Effect of Different Drying Parameters on Green Chili Nutritional Quality

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ABSTRACT

This study was carried out to analyze the effect of different mechanical dryer with sun drying on different parameters of green chili powder. The green chili were longitudinal and lateral cut and Acetic acid (CH₃COOH) and Potassium metabisulfite (K₂S₂O₅) pretreatment were used for the experiments in different drying condition on different drying system. Cabinet drying at 55 °C, 25% relative humidity shows the best quality in terms of the nutritional and sensory parameters after every drying technique. Pretreated by Potassium metabisulfite (K₂S₂O₅) had higher overall acceptability than other treatments.

Keywords: Drying, Green Chili, Nutritional, Proximate analysis.

I. INTRODUCTION

Chili or pepper (Capsicum annuum L.) belongs to the family Solanaceae which has significant economic importance not only in the south Asian region but also all around the world. It is an indispensable spice essentially used everywhere due to its pungency, taste, appealing odor, and flavor [1], [2]. The pungency of chili is due to a crystalline acrid volatile alkaloid called capsaicin (8-methyl-N-vanillyl-6-nonenamide), present in the placenta of fruit which has diverse prophylactic and therapeutic uses in allopathic and ayurvedic medicine. It is also a good source of chili oleoresin, which is the total flavor extract of dried and ground chilies and is concentration in the homogenous free-flowing product, which has various uses in processed food and beverage industries. The natural color extracts of chili are also finding their increased value in place of artificial colors in food items, especially in developed nations. Chili is rich in vitamin C and provitamin A, a good source of vitamin B complex, particularly vitamin B₆, and high in potassium, magnesium, and iron [3]-[5]. It is eaten raw or added to various fresh and cooked dishes to provide the desired pungent or spicy taste. Improved varieties and production systems combined with appropriate post-harvest techniques to reduce waste and maximize the use of the product can increase the supply of chili for the fresh market and processing industries. Green chili powder also contains health benefiting alkaloid compound, capsaicin, which gives a strong spicy pungent character that has anti-bacterial, anti-carcinogenic, analgesic, and anti-diabetic properties [6], [7]. Thus, chili has diverse uses as a spice, condiments, culinary supplements, medicines, vegetables, and ornamental plants [8].

Drying is a very popular prevention technique for vegetables, but sun drying is not a time-efficient technique because different environmental parameters can be hampering the drying process [1]. While different mechanical drying techniques are not cost-efficient methods due to various energy utilization and it also can hamper the product...
quality [1]. Pretreatment by Acetic acid (CH$_3$COOH) and Potassium metabisulfite (K$_2$S$_2$O$_5$) can minimize the nutritional losses drying [9], [10].

From the above points of view, it is very important to investigate which drying technique is more suitable for getting a higher amount of nutrients in green chili powder. That is why an experiment was performed on green chili for making green chili powder using different drying techniques utilizing different pretreatments and cutting methods. The objective of this study was to investigate the nutritional changes among different drying techniques.

II. MATERIALS AND METHODS

The fresh green chilies were collected from the local farmer at Basheer hut, Dinajpur and studies are carried at the laboratory of the Department of Food Processing and Preservation under the Faculty of Agro-Industrial and Food Process Engineering and Department of Agri-chemistry, Faculty of Agriculture, Hajee Mohammad Danesh Science and Technology University. All green chilies are separated from the red chilies, cleaned, sorted, and washed manually.

A. Slices Technique
1) Longitudinal;
2) Lateral.

B. Pretreatments
The following treatments used for green chilies before sun and mechanical drying.
1) Acetic acid (CH$_3$COOH) – 0.5% Acetic acid solution for 1 minute.
2) Potassium metabisulfite (K$_2$S$_2$O$_5$) - 0.05% Potassium metabisulfite (KMS) solution for 1 minute.

C. Drying Procedure
1) Sun drying: The green chili was dried for 120 hours by scattering on the polyethylene drying floor. Properly dried green chili was powdered then the green chili was packed in polyethylene bags, sealed, and stored.
2) Mechanical drying
   a. Green chilies dried for 23 hours in the cabinet drier where temperature was 550 °C, air velocity was 0.5 m/s, Relative Humidity was 25%.
   b. Green chilies dried for 40 hours in the oven drier where temperature was 550°C, Relative Humidity was 30%, and air velocity was 0.3 m/s.

D. Powder Preparation
After drying the green chili which are slices at in different technique, pretreatment by Acetic acid (CH$_3$COOH) and Potassium metabisulfite (K$_2$S$_2$O$_5$) and dried at different drying system are Griend and sieved at 40 meshes.

E. Proximate Analysis of Green Chili Powder
Moisture, protein, and ash content of flours were determined by official methods [11].

F. Determination of Vitamin C (Ascorbic Acid) Content
Vitamin C (Ascorbic acid) content can be determined by the Bessey’s titrimetric method which was described by Ranganna [12].

G. Determination of Phenolic Content
Determination of the phenolic content was done by Saikia et al. [13] and Asaduzzaman et al. [14] method.

H. Determination of Calcium Content
Calcium content outlined by Masamba and Nguyen [15] method. 5 ml sample was taken in a 250 ml conical flask. About 50 ml of distilled water was added. 5 ml NaOH (10%) was added. The flask was shaken thoroughly. 10 drops of sodium tungstate solution, hydroxylamine hydrogen chloride, potassium ferrocyanide, triethanol amine was added and shaken the flask thoroughly. 6 drops of calcon indicator solution were added and shaken the flask thoroughly. The solution was titrated against Na$_2$- EDTA (0.01M) from a burette. The experiment was repeated for three times. A blank experiment was conducted by taking all agents except sample [15].

1 ml 1M Na$_2$–EDTA ≡ 1 ml 1M Ca ≡ 40.08 mg of Ca.

Percent of calcium content = \(\frac{\text{mg of calcium obtained}}{\text{wt. of sample}}\) × 100

I. Determination of Magnesium Content
Magnesium content was determined by titrimetric method which is outlined by Ramalakshmi et al. [16]. 5-10 ml sample was taken in a 250 ml conical flask. About 50 ml of distilled water was added. 5 ml NH$_4$-NH$_4$ buffer solution was added. The flask was shaken thoroughly. 10 drops of sodium tungstate solution, hydroxylamine hydrogen chloride, potassium ferrocyanide, triethanol amine was added and shaken the flask thoroughly. 4-5 drops of EBT indicator solution were added and shaken the flask thoroughly. The solution was titrated against Na$_2$- EDTA from a burette. The experiment was repeated for three times. A blank experiment was conducted by taking all agents except sample [16].

1 ml 1M Na$_2$–EDTA ≡ 1 ml 1M Mg ≡ 24.305 mg of Mg

Percent of Magnesium content = \(\frac{\text{mg of Magnesium obtained}}{\text{wt. of sample}}\) × 100

J. Sensory Evaluation
Green Chili powder were tested by a panel of ten judges. All the judges consisting of the panel were conversant with the factor governing the quality of the product. The products were evaluated organoleptically for color, flavor, taste, and overall acceptability. The test panelists were asked to rate the sample for color, flavor, taste, and overall acceptability on 1–9-point scale. Where 9=like extremely, 8=like very much, 7=like moderately, 6=like slightly, 5=neither like nor dislike, 4=dislike slightly, 3=dislike moderately, 2=dislike very much, 1=dislike extremely. The results were evaluated by analysis of Duncan’s Multiple Range Tests (DMRT) of the statistical analysis system.

K. Statistical Analysis
The results were expressed as the mean, standard error of the mean (SEM), and coefficient of variation of each species for each parameter was determined. Data were statistically

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analyzed (R statistical software 3.4.1) by one-way analysis of variance (ANOVA). Mean comparisons were performed using Duncan’s multiple range tests for significant effect at P < 0.05.

III. RESULT AND DISCUSSION

A. Proximate Analysis of Green Chili Powder

Table I shows that sample 08 contain lowest moisture content compared to others and highest in sample 04. The variation of moisture content among different drying techniques is not significant. The second lowest moisture content in sample 1. According to Jyothirmayi et al. [17] the moisture content of green chili powder is 7.20±0.31% which is slightly differ from our studies [17].

Table I shows that sample 03 & 04 contain higher ash content compared to others and lowest in sample 08. Our result shows little variation compared with Jyothirmayi et al. [17] in which the ash content of green chili powder is 5.44±0.26%.

According to Table I Sample 08 contain higher protein content compared to others and sample 04 contain lowest amount. In literature (The National Institute of Nutrition, Hyderabad, 2009) the protein content of dried green chili powder is 15.00 g/100 g and fresh green chili is 2.900 g/100 g. Experiment shows that the protein content of dried green chili powder is higher than the fresh green chili.

B. Total Phenolic Content

Table II shows that sample 06&12 contain higher phenolic content compared to others and lowest in sample 04. According to Ribarova [18] the phenolic content of green chili powder is 246.5 mg/100 g.

C. Vitamin C Content

Table II shows that sample 07 contain highest vitamin C than other samples and samples 01 contain lowest vitamin C. From literature (The National Institute of Nutrition, Hyderabad, 2009) the vitamin-C content of dried green chili powder is 50.00 mg/100gm and fresh green chili is 111.00 mg/100 g. The decrease of vitamin-C occurs due to the drying but 50% of the vitamin-C retained.

<table>
<thead>
<tr>
<th>Sample name</th>
<th>Sample number</th>
<th>Moisture content (%)</th>
<th>Ash content (%)</th>
<th>Protein content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun drying</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Longitudinal</td>
<td>01</td>
<td>8.30 ± 0.1*</td>
<td>5.366 ± 0.1*</td>
</tr>
<tr>
<td>Pretreatment by Potassium metabisulfite (K₂S₂O₅)</td>
<td>Longitudinal</td>
<td>03</td>
<td>8.65 ± 0.31*</td>
<td>5.793±0.05*</td>
</tr>
<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Lateral</td>
<td>02</td>
<td>8.45 ± 0.21*</td>
<td>5.366 ± 0.3*</td>
</tr>
<tr>
<td>Mechanical drying</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Longitudinal</td>
<td>05</td>
<td>7.15 ± 0.10*</td>
<td>4.960± 0.1*</td>
</tr>
<tr>
<td>Pretreatment by Potassium metabisulfite (K₂S₂O₅)</td>
<td>Lateral</td>
<td>06</td>
<td>7.35 ± 0.31*</td>
<td>4.960±0.07*</td>
</tr>
<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Longitudinal</td>
<td>07</td>
<td>7.15 ± 0.71*</td>
<td>4.873±0.01*</td>
</tr>
<tr>
<td>Mechanical drying</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Longitudinal</td>
<td>09</td>
<td>8.05 ± 0.21*</td>
<td>5.143± 0.06*</td>
</tr>
<tr>
<td>Pretreatment by Potassium metabisulfite (K₂S₂O₅)</td>
<td>Lateral</td>
<td>10</td>
<td>8.0±0.51*</td>
<td>5.144±0.01*</td>
</tr>
<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Longitudinal</td>
<td>11</td>
<td>8.0±0.71*</td>
<td>5.147± 0.1*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample name</th>
<th>Sample number</th>
<th>Total Phenolic Content (mg/100 gm)</th>
<th>Vitamin C Content (mg/100 gm)</th>
<th>Calcium content (mg/100 gm)</th>
<th>Magnesium content (mg/100 gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun drying</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Longitudinal</td>
<td>01</td>
<td>216 ± 0.15*</td>
<td>39.4±0.15*</td>
<td>170 ± 1.9*</td>
</tr>
<tr>
<td>Pretreatment by Potassium metabisulfite (K₂S₂O₅)</td>
<td>Longitudinal</td>
<td>03</td>
<td>208 ± 0.21*</td>
<td>40.64± 0.9*</td>
<td>180 ± 2.6*</td>
</tr>
<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Lateral</td>
<td>02</td>
<td>218 ± 0.11*</td>
<td>40.29±0.4*</td>
<td>170.3± 1.5*</td>
</tr>
<tr>
<td>Pretreatment by Potassium metabisulfite (K₂S₂O₅)</td>
<td>Lateral</td>
<td>04</td>
<td>206±0.81*</td>
<td>40.64±0.5*</td>
<td>180.5±3.7*</td>
</tr>
<tr>
<td>Mechanical drying</td>
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<td></td>
</tr>
<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Longitudinal</td>
<td>05</td>
<td>216 ± 0.19*</td>
<td>49.19± 0.8*</td>
<td>260.5 ± 1.9*</td>
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<tr>
<td>Pretreatment by Potassium metabisulfite (K₂S₂O₅)</td>
<td>Longitudinal</td>
<td>07</td>
<td>218 ± 0.11*</td>
<td>53.0±0.1*</td>
<td>300.5 ± 1.9*</td>
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<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Lateral</td>
<td>06</td>
<td>224 ± 0.51*</td>
<td>48.0±0.53*</td>
<td>263.4± 2.7*</td>
</tr>
<tr>
<td>Pretreatment by Potassium metabisulfite (K₂S₂O₅)</td>
<td>Lateral</td>
<td>08</td>
<td>220 ± 0.16*</td>
<td>50.58 ± 0.3*</td>
<td>300.6 ± 1.5*</td>
</tr>
<tr>
<td>Oven dryer</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Longitudinal</td>
<td>09</td>
<td>210 ± 0.71*</td>
<td>49.58± 0.11</td>
<td>201.9± 1.2*</td>
</tr>
<tr>
<td>Pretreatment by Potassium metabisulfite (K₂S₂O₅)</td>
<td>Longitudinal</td>
<td>11</td>
<td>216 ± 0.18*</td>
<td>49.19 ± 0.8*</td>
<td>200.3 ± 5*</td>
</tr>
<tr>
<td>Pretreatment by Acetic acid (CH₃COOH)</td>
<td>Lateral</td>
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<td>212 ± 0.14*</td>
<td>49.0±0.9*</td>
<td>230.5 ± 1*</td>
</tr>
<tr>
<td>Oven dryer</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pretreatment by Potassium metabisulfite (K₂S₂O₅)</td>
<td>Longitudinal</td>
<td>12</td>
<td>224 ± 0.11*</td>
<td>48.0±0.4*</td>
<td>234.6 ± 1.7*</td>
</tr>
</tbody>
</table>
D. Mineral Content

Table II shows that the Calcium content was higher in sample 07 and lower in sample 01 and the Magnesium content was higher in sample 03 & 04 and lower in sample 01. The mineral contents of the green chili powder under this study seemed to be much higher than the results found in the red chili powder as reported by Saimbhi et al. [19], Khadi et al. [20] and Essen [21]. These variations may be due to multiple factors, such as the differences in soil conditions where it is grown, variety of chili, maturity of chili, growing season, climatic condition, processing treatments and preservation method.

E. Sensory Evaluation of Green Chili Powder

The color, taste, flavour and overall acceptability of the green chili powder prepared from drying and grinding of fresh green chili were evaluated by a panel of ten taste testing judges. The judges gave the score for preference of colour, flavour, taste, and overall acceptability. The score was tabulated and analyzed for any variance among the formulation. From DMRT it was observed that the sample A gave the highest score in respect of colour, flavour, taste and overall acceptability followed by the green chili powder from sliced with KMS treatment. The analysis of variance Fig. 1 showed that green chili powder produced by cabinet drying had significantly (P<0.05) better color, flavour and pungency retention.

![Fig. 1. Sensory evaluation among different drying techniques: (A) Cabinet (B) Sun and (C) Oven drying.](image)

IV. CONCLUSION

Variations in nutritional quality in terms of proximate analysis, physiochemical analysis (Total Phenol content and Vitamin C content) and mineral contents of green chili powder due to different processing treatments with different drying method were observed in this study. Green chili processed in powder form by cabinet drying given the best results considering nutritional value such as protein 13.97%, ash 4.960%, vitamin C 53.08 mg/100 g, phenolic content 224 mg/g 100 g, calcium 300.6 mg/100 g. Not only has the drying temperature affected the nutrient content but also the drying time. The drying temperature and time used for the preparation of sample in cabinet, oven, and sun. It was found that the best performance was observed when the sample treated with 0.05% KMS solution in cabinet drier. The slicing difference between longitudinal and lateral very low, so we can also include that slicing has no effect for drying the green chili. The dried green Chili powder contains higher amount of protein compared to green chili. It can be used as a good source of protein and vitamin C. This powder can be used with many food adjuncts in place of fresh green chillies and red chili powder. A statistical analysis on scores given by the panelists on the sensory properties of various samples from different drying methods such as cabinet, oven and sun drying showed that color, flavor, pungency, and overall acceptability were significantly (P<0.05) better in cabinet drying product compared to other drying methods. Further research is recommended for standardizing the efficient and sustainable technique for processing and preserving green chili powder using other mechanical drying methods such as vacuum drying, freeze drying, fluidized bed drying and so on, both in domestic and industrial scales.

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

REFERENCES


