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STUDY OF DEHYDRATED CURVES OF RADISH AND PURSLANE LEAVES

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ABSTRACT

Dehydration of leafy vegetables project is a new product of value addition series where the shelf life is increased & space for storage is reduced along with easy transportation. If dehydrated leafy vegetables are managed efficiently, we can earn good revenue in the form of foreign exchange by exporting dehydrated vegetables which will indirectly improve the status of farming community. Drying time and drying conditions are important factors in dehydration of leafy vegetables. Thus the study of drying behaviour has been the subject of intense investigation as the mechanism of moisture transport are so varied with types, maturity, drying modes, pre-drying stages adopted. Moreover the mechanism of drying foods is not as simple as perceived and follows the constant rate and falling rate periods. In constant rate period of drying, the surface temperature of food remains near to the wet bulb temperature of surrounding air. Hence rate of drying can be easily worked out for this period. However during falling rate period due to additional resistance, which vary with the type of product, plays significant role in moisture transfer. This internal resistance to moisture transfer

becomes limiting in selecting the process equipment as well as operating parameters. This of data for vegetables is not readily available. Hence the present study was undertaken to find out dehydration behaviour of selected vegetables. The dehydration kinetics revealed that the moisture content decreased very rapidly during the first hour of drying with sun drying requiring about eight hours and mechanical drying about four hours to reach the desired moisture level of 9-11 per cent. The dehydration processes not only affects the colour and other pigments but also the sensory attributes like colour, appearance, texture, aroma and overall quality to a varying degree. These variations depend not only on the type of vegetable but also on the method of processing.

KEYWORDS: Radish leaves, Purslane leaves, Tray drying, Sun drying and drying curves.

INTRODUCTION

Dehydration of leafy vegetables project is a new product of value addition series where the shelf life is increased & space for storage is reduced along with easy transportation. The quality of the dehydrated product in terms of rehydration ratio, colour and flavour retention depends on the pre-treatments and method of drying. Major objective of dehydration is to remove moisture as quickly as possible at a temperature that does not seriously affect flavour, texture and colour of the food. Drying can be accomplished by a number of traditional and advanced techniques. Sun and Tray drying are conventional heating methods where transfer of thermal energy from the product surface towards their centre is slow. Moreover sun drying cannot be employed all through the year and at all places. Shade drying though maintains better quality takes many days to dry to constant weight. Tray drying employs removal of moisture by flow of hot air under controlled conditions of temperature, relative humidity and constant air flow. The process of dehydration, heat application result in changes in the quality specially, the concentration of nutrients, sensory changes like colour, texture and flavour. Dehydration is a simple and economical method of preservation of green leafy vegetables. While it is of great importance to produce dehydrated vegetables without marked loss of vitamins during preparation and dehydration, it is equally important to prevent considerable losses during the period between dehydration and consumption. The main purpose of dehydration of vegetables is to preserve for a longer duration with the retention of good quality. Dehydrated vegetables can be utilized for the preparation of various products either as main or supporting ingredient which can be incorporated in various forms. The dried leaves were powdered and incorporated in various recipies either alone or in blended combination. Uniform quality of product can be obtained when dried under controlled conditions. Less time is required for drying in cabinet driers and microwave ovens as compared to open sun or shade drying.

Radish leaves

The **Radish** (*Raphanus sativus*) is an edible root vegetable of the Brassicaceae family,that was domesticated in Europe in pre-Roman times. Radishes have numerous varieties, varying in size, colour and duration of required cultivation time. The descriptive Greek name of the genus *Raphanus* means "quickly appearing" and refers to the rapid germination of these plants. *Raphanistrum*, from the same Greek root, is an old name once used for this genus. The common name "Radish" is derived from Latin *radix* (root). Radishes grow best in full sun and

light, sandy loams with pH 6.5–7.0. Leaves are without stipules and range between 2 and 12 inches in length. Flowers are bisexual, fragrant, lilac to white and up to 1/2 inch in diameter.

Varieties

Broadly speaking, Radishes can be categorized into four main types (summer, fall, winter, and spring) and a variety of shapes lengths, colours, and sizes, such as red, pink, white, gray-black or yellow radishes, with round or elongated roots that can grow longer than a Parnips.

Nutrition Facts

Serving Size (30g)
Servings Per Container

Amount Per Serving

Calories 15	Calories from Fat 10
	% Daily Value*
Total Fat 1g	**2%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 0mg	**0%**
Total Carbohydrate 1g	**0%**
Dietary Fiber 0g	**0%**
Sugars 0g	
Protein 1g	

Vitamin A 2% •	Vitamin C 15%
Calcium 0% •	Iron 0%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Benefits of Radish leaves

The leaves of the radish plant actually contain more Vitamin C, protein and calcium than their roots. They have been used to treat kidney and skin disorders, fight cancer and even soothe insect bites. Radish helps to relieve congestion within the respiratory system, making it an excellent food for asthmatics and those who suffer from bronchial infections and sinus problems. It is beneficial for both the gallbladder and liver functions, as it acts as a cleanser. It contains sulphur based chemicals, which regulate the production and flow of bilirubin and bile, enzymes and acids and also help remove excess bilirubin from the blood. This makes it an excellent detoxifying agent for the body. It protects and soothes the gallbladder and liver, while protecting them from infections.

Radish is a natural diuretic. This makes them effective in preventing and fighting urinary tract infections. Radish juice helps to cure the burning feeling during urinary tract or bladder infections, as it is an excellent kidney cleanser.

Purslane leaves

Portulaca oleracea (**Common Purslane**, also known as **Verdolaga**, **Pigweed**, **Little Hogweed**, or **Pursley**, and **Moss rose**) is an annual succulent in the family Portulacaceae, which may reach 40 cm in height. It has smooth, reddish, mostly prostrate stems and alternate leaves clustered at stem joints and ends. The yellow flowers have five regular parts and are up to 6 mm wide.

Varieties

Approximately forty varieties currently are cultivated. It has an extensive Old World distribution extending from North Africa through the Middle East and the Indian Subcontinent to Malaysia and Australasia. The species status in the New World is uncertain: in general, it is considered an exotic weed. It is naturalised elsewhere and in some regions is considered an invasive weed. It has smooth, reddish, mostly prostrate stems and alternate leaves clustered at stem joints and ends.

Nutritional value per 100 g (3.5 oz.)	
Energy	84 kJ (20 kcal)
Carbohydrates	3.39 g
Fat	0.36 g
Protein	2.03 g
Water	92.86 g
Vitamin A	1320 IU
Thiamine(vit. B_1)	0.047 mg (4%)
Riboflavin (vit. B_2)	0.112 mg (9%)
Niacin (vit. B_3)	0.48 mg (3%)
Vitamin B_6	0.073 mg (6%)
Folate (vit. B_9)	12 µg (3%)
Vitamin C	21 mg (25%)
Vitamin E	12.2 mg (81%)

Benefits of Purslane Leaves

Fresh leaves contain surprisingly more **omega-3 fatty acids** (α-linolenic acid) than any other leafy vegetable plant. 100 grams of fresh purslane leaves provide about 350 mg of α-linolenic acid.

It is an excellent source of **Vitamin A**, (1320 IU/100 g, provides 44% of RDA) **one of the highest among green leafy vegetables**. Vitamin A is a known powerful natural antioxidant and is essential for vision. This vitamin is also required to maintain healthy mucus membranes and skin. Consumption of natural vegetables and fruits rich in vitamin A is known to help to protect from lung and oral cavity cancers.

Purslane is also a rich source of vitamin C, and some B-complex vitamins like riboflavin, niacin, pyridoxine and carotenoids, as well as dietary minerals, such as iron, magnesium, calcium, potassium, and manganese.

Furthermore, present in Purslane are two types of **betalain** alkaloid pigments, the reddish *beta-cyanins* and the yellow *beta-xanthins*. Both pigment types are potent anti-oxidants and have been found to have anti-mutagenic properties in laboratory studies.

Equipment used

Tray drier

The term tray drying is normally refers to small industrial systems with some form of air heater and a fan to pass air over the product being dried. The dryers are made of trays held in a cabinet which is connected to a source of air heated by gas, diesel or bio-mass such as rice husk. The air temperature is usually controlled by a thermostat which is normally set between 50 and 70OC. The air enters the bottom of the chamber below the trays and then rises, through the trays of food being dried, and exits from an opening in the top of the chamber. In the Practical Action systems the trays are designed to force the air to follow a longer zigzag route which increases the air/food contact time and thus improve its efficiency.

Semi-Continuous Tray drier

In a semi-continuous cabinet a lifting mechanism allows all of the trays except the bottom tray to be lifted. It is thus possible to remove the lowest tray as soon as the product is dry. The mechanism then allows all the trays to be lowered (now tray 2 is at the bottom of the stack). This leaves a space at the top of the stack to load a tray of fresh material. Two types of lifting mechanism are available both of which activate four movable fingers that lift the second tray upwards. One design is operated by a handle which is pulled downwards. The other design, developed in Sri Lanka, has been found more suitable for use by women and here the lifting mechanism is a car screw jack which, on winding up, lifts the four fingers.

The advantages/disadvantages of this system are

- Over-drying is avoided
- Product quality is higher

- Fuel efficiency is considerably increased
- A higher daily throughput is possible
- The cabinet is however more expensive to construct
- Labour costs are higher due to loading and unloading trays at regular intervals in order to maximise output 24 hour working is recommended

Sun drying

Sun drying is a traditional method of drying the leaves. Sun drying is only possible in areas where, in an average year, the weather allows foods to be dried immediately after harvest.
The main advantages of sun drying are low capital and Operating costs and the fact that little expertise is required.

The main disadvantages of this method are as follows:

- Contamination, theft or damage by birds, rats or insects; slow or intermittent drying and no protection from rain or dew that wets the products.
- Encourages mould growth and may result in relatively high final moisture content.
- Low and variable quality of products due to over - or under-drying.
- Large areas of land needed for the shallow layers of food; laborious since the crop must be turned, moved if it rains; direct exposure to sunlight reduces the quality (colour and vitamin content) of some fruits and vegetables.
- Moreover since sun drying depends on uncontrolled factors, production of uniform and standard products is not expected.

A typical Tray drier

Dehydration of Radish leaves in Tray drying

Selection and procurement of Radish leaves

Radish were selected and procured from the local market. Roots, stems and damaged leaves were trimmed off and the leaves were thoroughly washed in cold water to remove adhering dirt dust before being used for further study.

Standardization of drying temperature

The cleaned leaves were subjected to drying under cabinet drier at temperature of 60°C. Total time required for drying, yield and visual characteristics were recorded. Drying temperature recording better yield with attractive colour was selected for further study.

Drying rate of green leafy vegetables dried at Tray drier

Drying rate of selected leaves were assessed by recording the loss in weight of leaves at interval of 30 minutes in tray drier.

The following are the values obtained during Drying of leaves.

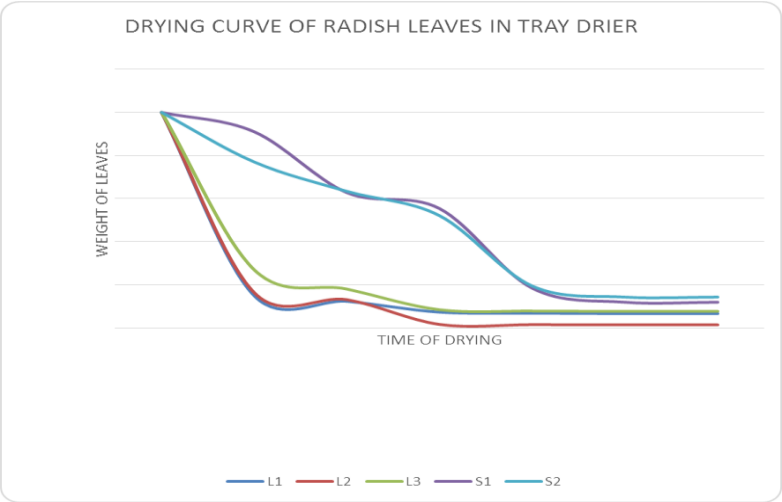
S.no	L_1(g)	L_2(g)	L_3(g)	S_1(g)	S_2(g)
1	100	100	100	100	100
2	15	16.4	27	91	77
3	12.4	13.2	18.1	62.8	63.4
4	7.4	1.7	8.5	55.4	52.1
5	6.9	1.6	7.9	18.5	19.5
6	6.7	1.5	7.8	12.0	14.4
7	6.7	1.5	7.8	12.0	14.4

Drying curve

A graph between time and weight of the dried leaves was drawn by taking time on X- axis and weight on Y-axis.

L_1, L_2, L_3-indicate leaves samples

S_1, S_2 -indicate stalk samples.



The graph shows that total time taken for drying of leaves in tray drier is 210 Minutes (3.5 hours).

- The graph also clearly depicts that leaves have taken less time to dry than the stalks.
- The dried leaves and stalks were grinded and was made into powder.
- The graph also shows that stalks consists of a major mass left out.
- The powder obtained was green in colour.
- The powder has a shelf life of 1 month since it contains no moisture.
- Drying Radish leaves under tray drier turned the leaves crisp and military green.

Dehydration of Radish leaves in Sun drying

Selection and procurement of Radish leaves

Radish were selected and procured from the local market. Roots, stems and damaged leaves were trimmed off and the leaves were thoroughly washed in cold water to remove adhering dirt dust before being used for further study

Standardization of drying temperature

The cleaned leaves were subjected to drying under sun in trays.

Total time required for drying, yield and visual characteristics were recorded. Drying temperature recording better yield with attractive colour was selected for further study.

Drying rate of green leafy vegetables dried at Tray drier

Drying rate of selected leaves were assessed by recording the loss in weight of leaves at interval of 30 minutes in tray drier.

The following are the values obtained during Drying of leaves.

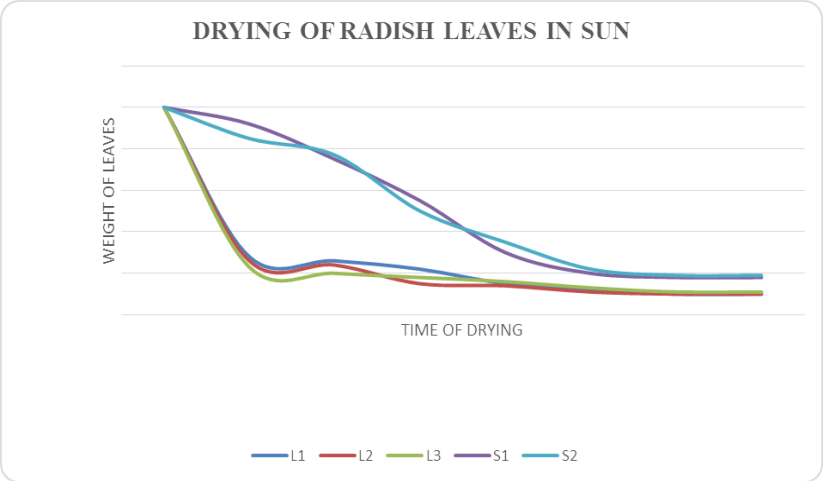
S.no	L_1 (g)	L_2(g)	L_3(g)	S_1(g)	S_2(g)
1	100	100	100	100	100
2	28	26	23	92	85
3	26	24	20	75	77
4	22	15	18	55	50
5	15	14	16	30	35
6	12	11	13	20	22
7	10	10	11	18	19
8	10	10	11	18	19

Drying curve

A graph between time and weight of the dried leaves was drawn by taking time on X- axis and weight on Y-axis.

L_1, L_2, L_3-indicate leaves samples

S_1, S_2 -indicate stalk samples.



The graph shows that total time taken for drying of leaves in tray drier is 240minutes (4hours).

- The graph also clearly depicts that leaves have taken less time to dry than the stalks.
- The dried leaves and stalks were grinded and was made into powder.
- The graph also shows that stalks consist of a major mass left out.
- The powder obtained was green in colour.
- The powder has a shelf life of 1 month since it contains no moisture.
- Drying raddish leaves under tray drier turned the leaves bottle green.

Dehydration of Purslane leaves in Tray drying

Selection and procurement of Purslane leaves

Purslane were selected and procured from the local market. Roots, stems and damaged leaves were trimmed off and the leaves were thoroughly washed in cold water to remove adhering dirt dust before being used for further study.

Standardization of drying temperature

The cleaned leaves were subjected to drying under cabinet drier at temperature of 60°C. Total time required for drying, yield and visual characteristics were recorded. Drying temperature recording better yield with attractive colour was selected for further study.

Drying rate of green leafy vegetables dried at Tray drier

Drying rate of selected leaves were assessed by recording the loss in weight of leaves at interval of 30 minutes in tray drier.

The following are the values obtained during Drying of leaves.

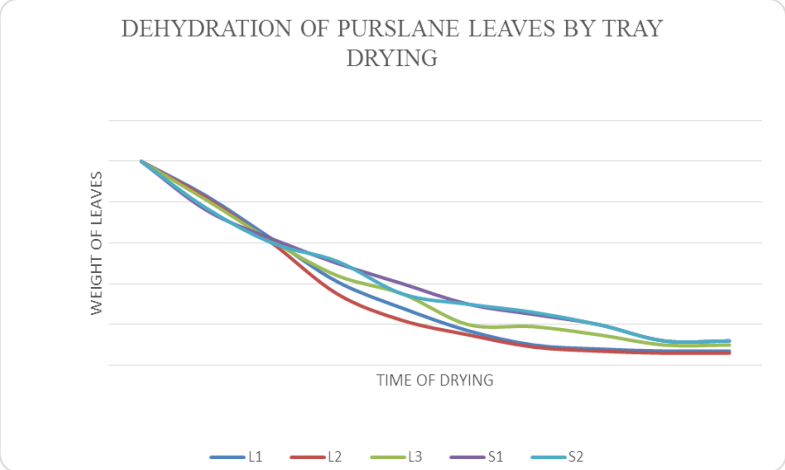
S.no	L_1 (g)	L_2(g)	L_3(g)	S_1(g)	S_2(g)
1	100	100	100	100	100
2	83	82	81	76	77
3	62	60	61	62	60
4	41	35	44	50	51
5	28	22	35	40	35
6	17	15	20	30	30
7	10	9	19	25	26
8	8	7	15	20	20
9	7	6	10	12	12
10	7	6	10	12	12

Drying curve

A graph between time and weight of the dried leaves was drawn by taking time on X- axis and weight on Y-axis.

L_1, L_2, L_3-indicate leaves samples

S_1, S_2 -indicate stalk samples.



The graph shows that total time taken for drying of leaves in tray drier is 300minutes (5 hours).

- The graph also clearly depicts that leaves have taken less time to dry than the stalks.
- The dried leaves and stalks were grinded and were made into powder.
- The graph also shows that stalks consist of a major mass left out.
- The powder obtained was green in colour.
- The powder has a shelf life of 1 month since it contains no moisture.
- Drying Purslane leaves under tray drier turned the leaves crisp and brilliant green.

Dehydration of Purslane leaves in Sun drying

Selection and procurement of Purslane leaves

Purslane were selected and procured from the local market. Roots, stems and damaged leaves were trimmed off and the leaves were thoroughly washed in cold water to remove adhering dirt dust before being used for further study.

Standardization of drying temperature

The cleaned leaves were subjected to drying under sun in trays.

Total time required for drying, yield and visual characteristics were recorded. Drying temperature recording better yield with attractive colour was selected for further study.

Drying rate of green leafy vegetables dried at Tray drier

Drying rate of selected leaves were assessed by recording the loss in weight of leaves at interval of 30 minutes in tray drier.

The following are the values obtained during drying of leaves.

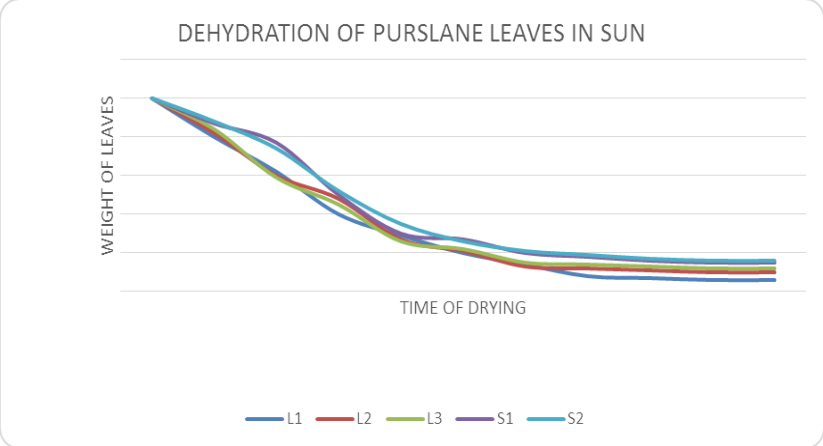
S.no	L_1 (g)	L_2(g)	L_3(g)	S_1(g)	S_2(g)
1	100	100	100	100	100
2	80	82	84	87	88
3	62	60	59	77	74
4	40	48	45	50	52
5	29	27	26	30	35
6	20	21	22	27	26
7	14	13	15	20	21
8	8	12	14	18	19
9	7	11	13	16	17
10	6	10	12	15	16
11	6	10	12	15	16

Drying curve

A graph between time and weight of the dried leaves was drawn by taking time on X- axis and weight on Y-axis.

L_1, L_2, L_3-indicate leaves samples

S_1, S_2 -indicate stalk samples



The graph shows that total time taken for drying of leaves in tray drier is 300minutes (5 hours).

- The graph also clearly depicts that leaves have taken less time to dry than the stalks.
- The dried leaves and stalks were grinded and was made into powder.
- The graph also shows that stalks consist of a major mass left out.
- The powder obtained was green in colour.
- The powder has a shelf life of 1 month since it contains no moisture.
- Drying Purslane leaves under sun turned the leaves bottle green.

RESULTS

The drying curves were drawn for various samples and it was found that. Sun drying took more time to dry the leaves than tray drier. And there was very little colour change in powder of leaves after drying.

CONCLUSION

The drying curves were drawn for tray drying and sun drying of Radish leaves and Purslane leaves.

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