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Effect of Drying, Blanching and Rehydration Behavior on the Quality of Green Peas

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A B S T R A C T

Green Peas (*Pisum sativum*) is one of the most commonly grown food legumes in the world. 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°C). The moisture content of green peas decreases an elapsed drying time during tray drying of green peas. The result shows that the blanched green peas had slightly higher moisture content than raw and pricked green peas. The drying rate was higher at 70°C when compared to 50°C and 60°C drying air temperature. The value of Rehydration Ratio (RR) and Coefficient of Rehydration (COR) where higher in case of dried pricked green peas samples at all drying air temperature. The maximum value of RR and COR where found as 1.968 and 0.617 for pricked green peas at 50^0C drying air temperature. The above dried green peas show best rehydration characteristics to yield good quality rehydrated Green Peas which could be preserved and used during off-season.

Introduction

Green peas (*Pisum sativum*) is one of the most commonly grown food legumes in the world it has been widely used in human diet for a long time because it is an excellent source of nutrients and contains high proportion of digestible protein, carbohydrates, minerals and vitamins. In case of Indian peoples, they consume fresh green peas as a vegetable in food. But due to their seasonal and perishable nature, drying is useful to increase the shelf life. The cultivation of green peas is a very ancient. They are recognized as a high quality nutritious source. The field pea is native to the Mediterranean region of the Southern Europe and to Western Asia. It is probably indigenous to the region comprising Italy and South Western Asia, eastwards of the Himalayas, including northern India. The major producer countries include China, India, United States, France and Egypt (Singh *et al*., 1983). The fruit is a typical pod containing four to nine seeds. The length of pods is 5 to 9 cm and shape are inflated but they are available only during seasons. 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.

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 of the weight and volume of the final product (Doymaz and Kocayigit, 2011).

Water content for properly dried foods varies from 5 to 25% depending on the food. When drying foods, the key is to remove moisture as quickly as possible at a temperature that does not seriously affect the flavor, texture and color of the food. If the temperature is too low in beginning, micro-organisms may survive and even grow before food is adequately dried. 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). But drying technique preserves them for few months and the original taste, flavor and color is also retained. In drying of fruits and vegetables the color changes during process is important factor.

So, pretreatments 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 (CFTRI, Mysore). So, keeping in view the main aim of this research work is to study the traditional methods for processing of green peas, to study the drying characteristics of different green peas samples during hot air drying and to study the quality characteristics of dried green peas.

Materials and Methods

Good quality fresh Green Peas *(Pisum sativum)* was purchased from a local market. Damaged, immature, and dry pods was removed manually by visual inspection. The pea pods were shelled manually. The average diameter sized green peas were 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 (Association of Official Analytical Chemist) method. The most critical raw material was collected fresh and matured green pea pods.

Traditional methods of drying

Most of the agricultural products especially fruits and vegetables are perishable materials. So, from time immemorial there were big efforts in every culture about preservation of foods. These efforts called traditional methods of food processing. These traditional methods play very important role in every culture. So, this study deals with survey of traditional methods for green peas processing.

Procurement of raw material and sample preparation

The fresh and good quality green p**e**as were procured from local market of Kolhapur as showed in Figure 1. A damaged, immature, and dry pod was removed manually by visual inspection. The average diameter sized green peas were selected by using required sieves. The concerned information was collected from farmers, local market, processors and traders.

Pretreatments

Pretreatment prevents the loss of color by inactivating enzymes, reduces the drying time by relaxing tissue structure, and yields a good quality dried product. Pricking was done by

using needle of regular size as it affects the drying rate and blanching is a pretreatment method used to arrest some physiological process for drying of vegetables and fruits. For blanching green peas was immersed in hot water at 85°C for 1 minute and then immediately placed under running cold water for at least 3 minutes (Doymaz and Kocayigit, 2011).

Determination of moisture content

The determination of moisture is empirical methods because the various moisture determination methods measure more or less the water present in the product. Thus, the experimental conditions or method govern to some extent, the amount of moisture obtained. Air oven method is most suitable method for determination of moisture content. Initial moisture content of the green peas was determined for finding the dry matter as well as moisture content of the raw sample.

The samples (20-25g) were dried in the hot air oven at 102°C ± 2°C for 24 hours. The moisture content of prepared raw green peas was determined from 70 to 75% (w.b).

Samples: Raw, Blanched and Blanched after pricking as showed in Figure 2, 3 and 4.

Drying air temperatures: 50°, 60° and 70° C.

Blanching time: 1 minute in boiling water at 85°C.

In these ways three samples of green peas viz. Raw, Blanched and Blanched after pricking was prepared. The total dry materials or the initial moisture content of raw green peas was determined in accordance with AOAC method (Anonymous, 1990) and Moisture Content (w.b) was calculated using following formula:

$$\text{Total dry matter} = \frac{W_m}{W_m + W_d} \times 100 \quad (1)$$

In this expression W_m is the weight of material in gram and W_d is the weight of dry matter in gram.

The moisture content of the sample can be calculated as:

$$M.C. = \frac{W_1 - W_2}{W_1} \times 100 \quad (2)$$

In this expression $W_1$is the initial weight of sample in gram and $W_2$is the final weight of sample in gram.

Drying rate is expressed as follows:

$$\text{Drying Rate } \left(\frac{kgW}{kg.dm.h}\right) = \frac{\text{Amout of moisture content, (kg)} \times 60}{\text{Time taken} \times \text{Bone dry weight, (kg)}} \quad (3)$$

Drying of green pea samples

The drying operation was carried out with following independent and dependent parameters/variables to study the Drying Characteristics.

Independent variables

Type of sample: Raw, blanched, blanched after pricking

Drying air temperature: 50°, 60° and 70°C

Dependent variables

Drying time (minutes)
Drying rate (kgW/kg.dm.h)
Moisture content in final product (% w.b.)

Experimental procedure

An electrical tray dryer was used for drying green peas. Three different samples of green

peas viz. raw, blanched and blanched after pricking was taken for drying experiment at each level of drying air temperature.

The drying air temperature was set at desired level (50°, 60°, 70°C) by adjusting thermostat an electric balance was used to measure the weight of green peas at different time intervals. Drying was continued till the green peas up to attained constant weight (safe moisture content). Drying time, drying rate, moisture content of final product was calculated by using experimental records. The experimental procedures of pre-treatments of green pea are as shown in Figure 5.

Quality characteristics of dried green peas

The dried green pea samples were evaluated for their quality by sensory evaluation for colour, taste, and appearance. Rehydration characteristics of dried green peas were also determined**.**

Sensory evaluation

To the customer point of view, organoleptic characteristics such as colour, taste, texture, and appearance was observed. The dried green peas were tested for above organoleptic attributes. Performa consisting of basic organoleptic characteristics was prepared and evaluated in a 9-point hedonic scale as per method described by Ranganna (1986). A group of 10 technically competent panelists of the college was asked to judge the quality of the products sensorially and give marks for different quality attributes out of 10 marks.

Rehydration

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°C to 45°C for 60 min as showed in Figure 6. The excess water was drained off through filter paper. The drained samples were weighed. Rehydration Ratio (RR), Coefficient of Rehydration (COR) and moisture in the rehydrated samples (MCR) were computed using following formulae:

$$RR = \frac{C}{D} \quad (4)$$

$$COR = \frac{C \times (100 - A)}{(D - \frac{BD}{100}) \times 100} \quad (5)$$

$$MCR = \frac{C - E}{E} \times 100 \quad (6)$$

Where,

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

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

C = Drained weight of rehydrated sample, gram.

D = Weight of dehydrated samples taken for rehydration test, gram.

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

Results and Discussion

In this chapter, the results of the current investigations have been presented under appropriate heads and sub-heads and have been discussed wherever possible in light of the causes and effects. This chapter deals with the results of survey of traditional methods for green pea processing, blanching of green pea, blanched after pricking of green pea and quality characteristics of dried green pea

Traditional methods for green pea processing

A survey was conducted to study the present status of processing of green peas in nearby

area of Kolhapur. Efforts were made to obtain complete information from farmers, traders, local processers etc. The collected information included the practices carried out after harvesting of green peas.

The results of survey show that common practices like cleaning, sorting of green peas pods is the first step off after harvesting. the major portion of this green peas pods goes to the market where it is sold as a fresh vegetable. Some portion of fresh green peas sun dried up to 3 to 4 days depends on available sunshine. Sun drying produces inferior quality product with high loss of nutrients also the shelling of pods and sun drying process are time consuming and labour intensive practices.

Survey result underlined the need of technological investigation at various stages of post-harvest processing of green peas.

Drying characteristics of dried green peas

Raw, blanched and blanched after pricking samples of dried green peas were dried in the tray dryer at three drying air temperatures namely 50°C, 60°C and 70°C. Weight loss in terms of moisture was recorded and observations are tabulated Table 1. Drying time, moisture reduction and drying rate was seen through different data tables constructed to plot drying curves.

Effect of drying air temperature, 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 1, 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°C, 60°C and 70°C respectively.

The changes in the moisture content of green pea samples with drying time under different drying conditions was studied with the help of Figure 7, 8 and 9. 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 Figure 7, 8 and 9 to see the moisture-time relationship. An exponential type relationship was observed in all three types of peas.

Effect of drying air temperature and treatment on drying rate of green peas

The drying rates were calculated from the drying data by estimating the change in the moisture content, which occurred in each consecutive time interval and was expressed in kgw/kg.dm.h $\times 10^{-3}$ as shown in Tables 2, 3 and 4 and to plot different drying rate curves (Figure 10). The drying rate curves were plotted between average moisture content (kgw/kg.dm) and drying rate (kgw/kg.dm.h $\times 10^{-3}$). The drying rates were higher at the beginning of the drying process when moisture content was highest and later decreases with decreasing moisture content, for all the drying conditions.

The main factor influencing the drying rate was the drying air temperature. The higher air temperature resulted in higher drying rate, and consequently shorter drying time. This is due to increase of heat transfer between the air

and the green pea samples. The rate of drying was higher at 70°C when compared to 50°C and 60°C drying air temperature.

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 are presented in Table 5.

From Table 5, 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 5, 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°C earned the best scores for all sensory attributes as compared to samples dried at 60°C and 70°C. The maximum scores for pricked samples dried at 50°C were obtained as 5.77, 6.00, 6.44 and 24.44 for colour, texture, taste, appearance and overall acceptability respectively. These scores were highest among all three samples within 50°C drying air temperature. Thus, the green peas samples dried at drying temperature of 50°C resulted in the best acceptable quality product for different types of temperature.

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

Elapsed Drying Time (min)	Raw Samples			Blanched Samples			Blanched after pricking Samples		
	50°C	60°C	70^{0}C	50°C	60°C	70°C	50°C	60°C	70°C
0	2.6	2.84	2.832	2.51	2.87	2.516	2.26	2.4	2.25
15	2.32	2.8	2.616	2.32	2.7	2.17	1.9	2.1	1.62
30	2.18	2.6	2.378	2.1	2.4	1.8	1.54	1.435	1.17
45	2.02	2.35	2.202	2	2.22	1.48	1.12	1.1	0.7
60	1.9	2.18	2.062	1.67	2.1	1.26	1.04	0.83	0.605
75	1.8	2.06	1.916	1.47	1.937	0.98	0.81	0.52	0.47
90	1.7	1.9	1.763	1.25	1.814	0.78	0.69	0.38	0.37
120	1.7	1.6	1.451	0.93	1.616	0.62	0.49	0.331	0.318
150	1.24	1.229	1.241	0.709	1.422	0.5	0.32	0.29	0.3
180	1.01	0.932	1.097	0.53	1.16	0.48	0.3	0.27	0.27
210	0.64	0.64	0.822	0.401	0.75	0.341	0.232	0.209	0.215
240	0.49	0.489	0.692	0.39	0.513	0.27	0.212	0.19	0.199
270	0.39	0.37	0.501	0.3	0.26	0.16	0.16	0.122	
300	0.29	0.32	0.381	0.16	0.445	0.15	0.124		
360	0.22	0.2	0.183	0.13	0.445				
420	0.12	0.09	0.183	0.13					
480	0.09	0.09							
510	0.09								

Table.2 Variation in drying rate of raw green peas with average moisture content at different drying air temperatures

Drying at 50°C		Drying at 60°C		Drying at 70°C	
Average moisture content kgW/kg.dm	**Drying rate kgW/kg.dm.h × 10^{-3}**	**Average moisture content kgW/kg.dm**	**Drying rate kgW/kg.dm.h × 10^{-3}**	**Average moisture content kgW/kg.dm**	**Drying rate kgW/kg.dm.h × 10^{-3}**
70.891	0.900	73.658	279.73	73.120	0.866
69.225	0.752	72.406	262.66	71.368	0.908
67.700	0.708	70.884	243.69	69.584	0.840
66.408	0.617	69.323	226.19	68.062	0.769
65.248	0.583	67.917	211.80	66.529	0.733
63.540	0.590	66.356	197.46	64.759	0.712
60.942	0.545	63.493	174.66	61.509	0.690
57.464	0.521	58.357	141.58	57.296	0.636
52.907	0.514	51.685	108.03	53.853	0.578
44.593	0.547	43.768	78.96	48.726	0.574
35.700	0.518	35.969	56.59	43.028	0.535
30.111	0.482	29.596	42.30	37.171	0.518
24.936	0.453	25.674	34.56	30.521	0.490
20.015	0.389	20.761	26.52	21.554	0.441
14.343	0.347	12.523	14.57	15.484	0.378
9.337	0.308	8.326	9.08		
7.886	0.290				

Table.3 Variation in drying rate of blanched green peas with average moisture content at different drying air temperatures

Drying at 50°C		Drying at 60°C		Drying at 70°C	
Average moisture content kgW/kg.dm	**Drying rate kgW/kg.dm.h × 10^{-3}**	**Average moisture content kgW/kg.dm**	**Drying rate kgW/kg.dm.h × 10^{-3}**	**Average moisture content kgW/kg.dm**	**Drying rate kgW/kg.dmkh × 10^{-3}**
70.689	241.354	73.33	275.40	70.003	1.381
68.806	220.917	71.53	251.77	66.340	1.440
66.679	200.437	69.73	230.69	61.913	1.387
64.047	178.646	68.31	215.70	57.593	1.264
60.980	156.681	66.82	201.63	52.497	1.231
57.487	135.721	65.20	187.56	46.554	1.159
51.920	109.170	63.12	171.56	41.071	0.945
44.885	82.140	60.25	151.96	35.935	0.805
38.054	61.921	56.12	128.72	32.763	0.681
31.653	46.594	48.19	95.10	28.759	0.621
28.279	39.432	38.40	63.20	23.115	0.563
25.318	34.061	27.14	38.47	17.254	0.524
18.097	22.489	16.50	20.02	13.274	0.474
12.519	14.323	12.66	14.50		
11.583	13.100				

Table.4 Variation on drying rate after pricking green peas with average moisture content at different drying air temperatures

Drying at 50°C		Drying at 60°C		Drying at 70°C	
Average moisture content kgW/kg.dm	**Drying rate kgW/kg.dm.h × 10^{-3}**	**Average moisture content kgW/kg.dm**	**Drying rate kgW/kg.dm.h × 10^{-3}**	**Average moisture content kgW/kg.dm**	**Drying rate kgW/kg.dm.h × 10^{-3}**
67.009	204.494	68.197	216.214	65.585	2.490
62.727	169.109	62.378	168.039	57.838	2.177
57.582	137.004	55.720	127.037	49.033	1.938
52.714	111.781	49.044	97.156	41.022	1.644
47.961	92.794	39.908	67.912	34.862	1.423
42.764	74.980	30.823	44.907	29.316	1.258
36.582	58.300	26.145	35.441	25.357	0.966
28.475	40.283	23.558	30.857	23.449	0.782
23.497	30.729	21.724	27.759	21.815	0.662
20.762	26.275	19.269	23.939	19.290	0.581
18.207	22.267	16.505	19.779	17.172	0.513
15.384	18.259	13.285	15.407		
12.149	13.846				

Table.5 Average scores for different sensory attributes of dried Green Pea samples

Quality	Type of Sample	Drying Air Temperature		
		50°C	**60°C**	**70°C**
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.6 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.7 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	Coefficient of Rehydration
Raw	50°	49.357	1.998	**0.594**
Blanched		56.985	2.097	**0.571**
Pricked		62.458	2.652	**0.728**
Raw	60°	44.653	1.968	**0.617**
Blanched		52.450	2.345	**0.638**
Pricked		56.127	2.629	**0.708**
Raw	70°	39.280	2.124	**0.688**
Blanched		48.347	2.278	**0.707**
Pricked		**56.289**	**2.598**	**0.681**

Fig.1 Raw green pea pods

Fig.2 Fresh green peas

Fig.3 Blanched green peas

Fig.4 Pricked green peas with needle

Fig.5 Flow diagram showing the studies on drying of green peas

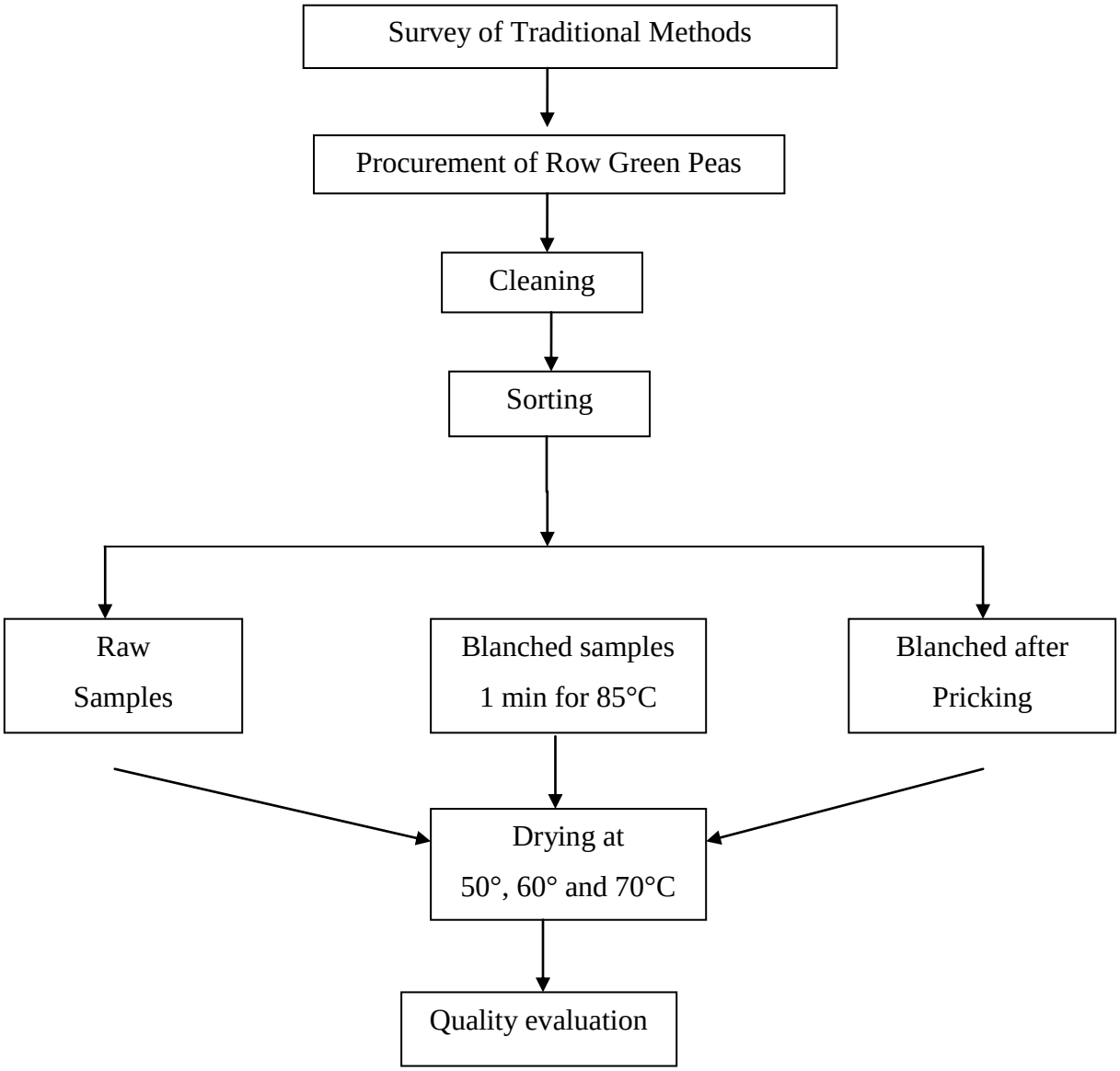


Fig.6 Rehydration of dried green peas

Fig.7 Variation in moisture content of raw green peas with elapsed drying time at different drying air temperatures

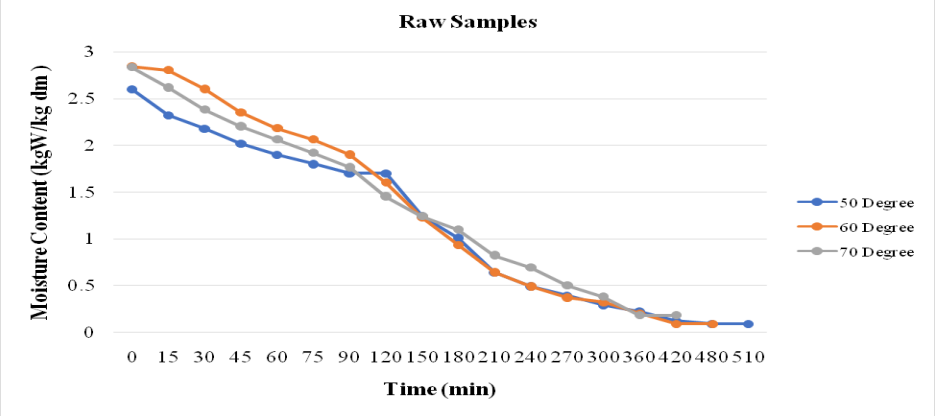


Fig.8 Variation in moisture content of blanched green peas with elapsed drying time at different drying air temperatures

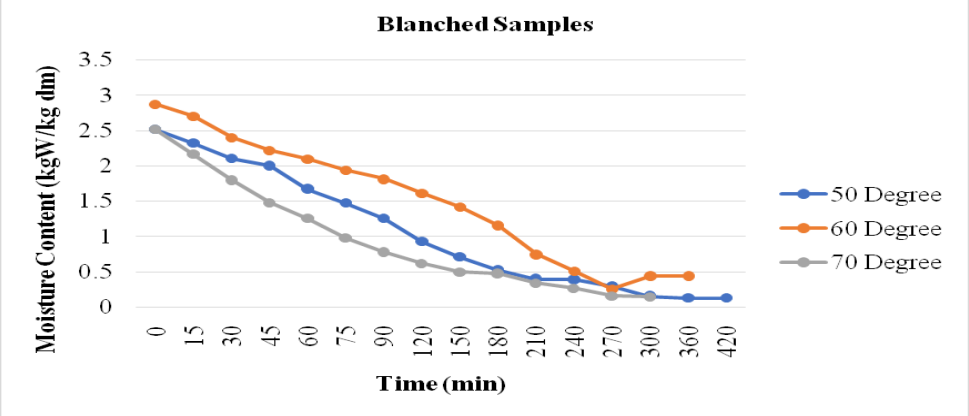


Fig.9 Variation in moisture content of blanched after pricking green peas with elapsed drying time at different drying air temperatures

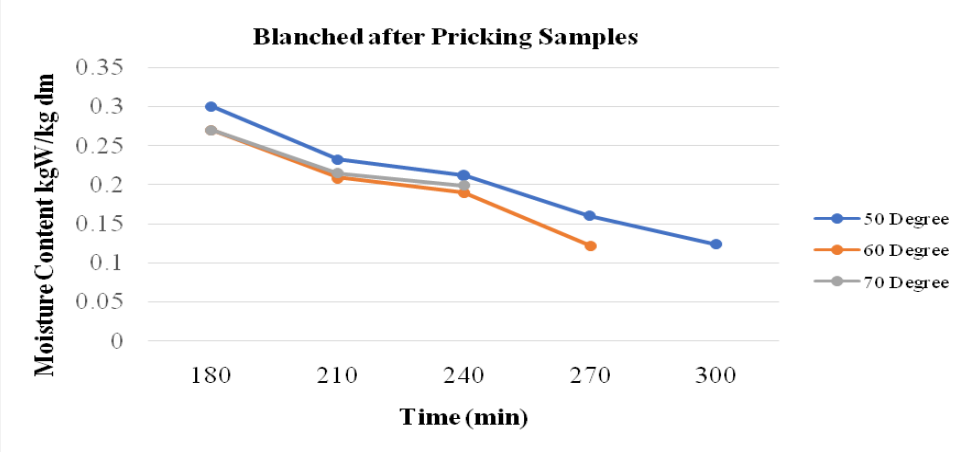
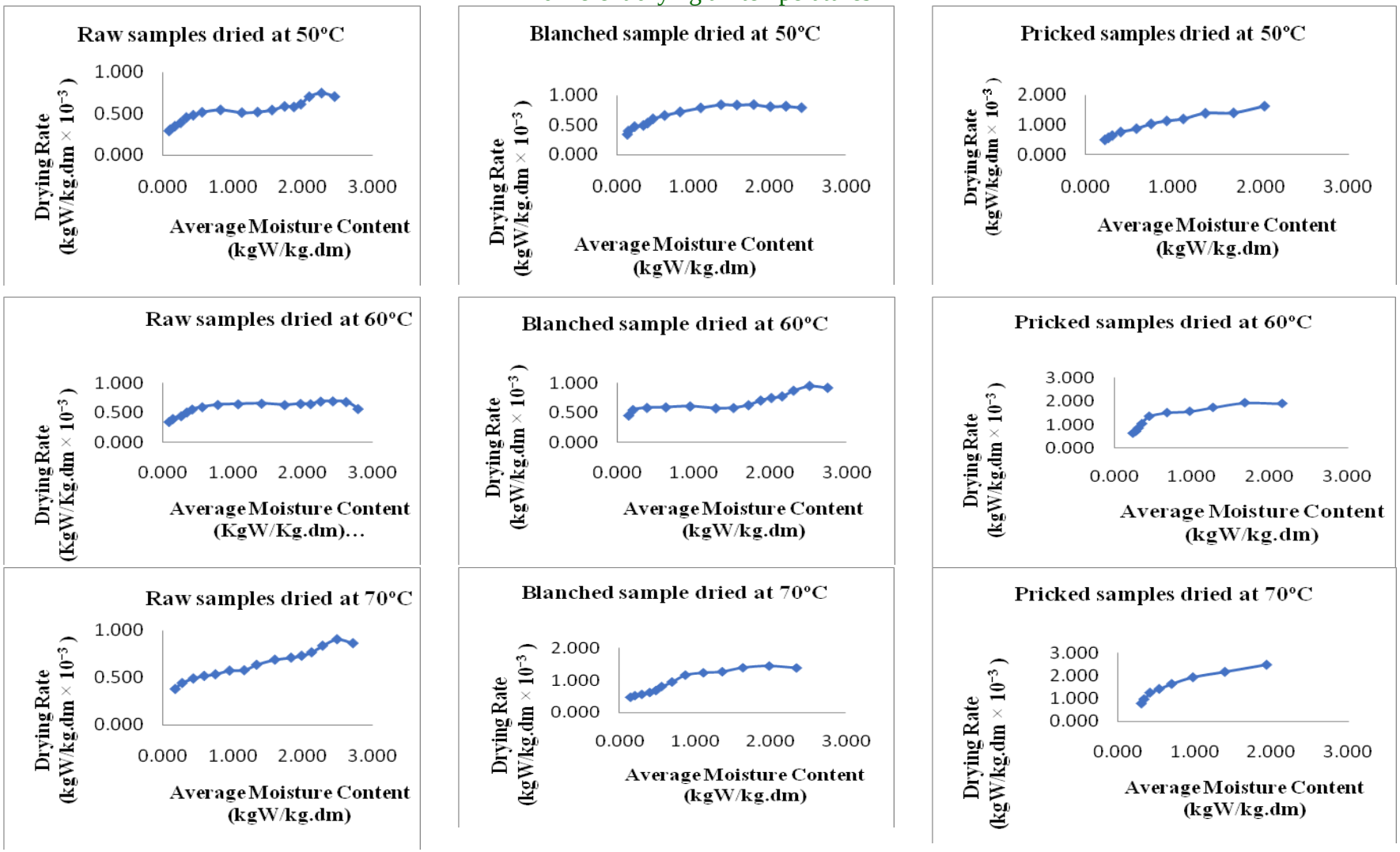


Fig.10 Variation in moisture content of raw, blanched and blanched after pricking green peas with average moisture content at different drying air temperatures



Raw Green Peas **Blanched Green Peas** **Blanched after pricking Green Peas**

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 6.

Rehydration characteristics of final product

The rehydration characteristics i.e. rehydration ratio, coefficient of rehydration, and moisture in rehydrated samples of dried Green Peas are shown in Table 7.

Table 7 reveals that the values of rehydration ratio (RR) and coefficient 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 2.652and 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. 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°Cdrying 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.

In conclusion, blanched green peas had slightly higher moisture content than raw and pricked green peas. The drying rate was higher at 70°C when compared to 50°C and 60°C drying air temperature. The value of Rehydration Ratio (RR) and coefficient of Rehydration (COR) where higher in case of dried Pricked Green Peas samples at all drying air temperature. The maximum value of RR and COR where found as 1.968 and 0.617 for pricked green peas at 50^{0}C drying air temperature. The above dried green peas show best rehydration characteristics to yield good quality rehydrated green peas which could be preserved and used during off-season. 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. The dried green peas with final moisture content 7.5% on wet basis showed best rehydration characteristics to yield good quality rehydrated peas which could be preserved and used during off-season.

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