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Effects of pre-treatments and drying temperatures on the quality of dried green peas

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■ **ABSTRACT :** The freshly harvested green peas procured from local market were cleaned and sorted. The average moisture content of the fresh green peas was found 70 to 75 per cent on wet basis. Three different samples of green peas with respect to pre-treatments *viz.*, raw, blanched and blanched after pricking were taken for drying experiment. A laboratory model tray dryer was used for drying green peas with different levels of drying air temperatures (50, 60, 70^{0}C). Drying time, moisture reduction was calculated later with the help of observed data during tray drying. The dried green pea samples were taken for quality evaluation by sensory method, rehydration of final product was also carried out. Survey results underlined the need of technological intervention at various stages of post-harvest processing of green peas in this region. Drying of blanched green peas after pricking at 50^{0}C drying air temperature resulted in shorter drying time to produce best quality dried product as compared to raw and blanched green peas. The dried green peas with final moisture content 7.52 per cent on wet basis showed best rehydration characteristics to yield good quality rehydrated peas which could be preserved and used during off-season.

■ **KEY WORDS :** Pre-treatments, Drying time, Drying rate, Drying air temperature, Quality evaluation

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Green pea (*Pisum sativum*) is a popular pulse crop of India. It provides a variety of vegetarian dishes and hence, it is liked throughout the world. The major producer countries are China, India, United States, France and Egypt (Singh *et al.*,1983). Mature seed is highly nutritive and contains high proportion of digestible protein, carbohydrates, minerals and vitamins. Anastasia Schepers (2007). The fruit is a typical pod containing four to nine seeds. The length of pods is 5 to 9 cm and shape is inflated, but they are available only during winter season. Green peas are available for around 5 months during winter season only. They are used for making vegetables, as additives in certain vegetables and for making several snack preparations. But the shelf-life of green peas is not more than 3-4 days. The drying technique preserves them for few months and the original taste, flavour and colour is also retained. In drying of fruits and vegetables the colour change during the process is important factor. So pre-treatments like blanching or acid treatments are concerned. Also the drying time and drying rate are important during drying, so before drying, operation like pricking is carried out (Sudha and Leelavathi, 2012). Green pea is one of the most commonly grown food legumes in the world and it

has been widely used in the human diet for a long time because it is an excellent source of protein, vitamins, minerals and other nutrients and low in fat, high in fibre, and contains no cholesterol. To fulfill the demand of dried green peas the traditional methods like sun drying are available (Waruthaithanasan, 2000). Sun drying produces inferior quality products with loss of nutritive value. Hence, to overcome this increasing demand of dried green peas, there is need of technological intervention at various stages of processing of green peas (Hall, 1998).

Drying is one of the oldest methods and most traditional methods. By reducing the moisture up to a certain level in fruits and vegetables, the microbiological spoilage and deteriorative chemical reactions are greatly minimized. In addition to preservation, drying lowers the cost of packaging, storage and transportation by reducing both, the weight and volume of the final product (Doymaz and Kocayigit, 2011). Water content for properly dried foods varies from 5 to 25 per cent depending on the kind of food. When drying foods, the key is to remove moisture as quickly as possible at a temperature that does not seriously affect the flavour, texture and colour of the food. If the temperature is too low in beginning, micro-organisms may survive and even grow before food is adequately dried (Waddle *et al*., 1992). If the temperature is too high and the relative humidity is too low, the food may harden on the surface. This makes it more difficult for moisture to escape and the food does not dry properly (Sahay and Singh, 1994).

Pre-treatment prevents the loss of colour by inactivating enzymes, reduces the drying time by relaxing tissue structure and yields a good quality dried product. Pricking will be done by using needle of regular size as it affects the drying rate and blanching is a pre-treatment method used to arrest some physiological process for drying of vegetables and fruits. For blanching green peas will be immersed in hot water at 85^0C for 1 min. and then immediately placed under running cold water for at least 3 min (Doymaz and Kocayigit, 2011). The complete procedure for carrying out rehydration tests on dehydrated fruits and vegetables. He has also provided formulae for calculating different rehydration parameters like rehydration ratio, co-efficient of rehydration and per cent water in the rehydrated material (Ranganna, 1986). By keeping all these things in view the present study was carried out with the objective to investigate the drying characteristics of different green peas samples during hot air drying and the quality characteristics of dried green peas.

METHODOLOGY

Good quality fresh green peas (*Pisum sativum*) were purchased from local market. Damaged, immature, and dry pods were removed manually by visual inspection. The pea pods were shelled manually. The average size of green peas selected by using required sieves. The initial moisture content of green peas was determined using a standard method by hot air oven drying at 102^0C±2 for 24 h by AOAC method (AOAC, 1990). The selected green peas were subjected to three pre-treatments *viz.*, raw, blanched and blanched after pricking etc. Three drying temperature 50^0, 60^0 and 70^0 C for 24 hrs. Drying experiment was performed in an electrical tray dryer. Three different samples of green peas *viz.*, raw, blanched and blanched after pricking were taken for drying experiment at each level of drying air temperature (Mudgal and Pandey, 2008). The drying air temperature was set at desired level (50, 60, 70^0C) by adjusting thermostat and electric balance used to record the weight of Green Peas at different time intervals. Drying was continued till the green peas were attained constant weight *i.e.* safe moisture content (Sahu *et al*., 2008). Drying time, moisture content of final product calculated by using experimental records. The dried green pea samples were evaluated for their quality by sensory evaluation for colour, taste and appearance (Patil and Kubde, 2011). Rehydration characteristics of dried green peas were also determined.

The dried green peas tested for above organoleptic attributes. A proforma consisting of basic organoleptic characteristics was developed and evaluated in a 9-point hedonic scale. The rehydration quality of dried green peas was determined by rehydration test (Ranganna, 1986). The dehydrated sample of 10 g each was placed in glass beakers, 200 ml of water was added and heated at 40^0C to 45^0C for 60 min. The excess water was drained off through filter paper. The drained samples were weighed. Rehydration ratio (RR), co-efficient of rehydration (COR) and moisture in the rehydrated samples (MCR) were computed using following formulae:

$$\mathbf{RR} = \frac{\mathbf{C}}{\mathbf{D}}$$

$$COR = \frac{C \times (100 - A)}{\frac{D - BD}{100}} \times 100$$

$$MCR = \frac{C - E}{E} \times 100$$

where,

A = Moisture content of samples before dehydration, per cent (w.b.)

B = Moisture content of dehydrated sample, per cent (w.b.)

C = Drained weight of rehydrated sample, g

D = Weight of dehydrated samples taken for rehydration test, g

E = Dry matter content in the sample taken for rehydration.

■ RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of drying air temperature and treatment on drying time and moisture reduction of green peas:

The moisture content at different time interval (elapsed time) for tray drying of green peas samples at different drying air temperatures has been shown in Table 1. From the table, it is clear that as the drying air temperature increases, the reduction in moisture or weight loss also increases for all the treatments. Higher temperature of drying helps to reduce the time required to dry the peas up to equilibrium moisture content for the drying temperatures of 50^0C, 60^0C and 70^0C, respectively (Chen and Mujumdar, 2003).

The changes in the moisture content of green pea samples with drying time under different drying conditions was studied with the help of Fig. 1, 2 and 3. The moisture content of the green peas decreased with drying time irrespective of drying air temperatures indicating continuous drying process. The decrease in the drying time with increase in drying air temperature and type of sample was due to increase in the water vapour pressures within the food. Curve fitting was also carried out in Fig. 1, 2 and 3 to see the moisture-time relationship. An exponential type relationship was observed in all three types of peas samples dried under 50^0C, 60^0C and 70^0C drying air temperatures (Saputra, 2001).

It is clear that as the drying air temperature increased, the reduction in moisture or weight loss also increased for across all pre-treatments. Higher

Table 1 : Variation in moisture content (kgW/kg.dm) of green peas for different drying air temperatures

Elapsed drying time	Raw samples			Blanched samples			Blanched after pricking samples		
(min)	50^0C	60^0C	70^0C	50^0C	60^0C	70^0C	50^0C	60^0C	70^0C
0	2.551	2.838	2.832	2.512	2.869	2.516	2.256	2.389	2.25
15	2.327	2.727	2.616	2.314	2.639	2.170	1.840	1.925	1.627
30	2.176	2.526	2.378	2.103	2.396	1.796	1.542	1.435	1.161
45	2.020	2.347	2.202	1.904	2.220	1.475	1.120	1.105	0.697
60	1.935	2.177	2.062	1.668	2.096	1.251	1.038	0.837	0.605
75	1.822	2.058	1.916	1.465	1.937	0.976	0.817	0.520	0.470
90	1.668	1.890	1.763	1.248	1.814	0.776	0.681	0.378	0.362
120	1.641	1.603	1.451	0.934	1.116	0.624	0.484	0.331	0.318
150	1.245	1.229	1.241	0.709	1.422	0.502	0.321	0.286	0.295
180	1.010	0.932	1.097	0.530	1.151	0.472	0.293	0.270	0.262
210	0.637	0.647	0.822	0.401	0.750	0.340	0.232	0.209	0.215
240	0.481	0.484	0.692	0.387	0.513	0.262	0.212	0.186	0.199
270	0.383	0.361	0.501	0.294	0.255	0.159	0.152	0.122	
300	0.284	0.329	0.381	0.156	0.445	0.148	0.124		
360	0.219	0.200	0.183	0.131	0.445				
420	0.120	0.090	0.183	0.131					
480	0.085	0.090							
210	0.085								

temperature of drying helped to reduce the time required to dry the green peas up to equilibrium moisture content for drying temperatures of 50^0C, 60^0C and 70^0C (Kingsly *et al.*, 2007).

Quality characteristics of dried green peas :

Sensory evaluation of final product :

The sensory average scores given by 10 panelists for different quality attributes of the dried green peas

Table 2 : Average scores for different sensory attributes of dried green pea samples

Quality	Type of sample	Drying air temperature		
		50^0C	60^0C	70^0C
Colour	Raw	5.33	4.11	3.77
	Blanched	6.22	5.33	5.00
	Pricked	5.66	4.66	4.55
Texture	Raw	4.55	4.55	4.66
	Blanched	5.44	4.66	5.11
	Pricked	5.77	4.88	4.77
Taste	Raw	5.22	4.88	4.55
	Blanched	6.00	5.00	5.44
	Pricked	6.00	5.33	5.33
Appearance	Raw	5.44	4.55	4.22
	Blanched	6.33	4.88	5.00
	Pricked	6.44	4.66	4.66
Overall acceptability	Raw	5.00	4.00	3.75
	Blanched	6.75	4.25	3.50
	Pricked	7.00	4.50	4.00

Table 3 : Moisture content in final dried green peas at different drying air temperatures

Drying air temperature, ^{0}C	Sample type	Moisture content in final product		
		% w.b.	% d.b.	kgw/kg.dm
50	Raw	10.27	8.43	0.084
	Blanched	9.05	10.06	0.100
	Pricked	7.52	11.57	0.116
60	Raw	8.76	10.41	0.104
	Blanched	7.55	12.24	0.122
	Pricked	6.95	13.38	0.133
70	Raw	7.32	12.66	0.126
	Blanched	6.69	13.84	0.138
	Pricked	5.72	16.48	0.164

Table 4 : Rehydration characteristics of dried green peas at different drying air temperatures

Sample type	Drying air temperature (^{0}C)	Moisture in rehydrated sample (% w.b.)	Rehydration ratio	Co-efficient of rehydration
Raw	50	49.357	1.998	0.594
Blanched	50	56.985	2.097	0.571
Pricked	50	62.458	2.652	0.728
Raw	60	44.653	1.968	0.617
Blanched	60	52.450	2.345	0.638
Pricked	60	56.127	2.629	0.708
Raw	70	39.280	2.124	0.688
Blanched	70	48.347	2.278	0.707
Pricked	70	56.289	2.598	0.681

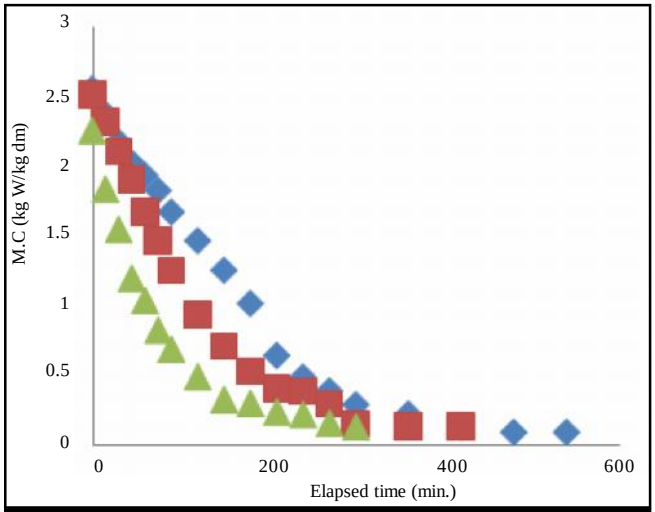

Fig. 1 : Effect of pre-treatment on moisture content of green peas at 50 ^{0}C

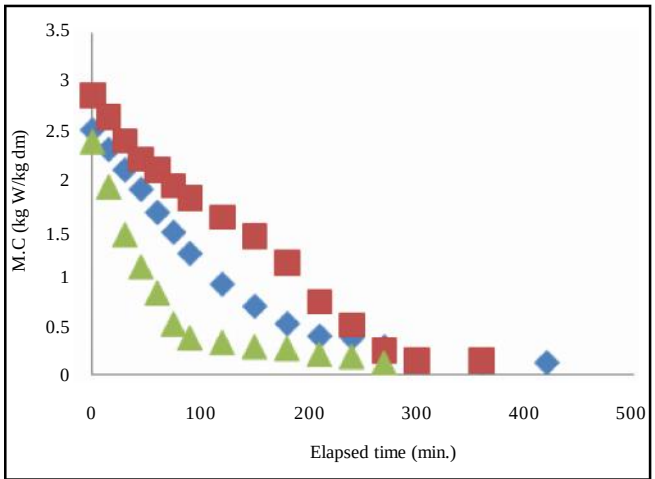

Fig. 2 : Effect of pre-treatment on moisture content of green peas at 60 ^{0}C

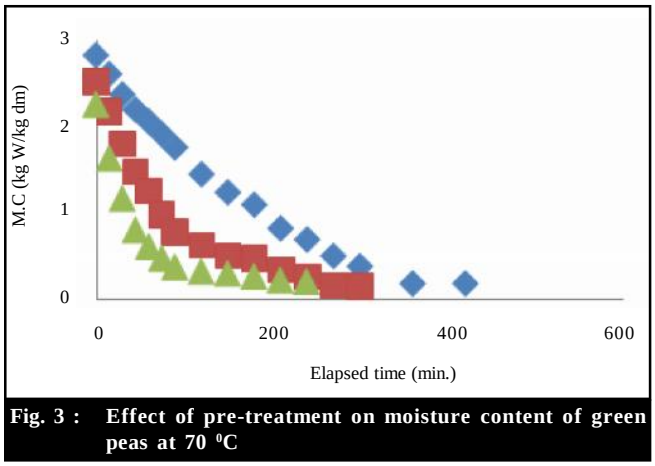

Fig. 3 : Effect of pre-treatment on moisture content of green peas at 70 ^{0}C

are presented in Table 2.

From Table 2, it is seen clearly that the blanched and pricked green peas got high scores as compared to raw samples in terms of colour, texture, taste, appearance and overall acceptability at all drying air temperatures. The dehydrated pricked samples were found best in colour, texture, taste, appearance and overall acceptability followed by raw and blanched samples. From the average scores in Table 2, it was found that the drying air temperature and sample type both affects the sensory attributes because score shows that with increase in drying air temperature there was decrease in average score. The samples dried at 50^{0}C earned the best scores for all sensory attributes as compared to samples dried at 60^{0}C and 70^{0}C. The maximum scores for pricked samples dried at 50^{0}C were obtained as 5.77, 6.00, 6.44 and 7.00 for colour, texture, taste, appearance and overall acceptability, respectively. These scores were highest among all three samples within 50^{0}C drying air temperature. Thus, the green peas samples dried at drying temperature of 50^{0}C resulted in the best acceptable quality product (Wakchaure *et al*., 2010).

Moisture content in final product :

Moisture content in the final dehydrated products was determined by hot air oven method. Observed values are presented in Table 3.

The moisture content in final product was decreases with increasing drying temperature (Pedreschi *et al.*, 2006).

Rehydration characteristics of final product :

The rehydration characteristics *i.e.*, rehydration ratio (RR), co-efficient of rehydration and moisture in rehydrated samples of dried green peas are shown in Table 4.

Table 4 reveals that the values of rehydration ratio (RR) and co-efficient of rehydration (COR) were higher in case of dried pricked green peas sample at all drying air temperatures. The maximum values of RR and COR were found as 2.652 and 0.728. Green peas dried at 50^o C drying air temperature. One important thing observed that was sample type and drying air temperature both played important role in rehydration characteristics. (Krokida and Marinos-Kouris, 2003).The moisture content of rehydrated green peas samples also followed the same trend. The highest value for moisture in

rehydrated sample (% w.b.) for the pricked green peas dried at 50°C drying air temperature, which depict that the rehydrated product could very well be utilized for substituting the fresh product in off-season.

Based on all the above quality characteristics, the pricked green peas samples dried at 50°C emerged as the best sample having desirable quality.

Conclusion :

The moisture content of green peas decreased with elapsed drying time during tray drying of green peas. Types of samples (raw, blanched and pricked) and drying air temperature provided as the most significant independent variables which affected the moisture content reduction pattern. The drying rate was higher at 70°C when compared to 50°C and 60°C drying air temperature.

The sensory evaluation shows that dried pricked green peas samples were found best in colour, texture, taste, appearance and overall acceptability followed by blanched and raw dried green peas samples. From average scores, it was found that the drying air temperature and sample pre-treatments both affected sensory attributes because scores shows that with increasing drying air temperature there was decrease in average scores. The samples dried at 50°C earned best scores for all sensory attributes as compared to samples dried at 60°C and 70°C. The value of rehydration ratio (RR) and co-efficient of rehydration (COR) were higher in case of dried pricked green peas samples at all drying air temperature. The maximum value of RR and COR were found as 1.968 and 0.617 for pricked green peas at 50°C drying air temperature.

Based on the above we can conclude that the drying of blanched after pricking green peas at 50°C drying air temperature resulted in shorter drying time to produce best quality dried product as compared to 60°C and 70°C with best. Rehydration characteristics to yield good quality rehydrated green peas which could be preserved and used during off-season.

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