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RESEARCH ARTICLE

THE EFFECT OF DRYING TECHNIQUE ON NUTRIENTS CONTENT OF LEAFY VEGETABLES

***Manisha Sonkamble and Narayan Pandhure**

Department of Botany, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad-431001

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ABSTRACT

Methods for preservation of green leafy vegetables are very important as nutritional point of view. The leafy vegetables such as Spinach, Radish, Chuka, and pods like Cowpea and Gaurare used on large scale as vegetables in Marathwada region. During the present piece efforts have been made to preserve the leafy vegetables to meet the need of common population. The preservation methods were sun drying, oven drying and shade drying. After treatment biochemical analysis was carried out to detect the retention of nutritional factors. Proximate analysis was conducted to determine the dry matter (DM), Acid soluble ash (ASH), Acid insoluble ash (AIA), amount of elements such as Calcium, Phosphorus, Nitrogen and Protein. Secondly, ash content from vegetables is a measure for total amount of minerals present within it, whereas the mineral content is a measure of the amount of specific inorganic components present within vegetables such as Ca, P, and N. Many vegetables crops have been used for medicinal values. Vegetables contribute protein, vitamin, minerals fibers and enzymes to the human diet. Results obtained indicate that, shade drying is more effective method than sun drying and oven drying to retain the nutritional factors.

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INTRODUCTION

Green leafy vegetables have health benefits for consumers, due to their content of vitamins, minerals, protein, fibers, antioxidant compounds, carbohydrates etc. Leafy vegetables contribute a major source of nutrients in daily human diet (Ioannou and Ghoul, 2013). This research is therefore focused on the effect of drying techniques such as oven drying, sun drying and shade drying on the proximate and mineral composition of *Spinacia oleracea* (spinach), *Raphanus sativus* (Radish), *Rumex vesicarius*, (Chuka), *Vigna unguiculata* (cowpea and *Cyamopsis tetragonoloba* (Guar). Drying is the most commonly used method for enhancing life of leafy vegetables. The dried green leafy vegetables were mostly used in powder form, which reduced the volume required for storage and easy to handle (Satwase *et al*., 2013). Processing of vegetables local makes it safe for consumption and destruction of pathogens. Drying is dehydrate in processing vegetables. Drying of vegetables removes moisture, the vegetables become smaller and lighter in weight. The common methods for drying are; sun drying. In this methods and leafy vegetables are exposed to direct Sun rays. Oven-drying requires the use of oven set and at certain temperature. Shade drying requires air current (Anieke *et al*., 2016). Green leafy vegetables (GLVs) occupy an important place in Indian dietaries as they provide variety, blend in different preparations, cheap and they are easily available. GLVs are rich sources of vitamins and minerals like carotene, ascorbic acid, calcium, iron, phosphorous and magnesium, but fair sources of protein, which gets concentrated on dehydration. Green leafy vegetables provide several other components that function as antioxidants. Primary among them are fiber, ß-carotene, ascorbic acid vitamin E, selenium and flavonoids. These offer protection against many life style related chronic diseases viz., heart diseases, obesity, diabetes, hypertension and certain type of cancers. The present study was undertaken to the compare the effect of three drying methods on the nutritional value (Oladele and Aborisade, 2009). The knowledge on different phytochemical presence and its content in these vegetables is important for an appropriate choice of products according to the physiological needs. Phytochemicals are a large group of plant derived compounds, the plant`s way of protecting itself. In addition they appear to have significant physiological effects in the human body. There are more than thousand known phytochemicals (Duma *et al*., 2014).

Corresponding author:* **Manisha Sonkamble,
Department of Botany, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad-431001

MATERIALS AND METHODS

a) Sample collection: Fresh samples of vegetables such as *Spinacia oleracea* (spinach), *Raphanus sativus* (Radish*), Rumex vesicarius*, (Chuka), *Vigna unguiculata* (cowpea) and *Cyamopsis tetragonoloba* (Guar) were purchased from a local market in Aurangabad.

b) Sample preparation: These samples were thoroughly washed with running tap water. The moisture content of the samples was determined. These samples were dried in shade, Oven and Sun and finely fine powder was prepared which was used for further analysis.

1. Sun Drying: - 200 gms of each vegetable samples were used for the experiment. The fresh leafy vegetables were washed and evenly spread on a tray and left to dry in the sun for at least seven hours per day for four days until the vegetables were brittle and considered to be dry.

2. Oven drying: - 200gms of each samples were washed in ordinary tap water. The vegetables were oven dried at 65°c until properly dried.

3. Shade drying: - 200gms of each samples were washed in tap water. Shade drying in enclosed Cabinet drier which protect the drying vegetables from the direct sunlight is also practiced.

4. Physico-chemical Analysis: - The parameter studied were total ash, Acid insoluble ash (AIA) and Acid soluble ash (ASA) and Minerals.

5. Total Ash:- Place about 2 to 4 gms of Plant material, accurately weighted, taken in a silica crucible. Spread the material in an even layer and crucible keep in muffle furnace allow the temperature to each 600°c and constant for 2 hours, until it is white, indicating the absence of carbon cool in desiccators and weight. Ash can be Calculated by using formula,

$$Ash\ value\ (\%) = \frac{\text{Weight of Ash}}{\text{Weight of sample}} \times 100$$

6. Acid Insoluble ash: -The total ash obtained was boiled with 50 ml of 5N HCL for 5-10 minutes and the insoluble matter was collected on ash less filter paper and was washed with hot water, ignited, cooled in a desiccators and weighed. Percentage of AIA was calculated with reference to the dried samples.

$$Acid\ Insoluble\ ash\ value\ (\%) = \frac{\text{Weight ofAcid insoluble Ash}}{\text{Weight of sample}} \times 100$$

7. Acid Soluble ash:- The total ash obtained was boiled with 50 ml of 5N HCL for 5-10 minutes and the insoluble matter was collected on ash less filter paper and was washed with hot water ,ignited ,cooled in a desiccators and weighed. Percentage of AIA was calculated with reference to the dried samples

$$Acid\ soluble\ ash\ value\ (\%) = \frac{\text{Weight of Acid soluble Ash}}{\text{Weight of sample}} \times 100$$

8. Calcium (Ca): The determination of calcium (Ca), acid soluble ash fraction of the plant material is utilised. In present method Ca in an aliquot is precipitated as calcium oxalate. This precipitate is dissolved in acid and the content of oxalate ions determined by titrating with potassium permanganate ($KMnO_4$).The amount of calcium was calculated by using an equation:

1 ml of $KMnO_4$ = 0.2004 mg of Ca

9. Phosphorus (P): In the present method, acid soluble portion of ash was diluted and treated with molybdate solution. It forms phosphomolybdic acid, was then reduced by the addition of 1, 2, 4 - Aminonaphthol sulfonic acid (ANSA) reagent which produces blue colour. The intensity of the colour was measured, which is proportional to the amount of phosphorus present.

10. Nitrogen (N): During the estimation of nitrogen dry sample was digested with concentrated sulphuric acid (H_2SO_4) in the presence of catalyst. Nitrogen from the sample was precipitated in the form of ammonium sulphate ($(NH_4)_2\ SO_4$). Then it was allowed to react with strongly alkaline with sodium hydroxide (NaOH) solution, it released ammonia (NH_3) was distilled into boric acid (H_3BO_3) solution. The ammonium tetra borate was formed, titrated against 0.035N hydrochloric acid for the determination of nitrogen (N).

11. Protein: On an average, most of the proteins have 16 % nitrogen in their composition. Thus the amount of nitrogen content, when multiplied by 6.25, gives the protein (p) content of the sample.

RESULTS

Three drying methods were employed which significantly affected the proximate composition of moisture content, total ash, acid Insoluble ash and acid soluble ash (Table, 1, 2, 3).Effect of drying methods on moisture content of five leafy vegetable samples i.e. Spinach, Radish, Chuka, Cow pea and Guar were studied using different drying methods. Amongthe three drying techniques, sun and oven drying had no significant effect on Ash and moisture content of the dried leaves. Shade dried sample had higher DM and ASH contents (Table 1, 2, 3)

Dry matter: The value for DM content ranged from 12.49%, 9.41%, 7.32%, 8.63% and 7.44%. The highest value was observed from the sample which was shade dried. The DM reported here from oven dried were 6.79%, 9.22%, 11.17%, 10.32% and 7.67% which were low in DM value. From Sun dried samples DM value recorded was 10.59 %, 9.09 %, 7.07%, 9.94% and 9.34% and equally low compared to dried vegetables.

Ash content: Ash content recorded was 24.5%, 16%, 18%, 7.5% and 7.5%. The highest recorded value was from shade dried sample. This is high compare to ash content of spinach leaves. Ash content of oven dried samples recorded was 18.5%, 18%, 17%, 6.5 &7 %. Sun dried samples was 20.5%, 16.5%, 17%,8% and 6%. From the above observations it could be concluded that, variation in reading is due to location where vegetables grow, variety, soil type and temperature at which the leaves were dried.

Calcium: The value for Calcium ranged from 26.05 , 18.04, 33.83, 8.90 &11.94 for shade and oven dried and Sun dried leaf samples, respectively and 17.31, 23.65, 33.59,12.50 & 9.54 and 24.2, 15.87, 31.42 10.5 8.17 was recorded for dried sample. This is low compare to the range of 17.31 to 9.54 for calcium content of oven dried leaves and high compare to Shade & Sun dried leaves samples.

Table 1. Effect of Shade drying on nutritional quality of vegetables

	DM	Total	AIA	ASA	Calcium	Phosphorus	Nitrogen	Protein
Sample	(%)	Ash%	%	%	mg/100ml	mg/100ml	(%)	(%)
Spinach	12.49	24.5	4.55	19.95	26.05	0.67	2.66	16.62
Radish	9.61	16	1.3	14.7	18.04	0.57	2.16	13.5
Chuka	7.32	18	1.85	16.15	33.83	0.64	2.03	12.68
Cow pea	8.63	7.5	4.8	2.7	8.90	0.57	1.63	10.18
Guar	7.44	7.5	1.25	6.25	11.94	0.51	1.93	12.06

Table 2. Effect of oven drying on nutritional quality of vegetables

	DM	Total	AIA	ASA	Calcium	Phosphorus	Nitrogen	Protein
Sample	(%)	Ash%	%	%	mg/100ml	mg/100ml	(%)	(%)
Spinach	6.79	18.5	2.35	16.15	17.31	0.57	1.93	12.06
Radish	9.22	18	3.35	14.65	23.65	0.53	1.26	7.8
Chuka	11.17	17	1.5	15.5	33.59	0.56	1.83	11.43
Cow pea	10.32	6.5	2.45	4.05	12.50	0.45	1.38	8.6
Guar	7.67	7	1	6	9.54	0.49	1.16	7.25

Table 3. Effect of Sun drying on nutritional quality of vegetables

	DM	Total	AIA	ASA	Calcium	Phosphorus	Nitrogen	Protein
Sample	(%)	Ash%	%	%	mg/100ml	mg/100ml	(%)	(%)
Spinach	10.59	20.5	1.7	18.8	24.2	0.51	1.71	10.68
Radish	9.09	16.5	3.2	13.3	15.87	0.42	1.5	9.3
Chuka	7.07	17	2.25	14.75	31.42	0.33	1.53	9.56
Cow pea	9.94	8	0.6	7.4	10.5	0.52	1.43	8.93
Guar	9.34	6	0.95	5.05	8.17	0.57	1.33	8.31

Phosphorus: It was detected in a range of 0.67-0.51, 0.57-0.49 and 0.51 -0.57 are reported by Phosphorus as an equally reported the value in Shade, Oven, and Sun dried.

Nitrogen: The observed Nitrogen % reported here from Oven dried range to 1.91-1.16% & Sun dried 1.71-1.33 % which were low percentage and the highest recorded % was from Shade dried samples i.e. 2.66-1.93.

Protein: Protein content ranged from12.06% to 10.68% for oven and sun dried samples, respectively and shade dried sample had 16.62% protein content. The DM and Ash content, Ca, N, P and protein of the dried leaves was reported here high compare to Shade dried, Sun dried and Low Oven dried samples. Similar results were recorded using different vegetables.

Conclusion

Different vegetables are considered as sources of human health promoting components. Leafy vegetables are widely used in human diet. They are low in calories and fat, but high in dietary fibers, content of minerals, such as iron, phosphorus, Nitrogen, Protein, calcium and very high in phytochemicals such as vitamin C, carotenoids, lutein and others. On the one hand phytochemicals are a plant's way of protecting itself. Preservation techniques such as drying methods are helpful to retain the nutrients from leafy vegetables. During present investigations among the three drying techniques studied, shade drying was most effective in increasing the Ash content, Calcium, Nitrogen, and Protein from the vegetables. The Dry matter and ash content of the dried leaves was reported high compare to Shade dried, Oven dried and sun dried samples. On the other hand they have beneficial effect on human health.

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