33), E_1D_3 (2.22) and E_1D_2 (2.11) were showed similar good results, while poorest results were recorded in combinations E_0D_4, E_0D_3 and E_0D_1 with mean score (0.55). Lubiana *et al.*, (11) also identified best treatment combination for asparagus leaves drying, which gives highest score for aesthetic traits like shape and concluded that room drying in sand:borax or sand as embedding media for 6 to 7 days were given best results.

Texture

Effect of embedding materials, drying techniques and treatment combinations on texture of hedera leaves were found significant. Embedding materials E_1 (1.46) was showed maximum score of texture and at par with E_3(1.44) and E_4 (1.41). Within drying techniques D_4 (1.30), D1 (1.26) and D_2 (1.24) were showed similar good results. These results are also in agreement with Kumari and Peiris (10). The treatment combination E_1D_1 (1.77) was showed highest score for this parameter, which was also statistically at par with E_3D_4 (1.66), E_1D_4 (1.55) and E_4D_1 (1.55).

Overall ornamental value

Embedding materials drying techniques and treatment combinations affect the overall ornamental value of hedera leaves. Among embedding materials highest score of this parameter was recorded in E_2(6.91) followed by E_1 (6.42) and E_4 (4.98). Within drying techniques D_2 (5.72) was showed best result followed by D_1 (5.43) and poorest in D_4 (5.15). Treatment combinations were showed highest score in E_2D_1 (7.51), which were at par with E_2D_2 (7.29) and E_1D_1 (7.05), while lowest score was recorded in combination E_0D_4 (3.29). These observations are being also supported with the study of Kumari and Peiris (10) who reported that highest quality standard in dried rose cv. Cherish flower were found when they dried with 2 weeks air-drying in silica gel. Thus on the basis of evaluation of overall ornamental value with respect to treatment combinations, three best drying techniques (treatment combinations) were recommended for hedera leaves drying i.e. (I) E_2D_1-10 days; (II) E_2D_2- 45^{o}C, 30 hours; (III) E_1D_1 -10 days.

It was also observed that dried foliage of hedera can be used in making various dried floral crafts viz. flower arrangement in vases/ pots, wall hanging, wreath, swags, greeting cards, wedding cards, diary cover, mirror decorations etc. Desh Raj (7) also reported such uses of different dried forest product in his study. These floral crafts have good demand in domestic as well as in international market. Therefore it was concluded that people of other places where hedera not grows well can enjoy its beauty in the form of various dried floral crafts.

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