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Effect of pre-treatments and drying methods on various parameters of Coriander leaves

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Abstract

During dehydration, very much important thing is to fresh coriander leaves are very delicate, sensitive to heat and more prone to discoloration. The article entitled "Dehydration of coriander leaves" was conducted in B-tech Laboratory, Department of Food Processing and Technology and Department of Horticulture, UAS, Dharwad during 2021. The aim of the study to identify the combined effect of pretreatment and drying methods used during dehydration of coriander leaves. It included three factors: a) Pre-treatment like 1) Untreated, 2) Blanched with 0.5% sodium metabisulphite for 2 minutes and 3) Chemical treatment of fresh leaves with 0.1% magnesium chloride + 0.1% sodium bicarbonate + 2% potassium metabisulphite dip for 15 minutes. b) Drying methods viz., 1) Sun drying, 2) Shade drying, 3) Microwave oven drying, 4) Cabinet drying, 5) Tray drying and 6) Vacuum drying. In dehydration of coriander leaves, untreated leaves had maximum drying rate (5.89 g/min) and minimum moisture content (1.66%). Chemical treated leaves had maximum of chlorophyll (7.20 mg/100 g) content and carotenoids (13.51 mg/100 g). Among drying methods, microwave oven drying had quicker drying rate, maximum chlorophyll (7.16 mg/100 g) and carotenoids (13.76 mg/100 g). Coriander leaves treated with 0.1% magnesium chloride + 0.1% sodium bicarbonate + 2% potassium meta bisulphite solution for 15 minutes and microwave oven dried leaves found to be the best for maintenance of physical and chemical qualities.

Keywords: Pre-treatments, drying methods, dehydration of coriander leaves, blanching, microwave oven drying, magnesium chloride

1. Introduction

Coriander is annually grown spice scientifically *Coriandrum sativum* belongs to family apiaceae. It most preferable fresh leaf spice for Indians food because of its vibrant color and pleasant aroma without which cooking never completes. In addition to that also have health benefits like memory booster and also immunity booster. Coriander improves digestion, vision, regulates blood sugar level, protects kidney and liver which also cure bile disorders and jaundice (Anon., 2018) [4]. It also contains mineral like 0.14% of calcium, 10 mg of iron, 0.067% of phosphorus, and vitamins like vitamin C 250mg and vitamin A 10000 to 12000 IU along with protein 3.5%, fat 0.6% and carbohydrate 6.5% in hundred grams of fresh leaves (Anon., 2018) [3]. With all these benefits, Coriander leaves will have 87.9% of moisture which is major disadvantage for storability. Because of high moisture content and succulent leaf structure destruct leaf early which leads decaying of tissues, blackening and leads loss of nutritional and physical properties. To avoid these, we can go for our old tradition of storability that is dehydration. Indian tradition to dehydrate moisture product to avoid storage loss like in onion, garlic, etc. this is the cheap and best method for long storage life but improper drying also leads off color and flavour. Because of that proper pre-treatment and drying method knowing is necessary. Many research works are carrying-out by using variety of drying methods. The research was carried-out to find the effect of combination of pretreatment and drying method on coriander leaves.

2. Materials and Methods

For dehydration, coriander leaves of the cultivar 'DWD3' seeds were collected from the seed unit of University of agricultural science, Dharwad and sown in plot. Fourty days of herb were

harvested in early morning 8 am to 10 am leaf samples were collected from plot. Immature or over matured, pest infected, diseased and dried leaves were sorted out to get good quality and uniform quality product.

2.1. Pre-treatments

2.1.a. Untreated (T₁)

Coriander leaves were cleaned and used for drying without any treatment. Leaf samples were washed, weighed, dried in six different drying methods (Sun drying, Shade drying, Microwave oven drying, Cabinet drying, tray drying and vacuum drying). The dried leaves were used for analysis.

2.1.b. Blanching (T₂)

Leaf samples were weighed and boiled for 2 min in water containing 0.5% sodium metabisulphite (Na₂S₂O₅) at ratio of 1:5 (leaves: water). Then blanched leaves were partitioned into 6 groups for six drying methods.

2.1.c. Chemical treatment (T₃)

Coriander leaf samples were soaked in the solution contained of 0.1% magnesium chloride (MgCl₂), 0.1% sodium bicarbonate (NaHCO₃) and 2% potassium metabisulphite (K₂S₂O₅) for 15 minutes. After treatment, drained leaf samples were separated for six different drying methods.

2.2 Drying methods

2.2.a. Sun drying (D₁)

Untreated, blanched and chemical treated coriander leaves were weighed for one kilogram and were thinly levelled on separate aluminum tray (100 mm × 40 mm) uniformly. And kept upon the roof where tray expose to more sun shine for more hour and weighed hourly to check moisture loss percent until weigh loss deference become zero.

2.2.b Shade drying (D₂)

Different treatment leaf samples were weighed for one kilogram and spread over an aluminium tray in a uniform thin layer. Leaves filled tray was kept for shade drying at ambient temperature of 25 °C to 30 °C with varied relative humidity of 40 - 60%. While drying, weight loss was observed and recorded with precision electrical weighing balance at hourly interval. The process is continued up to sample weight difference reaches zero.

2.2.c Microwave oven drying (D₃)

For microwave oven drying electrical IFB 25SC3 with a range of 270 watts was used. Coriander leaves were weighed to 20 g and spread over the turntable glass plate and kept in the oven for drying. While drying, every minute record were observed the loss of weight was recorded per minute. The process is continued up to sample weight difference reaches zero.

2.2.d Cabinet drying (D₄)

Pre-treated coriander leaf samples were weighed and spread over the perforated aluminium tray (40 cm × 80 cm) and kept in drier. In drier cabinet 56 °C was maintained. Sample weight checked at hourly interval. This process continued till steady moisture loss.

2.2.e. Tray drying (D₅)

Pre-treated coriander leaves were weighed separately and kept on perforated tray drier at 60 °C (Varada engineers). Samples weight loss was recorded along the during at hourly intervals.

2.2.f. Vacuum oven drying (D₆)

Different pre-treated done coriander leaf samples were weighed and spread uniformly over vacuum drier tray. Then the tray kept inserted inside the vacuum oven. The temperature inside the oven were controlled by regulating the degree of vacuum in the chamber. For every hour dried sample were weighed to check moisture loss and weight difference. Readings were continued till get constant weight.

2.3. Experimental design: Factorial- Complete Randomized Design (F- CRD)

2.4. Analytical Parameters

Dehydrated coriander leaves were analyzed with respect to the following parameters.

2.4.a Drying rate (g/min)

Coriander leaf samples were weighed before dehydration and after dehydration. And the same recordings were used to compute drying rate.

$$\text{Drying rate} = \frac{\text{Fresh weight of sample (W}_1\text{)} - \text{final weight of dried sample (W}_2\text{)}}{\text{Time taken for drying (T)}} \times 100$$

2.4.b. Moisture content (%)

Moisture content of drumstick leaves was recorded by using the AOAC (AOAC, 1984)² method.

$$\text{Moisture content (\%)} = \frac{\text{Initial weight of dried sample (D}_1\text{)} - \text{Final weight of dried sample (D}_2\text{)}}{\text{Initial weight of dried sample (D}_1\text{)}} \times 100$$

2.4.c. Total Chlorophyll content (mg/g)

Chlorophyll content was calculated by using spectrophotometer (Arnon, 1949) ^[5].

Pre-treated leaf sample were chopped and weighed into one gram then smashed by using pestle and mortar after adding 80% acetone of 20 ml. Then, was centrifuged at 2500 rpm for five minutes and the supernatant was collected and transferred to a 50 ml volumetric flask. Thereafter, 80% acetone was added to make up volume to 50 ml. Then, sample extract feed to double beam UV-VIS spectrophotometer and the absorbance was recorded at 645 nm and 663 nm in a Finally, chlorophyll content was calculated by using the formula as given below,

$$\text{Total chlorophyll (mg/g tissue)} = 20.2 (A_{645}) + 8.02 (A_{663}) \times \frac{V}{1000 \times W}$$

Where, A= Absorbance at specific wavelength,
V= Final value of chlorophyll extract in 80% acetone,
W= weight of tissue extracted,

2.4.d. Total carotenoid (mg/100 g)

Dried coriander leaves samples were weighed to five grams. Then were crushed with pestle and mortar 80% acetone, in addition of crystals of anhydrous sodium sulphate. Then supernatant was poured to a beaker with 10-15 ml petroleum ether and mixed thoroughly. The above settled suspension was collected in a 100 ml volumetric flask and added 100 ml of petroleum ether then recorded the absorbance at 452 nm using spectroscopy (Ranganna, 1997) ^[12].

$$\text{Total carotenoid (mg/100g)} = \frac{(7.6 (A_{480}) - 1.49 (A_{510}))}{(d \times 1000 \times W) V}$$

A- Absorbance (nm),
W- Weight of the sample (g),
V- Volume of extractant (ml),

2.5. Statistical analysis

The study was analysed by two factorial complete randomized design (3×6) design (F-CRD) with two-way ANOVA is at 1% of critical difference (Panse and Sukhatme, 1967) ^[10].

3. Results and Discussion

Pre-treated and dehydrated leaf sample were analyzed for drying rate, moisture content, chlorophyll content and carotenoid content. And the results were significant with pre- treatments, drying methods and weather conditions due to different reactions like denaturation, oxidation, leaching *etc* during pre-treatment and drying. The results were discussed here.

3. Effect of pretreatment and drying methods on parameters of coriander leaves

3.1. Drying rate (g/min)

Drying rate depends on the pressure gradient difference between leaf sample and media used for drying, leaf succulence nature and air temperature. Drying rate is the quickness of the coriander leaf sample dried from fresh form. Drying rate depends on moisture difference between product and weather at which the sample kept. It means the rate at which internal moisture of leaf tissue evaporates to the surroundings. Significantly higher dehydration rate observed in plain water washed coriander leaves (5.89g/min) followed by combine chemical treated leaves (0.1% MgCl_2 + 0.1% NaHCO_3 + 2% $\text{K}_2\text{S}_2\text{O}_5$ dip) dried at the rate of 4.72g/min (Fig.1). Untreated leaves were just washed in normal water, so there is no absorption of water by leaf tissues hence available moisture for evaporation was very less. Hence quick drying was possible. In T_3 , coriander leaves were washed and soaked in combine chemical solution for 15 minutes, hence leaves absorbed solution due to difference in pressure gradient. Which leads slow drying rate. Very slow drying rate was observed in coriander blanched leaves (4.13g/min). Hence, blanched leaves became unattractive and not acceptable. Very slow drying rate might be due to boiled soft leaf tissues. The same result was found by Subadra *et al.* (1997) ^[15] in drumstick leaves and Shaw *et al.* (2007) ^[14] in coriander leaves. But in case of basil and spice paprika, drying rate was significantly maximum in steam blanched sample due to higher cell wall destruction, Which, less resist to moisture movement during drying which was reported by Ramesh *et al.* (2001) ^[11] and Rocha *et al.* (1993) ^[13].

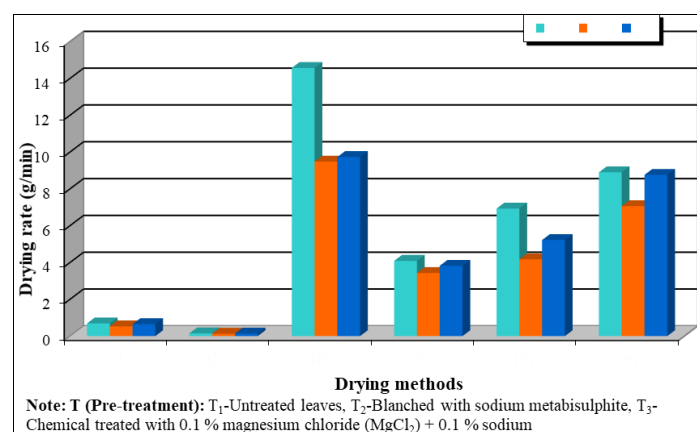
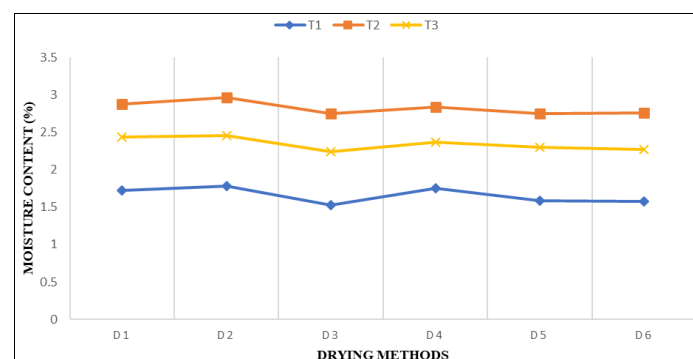


Fig 1: Influence of pre-treatments and drying methods on drying rate of coriander leaves

3.2 Moisture content (%)

Moisture content present in dried coriander leaves varied significantly with pre-treatment, drying method and their interaction. Blanched leaves had maximum moisture content (2.83%) slightly less moisture observed in chemical treated leaves (2.35%) and least moisture was observed in untreated leaves (1.66%). Among drying methods, maximum moisture content was retained in shade dried leaves (2.40%). Minimum moisture content present in microwave oven dried leaves (2.17%). For combine effect, Blanched and shade dried leaves were showed maximum moisture per cent retention (2.97%) and untreated and microwave oven dried leaves exhibited minimum moisture retention (1.53%). Even dried leaves have moisture content. This was calculated by the ratio of weight difference in initial weight of dried material to final weight of the oven dried leaves. Blanched (T_2) leaves had higher moisture content because, blanched leaf cells are more compact and there would be hidden moisture. Untreated leaves (T_1) were more porous. While drying, complete moisture loss will be there. Hence, least moisture content of untreated dried leaves (2.83%) simultaneously increased the storage period which prohibited the microbial growth. Similar observations were found by Ankita (2013) ^[11] in spinach leaves powder. This result is contradictory to the result reported by Pande *et al.* (2000) ^[9] in coriander and methi leaves, and he stated it was due to conspicuous anatomy and symplast movement of water.



Note: T (Pre-treatment): T₁- Untreated leaves, T₂- Blanched with 0.5% sodium meta bisulphite, T₃- chemical treated with 0.1% magnesium chloride (MgCl_2) + 0.1% sodium bicarbonate (NaHCO_3) + 2% potassium metabisulphite ($\text{K}_2\text{S}_2\text{O}_5$), D (drying methods): D₁- Sun drying, D₂- Shade drying, D₃- Microwave oven drying, D₄- Cabinet drying, D₅- Tray drying, D₆- Vacuum oven drying

Fig 2: Influence of pre-treatments and drying methods on total moisture retained in dried coriander leaves

3.3. Total chlorophyll (mg/100 g)

Chlorophyll content of dried coriander leaves was significantly influenced by pre-treatments, drying methods and their interaction. Maximum chlorophyll retained in T_3 leaves (7.20 mg/100 g) followed by T_1 leaves (6.99 mg/100 g). Minimum chlorophyll was observed in T_2 leaves (6.62 mg/100 g). Among drying methods, D_3 leaves had more chlorophyll content (7.16 mg/100 g) which is at par with D_6 leaves (7.12 mg/100 g) and D_5 (7.07 mg/100 g). Minimum chlorophyll was found in D_1 leaves (6.46 mg/100 g). Among different combinations, T_3D_3 leaves were found superior in retention of chlorophyll (7.41 mg/100 g) which was at par with T_3D_6 (7.37 mg/100 g), T_1D_3 (7.30 mg/100 g), T_1D_6 (7.21 mg/100 g) and T_1D_5 (7.19 mg/100 g). Minimum chlorophyll content was observed in T_1D_1 leaves (6.28 mg/100 g) which is due to sun light effect leaves mature early at par with T_2D_1 (6.35 mg/100 g).

Chlorophyll degradation increases with increasing duration of

drying. T₃ leaves dried quick along with chemical imbibition with NaHCO₃ and K₂S₂O₅ was influenced total chlorophyll retention (Fig. 3). T₂ had very low chlorophyll content due to high temperature total chlorophyll may degraded. In T₁ leaves, because of delicate nature of leaves influence the degradation of chlorophyll and degradation continued along the storage. This similar result were reported by Bishnoi *et al.* (2020) [6] and Dhotre *et al.* (2012) [7] in fenugreek leaves and in bitter gourd slices respectively.

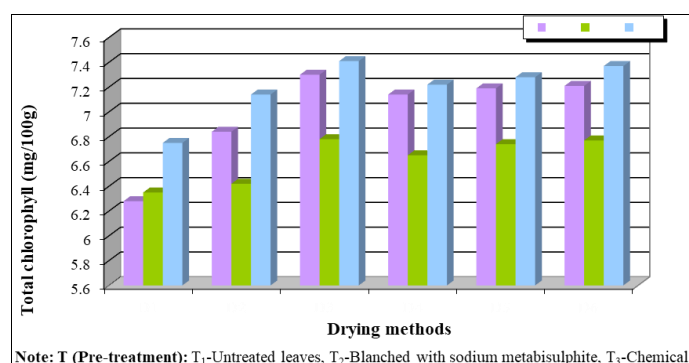


Fig 3: Influence of pre-treatments and drying methods on total chlorophyll content retention in dried coriander leaves

3.4 Total carotenoids (mg/100 g)

Pre-treatments, drying methods and their combination dried leaves were significantly influenced the total carotenoid retention. Maximum carotenoids were observed in T₃ chemical treated leaves (13.51 mg/100 g) followed by (T₁) untreated leaves (12.59 mg/100 g). Least carotenoids were observed in (T₂) blanched leaves (12.28 mg/100 g). In drying methods, D₃ leaves retained maximum carotenoids (13.11 mg/100 g). D₁ reduced the carotenoids content (12.27 mg/g) followed by D₄ (12.77 mg/100 g). Among different combinations, T₃D₃ leaves had maximum carotenoids (13.76 mg/100 g) and T₃D₆ (13.75 mg/100 g) and T₃D₅ (13.71 mg/100 g). T₂D₁ significantly reduced chlorophyll retention (11.74 mg/100 g). The T₃ leaves had more carotenoids but during blanching, carotenoids were oxidised and retained less. Similar results were reported by Bishnoi *et al.* (2020) [6] and Negi and Roy (2000) [8] and in fenugreek leaves.

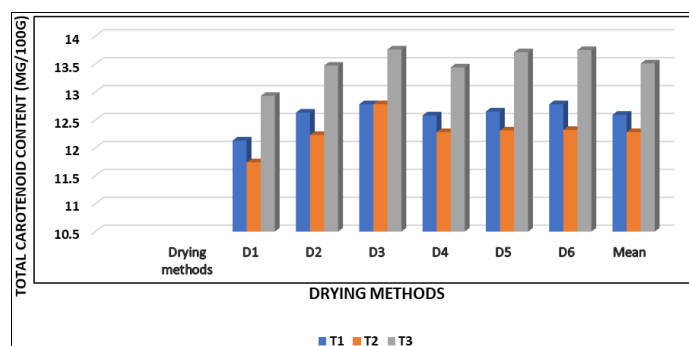


Fig 3: Influence of pre-treatments and drying methods on carotenoid content retention in dried coriander leaves

Conclusion

For physical parameters, untreated (T₁) showed maximum drying rate (5.89 g/min), minimum moisture content (1.66%), and Chemical treated (T₃) with 0.1% magnesium chloride (MgCl₂) + 0.1% sodium bicarbonate (NaHCO₃) + 2% potassium meta bisulphite (K₂S₂O₅) for 15 minutes found to have highest retained chlorophyll (25.08 mg/100 g) and carotenoids (13.11

mg/100 g). This research concludes, pre-treatments and drying methods significantly influence the physical and chemical quality parameters during drying. Use of 0.1% magnesium chloride (MgCl₂) + 0.1% sodium bicarbonate (NaHCO₃) + 2% potassium metabisulphite (K₂S₂O₅) for 15 minutes dip along with microwave oven dried leaves found to be good for many physical, chemical properties.

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