PRESERVATION OF FENUGREEK BY USING IMPROVED TRADITIONAL TECHNIQUES

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ABSTRACT

Trigonella foenum-graecum L. commonly known as fenugreek is nutrient rich green leafy vegetable. India is one of the major producers and exporters of fenugreek. Preservation of green leafy vegetables like fenugreek is key problem in subtropical climate of Maharashtra. Ordinary population in India lives below poverty line in rural region and could not afford refrigerator for preservation of green vegetables. Due to absence of effective preservation technique many nutrients are lost results in malnutrition. In this investigation, an improved traditional technique of vegetable preservation made up of locally available ecofriedly material is set for reducing nutrient losses. Fenugreek was preserved by five different treatments and compared with refrigerator and control treatment. Nutrient analyses of Fenugreek in all treatments were carried out after every 24 hr. During preservation, decrease in fresh weight and increase in dry matter was observed after every 24 hours. Treatment 5 is the best alternative to refrigerator; it preserves β-carotene nearly 2.5 times better, ascorbic acid nearly 3 times better and preserves total chlorophyll content nearly 2.5 times better than control condition.

Key Words: ascorbic acid, β-carotene, chlorophyll, fenugreek, nutrients, preservation

INTRODUCTION

According to the National Family Health Survey of India, the problem of malnutrition is very severe, 55% of children living in rural areas suffer from malnutrition compared to 45% of children in urban areas (Bhat, 2004).. The situation is particularly grave in states like Bihar, Uttar Pradesh, Madhya Pradesh and Rajasthan. 29% of the Indian population is below the poverty line, 70% of which live in rural areas (Coonrood, 1998). This problem of malnutrition is not only due to unavailability of sufficient quantity food but also quality of food. During preservation many nutrients are lost results in consumption of low nutritious vegetable and other food.

Green Leafy Vegetables (GLVs) like fenugreek are very good source of minerals and vitamins and when consumed regularly they can substantially improve micronutrient status of the Indian population. It is important in the diet as it provides variety and are a good source of ascorbic acid, carotene and fiber (Oneyami and Badifu, 1987).Vegetables constitute essential components of the meal by contributing protein, vitamins, iron, calcium, and other nutrients which are usually in short supply in the daily diets (Gura, 1986).

In this investigation, a novel technique of vegetable preservation is set as an appropriate preservation technique for rural India. The system of preservation is built by locally available eco-friendly material which costs not more than 200 rupees. It lowers the temperature of vegetables than surrounding. The aim of the work reported here was to study the effect of traditional preservation methods on nutrient contents of vegetables and improve it to solve the crisis of poor nutrition in the rural region.

MATERIALS AND METHODS

Experimental site -

Field experiment was carried out from 04 May 2010 to 12 May 2010 in the Research farm located in the Botanical garden of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. The temperature range during experiment was 44^0C to 25^0C.

Green leafy vegetable fenugreek was purchased from local Aurangabad vegetable market early in the morning. The vegetable was washed with water and debris and mud was removed. The moisture was removed with the help of blotting paper.

Treatments and Methods -

Fenugreek was preserved by eight different treatments. Out of which six treatments are made from locally available earthen components made by potter and are compared with refrigerator and control treatment.

The first treatment is a model composed of earthen structure locally called *math* which is placed under soil surface. Ground is dug and a hollow is created which then filled with sand, coconut fiber etc. *Math* is placed in centre of that material and buried in soil. For cooling of math continuous supply of water is maintained by drip attached to water container. In second treatment all contents are arranged same except *math* replaced by *ranjan* with more thickness.

In third treatment an earthen *math* is bounded in a jute sack filled with coconut fiber. The math is insulated from outer surrounding with the help of fiber and continuous supply of water is arranged by drip. In fourth treatment model composed same except math replaced by *ranjan* having more thickness.

The fifth treatment is a model composed of two earthen open mouth cylinders locally called *ranjan*. The bigger *ranjan* is filled with water in which smaller ranjan was kept floating. Due to porous nature of *ranjan* water is evaporated from surface of outer *ranjan.* The heat required for evaporation was taken from inner water due to which the temperature of water gets lowered and water become cooler and cooler. Because of cooling of water the inner smaller *ranjan* also get cooled and temperature of inner space gets decreased. The vegetables are kept in the space so that minimum temperature for preservation is maintained.

In sixth treatment vegetables are preserved in refrigerator (Model Godrej 165 lit.) at 7 ^{o}C. The seventh treatment is controlled condition in which vegetables were kept in *duradi* at room temperature as common preservation method in rural areas.

Fresh fenugreek (wt. 3 kg each) was kept in different seven treatments for preservation. Experiment was carried out for eight days. The β carotene, Ascorbic acid, total chlorophyll content was estimated.

Nutrient Analyses

The β carotene, Ascorbic acid, total chlorophyll content of fenugreek was estimated in fresh material after every 24 hrs. The leaf chlorophyll contents (a, b and total) were estimated following Arnon (1961), using 80 % acetone as a solvent for extraction of pigments. The amount of β-carotene (Pro- vitamin A) was estimated by extracting it in petroleum ether and acetone (2: 1) following the method described by Knuckles *et al.,* (1972). Ascorbic acid was estimated by titration method given by Sadasivam and Manickam (1992).

Statistical analyses

All the results were statistically analyzed using analysis of variance (ANOVA) test and treatments means were compared using the least significant difference (C.D., p = 0.05) (Mungikar, 1997).

RESULTS AND DISCUSSION

Decrease in fresh weight and increase in dry matter percentage

Observations showed that, there is decrease in fresh weight and increase in dry matter in fenugreek after every 24 hours. Decease in fresh wt. and increase in dry matter in fenugreek is statistically significant among a day compared with next day. During preservation after every 24hrs. (In some cases 48hrs.) fenugreek loss moisture significantly in all treatments.

Nutrient content of fenugreek

β carotene-

β carotene is a precursor of vitamin A. Carotenoids are responsible for responsible for colour in fruit and vegetables. β carotene is an antioxidant (Arckoll, 1973). β carotene content in fresh spinach at beginning was (5.57mg/100g). At the end of eight days of preservation, the highest carotene content was found by Treat.6 followed by Treat.5, Treat1, Treat.2, Treat.3, and Treat. 4 and lowest in Treat.7. This trend was observed almost similar in all days. Overall retention of β carotene was maximum in Treat.6 i.e. 37.60% while minimum in control condition Treat.7 i.e. 13.56% (Table1).

The losses of provitamin carotenoids on drying and storage have been associated with heat damage and oxidation. The storage techniques involving heat, light and open air systems result in extensive damage of carotenoids by oxidation, isomerization and/or free radical formation (Erdman *et al.,* 1988).

Losses during storage have also been attributed to autoxidation and to the action of lipoxygenase enzyme (Dietz *et al.,* 1988). Auto-oxidation causes considerable losses of carotene and xanthophylls during storage. Oxidation of pigments is especially rapid in light (Pirie, 1986).

Table 1. Loss in β carotene content and overall percent retention of Fenugreek

Days	Treatments													
	1		2		3		4		5		6		7	
	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n
1 Day	5.57	100.00	5.57	100.00	5.57	100.00	5.57	100.00	5.57	100.00	5.57	100.00	5.57	100.00
2 Day	4.87	87.51	4.80	86.09	4.74	85.08	4.96	89.12	4.99	89.63	5.29	94.90	4.08	73.33
3 Day	4.39	78.78	4.27	76.63	4.07	73.15	4.02	72.15	4.35	78.15	4.76	85.43	2.74	49.19
4 Day	3.65	65.54	3.59	64.44	3.40	60.97	3.47	62.24	3.85	69.10	4.21	75.59	2.01	36.07
5 Day	3.23	57.92	3.05	54.77	2.69	48.24	2.77	49.66	3.25	58.39	3.67	65.93	1.47	26.37
6 Day	2.51	45.11	2.35	42.28	2.29	41.10	2.22	39.79	2.58	46.39	3.03	54.41	1.11	19.97
7 Day	2.14	38.39	2.07	37.20	1.86	33.33	1.95	34.97	2.20	39.47	2.64	47.44	0.90	16.23
8 Day	1.66	29.78	1.57	28.18	1.37	24.67	1.34	24.15	1.68	30.18	2.09	37.60	0.76	13.56
Treatment	S. E.=	0.121					Days	S. E.=						0.129
	C .D. =	0.237						C .D. =						0.254

Table 2: Loss in Ascorbic acid content and overall percent retention of Fenugreek

Days	Treatments													
	1		2		3		4		5		6		7	
	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n	mg/100 gm	% Ret^n
1	254	100.00	254	100.00	254	100.00	254	100.00	254	100.00	254	100.00	254	100.00
2	183	72.05	178	70.08	160	62.99	163	64.17	191	75.20	200	78.74	120	47.24
3	133	52.36	116	45.67	113	44.49	116	45.67	131	51.57	146	57.48	78	30.71
4	76	29.92	73	28.74	67	26.38	69	27.17	74	29.13	121	47.64	50	19.69
5	57	22.44	54	21.26	54	21.26	55	21.65	57	22.44	80	31.50	34	13.39
6	48	18.90	46	18.11	44	17.32	44	17.32	48	18.90	68	26.77	24	9.45
7	36	14.17	33	12.99	33	12.99	30	11.81	37	14.57	57	22.44	18	7.09
8	25	9.84	20	7.87	20	7.87	23	9.06	24	9.45	41	16.14	10	3.94
Treatment				S. E.=	4.716		Days	S. E.=		5.042				
				C .D. =	9.244			C .D. =		9.882				

ii) Ascorbic acid content-

Among the vitamins, vitamin C (ascorbic acid) is an essential micronutrient required for normal metabolic function of the body (Jaffe, 1984). Ascorbic acid content in fresh fenugreek sample was (254mg/100g).

After eight days preservation, the uppermost ascorbic acid content in fenugreek was found by Treat.6 followed by Treat.1, Treat5, Treat.4 followed by Treat.2 and Treat.3 with same amount while lowest in Treat.7. This trend was observed almost similar in all days. Overall retention of ascorbic acid was maximum in Treat.6 i.e. 16.14% while minimum in control condition Treat.7 i.e. 3.94% (Table 2). Decrease in ascorbic acid content in fenugreek was statistically analyzed and found significant from first day to eighth day as well as from all treatments to control. The values of ascorbic acid content of Treat.5 and

refrigerator are not always significant to each other indicate that Treat.5 preserves ascorbic acid near to refrigerator. The chief reasons for losses in the content of the vitamin C are the solubility in water, thermic destruction and enzymatic oxidation during the technological process (Selman, 1994).

iii) Total chlorophyll

Chlorophyll is also referred as 'blood of plant' because the chemical composition of chlorophyll and haemoglobin is similar (Gala and Gala, 2000). Chlorophyll has an antibacterial effect on wounds and anti yeast effect in digestive tract. It appears to counteract many toxins to the body. It has the effect of reducing inflammation. The total chlorophyll content in fenugreek was (1.342 mg/1g). These values are in accordance with Amandeep Kaur *et al.,* (2008).

Table 3. Loss in Total chlorophyll content and overall percent retention of Fenugreek

Days	Treatments													
	t. 1		t. 2		t. 3		t. 4		t. 5		t. 6		t. 7	
	mg/ 1gm	% Ret^{n}	mg/ 1gm	% Ret^{n}	mg/ 1gm	% Ret^{n}	mg/ 1gm	% Ret^{n}	mg/ 1gm	% Ret^{n}	mg/ 1gm	% r Ret^{n}	mg/ 1gm	% Ret^{n}
1 Day	1.34	100.0	1.34	100.0	1.34	100.0	1.34	100.0	1.34	100.0	1.34	100.0	1.34	100.0
2 Day	1.03	77.12	0.99	73.85	0.97	72.43	0.97	72.95	0.99	73.92	1.11	82.86	0.83	62.30
3 Day	0.91	68.26	0.89	66.54	0.87	64.83	0.88	65.95	0.91	68.18	0.95	71.16	0.64	47.69
4 Day	0.84	62.82	0.82	61.40	0.79	59.17	0.80	60.28	0.83	62.37	0.89	66.62	0.47	35.47
5 Day	0.74	55.59	0.71	53.20	0.72	53.95	0.69	51.79	0.73	54.92	0.78	58.79	0.34	25.48
6 Day	0.58	43.74	0.54	40.91	0.55	40.98	0.53	40.16	0.59	44.41	0.67	50.52	0.23	17.81
7 Day	0.44	33.16	0.40	29.88	0.38	28.61	0.41	30.92	0.45	34.20	0.53	39.87	0.15	11.40
8 Day	0.28	21.01	0.26	19.67	0.21	15.65	0.23	17.21	0.30	22.58	0.41	31.00	0.09	6.86
Treatment		S. E.=		0.02637			Days	S. E.=		0.02819				
		C .D. =		0.05168				C .D. =		0.05525				

After eight days preservation, the uppermost total chlorophyll content in fenugreek was found by Treat.6 followed by Treat.5, Treat1, Treat.2, Treat.4, Treat.3 and lowest in Treat.7. This trend was observed almost similar in all days. Overall retention of total chlorophyll was maximum in Treat.6 i.e. 31.00% while minimum in control condition Treat.7 i.e. 6.86% (Table 3). Decrease in total chlorophyll content in vegetables was statistically analyzed and found significant among subsequent days as well as among treatments. Losses in total chlorophyll content are significant from first day to eighth day as well as from all treatments to control. Chlorophyll degradation in processed foods and plant tissues has been reviewed by Heaton and Maragoni (1996). Schwartz and Lorenzo (1991) observed that chlorophyll is sensitive to heat. It means that Treat.5 lowers the temperature of vegetable and preserves total chlorophyll content.

During preservation of fenugreek decrease in fresh weight and increase in dry matter was observed after every 24 hours. It may be due to loss of water in the form of water vapors from vegetables in preservation in *duradi*. It showed that Treatment 1 and 6 are the best treatments for retention of moisture in vegetables during preservation. It can be minimized by covering vegetables by polythene or airtight containers.

Carotene is degraded by a free radical oxidation mechanism, and the degree of oxidation depends on temperature (Harris and Karmas 1975). Treat.5 showed maximum overall retention of β carotene next to refrigerator, in fenugreek which indicates that by reducing temperature Treat.5 checked carotene degradation satisfactorily. The losses in ascorbic acid could be attributed to increased activities of ascorbic acid oxidizing enzymes, leaching and destruction (Tapadia *et al.,* 1995). But Treat.5 lowered losses of ascorbic acid.

As the time duration between harvesting and consumption of vegetable get increased there is starting of decaying process results in loss in nutrients Jadhav *et al.,* (1979). Loss of nutrients from vegetables can be minimized by storing at low temperature by rural technology methods composed from inexpensive locally available material.

Utilization of different rural technology methods for preservation of vegetables may help in improving the strategy for the endemic malnutrition in most underdeveloped and developing countries.

This technology is quite simple and appropriate with respect to the cost of operation, potential for adoption in rural communities and prevention of post harvest losses of vegetables.

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