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DEVELOPMENT OF PRODUCTION TECHNOLOGY TO MANUFACTURE OF GREEN CHILI POWDER

Abhilasa Singh
Research Scholar (Food Technology), Centre of Food Science Technology, Banaras Hindu University, Varanasi-221005 (India)

Anil Kumar Chauhan
Professor (Food Technology), Centre of Food Science Technology, Banaras Hindu University, Varanasi-221005 (India)

Ravi Pratap Singh
Professor and Director, Institute of Agricultural Science, Banaras Hindu University, Varanasi-221005 (India)

Poonam Yadav
Research Scholar (Food Technology), Centre of Food Science Technology, Banaras Hindu University, Varanasi-221005 (India)

Mohammed Ahmed Qasem ALsebaeai
Research Scholar (Food Technology), Centre of Food Science Technology, Banaras Hindu University, Varanasi-221005 (India)

ABSTRACT

The objectives of present investigation are to prepare green chilli powder from the fresh green chilli from Kashi Anmol and Pusa Sadabahar varieties and to study the effects of various drying methods such as sun drying, tray drying, vacuum drying and lyophilizer drying and packaging material (low density polyethylene) on the composition and keeping quality of green chilli powder. After drying, the green chillies were ground to powder and packed in polyethylene bags separately and stored at room temperature (25-30˚C) for further study. The effects of drying method on the physio-chemical properties and keeping quality of the green chilli powders of both varieties (Kashi anmol and Pusa sadabahar) were observed at 15 days interval up to 60 days storage period at room temperature (25-30˚C).A gradual decrease in pH value was recorded during storage. It can be recorded that there was a gradual loss of solubility, flowability, whereas, bulk density and sinkability increased during storage at 37ºC. The losses in flowability, wettability and solubility were faster in samples packed in low density polyethelene. A progressive increase in solubility index of green chilli powders may be attributed to the formation of water insoluble compounds. The microbial counts largely depend upon the quality of raw materials used in the product preparation and the methods of processing. The type of package and temperature of storage showed significant influence on the growth and survival of microorganisms in green chilli powder. While yeast and mould counts decreased rapidly during storage, spores exhibited a great resistance. The Yeast and Mould Count (YMC) also showed a declining trend during the entire storage period, becoming almost negligible at the end of storage study. A statistical analysis in response to taste panel on the sensory properties of green chilli powder packed in polyethylene packet separately and stored at room temperature revealed that the color, flavor, pungency and overall acceptability of different samples were significantly ($P < 0.01$) affected. The analysis revealed that the green chilli powders obtained by lyophilizer drying method was most acceptable in respect of color, flavor, pungency and texture followed by other drying methods such as sun, tray and vacuum and also revealed that Kashi anmol variety of chilli gave most acceptable response in respect to color, flavor, pungency and texture followed by Pusa sadabahar.

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INTRODUCTION

Chilli (Capsicum spp.) is an important commercial spice and vegetable crop for small and marginal farmers in Asia, Africa and South America. Among the 5 cultivated species of the genus Capsicum, C. annuum is the most widely cultivated in India for its pungent (chilli syn. hot pepper) and non-pungent (sweet pepper syn. capsicum, bell pepper) fruits.

Chilli market types prevalent in India can broadly be grouped into the following 4 categories: (i) fresh market (green, red, multi-color whole fruits), (ii) fresh processing (sauce, paste, canning, pickling), (iii) dried spice (whole fruits and powder), and (iv) industrial extracts (paprika oleoresin, capsaicinoids and carotenoids). Besides conventional nutritional food uses, a number of versatile food (paprika oleoresin) and non-food (defense, spiritual, ethnobotanical) uses of chillies are known (Kumar et al., 2006; Meghavansi et al., 2010).

Green chilli has the higher demand than the red chilli. In season the price of green chilli is reasonable having Rs. 25-35 per kg but in off season, the market rises up to Rs. 50-60 per Kg. The preservation of green chilli is very difficult due to its perishability; it is subject to quick deterioration during storage, transportation, and marketing. Huge amount of green chilli found to be wasted in the field for the lack of proper processing and preservation technology (Shanmugavelu, 1989).

Literature on usages of green chilli and its products is limited. The delicate aroma of fresh green chilli cannot be compared with that of dried chilli. Thus there is potential to explore the technology for processing of the chilli which can retain delicate fresh flavour. On the basis of the information so far accumulated, the present study has been undertaken with the following major objectives: Study the proximate compositions of green chilli of both Kashi anmol and Pusasadabahar; Development of technology for production of green chilli powder; Study the shelf life of the green chilli powder and Work out the cost of production of final product. The present research covering the methodology, result and discussion and conclusion.

MATERIALS AND METHODS

The sample of green chilli was collected from local market of Varanasi. The experiments were conducted at Centre of Food Science and Technology, Institute of Agricultural Sciences; department of Pharmacy, Indian Institute of technology; department of Ayurveda, Indian Institute of Medical Sciences; department of Botany, Faculty of Sciences; Banaras Hindu University, Varanasi (UP), India.

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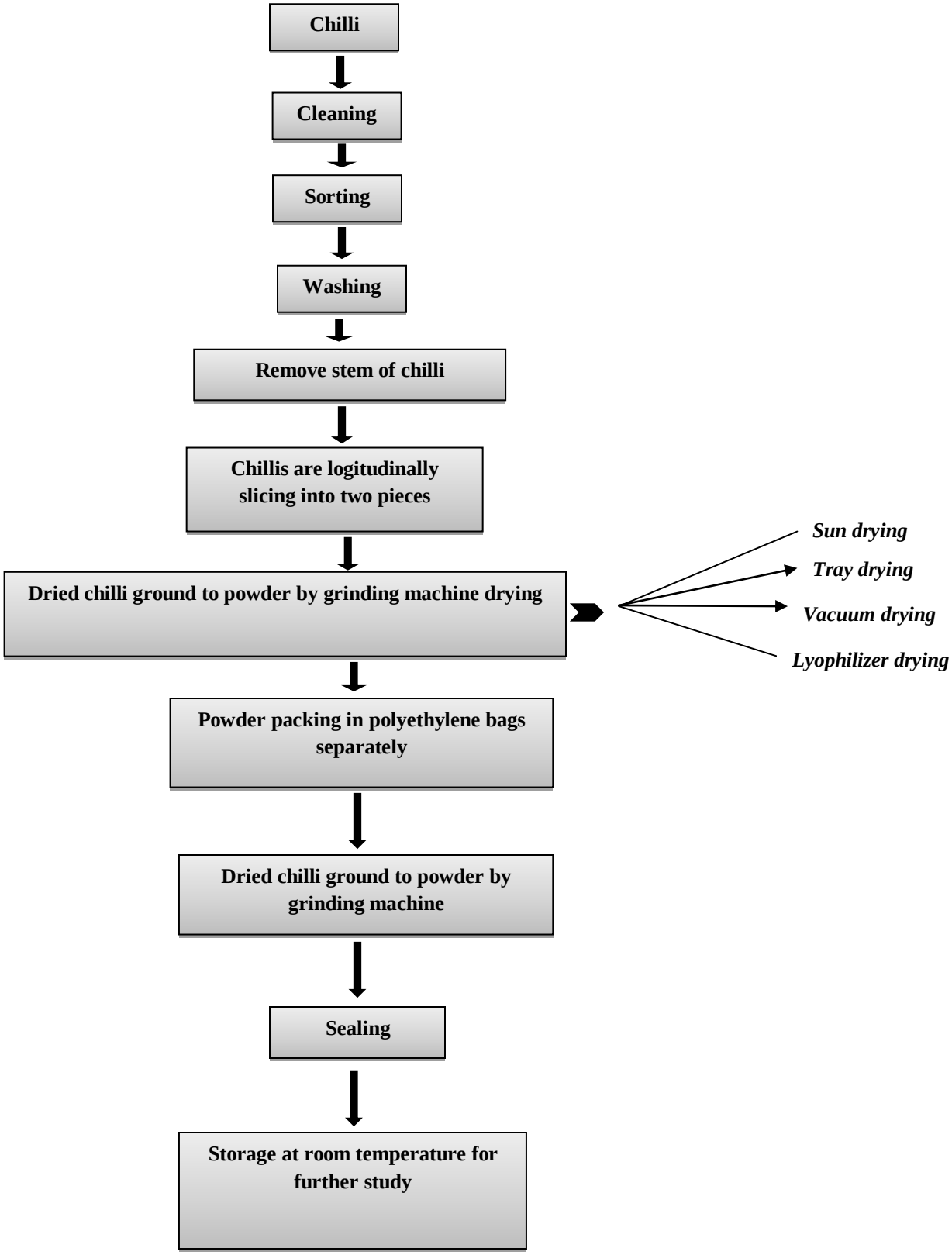
Flow diagram for development of green chilli powder



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Proximate analysis

In proximate analysis moisture, crude fat, crude proteins, ether extract, nitrogen free extract, ash content were analyzed by the method of AOAC (1990).

Chemical Analysis:

Ascorbic Acid, Sugars (total, reducing and non–reducing sugar) estimated were estimated by Lane and Eynon's method reported by (Ranganna, 2001).

Physical Analysis:

Determination of Ph

Exactly 50ml of slurry of green fresh chilli was taken in a beaker and tempered at 30˚C in a water bath. The pH was measured by direct immersion of electrode into the sample. A digital pH meter (LAB India Instruments Pvt. Ltd., Mumbai) was used. pH meter was calibrated before use with a standard buffer solution at 30˚C each day before use. The sinkability of green chilli powder was measured by Spectrophotometric method as described by (Sammhammer, 1966). Sediment of reconstituted green chilli powder enriched beverage was measured by filling in 100 ml cylinder. The level was brought up to 100 ml mark and kept in refrigerator for overnight. The sediment at the bottom will be measured in ml. Bulk density was determined according to (Sahin-Nadeem et al., 2013) method. The flowability of the powders was evaluated in terms of the Carr index (CI) and Hausner ratio (HR), (Jinapong et al., 2008).

The color of green chilli powder were analysed by using spectrophotometer (Hunter lab) (manufactured by M/s Hunter associate laboratory Inc-USA). ISI, 1981 method was followed for the determination of solubility index of green chilli powder.

Microbiological Analysis:

The samples of green chilli powder pouches were opened in a covered chamber sterilized by U.V. radiation. An aseptic environment was created during sampling. Dilution was prepared by using 99ml dilution blank prepared with 0.9 per cent sodium chloride solution. After that determined total yeast and mould count. Potato dextrose agar medium was used to determine the yeast and mould counts in green chilli powder as per the ISI method mentioned in (SP, 1981).

For spore count the first dilution of green chilli powder samples were heated in water bath at 80˚C for 10 min. Spore counts in green chilli powder were enumerated as per the method described in BS: 4285 (1968) using tryptone glucose yeast agar with following composition.

Sensory Analysis:

Sensory evaluation of green chilli powders for color; flavor, pungency and overall acceptability were carried out by a panel with 15 members. (Ranganna, 2001).

Statistical Analysis:

For Statistical Analysis, the results were evaluated by analysis of variance (ANOVA) procedures of the statistical analysis system (SAS, 1985).

The green chilli powder was developed by lyophilizer deep freezing technology for maintaining all type of the entire ingredient in the green chilli powder. The developed product was prepared without using surfactant. The functional property was determined the study for accessing the properties like particle size, hygroscopic condition, solubility index and solubility coefficient etc.

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RESULT & DISCUSSION

Composition of fresh green chilli

The varieties of fresh green chilli (Kashi anmol and Pusasadabahar) were analyzed for moisture, protein, fat, ash and vitamin C and these results are presented in Table 1.The results reported by (Srivestava et al., 1994) were similar to the proximate chemical composition of fresh green chilli per 100 gm as 85.7 % moisture content, 5.4 % protein, 0.6 % fat, 1.0 % mineral and 110 mg per 100g of vitamin C. The small variation were due to varietal difference, soil property, and growing condition, harvesting period, maturity stage, agro-ecological condition and methods of analysis.

Table1: Proximate analysis of fresh green chilli

Nutrients		Fresh green chilli (wet basis)	
		Kashi anmol	Pusasadabahar
Moisture (%)		87.5	86.3
Protein (%)		2.3	1.4
Fat (%)		1.5	0.9
Ash (%)		1.5	1.2
Vitamin C (mg per 100g)		104	98
Fiber (%)		3.1	2.4
Ether (%)		2.5	2.0
NFE*		1.6	5.8
Total sugar		1.1	0.9
Reducing sugar		0.3	0.4
Non reducing sugar		0.8	0.5
Color	L	61.38	62.74
	A	-6.62	-7.18
	B	8.07	8.57

NFE* - Nitrogen Free Extract

Yield of green chilli powder from fresh green chilli

The yield of green chilli powders of varieties of Kashi anmol and Pusasadabahar were 25 and 23gm per 100 gm of fresh green chilli respectively. The result is in agreement with the reports of (Purseglove, 1968) who reported 25-30gm of dried chillies was produced from 100 gm of fresh green chilli. (Savita, 2005) also reported significantly higher yield 0.498 kg per 2 kg of fresh chillies dried in electric dryer.

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Table 2: Proximate analysis of green chilli powder

Components	Drying Methods							
	Sun Drying		Tray Drying		Vacuum Drying		Lyophilizer Drying	
	Kashi anmol	Pusasadabahar	Kashi anmol	Pusasadabahar	Kashi anmol	Pusasadabahar	Kashi anmol	Pusasadabahar
Moisture %	8.3	8.6	7.9	8.3	9.1	9.4	9.4	9.9
Crude fiber %	23.6	23.2	21.4	20.7	24.3	23.7	26.6	26.2
Crude protein %	14.3	13.6	15.1	14.7	15.9	15.4	16.4	16.1
Crude fat %	4.0	3.7	4.1	3.7	4.3	4.1	4.2	3.9
Ether %	1.3	0.8	1.1	0.7	2.4	2.2	2.5	2.1
Ash %	4.2	4.0	4.6	4.2	4.3	3.9	4.8	4.4
NFE* %	44.3	46.1	45.8	47.7	39.7	41.3	36.1	37.4

NFE* – Nitrogen Free Extract

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Proximate analysis of green chilli powders

The chemical compositions (proximate analysis) of green chilli powders of Kashi anmol and Pusasadabahar for moisture, protein, fat, ether, fiber and ash content were analyzed. The results are presented in Table 2. Moisture content of green chilli powder The results are in agreement with the reports of (Krishnamurthy and Natarajan, 1973) who reported that the moisture content of green chilli powder were in the range of 8-10 % per 100 gm. (Mahadevaih et al., 1976) reported that moisture content higher than 15 percent in chilli powder was critical with respect to mould growth. Similar observations were also made by (Naik et al., 2001). The variations in moisture contents between samples were due to difference in treatments, preparation and drying methods employed. Ash content of green chilli powder were more or less similar to those reported by (Raina and Teotia, 1985) who noticed ash content ranging from 4.53 to 7.39 % in green chilli powder. Similarly, (Lauhadia and Kulkarni, 1978) who noticed that ash content 5.60 % in green chilli per 100 gm. The variations in ash contents between samples were due to difference in treatments, preparation and methods employed. Then it was comment that the stem of the green chilli contain the additional ash of the green chilli powder.

Protein content of green chilli powder the results were more or less similar to those reported by (Srivestava et al., 1994) who noticed that was protein 15.4% in dry chilli per 100 gm. The variations in protein contents between samples were due to difference in treatments, preparation and drying methods employed. Fat content of green chilli powder The results were more or less similar to those reported by (Srivestava et al., 1994) who showed that is fat (6.2%) in dry chilli per 100 gm. The variations in fat contents between samples were due to difference in treatments, preparation and drying methods employed.

Chemical analysis of green chilli powders

The chemical compositions (chemical analysis) of green chilli powders of varieties of Kashi anmol and Puassadabahar for pH, ascorbic acid, total sugar, reducing sugar and non-reducing sugar, content were analyzed. The results are presented in Table 3. The results were more or less similar to those reported by (Leung et al., 1972) who noticed that is vitamin C 184 mg/100 gm in dry chilli per 100 gm. Ahmed et al., 1986, analyzed the ascorbic acid content in 12 different chilli genotypes and reported that it increased from green stage (98-1616 mg/100 gm) to ripe stage (905-2254 mg/100 gm) and further at sun drying stage (240-4550 mg/100 gm). The ascorbic acid content of chilli powder increased significantly with maturity stage. The quite high variation of vitamin C between sun drying and lyophilizer drying method was occurred due to difference in treatments, preparation and drying methods employed, but 60% of the vitamin C retained in lyophilizer dried green chilli powder. It is difficult to ascertain whether the slight increase in moisture percentage in the samples was due to ingress of moisture or the chemical changes occurring during storage. However, a gradual increase in moisture content in dried whole milk during storage reported by (Ardito et al., 1980; Mrithyunjaya and Bhanumurthi, 1987).

Titratable acidity (Vitamin C) showed a minor increase during the storage irrespective of packaging used, suggesting the interplay of various constituents and resulting chemical changes. A gradual decrease in pH value was noted during storage. Increasing moisture levels caused a slight reduction in total protein content in the sample during storage. There was no change in protein content during storage on dry matter basis. These results are consistent with those reported by (Furukava and Yamamanaka, 1972) in kulfi mix powder titration acidity increased over a period of eight months storage at 37˚C when packed in the different kinds of packaging materials.

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Table 3: Chemical analysis of green chilli powder

Components	Drying Methods							
	Sun Drying		Tray Drying		Vacuum Drying		Lyophilizer Drying	
	Kashi anmol	Pushasadabahar	Kashi anmol	Pusasadabahar	Kashi anmol	Pusasadabahar	Kashi anmol	Pusasadabahar
pH	4.5	4.2	4.8	4.3	5.0	4.4	4.5	4.0
Ascorbic acid (mg/100g)	88.1	85.7	90.6	88.3	95.2	90.3	124.3	118.2
Total sugar	5.05	4.32	3.85	2.21	5.43	4.78	5.98	5.31
Reducing sugar	5.02	4.28	3.45	2.19	5.34	4.65	5.41	5.10
Non reducing sugar	0.03	0.4	0.40	0.2	0.9	0.13	0.57	0.21

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Table 4: Physical analysis of green chilli powder

Components		Drying Methods							
		Sun Drying		Tray Drying		Vacuum Drying		Lyophilizer Drying	
		Kashi anmol	Pudasadabahar	Kashi anmol	Pusasadabahar	Kashi anmol	Pusasadabahar	Kashi anmol	Pusasadabahar
Bulk density(g/cm^3)		0.1690	0.1782	0.1841	0.1845	0.1690	0.1705	0.1532	0.1589
Tapped density (g/cm^3)		0.1778	0.1932	0.1945	0.1972	0.1730	0.1783	0.1644	0.1693
Solubility index (ml)		6.0	6.5	5.9	6.3	5.5	6.1	6.5	6.9
Color	**L**	120.43	123.13	118.56	188.34	107.87	108.78	87.65	89.78
	A	9.12	9.43	10.42	10.31	12.64	12.78	-1.23	-1.03
	B	-29.12	-31.63	-31.67	-32.63	-30.54	-29.21	0.45	0.75

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Physical analysis of green chilli powders

The physical analysis of green chilli powders of varieties of Kashi anmol and Pusasadabahar for bulk density, solubility index, flowability color and sinkability content were analyzed. The results are presented in Table 4
Microbiological analysis of green chilli powders

The microbiological analysis of green chilli powders of varieties Kashi anmol and Pusasadabahar for total vival count, yeast and mould count content were analyzed. The results are presented in Table 5, 6 and 7

Table 5: Total viable counts of green chilli powder before packing in low density polyethylene at room temperature.

Components	Drying Methods			
	Sun Drying cfu×10^3	Tray Drying cfu×10^3	Vacuum Drying cfu×10^3	Lyophilizer Drying cfu×10^3
Kashi anmol	12	11	13	12
Pusasadabahar	12.5	11.9	13.5	12

Table 6: Yeast and Mould Counts of green chilli powder before packing in low density polyethylene at room temperature.

Components	Drying Methods			
	Sun Drying ymc×10^1	Tray Drying ymc×10^1	Vacuum Drying ymc×10^1	Lyophilizer Drying ymc×10^1
Kashi anmol	6.6	6.4	6.5	6.3
Pusasadabahar	6.8	6.5	6.7	6.4

Table 7: Spore Counts of green chilli powder before packing in low density polyethylene at room temperature.

Components	Drying Methods			
	Sun Drying Spore counts×10^1	Tray Drying Spore counts×10^1	Vacuum Drying Spore counts×10^1	Lyophilizer Drying Spore counts×10^1
Kashi anmol	12	12	13	12
Pusasadabahar	12.4	12.6	13.2	12.7

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CONCLUSION

The present study was under taken to develop the technology for manufacture of green chilli powder of both the Indian varieties of green chillies viz- Kashianmol and Pusasadabahar. The process development involves the different drying methods. The effect of packaging materials on the composition of raw green chilli varieties of both Kashianmol and Pusasadabahar stored at room temperature and to evaluate the shelf life and cost of final products. There was no change in protein content during storage on dry matter basis. Ash content was nearly constant. The physical properties of green chilli powder was observed and it was found that the significant effect on the solubility, flowability, whereas the slightly decrease in solubility, flowbility and bulk density. While slightly increment was found in sink ability and bulk density at ambient temperature.

The microbial counts was depend upon the quality of raw materials and The type of packages and temperature of storage showed significant influence on the growth and survival of microorganisms in green chilli powder at ambient temperature.

The study has demonstrated exclusively that green chilli powders of both the varieties Kashianmol and Pusasadabahar obtained by lyophilizer drying method gave the best results rather other processing methods because in other methods like sun drying, tray drying and vacuum drying the color and ascorbic acid content lost during the processing.

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