THE EFFECT OF DRYING ON THE SHELFLIFE OF AMARANTHUS LEAVES

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Abstract - Amaranthus (*Amaranthus viridis*) is a common green leafy vegetable rich in vitamin A, vitamin C, micronutrients and minerals. Through the leaves are not available during rainy season it is important to preserve them for the off season. It is highly perishable and can be stored for five days in ambient temperature. An investigation was undertaken to study the effect of vacuum drying of amaranthus on the shelf life using different packaging material. Amaranthus leaves were subjected to three different drying methods namely: sun drying, cabinet drying and vacuum drying. The study involves pre- treatments such as hot water blanching, steam blanching, sulphitation, citric acid treatment and combination treatments. The quality of the dried amaranthus leaves were was expressed in terms of moisture content, ascorbic acid and fibre content and also cooking quality through sensory evaluation. Quality parameters were analysed after of 30 and 60 days. The result revealed that vacuum dried products at a temperature of 60°C at 680mm of Hg exhibit good rehydration ratio, better colour, texture and overall acceptability. The drying time was lesser than other methods. Hot water blanched vacuum dried amaranthus leaves were reported is to be the best among the vacuum dried products. Longer shelf life of 60 days was noted with all the packaging materials such as polypropylene, polyethylene and shrinking packing. It showed the amaranthus laves stored in different packaging obtained minimum physiological loss. Longer shelf life was observed for shrink packaging in areacanut sheet trays is to be better in reducing damage.

Key words: **Vacuum drying, Rehydration ratio, Amaranthus (*Amaranthus viridis*)**

1. Introduction

Amaranthus viridis include in the family (*Amaranthaceae*) collectively known as amaranth, is a cosmopolitan genus of annual or short-lived perennial plants. Some amaranth species are cultivated as leaf vegetables, cereals, and ornamental plants. Amaranthus contain about 90% moisture content. The leaf is a good source of proteins and the dry matter of leaves contained as much as proteins as legumes. Besides, they are known to be the most inexpensive sources of several vital nutrients. This group of foods are rich sources of vitamins like vitamin-A in the form of β-carotene, ascorbic acid, riboflavin, folic acid; minerals like calcium, iron, potassium, sodium and phosphorous. Amaranth leafy vegetables are highly perishable with shelf-life of only few days owing to higher amount of moisture due to which around 30 per cent of the produce gets rotten and spoilt, becomes inedible, rendering wastage of a huge amount of nutritious products. This calls for preservation and processing to prevent losses as well as make them available in the lean season at remunerative prices.

Drying is one of the traditional methods of preservation, which converts the leafy vegetables into light weight, easily transportable and storable product. Advantage of this method is that the vegetable can be easily converted into fresh like form by rehydrating it and can be used throughout the year.

The quality of the dehydrated product in terms of rehydration ratio, colour and flavour retention depends on the pre-treatments and method of drying. Vacuum drying is ideal for materials that would be damaged or changed if exposed to high temperatures. The vacuum removes moisture while preventing the oxidation or explosions that can occur when certain materials combine with air. Vacuum drying is also ideal in situations where a solvent must be recovered or where materials must be dried to very low levels of moisture. Unlike atmospheric drying, drying under reduced pressure lowers the boiling point and provides a greater temperature difference between the heating medium and product. This results in faster drying and more efficient heat recovery. Drying at lower temperatures reduces energy consumption. Vacuum drying has some distinctive characteristics such as higher drying rate, lower drying temperature and oxygen deficient processing environment etc., these characteristics may help to improve the quality and nutritive value of the dried products.

With these background a study has been carried out with the following objectives:

1 To study the effect of pre-treatments to retain the drying quality of amaranthus leaves.

2. To compare the drying characteristics of vacuum and conventional drying on amaranthus leaves

3. To study the effect of packing material on the shelf life of dried amaranth leaves.

2. Materials and methods

The raw material required for the study, amaranthus was bought from the local vegetables markets of Tavanur, Malapuram district and sorted with healthy leaves and were washed by dipping in water for one minute. The procedure was repeated till the vegetable was free from dirt and soil. The quality of the final product after processing depends on the quality of the fresh leaves. Sorted and cleaned amaranthus were divided in to nine lots and subjected to different treatments prior to the drying.

Therefore pre-treatments such as blanching, chemical treatment and different combination treatments were carried out. Hot water blanching (2 minutes) and steam blanching (1 minutes) chemical treatments consist of Citric acid and sulphitation by dipping the leaves were in the solution of 0.1% citric acid and 0.2% KMS for two minutes. Combination treatments of Hot water blanching + citric acid dipping and Hot water blanching + sulphitation takes by 1 minutes which were compared with control followed by Steam blanching + citric acid dipping and Steam blanching + sulphitation were carried out for 30 seconds. Afterwards the leaves were spread for few minutes for cooling. Last lot was dried without any pre-treatment.

The pre-treated amaranthus were dried by three methods; sun drying, cabinet drier (60°C) and vacuum drying. Three levels of vacuum of 510, 600 and 640 mm of Hg (gauge) and drying chamber temperature at of 40°C and 50°C. The recommended moisture content of amaranthus for prolonged shelf is 4 to 10% thus drying was continued till the optimum moisture content of around 4%. The time taken for drying, moisture, crude fibre, ascorbic acid content and rehydration ratio were recorded. They were packed in three different types of packaging materials such as low density polyethylene (LDPE), polypropylene (PP) and poly ethylene (PE) at room temperature. The packets were sealed by using a hot bar sealing machine. After every 15 days these quantitative analysis test were repeated. The tests were conducted for a storage period of 60 days.

2.1 Quantitative Analysis of Green and Dried leaves

The major constituents of amaranthus leaves such as moisture, ascorbic acid, fibre and rehydration ratio etc. were estimated as per the procedure mentioned as described by Ranganna *et al*., (1986).

3. Result and Discussion

Pre- treatments such as Hot water blanching at 75˚C for 1 minute was found to improve the colour and reduces the activity of enzymes. Also it was revealed that blanched leaves after drying have bright green colour. Colour was found to be retained even after packaging and storage. Steam blanching for 30 seconds also found to improve the colour and reduces the activity of enzymes. Steam blanched amaranthus leaves have the colour similar to the fresh even after packaging and storage. Citric acid treatment amaranths leaves treated with 0.1% citric acid for 2 minutes was found to reduce the curling of leaves while drying. But the colour was found to be slight yellowish when compared to other dried samples. Sulphitation of amaranthus leaves treated with 0.05% potassium meta bisulphite for 2 minutes reduce the curling of leaves during drying. The colour was found to be similar with citric acid treatment.

Table 1 Different drying methods of amaranthus leaves

Vacuum Time :120 min		Cabinet Time:180 min		Sun Time:360 min	
sample	m.c	sample	m.c	sample	m.c
T_1	4.25	T_1	4.75	T_1	9.7
T_2	4.25	T_2	4.75	T_2	9.7
T_3	4.24	T_3	4.74	T_3	9.7
T_4	4.24	T_4	4.73	T_4	9.7
T_5	4.23	T_5	4.72	T_5	9.7
T_6	4.23	T_6	4.72	T_6	9.7
T_7	4.23	T_7	4.72	T_7	9.7
T_8	4.24	T_8	4.72	T_8	9.7
T_9	4.28	T_9	4.78	T_9	9.2
T_1- Control; T_2 - T_9 Treated samples					

3.1 Effect of moisture content, ascorbic acid, rehydration ratio and crude fibre on different drying methods

Table 1 shows vacuum drying of amaranths; in order to reach this ideal moisture content the temperature and period of drying was determined by trial and error basis. Vacuum drying for two hours at 60°C at 680 mm of Hg was sufficient to reach the ideal moisture content. From the above table, it was found that the control sample had moisture content of 4.28% whereas the pre-treatments reduced the moisture content to a range of 4.23% to 4.25%. This reduction in moisture content of pre- treated sample is due to relaxation of the tissues that enabled the easy removal of water by Anonymous (1999).

Cabinet dryer maintained at 60°C gave higher browning values due to longer drying time and exposed to hot air. Table 1.1 is inferred that the cabinet drying of control sample for 3 hours reduced the moisture content only up to 4.78% whereas in pre-treated samples the moisture content was brought to 4.75-4.72%. This is because of slow diffusion of water molecules from the interior to the surface implying that drying process is in the falling rate period. The drying rate was maximum during the first 30 minutes of exposure in cabinet drier, confirming that in initial stages, wet plant tissues behave like surfaces saturated with water which is in agreement with Brennan *et al (*1990) and later stagger. In spite of shrinkage and browning during drying, quality of convective dried amaranths leaves was better than sun dried leaves.

Sun drying is a slow process and it is not possible to dry below 8%. The entire process is unhygienic and requires large floor area. It could not lower the moisture content below 9.2%. Pre- treatments relaxed the tissues and thus reduced the moisture content to 9.2% in 6hours. The dried product was of poor quality and hard due to structural changes.

From the various result obtained, it was found that the various methods does not have any effect on fiber content. Drying amaranthus leaves in vacuum after both steam and hot water blanching resulted in similar amount of fibre content as that of fresh leaves at the same time chemically treated samples showed the reduction in the fibre content.

Rehydration ratio indicates the capacity dehydrated leafy vegetables to absorb the moisture. In the present study, the samples dried in vacuum drier exhibited higher absorption of water while, those dried in cabinet and sun dried sample indicated significantly lower rehydration or water pick up. The slight difference in moisture uptake can be attributed to variation in the drying conditions, initial moisture content, moisture removal and interactions between the components during dehydration.

The vacuum dried amaranths leaves were close to that of the fresh samples leading to the conclusion that vacuum retain the fresh like flavour and aroma. Vacuum drying retained vitamin C without significant losses compare to hot air and sun drying methods. It may be due to drying without air in vacuum condition. So vacuum dried leaves were filled and sealed in the packaging materials such as polypropylene (PP), polyethylene (PE) and shrink packaging. Quantitative analysis of the quality characteristics were carried out. It showed the amaranths leaves stored in different packaging showed minimum physiological loss and shrink packaging is found to be better in reducing damage. Longer shelf life of 60 days was noted with all the packaging materials.

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