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EFFECT OF PRE-TREATMENTS AND DRYING METHODS ON PHYSICO-CHEMICAL QUALITY OF DEHYDRATED PEA (*PISUM SATIVUM* L.)

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ABSTRACT
A study on effect of pre-treatments and drying methods on physico-chemical quality of dehydrated pea was conducted which comprised of twenty treatment combinations, four level of pre-treatments viz., untreated, blanching with NaCl for 3 min (10% and 15%), blanching with KMS for 3 min (0.05% and 0.1% KMS) and four level of drying methods viz., sun drying, solar drying, microwave drying, mechanical drying including one control without any treatment under different drying methods. Among the tested treatments, the pre-treatment of blanching with 15% NaCl for 3 min was found best which exhibited minimum drying time (0.43 h), moisture content (5.97%), loss in weight (73.53%) and maximum recovery (26.27%) whereas among the tested drying methods, the mechanical drying was found best which exhibited maximum protein content (23.62%) with loss in weight (73.53%). Therefore, it can be concluded that treatment combination of blanching with 15% NaCl for 3 min with mechanical drying was found best for most of the physical and chemical characteristics of dehydrated pea.

INTRODUCTION

Pea (*Pisum sativum* L.) is a very popular leguminous vegetable crop grown in the cool season throughout the world. Pea is one of the oldest vegetables in the world and ranks in the top ten vegetable crops. In India, pea is grown as winter vegetable in the northern plains, while in hilly terrain it is grown as off-season vegetable during summer seasons. Peas are considered valuable vegetable for vegetarians. In, India pea occupies an area of 420.9 thousand ha and production is 40.06 lakh tonnes with average productivity of 9.5 MT/ha. Madhya Pradesh ranks second in pea production by contributing 13.3% shares of total production of India (Anonymous, 2013). Pea is extremely perishable and also its availability is seasonal (Pradeshi *et al.*, 2001). Green pea is generally consumed as fresh, frozen, dehydrated and processed canned peas. Fresh pea can be stored for about 2 weeks at 0°C with 85-95% relative humidity (Yawalkar, 1992).

The dehydrated peas are gaining popularity because they offer the advantages of greater shelf-life, palatability, convenience during transport & handling and also the original taste, flavour and colour is retained. Drying of horticultural produce is an important unit operation under post-harvest management. It refers to removal of moisture from fruits and vegetables and other products to a predetermined level. Processing should be done in such a way that food value, taste, natural flavour and cooking quality of fresh material are retained after drying. It also lowers the cost of packaging, transportation and storing by reducing both weight and volume of the final product. Seasonal gluts of peas cause uneconomic returns to the growers, which can be overcome by dehydrating them and making it available during off seasons. The present investigation is an attempt to find out the best suitable pre-treatment, drying method and their combination for value addition of green pea.

MATERIALS AND METHODS

The experiment was conducted in the Department of Post Harvest Management, KNK College of Horticulture, Mandsaur (M.P.) during 2010-2011.Fresh pea cultivar Arkel was used for drying and analysis of the study which was harvested from the farmer's field. Damaged and diseased pods were sorted out. After the sorting of pods the shelling was done manually by hands and seeds were graded according to their size. A total of twenty treatment combinations, four level of pre-treatments viz., untreated (T_0), blanching with 10% NaCl for 3 min (T_1), blanching with 15% NaCl for 3 min (T_2), blanching with 0.05% KMS 3 min (T_3), blanching with 0.1% KMS 3 min (T_4) and four level of drying methods viz., sun drying (D_1), solar drying (D_2), microwave drying (D_3), mechanical drying (D_4) and one control (untreated without any blanching pre-treatment) were selected for experiment (Table 1). A sample of 250 g was weighed for different treatments after initial chemical analysis of fresh pea seed. For three replications, a total 15 Kg of pea seed was taken for the experiment.

The dehydrated pea were analyzed for various physical and

chemical parameters viz., drying time (h), moisture content (%), diameter (mm), test weight (g), recovery (%), loss in weight (%), protein content (g), reducing sugars (%) and total sugars (%). The moisture content was determined by standard official methods of analysis. For evaluation of the moisture content of the fresh and dried pea, a sample of 100 g pea was kept in petri-dishes and the dishes were covered and then placed in hot air oven and dried for 24hr at 80°C. After drying the cover was replaced and the dishes were cooled in a desiccator and weighed again.The percentage moisture content was calculated as loss in weight of the original samples. The diameter pea seed was measured with digital vernier's caliper (Omega, Japan) and expressed in millimeter. The protein content of the peas sample was calculated by standard methods as suggested by A.O.A.C. (1960). Reducing sugars and total sugars of fresh and dried pea was estimated by using dinitro salicylic acid (DNS) as described by Miller (1972).To test the significance of variation in the data obtained, the analysis of variance (ANOVA) technique completely randomized block design was adopted and the significance of the difference in the treatment effect was tested through 'F' test.

RESULTS AND DISCUSSION

The different physico-chemical characteristics of pea analyzed during the study were significantly affected by different pre-treatments, drying methods and their combinations (Table 2).The results pertaining to drying time of pea as affected by different pre-treatments and different drying methods revealed that pre-treatment significantly affected the drying time. The minimum drying time (16.61 h) was recorded in T_2 where as the maximum drying time (22.62h) was recorded in T_0. Irrespective of pre-treatments, drying methods significantly affected the drying time of pea. Maximum drying time (33.2 h) was recorded in $D_1$and minimum drying time (0.45h) in D_3.The combination effects between the different pre-treatments and drying methods were also found significant. The minimum drying time (0.43 h) was observed in T_2D_3, whereas the maximum drying time (40 h) observed in T_0D_1. This is due the fact that the blanching has been found to enhance the drying rate of peas due to cell wall destruction. The similar results were reported by Pokharkar (2001) and Walde *et al.* (2006).

The moisture content of dehydrated pea was significantly affected by different pre-treatments, drying methods and their combinations. Irrespective of drying methods the minimum moisture content (6.15%) was recorded in T_2 and maximum (7.32%) in T_0. Irrespective of pre-treatments, the maximum moisture content (7.09%) was recorded in D_1 and minimum (6.14%) in D_3. This is due the fact that the moisture content decreases rapidly with increased temperature. In various treatment combinations, the maximum moisture content (8.67%) was obtained in T_0D_1 and minimum (5.97%) in T_2D_3. The similar results were reported by Walde *et al.* (2006), Shukla and Singh (2007), and Thakur (2008).

The different pre-treatments non-significantly affected the diameter of dehydrated pea. The diameter of dehydrated pea was significantly affected by drying methods. The maximum diameter (6.77 mm) was recorded in D_3 and minimum (5.19 mm) in D_4. The reason may be the hydrostatic pressure generated by physiological processes within the living cells giving rigidity to fresh produce but this turgor is lost when tissue is heated. The interaction effects between the different pre-treatments and drying methods were found significant. The minimum diameter (5.04 mm) was observed in T_3D_1, whereas maximum (7.39 mm) was observed in T_4D_3. Similar results have been reported by Pradeshi *et al.* (2001) and Sethi *et al.* (2003).

The test weight of dehydrated pea was significantly affected by different pre-treatments, drying methods and their combinations. Irrespective of drying methods, the minimum test weight (11.86 g) was obtained in treatment T_2, whereas the maximum test weight (13.17 g) was recorded in T_0. Irrespective of pre-treatments, the maximum test weight (13.14

Table 1: Various treatment combinations

S.No.	Treatment combination		Symbol
	Pre-treatment	Drying method	
1	Untreated (Without any blanching treatment)	Sun drying	T_0D_1
2	Blanching with 10% NaCl for 3 min	Sun drying	T_1D_1
3	Blanching with 15% NaCl for 3 min	Sun drying	T_2D_1
4	Blanching with 0.05%KMS for 3 min.	Sun drying	T_3D_1
5	Blanching with 0.1% KMS for 3 min	Sun drying	T_4D_1
6	Untreated (Without any blanching treatment)	Solar drying	T_0D_2
7	Blanching with 10% NaCl for 3 min	Solar drying	T_1D_2
8	Blanching with 15% NaCl for 3 min.	Solar drying	T_2D_2
9	Blanching with 0.05%KMS for 3min	Solar drying	T_3D_2
10	Blanching with 0.1% KMS for 3 min	Solar drying	T_4D_2
11	Untreated (Without any blanching treatment)	Microwave drying	T_0D_3
12	Blanching with 10% NaCl for 3 min	Microwave drying	T_1D_3
13	Blanching with 15% NaCl for 3 min	Microwave drying	T_2D_3
14	Blanching with 0.05%KMS for 3 min	Microwave drying	T_3D_3
15	Blanching with 0.1% KMS for 3 min	Microwave drying	T_4D_3
16	Untreated (Without any blanching treatment)	Mechanical drying	T_0D_4
17	Blanching with 10% NaCl for 3 min	Mechanical drying	T_1D_4
18	Blanching with 15% NaCl for 3 min	Mechanical drying	T_2D_4
19	Blanching with 0.05%KMS for 3 min	Mechanical drying	T_3D_4
20	Blanching with 0.1% KMS for 3 min	Mechanical drying	T_4D_4

Table 2: Effect of treatment combinations on different physico-chemical parameters of pea

Treatment combination	Parameter Drying time (h)	Moisture content (%)	Diameter (mm)	Test weight (g)	Recovery (%)	Loss in weight (%)	Protein content (g)	Reducing sugars(%)	Total sugars(%)
T_0D_1	40	8.67	5.35	14.27	23.60	76.40	22.38	3.92	6.28
T_1D_1	32	6.33	5.60	12.26	25.50	75.00	22.41	3.72	6.29
T_2D_1	30	6.50	5.18	11.94	24.47	75.27	22.46	3.91	6.28
T_3D_1	32	6.83	5.04	12.93	24.07	75.53	22.45	3.83	6.29
T_4D_1	32	7.10	5.27	14.31	23.87	75.67	22.46	3.73	6.31
T_0D_2	26	7.27	5.25	12.64	22.67	77.20	22.41	3.80	6.31
T_1D_2	22	6.25	5.20	11.85	24.60	75.00	22.43	3.96	6.32
T_2D_2	20	6.08	4.91	11.62	23.20	76.33	22.46	3.94	6.29
T_3D_2	22	6.43	5.39	13.47	22.00	77.33	22.47	4.01	6.35
T_4D_2	22	6.58	5.56	12.86	22.87	76.27	22.47	3.88	6.38
T_0D_3	0.48	6.17	6.78	12.64	22.40	77.13	22.39	3.93	6.64
T_1D_3	0.45	6.00	6.61	12.16	23.20	76.60	22.46	4.06	6.68
T_2D_3	0.43	5.97	6.34	11.47	24.93	76.13	22.54	4.23	6.72
T_3D_3	0.45	6.13	6.72	10.19	24.53	75.47	22.53	4.54	6.68
T_4D_3	0.46	6.43	7.39	10.93	23.87	76.80	22.48	4.16	6.77
T_0D_4	24	7.17	5.33	13.13	26.57	73.93	23.43	3.86	6.35
T_1D_4	20	6.37	5.08	12.60	25.27	74.73	23.46	3.96	6.37
T_2D_4	16	6.07	5.67	12.42	26.67	73.53	23.52	4.03	6.41
T_3D_4	18	6.23	5.20	12.86	24.87	75.80	23.56	4.11	6.38
T_4D_4	18	6.00	4.66	12.11	24.93	75.27	23.62	4.18	6.44
S.Em.±	0.742	0.247	0.151	0.083	0.436	0.720	0.017	0.101	0.024
CD at 5%	2.120	0.706	0.433	0.236	1.245	2.058	0.050	Non-significant	Non-significant

g) was recorded in D_1 and minimum (11.48 g) in D_3. In various treatment combinations, the minimum test weight (10.19 g) was obtained in T_3D_3, whereas maximum (14.31 g) in T_4D_1. The present findings are supported by Thakur (2008).

The recovery percent of dehydrated pea was significantly affected by pre-treatments. The maximum recovery (24.82%) was recorded in T_2, whereas the minimum recovery (23.81%) was recorded in T_0. Recovery percent was also significantly affected by drying methods. The maximum recovery (25.66%) was recorded in D_4 and minimum (23.07%) in D_2. The interaction effects between the different pre-treatments and drying methods were found significant. The maximum recovery (26.27%) was obtained in T_2D_4, whereas the minimum (22.00%) in T_3D_2. Higher recovery of dehydrated pea may be attributed to the process of osmosis. Similar results have been reported by Prajapati *et al.* (2011).

The loss in weight of dehydrated pea was significantly affected by pre-treatments. The minimum loss in weight (75.32%) was recorded in T_2, whereas the maximum loss in weight (76.17%) was recorded in T_0. Loss in weight was significantly affected by drying methods. The minimum loss in weight (74.65%) was recorded in D_4 and maximum (76.43%) in D_2 and D_3. The loss in weight of dehydrated pea was significantly affected by treatment combinations of drying methods and pre-treatments. The minimum loss in weight (73.53%) was obtained in T_2D_4, whereas the maximum (77.33%) in T_3D_2. The result indicates that the loss in weight of pea seeds increased after dehydration. The present findings are supported by Sagar *et al.* (1997) and Baysal *et al.* (2003) in carrot.

The protein content of dehydrated pea was significantly affected by pre-treatments. The maximum protein content (22.76 g) was recorded in T_4 and minimum protein content (22.65 g) was recorded in T_0. The protein content of dehydrated pea was significantly affected by drying methods. The maximum protein content (23.52 g) was recorded in D_4 and minimum (22.43 g) in D_1. The protein content of dehydrated pea was significantly affected by combinations of drying methods and pre-treatments. The maximum protein content (23.62 g) was obtained in T_4D_4, whereas the minimum (22.38 g) in T_0D_1. This is may be due to less break down of protein. Similar results were observed by Nahry *et al.* (1978) and Sethi *et al.* (2003).

The reducing sugars content of dehydrated pea was significantly affected by pre-treatments. The maximum reducing sugars content (4.12%) was recorded in T_3 and minimum reducing sugars content (3.88%) was recorded in T_0. Reducing sugars content of dehydrated pea was significantly affected by different drying methods. The higher reducing sugars content (4.18%) was recorded in D_3 and minimum (3.82%) in D_1. The reducing sugars content has been increased after dehydration of pea. The reducing sugars content of dehydrated pea was not significantly affect by combination of drying methods and pre-treatments. Similar results have been reported by Machewad *et al.* (2003), Prajapati *et al.* (2011) and Shivanand *et al.* (2015).

The total sugars content of dehydrated pea was significantly affected by pre-treatments. The maximum total sugars content (6.47%) was recorded in T_4 and minimum total sugars content (6.40%) was recorded in T_0. Total sugars content of dehydrated pea was significantly affected by the different drying methods. The higher total sugars content (6.70%) was recorded in D_3 and minimum (6.29%) in D_1. The total sugars content of dehydrated pea was not significantly affected by combination of drying methods and pre-treatments. Similar results have been reported by Machewad *et al.* (2003), Prajapati *et al.*

(2011) and Shivanand *et al.* (2015).

From the present investigation, it can be concluded that most of the physico-chemical characteristics of dehydrated pea were significantly influenced by different pre-treatments, drying methods and their combinations. Among the tested treatments, the pre-treatment of blanching with 15% NaCl for 3 min was found best which exhibited minimum drying time (0.43 h), moisture content (5.97%), loss in weight (73.53%) and maximum recovery (26.27%) whereas among the tested drying methods, the mechanical drying was found best which exhibited maximum protein content (23.62%) with loss in weight (73.53%). It is also concluded that the treatment combination T_2D_4 (blanching with 15% NaCl for 3 min x mechanical drying) was found best for most of the physical and chemical characteristics of dehydrated pea.

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