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Optimization of steam blanching treatment for minimal processing of French beans

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Abstract
Effect of blanching treatments on peroxidase (POD) enzyme activity, protein content, L a b values, moisture and ash content in French beans were studied. The experiment was planned as per CCRD RSM technique. The process variables were blanching time and length of French beans at steam pressure of 1.15kg/cm². Forced convection steam blancher was used for blanching French bean. It was found that blanching was adequate at length of French bean 5mm,10mm and blanching time 30sec, 60 sec,120 sec respectively with 95% peroxidase enzyme inactivation, where as it contained 12.10 to 17.24 protein content, 13.95 to 28.34 L, -3.43 to 2.27 a, 03.06 to -18.03 b value. Steam blanching has significant effect on color retention fresh alike, than unblanched dehydrated French bean.

Keywords: steam blanching, French bean, POD enzyme inactivation, physical and nutritional characteristics

Introduction
The increasing popularity of minimally processed fruit and vegetables has been attributed to the health benefits associated with fresh produce, combined with the ongoing consumer trend toward eating out and consuming ready to eat foods. Those foods that have fresh like characteristics are known as *minimally processed foods* (MPF) or *partially processed foods* (PPF) and satisfy at least partially, the demand of fresh like, high quality foods[1]. These types of products have been closely related to the changes in the consumption patterns[2, 3] and to certain needs of catering industries[4]. The term *minimal* processing is used to include a wide range of technologies for a) preserving short shelf-life vegetable and fruit products while minimizing changes that would alter freshness characteristics and b) improving quality of shelf-life products. The purpose of minimally processed foods is to deliver to the consumer a fresh like product with an extended shelf life while ensuring food safety and maintaining sound nutritional and sensory qualities. Blanching is a pre-treatment method and a process typically used to remove air in the product prior to canning, to prevent ice crystal formation during freezing, to destroy enzymatic activity and to prevent color changes of a food product5. Though the French beans belongs to the family Leguminoseae are good source of protein, dietary fibres, vitamins A,B and C as well as it contains folates, minerals, antioxidants. The Crop is widely cultivated in a temperature, tropical and subtropical regions. Specific heat and thermal conductivity of okra decreased linearly from 3.54 to 1.38 kJ/kg ^{0}C and 0.32 to 0.038 W/m ^{0}C, respectively, with decrease in moisture content from 88 to 12%(wb). The specific heat and thermal conductivity of bitter gourd decreased linearly from 3.76 to 0.95 kJ/kg ^{0}C and 0.61 to 0.07 W/m ^{0}C, (Yadav *et al.*, 2005) [7].

Materials and Methods
The raw material used was French beans. The study was carried out to evaluate the effect of steam blanching time and size of French beans on enzymatic activity, physical and nutritional characteristics and to optimize the blanching treatment for French beans. The samples were prepared as per the design matrix CCRD RSM technique as shown in Table-1 and Table-2. Fresh French bean was procured free from any kind of damage and infestation. In each trial, 1000gm of French beans cutted in different size as per treatment plan was blanched in steam blancher for time given as per the design. The blanched French bean was taken out from tray was kept under fan to cool down and to remove excess moisture adhered to surface of beans. The treated samples were dehydrated for 5 hr at 55 ^{0}C. The samples were analyzed for different parameters as per the standard methods.

Table 1: Experimental design matrix

Length	5mm	10mm	15mm	20mm	25mm
Coded value	-1.41	-1	0	1	1.41
Time	30sec	60sec	90sec	120sec	150sec

Table 2: Coded values

Length	1	1	0	0	-1	0	0	0	1.41	-1.41	0	0	-1
Time	-1	1	0	0	1	1.41	0	0	0	0	-1.41	0	-1

Peroxidase enzyme estimation

Peroxidase (POD) Enzyme was determined by the method described by AOAC (1995) method.

Protein estimation

The phenolic group of tyrosine and tryptophan residues (amino acid) in a protein will produce a blue purple color complex, with maximum absorption in the region of 660 nm wavelength, with Folin-Ciocalteau reagent which consists of sodium tungstate molybdate and phosphate. Thus the intensity of color depends on the amount of these aromatic amino acids present and will thus vary for different proteins. Most proteins estimation techniques use Bovin Serum Albumin (BSA) universally as a standard protein, because of its low cost, high purity, ready availability. The method is sensitive down to about 10 µg/ml and is probably the most widely used protein assay despite its being only a relative method, subject to interference from Tris buffer, EDTA, nonionic and cationic detergents, carbohydrate, lipids and some salts. The incubation time is very critical for a reproducible assay. The reaction is also dependent on pH and a working range of pH 9 to10.5 is essential.

Moisture content

The moisture content of the developed extrudate was determined by the method described by AACC (2000). 5g sample was weighed in a previously weighed and tared dish. The dish with its lid underneath will be placed in an oven maintained at 130 - 133° c for 2 hr. The sample was removed after 2 hours, cooled in desiccator and weighed.

$$\text{Moisture (\%)} = \frac{(w2-w3)}{(w2-w1)} \times 100 \quad \text{....Eq. 1}$$

Where,

w3= weight of the dishin grams

w1= weight of the dishin grams with the material before drying

w2= weight of the dishin grams with the material after drying

Ash content

The dehydrated material in the dish left after the determination of moisture was ignited with the flame of the burner till charred. It was transferred to a muffle furnace maintained at 550-600 ^{0}C and continued ignition was conducted till grey ash is obtained. Sample was allowed to cool in a desiccator and weighed again, and the ash content was expressed in terms of the oven-dried weight of the sample (AOAC 1995).

$$\text{Total Ash} = \frac{\text{Final weight}}{\text{Initial weight}} \times 100$$

Results and Discussion

The results found are graphically represented in 3D plots (Fig. 1 to 4).

L a b values of blanched samples

According to experiments of steam blanching method, L-values, a-values and b-values of vegetable French bean samples ranged between 13.95 to 27.06, -2.57 to 2.27, and 03.06 to 17.59, respectively. The brightness of treated blanched samples was significantly different from the unblanched vegetable samples. Similar trend has been observed by (Yadav, 2004) [8] for okra.

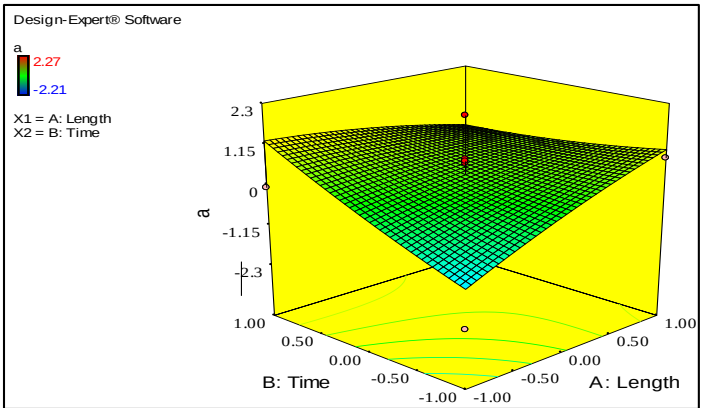

Fig 1: Effect of Length and Time on greenness 'a' value of French beans Final Equation in Terms of Actual Factors:

'L' = 21.3600 + 0.50968 × L + 0.50736 × T - 0.25750 × L× T + 2.71187 × L2 + 2.42688 × T2

'a' = 0.43400 + 0.34766 × L + 0.46823 × T - 0.73750× L × T - 0.12950 × L2 + 0.10800 × T2

'b' = 7.08800 - 0.83593 × L + 2.22744 × T - 0.44000 × L × T + 4.68787 × L2+2.71038×T2

Peroxidase content in blanched samples of French beans

There was no reactivation in POD enzymes during storage. Blanching of 5 mm, 10 mm French beans for 60 sec and 120 sec resulted in a 95% inactivation of POD enzymes. POD activities of blanched green beans was stable during 3 months of storage, but tended to decrease afterward especially for unblanched green bean samples.

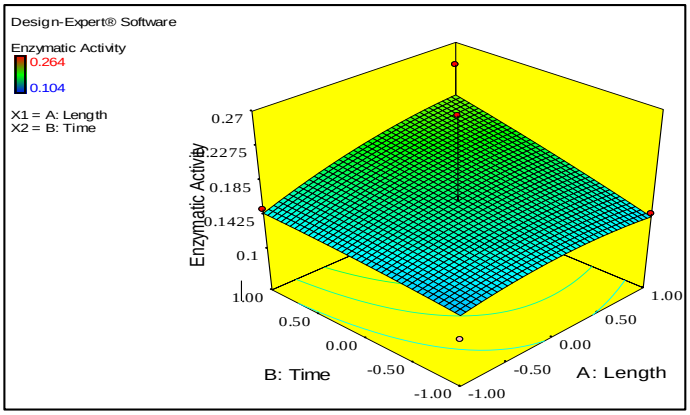

Fig 2: Effect of blanching on enzymatic activity

Final equation in terms of actual factors

Enzymatic Activity = 0.16740 + 0.015543 × L + 0.019134 × T + 0.013000 × L × T - 9.51250E-003 × L2 - 2.26250E-003 × T2.

Ash content in blanched samples of French beans

From experiment it was concluded that there was no loss in ash content of steam-blanched french beans as compared to that of unblanched dehydrated french beans. It means that leaching loss was not taking place hence steam blanched dehydrated vegetable retained nutritive value as well as the unblanched dehydrated vegetable.

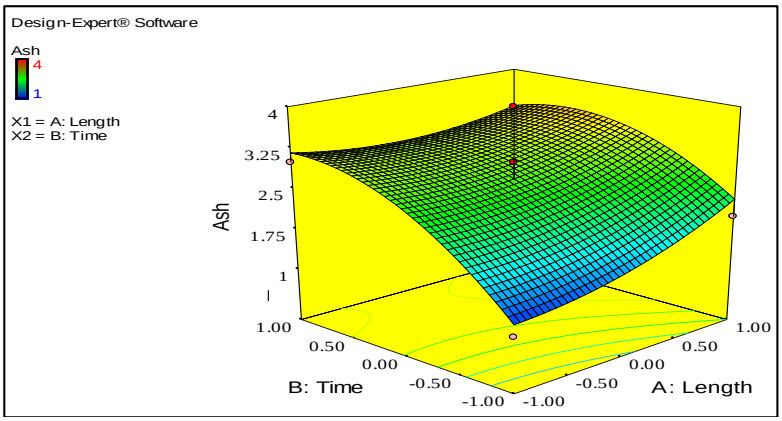

Fig 3: Effect of Length and Time on Ash content of French beans.

Final Equation in Terms of Actual Factors

Ash = 2.80000 + 0.30178 × L + 0.72855 × T - 0.25000 × L × T+ 0.22500 × L2 - 0.52500 × T2

Moisture content in Blanched samples of French beans

According to resultes of moisture content value of moisture contents decreases as length of sample increases. The moisture content of treated blanched samples shows minor different from the unblanched vegetable samples.

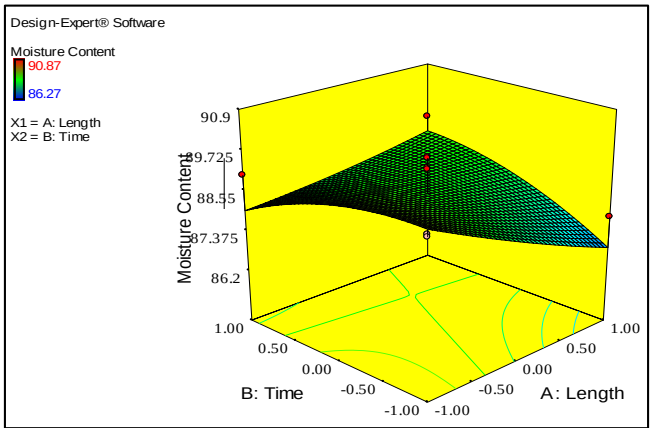

Fig 4: Effect of length and time on moisture content of French beans

Final equation in terms of actual factors

Moisture Content = 88.56800 - 0.41562 × L + 0.13687 × T + 0.81750 × L × T + 0.090375 × L2 - 0.39462 × T2

Protein content in blanched samples of French beans

According to experiments of steam blanching method, protein values of vegetable French bean samples ranged between 12.10 to 17.24. The variations in protein content may be affected because of availability of proportion of seed present in sample. The protein content of treated blanched samples was significantly different from the unblanched vegetable samples.

Final equation in terms of actual factors

Protein = 14.18600 - 0.043269 × L + 0.41348 × T + 0.13250 × L × T - 0.15362 × L2 - 0.028625 × T2

Conclusion

Steam blanching treatments was significantly effective in retention of greenness value of French beans where as better results were obtained for 10 mm length and 90 sec combination was adequate to blanch the French beans. Steam blanched French bean retained ash content as well as compared to unblanched dehydrated French beans.

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