



Prediction of Optimal Harvesting Time of Green Chilli for Production of Green Chilli Powder

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Abstract

Optimum maturity stage of green chilli was identified for production of chilli powder. Chillies of 16 to 22 days aged were selected for making green chilli powder. Destalked and washed chillies of different maturity stages were cut into longitudinally, pretreated with 0.05% KMS for 5 min and followed by drying at 55°C in cabinet dryer for 20-22 hr for production of chilli powder. Powder of mature chilli was found to be better in terms of nutritional compositions except vitamin C than in powder of early aged chilli. Vitamin C content was found to be decreased with the age of green chilli, whereas total phenol content was found to be vice versa. Sensory evaluation showed that powder of 20 days chilli was most acceptable to the panelists in terms of color, flavor, pungency and overall acceptability among samples. Based on sensory and nutritional qualities, it can be suggested that chilli of 20 days is optimum matured chilli for production of green chilli powder, which can be used as a substitute of fresh green chilli, red chilli and red ground.

Keywords: Green chilli powder, green chilli, chilli, harvest maturity, total phenol, vitamin C.

Introduction

Chilli (*Capsicum annuum* L.) is one kind of vegetable belonging to the family of Solanaceae. Chillies are cultivated in large parts of Africa, U.S.A., Southern Europe and all Asian countries¹. It is widely used as spice in South-East Asia and well known for its acidic color and flavor.

Green chilli is a rich source of vitamin B-complex, mainly thiamine, niacin, pyridoxine and riboflavin. It is also a good source of minerals and natural antioxidants like ascorbic acid, tocopherol and phenolic compounds². Chillies contain health benefiting alkaloid (capsaicin), which provides strong spicy pungent flavor to the dishes. Capsaicin is also found to act as anti-bacterial, analgesic, anti-carcinogenic and anti-diabetic compound³⁻⁵. It also reduces the bad cholesterol (LDL) level in the blood of obese individuals⁶. Very young and green chillies contain low amount of capsaicin (0.15-2.0%) but capsaicin level reaches the maximum (3%) before ripening and reduces largely at ripening stage.

In Bangladesh, chillies are used in three forms namely, as fresh green chilli, red chilli and red grind. According to BBS⁷, total production of green chilli was 1.69 t/ha during the economic years of 2010-2011. At ripening stage, the green color of chilli turns to red because of carotenoids. The demand of green chilli is always higher than red chilli, although red grind is mostly used form in Bangladesh because of its availability all around the year.

A lot of green chillies are found to be wasted in the farm level

during harvesting season due to lack of proper processing and preservation technique⁸. But in the off season, the price of green chilli raises up to 10-20 times higher than the price of peak season. Dehydration and green chilli pickling are found as chilli processing and preservation techniques. Another big problem in chilli processing is that green color turns to fade because of auto-oxidation of carotenoids due to effects of heat, light and oxygen⁹.

Several researches have been carried out on the preparation of green chilli powder but there is no sufficient information on maturity index of green chilli for producing green chilli powder. If it is possible to find out optimum harvesting period of green chilli for producing chilli powder, the availability of green chilli can be insured throughout the year in powder form. Thus, it is possible to minimize the postharvest loss of green chilli. On the basis of above information so far accumulated, this study was undertaken with the following objectives: to find out optimum maturity indices of green chilli for production of chilli powder, to analyze physico-chemical compositions of green chilli powder.

Material and Methods

Sample collection: A local variety of chilli was grown in the research field of Hajee Mohammad Danesh Science and Technology University. Fresh green chillies were harvested at different maturity stages. Chillies were harvested at 16, 17, 18, 19, 20, 21 and 22 days after fruit setting.

Preparation of green chilli powder: At first, undersized, black

and spoiled chillies were sorted out and pedicles were removed manually. To prepare good quality green chilli powder, chillies were then washed carefully with tap water to remove soil, dirt and spoiled leaf adhered with. Chillies were cut into longitudinally and pretreated in 0.05% KMS solution for 5 min. Then pretreated chillies were transferred to cabinet dryer for drying at 55°C up to constant weight. After complete drying (approximately 20-22 hr), dried chillies were ground with a blender to produce green chilli powder. Chilli powder was then packed in high density polyethylene and stored at ambient condition up to further analysis.

Physico-chemical analysis: Moisture, ash, protein, calcium and magnesium were determined by standard methods of AOAC¹⁰. The moisture content was determined by simple oven drying method at 105°C for 24 hr. Ash content was measured by dry ashing method at 550°C for 6 hrs. Protein content was determined by Macro Kjeldhal method. Calcium and magnesium were measured by simple titrimetric method using EDTA solution. Ascorbic acid was measured by titrimetric method developed by Rangana¹¹ with little modification. Total phenol in chilli powder was measured by Folin-Ciocalteu's reagent assay and expressed as gallic acid equivalents (lg GAE/g)¹².

Sensory evaluation: Sensory attributes of green chilli powder namely color, flavor, taste and overall acceptability were evaluated by a panel of 30 experienced panelists who gave scores for their preferences on sensory attributes. The scores were recorded over a hedonic scale with maximum score of 9 for "like extremely" and minimum of 1 for "dislike extremely". The hedonic rating test in a scale of 1-9 marking was given as follows: like extremely (9), like very much (8), like moderately (7), like slightly (6), neither like nor dislike (5), dislike slightly (4), dislike moderately (3), dislike very much (2), and dislike extremely (1).

Statistical analysis: For Statistical analysis, the results were evaluated by analysis of variance (ANOVA) using SPSS (version 20). All the analyses were carried out in triplicates, and results were expressed as mean values. Meanwhile, Duncan's multiple range test was employed to determine the significant difference among mean values at 5% significance level.

Results and Discussion

Physico-chemical analysis of green chilli powder: Physico-chemical compositions of green chilli powder with respect to moisture, ash, protein, fat, vitamin C and total phenol content are presented in table-1. The moisture content of green chilli powders ranged from 7.33 to 7.98% being lowest for sample S₁ and highest for sample S₇ (table-1). This result revealed that chilli powder of matured chilli retained higher moisture than powder of younger chilli during drying process. These results

were quite less than those reported earlier^{13,14}. Sarker et al.¹⁴ reported a range of higher moisture content (8.47-9.45%) in green chilli powders.

Ash content was found to be increased in chilli powder up to certain aged chilli, but significant (p<0.05) difference in ash content was not found among S₄, S₅, S₆ and S₇ sample (table-1). Ash content ranged from 9.09 to 9.42% being lowest in S₁ sample and highest in S₆ sample. Similar ash content (9.43%) in the powder of *Capsicum annum* was also reported¹⁵. These results were higher than the results carried out in previous studies^{13,16}. Conversely, higher ash content (13.92%) in green chilli powder was reported earlier¹⁴.

Data of table-1 revealed that there was significant (p<0.05) effect of maturity on protein content in chilli powder (table-1). Highest protein content (8.18%) and lowest protein content (5.46%) were found in sample S₇ and S₁ respectively. These findings were more or less similar to results carried out in previous studies^{13,14}. In contrast, Khatun et al.¹⁶ observed higher protein content (15.0-15.9%) in green chilli powder. Variation in proximate compositions namely, moisture, ash and protein content may be resulted due to differences in maturity stage, variety, pretreatment and drying conditions.

The effect of maturity of chilli on the mineral content in terms of calcium and magnesium in chilli powder is shown in table-1. Calcium and magnesium were increased in chilli powder significantly (p<0.05) with the increase of maturity of green chilli. But significant (p<0.05) difference in mineral content was not observed in last two samples. Highest calcium (62.65mg/100g) and magnesium (62.20mg/100g) were found in S₇, whereas sample S₁ was found to be contained lowest calcium (52.25mg/100g) and magnesium (54.00mg/100g). Similarly, calcium content (54.6mg/100g) in green chilli powder was observed¹³. Magnesium content in present study was seemed to be very much higher than the result (8.8mg/100g) carried out in an earlier study¹³. Possible reasons of variation in mineral content of green chilli powder are different soil condition, fertilizer management, climatic condition and maturity stage of green chilli.

Vitamin C content was found to be decreased significantly (p<0.05) in chilli powder with the increase of maturity of green chilli. Data revealed that lowest vitamin C (39.52mg/100g) was found in sample S₇, whereas S₁ was found to be contained highest vitamin C (43.85mg/100g) (table-1). These results were higher than those reported in a study⁹ where highest vitamin C (29.33mg/100g) was observed in chilli powder of Tegas variety. In contrast, highest vitamin C (67.6mg/100g) in mature green chilli powder was reported in a research¹⁶. However, possible reasons of variation in vitamin C content are differences in maturity of chilli, variety and methodology.

Table-1
Physico-chemical compositions of green chilli powder

Sample	Moisture content (%)	Ash (%)	Protein (%)	Calcium (mg/100gm)	Magnesium (mg/100gm)	Vitamin C (mg/100gm)	Total phenol (mg/100gm)
S ₁	7.33 ^{bc}	9.09 ^{ab}	5.46 ^c	52.25 ^d	54.00 ^c	43.85 ^a	204.00 ^f
S ₂	7.41 ^b	9.14 ^{ab}	6.93 ^b	53.67 ^c	54.00 ^c	43.25 ^a	208.00 ^e
S ₃	7.45 ^b	9.23 ^{ab}	7.93 ^{ab}	53.87 ^c	57.15 ^b	43.00 ^{ab}	216.00 ^d
S ₄	7.66 ^{ab}	9.48 ^a	7.87 ^{ab}	59.00 ^b	57.08 ^b	41.65 ^b	218.00 ^c
S ₅	7.89 ^a	9.52 ^a	8.05 ^a	62.40 ^a	62.25 ^a	41.09 ^{bc}	218.00 ^c
S ₆	7.86 ^a	9.58 ^a	8.07 ^a	62.60 ^a	62.25 ^a	41.15 ^{bc}	220.00 ^b
S ₇	7.98 ^a	9.42 ^a	8.18 ^a	62.65 ^a	62.20 ^a	39.52 ^c	245.00 ^a

Results are presented as mean; values with different superscript along with same column are significantly different at a level of $p < 0.05$. Sample = Green chilli powder at different maturity stages (Days after fruit setting - DAFS); S₁= 16 DAFS; S₂= 17 DAFS; S₃= 18 DAFS; S₄= 19 DAFS; S₅= 20 DAFS; S₆= 21 DAFS; S₇= 22 DAFS.

Data revealed interesting information that chilli powder of matured chilli contains highest amount of total phenol (245mg/100g) compare to early aged green chilli powder (table-1). It is interesting to note that no published research work has been found regarding total phenol content in green chilli powders of different maturity stages.

Sensory evaluation of green chilli powder: The results of sensory evaluation are presented in table-2. Significant ($p < 0.05$) effect of maturity stage on sensory attributes of green chilli powder was found in this study. From the DMRT result, it was observed that sample S₅ was scored with highest values for color, flavor, pungent and overall acceptability, whereas sample S₆ and S₇ were found to be moderately acceptable to the panelists. However, green chilli powder of early aged chilli was observed to be less acceptable to the panelists. Based on above results for sensory attributes, it can be summarized that neither early aged nor full matured chilli is suitable for making good quality green chilli powder.

Conclusion

Processing of green chilli powder is a potential technique to minimize postharvest loss of chilli at farm level. Due to different maturity stage and processing technique, variation in nutritional compositions of green chilli powder due was observed in this study. But it was clear that matured chilli was nutritionally and organoleptically superior compared to early aged chilli. However, green chillies of 20 days were proved to be excellent raw materials for making chilli powder in terms of color, flavor, pungency and overall acceptability than chillies of other maturity stages. This product can be used easily in many food products instead of using fresh green chilli, red chilli or red grind. In order to minimize the postharvest loss and recover the crisis of green chilli during off season, chilli of 20 days can be recommended as optimum maturity stage for production of green chilli powder.

Table-2
Sensory evaluation of green chilli powder

Sensory attributes	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇
Color	7.20 ^c	7.70 ^{bc}	8.30 ^{ab}	8.30 ^{ab}	8.50 ^a	8.10 ^{ab}	7.30 ^c
Flavour	3.60 ^d	4.10 ^d	6.20 ^c	8.30 ^a	8.30 ^a	8.10 ^a	7.30 ^b
Pungent	2.80 ^d	4.00 ^c	6.00 ^b	7.90 ^a	8.30 ^a	8.30 ^a	8.30 ^a
Overall acceptability	4.40 ^c	6.00 ^b	6.20 ^b	7.90 ^a	8.30 ^a	8.40 ^a	8.00 ^a

Results are presented as mean; values with different superscript along with same column are significantly different at a level of $p < 0.05$. Sample = Green chilli powder at different maturity stages (Days after fruit setting - DAFS); S₁= 16 DAFS; S₂= 17 DAFS; S₃= 18 DAFS; S₄= 19 DAFS; S₅= 20 DAFS; S₆= 21 DAFS; S₇= 22 DAFS

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