



**EFFECT OF SOLAR DEHYDRATION METHOD ON PHYSICO-
CHEMICAL AND SENSORY CHARACTERISTICS OF GREEN BEANS
(PHASEOLUS VULGARIS)**

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Abstract

Studies were done by different chemical treatments under solar dehydration of Green beans. The Green beans were treated by five different methods which are mentioned and the end product was underwent analysis for physico-chemical characteristics, nutritional characteristics, microbial analysis and sensory evaluation. Five treatments of different proportions with Magnesium chloride, Sodium chloride, Sodium bicarbonate and Magnesium oxide were done for solar dehydration of Green beans and (0.1% Magnesium chloride and 0.1% Sodium bicarbonate) treated Green beans were found to be good in all characteristics i.e. Physico-chemical (better chlorophyll retention) and nutritional characteristics when compared to other treatments.

Keywords: Green Beans; Chemical Treatments; Solar Dehydration; Physico-Chemical Analysis; Sensory Analysis.

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1. Introduction

In basic terms, a vegetable is an edible plant and its part intended for cooking purpose or eating raw as it. Some vegetables can be consumed raw, while some such as cassava must be cooked to destroy certain natural toxins or microbes in order to consume. Processed food items available in market contains vegetable ingredients, it can be referred as "vegetable derived" products. These products may or may not maintain nutritional integrity of the vegetables. Thus different vegetable derived products are produced in recent times to maintain nutritional values of vegetables and the nutritional content of vegetables vary from produce to produce. Generally they contain small amount fat, protein and also contain different types vitamins like vitamin A, vitamin K and vitamin B6, carbohydrates and minerals. Vegetables contain a large variety of

phytochemicals and some of them have antifungal, antibacterial, antioxidant and anti-carcinogenic properties. Few vegetables contain dietary fiber which promotes gastro-intestinal function. In case of drying of green leafy vegetables and vegetables, color loss is the major problem. In blanching process this loss happens more than in unblanched beans. In concern to reduce the chlorophyll loss and other compounds different chemical treatments are done. In either case, vegetables also contain anti-nutrients and toxins which interfere with the absorption of nutrients, those can be inactivated by adequate boiling, drying, soaking etc. Anti-nutrients includes oxalic acid, α -solanine, α -chaconine enzyme inhibitors and cyanide precursors, cyanide, and others. These toxins are natural defenses, used to ward off the insects and fungi that might attack the plant. Some beans contain vicins and cassava roots contain cyanogenic glycoside. Hygiene is very important while handling because food to be eaten raw foods and such products need to clean properly, handled and stored to reduce spoilage. Green potatoes contain glycoalkaloids and should be avoided. In India, RDI for adults is 275 grams of vegetables per day.

1.1. Health Benefits

Green beans have low calories i.e 32 cal/100 g and contain no saturated fats. These pod vegetables are richest sources of vitamins, minerals and phytochemicals. Rich source of vitamin A and polyphenolic compounds such as β -carotenes, leutins and zeaxanthins where these compounds possess neutralizing free radical properties and gives immune system and protects against infectious matter and reactive oxygen species that play a role in anti-aging process.

Dietary fiber, 9%/100 g as per RDA, excellent quantity is present in beans, acts as a bulk laxative which protects the mucus membrane layer of colon by reducing its expose to toxic substances. Binds itself to cancer causers in colon, consequently reducing the risk of cancer. Dietary fiber is also reduces cholesterol levels in blood by reducing re-absorption of cholesterol binding acids in colon. Green beans also contain carotenoid called “Zeaxanthin” which is the compound will be absorbed into eye’s retinal macosa and has antioxidant and light filtering property. It also helps in prevention of age related retinal macular diseases. Green beans contain good amounts of folic acid which plays a role in preconception during pregnancy that helps in prevention of neural tube defect in new borns. Potassium is the most important compound for body and cell wall fluid integrity maintenance which control blood pressure and heart rate. The iron element which is available in beans helps in respiration of cell level by producing haemoglobin that carries oxygen molecules to cells and tissues. Molybdenum is the micro mineral that detoxifies sulfites from blood streams. Copper found in better proportions beans, there to lower the chance of inflammatory disease, such as arthritis, maintain the elastic property of vessels, tendons, joints and ligaments by enhancing enzyme activity. Magnesium relieves fatigueness, relaxing of sore muscles, thereby reduces asthma and migraine symptoms. Other than dietary fiber, soluble fiber slow down the carbohydrate metabolism which indirectly regulates blood glucose levels and prevents sudden peaks in blood glucose. It is recommended for diabetic patients for insulin resistant. Folic acid in beans retards the accumulation intermediary metabolite compounds of protein metabolism called “haemocysteine” which promotes the risk of antherosclerosis.

1.2. Storage

Care should be taken for post-harvest storage purpose. Sound storage room with better hygiene conditions should be maintained. Tuber and vegetables should be stored by cold chains and

cellars and method of storing in refrigerated conditions in order to prevent fungal growth and sprouting. As the inherent properties differs from vegetable to vegetable and fruit and fruit care must be taken in understanding the properties of foods to be stored. Maintaining nutritional quality is most important thing in storage of foods. While storing the leafy vegetables as it loose its moisture and vitamin C has degrades rapidly. It should be stored in a cool place as short a time as possible where it should be packed in a sealed container, tight polyethylene covers or a plastic bag.

1.3. Nutritive Values of Green Beans

Nutrients	Values (100g)
Protein	2.50 – 2.70 g
Fat	0.26-0.28g
Carbohydrates	2.68-3.16 g
Fiber	4.38-4.71%
Thiamine	0.45 mg
Riboflavin	0.064 mg
Niacin	0.86 mg
Pantothenic acid	0.29 mg
Pyridoxine	0.37-0.423 mg
Biotin	4.71-4.96 mg
Folates	47.45-56.43 mg
Vitamin-C	15.81-20.04mg
β-carotene	413-424 IU
Calcium	60mg
Iron	1.56mg
Phosphorus	559mg
Energy	102-110 k.cal

(Indian Food Composition Tables, National Institute of Nutrition, 2017)

1.4. Review

Blanching is a cooking process usually a vegetable or fruit is plunged into boiling water, removed after a brief time interval and finally dipped in ice water or cold water that give has thermal shock property. Blanching has effect on chlorophyll retention, where chlorophyll converts into pheophytins and oxidates at -10°C, it was observed. Chlorophyll can't be retained in steam or water blanching methods. Effects of blanching are enzymes (peroxides and catalases) can be inactivated, reduces microbial load, initial dirt on surface and excludes air spaces in tissues. Dehydration is done under controlled conditions of temperature, humidity & airflow. The costs of processing are usually high. Air is used as drying medium. Temperature, moisture & velocity of air are controllable depending on the foods to be dried. Cooking quality foods are superior. Sanitary conditions are controllable with in a dehydration plant. It is a continuous fast process & the product is obtained within a short period. Dehydration of foods can be carried in all seasons for prolonged shelf life.

2. Methodology

2.1. Production and Processing of Green Beans

We collected raw green beans from local super market. Green beans which are free from contaminants are selected for dehydration and procured from the local super markets. The beans were washed under running tap water in order to remove the dust or dirt particles or any

adhering substances. The washing step increases the quality of final product and decreases the microbial load. Washed beans were made into cuts of 1-1.5 cms, where obtained pieces were subjected to water and steam blanching. Blanching is a heat treatment followed by immediate cooling. It helps in fixing the color of fruit, removes the air from tissues, inactivates the enzymes. The beans were blanched in boiling water for 2-3 mins. After blanching the surface moisture was removed by blowing hot air for 2-3 min.

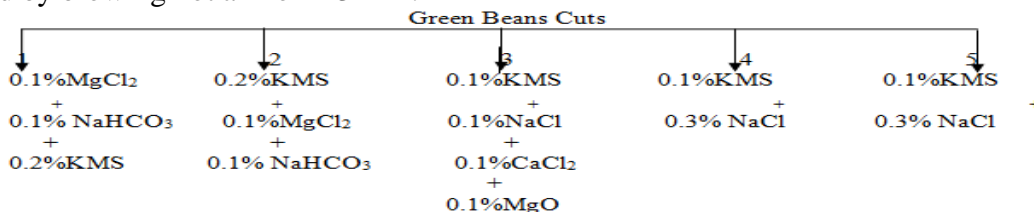


Figure 1: Chemical treatments

In above mentioned 5 treatments: treatments 1 and 5 blanching were not done. Treatment 2 and 3 were water blanching and treatment 4 was steam blanching. Cut beans were placed in tray on the top row of the drying chamber. In such a way the continuity of the drying process could assure without interruption. The drying temperature was shown by thermometer. The maximum temperature in the dryer is 48-54⁰C. The time taken for dehydration was 8 hrs. Solar dehydration process is attained by placing blue glass filter over the glass cover of dryer. Dehydrated beans are packed in air tight polythene pouches and stored at ambient temperature.

2.2. Physico-Chemical and Sensory Analysis

Parameters such as moisture, crude fiber, pH, bulk density were analysed by standard methods. Total chlorophyll, carotenoids, total phenols, flavonoids, vit C, blemish count, rehydration test were carried out according to reported methods suggested by Ranganna (1986). Sensory attributes like appearance, color, taste, flavor, texture and overall acceptability was evaluated by trained panels of 3 judges on nine point hedonic scale. The evaluation was conducted for green beans after rehydration.

3. Results and Discussion

3.1. Processing of Green Beans

Unit operations involved in the processing of treatment 5 treated green beans is presented in

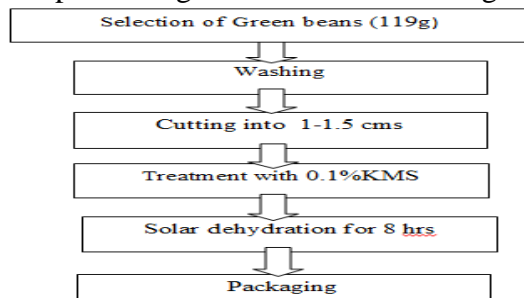


Figure 2: Flowchart of processing Green beans

Studies were done by different chemical treatments under solar dehydration of Green beans. The Green beans were treated by five methods which are mentioned and the end product was

underwent analysis for physico-chemical analysis and sensory evaluation which are procured from local market. Five treatments of different proportions with Magnesium chloride, Sodium chloride, Sodium bicarbonate and Magnesium oxide were done for solar dehydration of Green beans. From the five chemical treatments; treatment 1 and treatment 5 has been found better in physical characteristics, so those samples are analyzed further. The drying data was observed along with drying hours and % yield with moisture content under solar dehydration was observed.

Drying table:

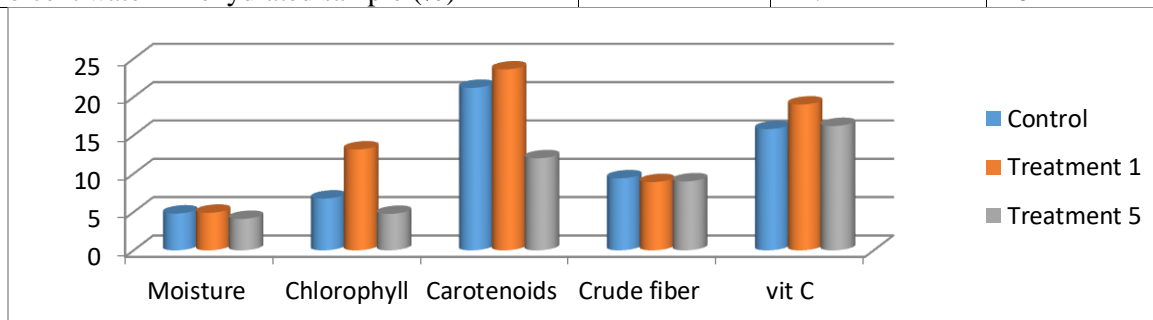
Table 1: Drying data table

Treatment	Initial Wt. (g)	Final Wt. (g)	Yield%	Drying hours	Cabinet(°C)
Control	200	45	22.5	8	60
Treatment 1	135	26	19.25	8	60
Treatment 2	132	23	17.42	8	60
Treatment 3	152	38	25	8	60
Treatment 4	122	15	12	8	60
Treatment 5	119	12	10	8	60

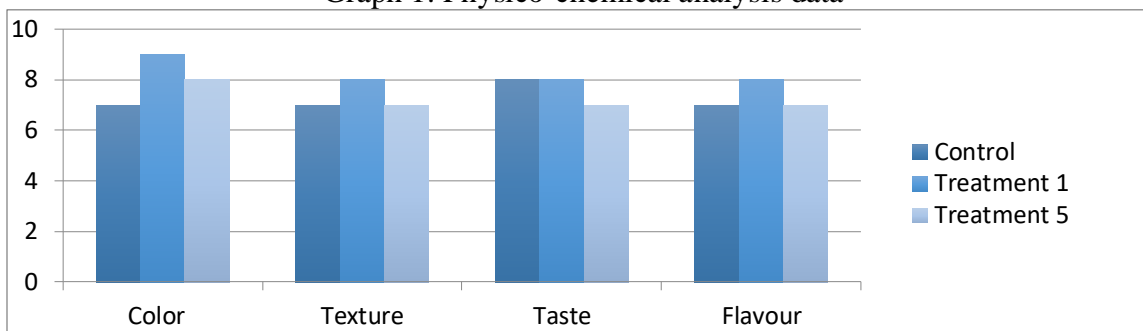
3.2. Physico-Chemical Tests

Table 2: Physico-chemical analysis

Parameters	Control	Treatment 1	Treatment 5
Moisture content (%)	4.8	4.9	4.1
Total Chlorophyll(mg/100g)	6.75	13.16	4.754
Chlorophyll a	15.72	10.42	9.89
Chlorophyll b	14.84	9.52	10.74
Carotenoids (µg/100g)	21.2	23.6	12.01
Crude fiber (g)	9.4	8.9	9.0
Phenols	0.93	1.18	1.06
Flavonoids	0.67	0.99	1.01
Ash (%)	1.04	0.97	1.05
Vit C(mg/100g)	15.81	19.02	16.22
Bulk density (kg/m ³)	0.188	0.173	0.173
Blemish count (no.)	0	0	0
pH	5.202	4.9	5.28
Rehydration test:-			
Rehydration ratio	2:7.2	2:9.8	2:7.5
Coefficient if rehydration	0.35	0.41	0.3
Percent water in rehydrated sample (%)	12	14.2	10



Graph 1: Physico-chemical analysis data



Graph 2: Sensory analysis data

4. Conclusion

By referring previous research paper have been concluded that loss of micronutrients, polyphenols and other compounds was very low in solar dehydration with comparison to solar drying. Blanched sample had more loss of chlorophyll even on drying. Not only other compounds; chlorophyll retention is also appreciable as solar dehydrated (blue filter) sample has 13.16 mg where solar dried has 2.69 i.e MgCl₂ treated sample retend more than MgO treated sample. Treatment 1 samples had better points in overall acceptability; it had better color, shape and texture. Rehydration test values have shown better result. Hence, it's concluded that treatment 1 sample show better characteristics in all aspects.

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