International Journal of Chemical Studies 2019; 7(2): 1088-1091

International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(2): 1088-1091

Received: 09-01-2019
Accepted: 13-02-2019

Ashok K Senapati
Centre of Excellence on Post Harvest Technology, Navsari Agricultural University, Navsari, Gujarat, India

Anil K Varshney
Deprtment of Processing and Food Engineering, College of Agricultural Engineering & Technology, JAU, Junagadh, Gujarat, India

Vineet K Sharma
Centre of Excellence on Post Harvest Technology, Navsari Agricultural University, Navsari, Gujarat, India

Correspondence
Ashok K Senapati
Centre of Excellence on Post Harvest Technology, Navsari Agricultural University, Navsari, Gujarat, India

Dehydration of green peas: A review

Ashok K Senapati, Anil K Varshney and Vineet K Sharma

Abstract
Green Pea (*Pisum sativum* L.) is the most common and one of the important and popular leguminous vegetable crops grown throughout the world and it ranks top ten among the vegetable crops. Apart from imparting a delicious taste, it has high nutritive value used in many culinary preparations and it serves several medicinal actions. Processing and preservation of green peas by suitable methods is a major thrust area since long back. The various kinds of methods followed for drying of green peas, such as solar drying, hot air convective drying, fluidized bed drying, microwave drying and infrared drying. These techniques are mainly used for preservation and value addition of green peas.

Keywords: green peas, dehydration, nutritional value

Introduction

Pea (*Pisum sativum* L.) is one of the most popular pulse crops of India. It ranks top ten among the vegetable crops and belongs to Fabaceae family. In India, pea is grown in winter as well as summer seasons and each pea pod is having several seed of green or yellow colour. The fruit is a typical pod containing four to nine seeds. They are used for 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. The area and production of green peas in India is about 5.46 million ha and 5.45 million tonnes, respectively. The major Pea producing states are Uttar Pradesh, Punjab, Himachal Pradesh, Orissa, Karnataka and Haryana, etc.

Due to their seasonal and perishable nature, peas must be subjected to preservation such as canning, freezing or drying in order to make them available for later consumption (Pardeshi *et al*., 2009; Shukla *et al*. 2014) [23, 31]. Taking into consideration the seasonal availability and regional abundances along with perishability of green peas which is of vital importance in human diet, the preservation becomes an essential requirement (Lin *et al*., 2005) [18]. Green peas are eaten cooked as a vegetable and are marketed fresh, canned, or frozen while dried peas are used whole, split, or made into flour (Davies *et al*., 1985) [7]. In some parts of the world, dried peas are consumed split as dal, roasted, parched or boiled. Some cultivars of green peas are grown for their tender green pods, which are eaten cooked or raw (Duke, 1981) [9].

The food preservation is very important from its safety point of view. As green peas *(Pisum sativum*) are one of the vital importances in human diet which is seasonally available as well as regional abundances with highly perishable in nature, the preservation is highly essential. Now a day, food market requires with high nutritional and organoleptic properties of the dried food products which are very similar with fresh product. Drying of food is a very important because it is one of the easiest and the most common and the oldest and most widely used methods of food preservation. Longer shelf life, palatability, product diversity and substantial volume reduction are the reasons for the popularity of dried products (Sharma and Prasad, 2001; Chauhan & Srivastava, 2009) [28, 5]. It also lowers the cost of packaging, transportation and storing by reducing both weight and volume of the final produce (Chauhan & Srivastava, 2009; Shukla *et al*. 2014) [5, 31]. The mould and bacteria growth as well as losses of active ingredients can be significantly reduced and post harvest infection could be avoided. Dehydration of food is meant to produce a final concentrated product, which when adequately packaged has a longer shelf life, after which the food can be simply reconstituted without substantial loss of flavour, taste, colour, aroma and overall acceptability.

Objective of this review studies is to indicate different dehydration method of pea and its effect on property of final product.

Various methods of drying of green peas
The most commonly adopted drying practices for green peas are sun drying or solar drying, convective hot air drying, fluidized bed drying, microwave drying, freeze drying and infrared drying.

Solar Drying and sun drying of green peas
The sun drying of agricultural produce is very widespread and cost effective method but it causes considerable quantitative losses due to factors such as rodents, birds, insects, dust and rain. Therefore, the quality of the dried products may also be lowered significantly. The inherent problems associated with open sun drying can be solved by making use of solar dryers which are generally classified on the mode of operation such as direct, indirect and mixed mode types with natural or forced circulation of the drying air (Madhlopa and Ngwalo, 2007) [19]. The quality of solar cabinet dehydrated green peas was found better as compared to open sun drying. In solar cabinet drying of generally the pretreated green peas is kept at 6 % moisture content (db). During drying the air temperature, relative humidity, and air velocity in the dryer were in the range 40, 60 ^{0}C, 40 and 50%, and 0.9 and 1.0 m/s, respectively (Jadhav *et al*. 2010) [15]. Sunil *et al*. 2013) [32] developed and evaluated a natural convection solar dryer (0.6 m^2 drying area with volume 0.108 m^3) for drying of green peas at drying temperature of 50-70 ^{0}C. The entire drying process took place exclusively in falling rate period starting from initial moisture content (73 % w.b.) to final moisture content (1.1 to 4.3 % w.b.). The drying time was reduced by solar drying as compared to open sun drying. Green peas dried in solar cabinet dryer using the pretreatment at optimum conditions and some selected quality parameters like color (a value), hardness, rehydration ratio, shrinkage, overall acceptability, and drying time were used to compare the solar cabinet drying method with other drying techniques. The solar dryer was found to be more efficient than open sun drying and resulted in saving to an extent of about 35.7% of drying time. The rehydration capacity of green peas dried in solar dryer was found higher than open sun dried peas.

Convective drying of green peas
The convective drying of green peas is used mainly now-a-days at a commercial scale. According to Pardeshi *et al*. (2009) [23], a thin layer drying of three varieties (Pb-87, Pb-88 and Matar Ageta-6) of green peas was carried out in hot air drying chamber using an automatic weighing system at five temperatures (viz. 55, 60, 65, 70 and 75 ^{0}C) with a air velocity of 100 m/min. The green peas were blanched and sulphited (0.5%) before drying. The result of the study revealed that difference between temperatures of drying air and that of green pea kernels was found to decrease with drying time for all the drying temperatures taken for investigation. The thin layer drying of green peas showed that all varieties of green peas are not suitable for the purpose of drying.
Shete *et al*. (2015) [29] studied the effects of pre-treatments and drying temperatures on the quality of dried green peas. The fresh green peas having 70 to 75 % wet basis moisture content with respect to pre-treatments viz., raw, blanched and blanched after pricking were taken for drying experiment. A laboratory model tray dryer was taken to dry green peas with different levels of drying air temperatures (50, 60 and 70 ^{0}C). Drying time, reduction in moisture was calculated using observed data during tray drying. The moisture content of green peas decreased with elapsed drying time during tray drying of green peas. The drying rate was found higher at 70 ^{0}C when compared to 50 ^{0}C and 60 ^{0}C drying air temperature.

Microwave drying of green peas
The heat generated at a particular location in the material is depended on the distance from the surface on which microwave incident (Lambert's microwave absorption relationship). Since the diameter of green peas is much smaller than the penetration depth of the microwave field, a uniform electric field strength distribution and thus a uniform microwave heating within the material could be considered (Chen *et al*., 2001) [6]. Priyadarshini *et al*. 2013) [25] investigated the drying characteristics of green peas under microwave dryer at power level of 20, 40 and 60W. The green peas were pretreated with citric acid solutions and blanched with hot water at 85 ^{0}C before drying. The drying process was continued until sample moisture fell to equilibrium moisture content. The drying rate curve contained no constant rate drying period but the drying process took place in the falling rate period (Shukla *et al.* 2014) [31].

Fluidized bed drying of green peas
The use of fluidization is one of the technologies commonly used in drying agro-food materials and other materials. Fluidized bed drying has been recognized as a gentle, uniform drying method, capable of drying down to very low residual moisture content with a high degree of efficiency (Borgolte *et al*., 1981) [4]. This process is characterized by high moisture and heat transfer rates and excellent thermal control capacity compared with conventional drying processes (Vanecek *et al*. 1966; Hovmand, 1987) [33, 14]. It is also a very convenient method for drying heat sensitive food materials as it prevents them from overheating due to mixing (Gibert *et al*., 1980; Giner and Calvelo, 1987) [12, 13]. Fluidized bed drying can be carried out as a batch or continuous process (Shilton and Niranjan, 1993) [30]. The physical properties such as particle density, bulk density of the bed, and shrinkage and bed porosity of fresh green peas were compared in fluidized bed drying with fixed bed drying at 50 ºC. Empirical mathematical models were developed to characterize the change of fluidization velocity with the moisture. Pablo Garcia Pascual *et al*. (2004) [21] investigated the drying of green peas in a fluidized bed heat pump dryer under normal and atmospheric freeze drying conditions. Three types of green peas and two bed heights were used in the drying trials, operating either in isothermal conditions or on a combination of temperatures. The atmospheric freeze drying permits to obtain dried samples with high quality sensory properties.
Zhanyong *et al*. (2006) [34] developed a modified fluidized bed termed as pulsed fluidized bed (PFB), to eliminate some limitations of the conventional fluidized bed (40,50,60,70 and 80 ^{0}C) by superposing a pulsating air stream (120-320 m^3/h) with a desirable air temperature (80 and 90 ^{0}C) on the continuously flowing fluidizing air. The PFB drying of green peas is superior to that in FB in terms of drying rate as well as colour preservation. The drying techniques are best suited for seat sensible agricultural products.
Deshmukh *et al*. (2015) [8] reported that fluidization is formed when solid particulate substance usually present in a holding vessel under appropriate conditions to cause the solid/fluid mixture to behave as a fluid. The drying rate increases as increasing the velocity of the drying air, while decreases with increases solids holdup. The drying rate was found to increase significantly with increase in temperature and flow rate of the heating medium as the time increases. Best result were found

in case for moisture ratio and initial to the final moisture content in case of split pea gram and in case of split red gram, mass in dry basis and wet basis were found to be best.

Hot air infrared drying

Drying of green peas in a Fluidized Bed Dryer (FBD) with inert particle, heated by combined sources of hot air and Infra Red (IR) radiation was studied.

Eshtiagh and Zare (2015) [11] examined the drying characteristics of green peas during combined hot air infrared drying. The experiments were carried out for combination of four infrared power intensities (0, 0.2, 0.4 and 0.6 W/cm^2), three levels of drying air velocity (0.5, 1 and 1.5 m/s), and three levels of drying air temperatures (30 °C, 40 °C and 50 °C). Application of infrared radiation in conjunction with hot air drying led to higher drying rate in comparison with the conventional hot air drying. The effective moisture diffusivity for several drying conditions was calculated in the range from 1.39×10^{-10} to 5.72×10^{-10} m^2/s.

Quality evaluation of green peas

Green Pea is healthy and nutritious vegetable and rich in crude protein, carbohydrate, vitamin A and C, calcium, phosphorous, iron, zinc and contains reasonable quantity of dietary fibres. Several scientists have been reported the nutritional composition of peas earlier. According to Agarwal *et al*. 1969) [1] moisture content of pea lies 71.87 to 75.40 % and Khurdiya *et al*. 1972) [17], Kaur *et al*. 1976) [16] and Michael Eskin, 1984) [20] also reported 76.3 to 79.2% and 75.08 to 77.48 % and 71.25 to 76.01% moisture content, respectively in different varieties of peas. Pawar *et al*. (1994) [24] reported the moisture content ranging from 71-25 to 73.65 % of green peas having cylindrical pods.

Savage and Deo, (1989) [27] reported pea contains high level of protein and digestible carbohydrates and low level of fiber as well as fat. The crude protein content of mature green peas were found to be 38.3 % (Pandey and Gritton, 1975) [22]. According to Renu and Bhattacharya (1989) [26], crude protein content of peas varied from 15.0 to 29.3 per cent. Black (1998) [3] reported that protein level of pea (dry matter basis) ranged from 19.4 to 31.0 per cent. According to several researchers the protein content of green peas varied from 15.6 and 32.5 g per 100g.

Edelenbos *et al.* (2001) [10] studied chlorophyll and carotenoid pigments from six cultivars of processed green peas such as Avola, Tristar, Rampart, Turon, Bella and Greenshaft which are extracted with 100% acetone and analyzed by reversed-phase HPLC. A total of 17 pigments were identified in the pea cultivars including 8 xanthophylls. On average of the two years, the chlorophyll a concentration varied from 4800 to 7300 micro g/100 g fresh weight, the chlorophyll b concentration varied from 2100 to 2800 micro g/100 g fresh weight, the (all-E)-lutein concentration from 1200 to 1900 micro g/100 g fresh weight and the (all-E)-beta-carotene concentration from 300 to 490 micro g/100 g fresh weight in the processed pea cultivars.

Jadhav *et al*. (2010) [15] reported the color (a value) and hardness (g) of the dehydrated green peas and found that at 4.24 min blanching time and0.49% KMS concentration resulting into 7.86 color (a value) and 548 g hardness.

Azadbakht *et al*. (2015) [2] was observed in the physical properties that moisture changes were affective at 1% in dimensions, geometric mean diameter, volume, sphericity index and the surface area. It was observed in the mechanical properties that moisture changes were effective at 1% on maximum deformation, rupture force, rupture energy, toughness and the power to break. Loading speed was effective on maximum deformation, rupture force; rupture energy at 1% and it was effective on toughness at 5%. Loading orientation was effective on maximum deformation, rupture force, rupturing energy, toughness at 1% and it was effective on power at 5%. The mutual effect of speed and orientation were effective on rupture energy at 1% and were effective on toughness at 5% probability. The mutual effect of moisture and speed were effective on rupture force and rupture energy at 1% and were effective on toughness 5% probability. The mutual effect of orientation and moisture on rupture energy and toughness were effective at 1%.

Conclusion

Review of different dehydration techniques of green peas reveal that several analytical and numerical methods are available for analyzing the drying behavior as well as quality parameters. However, there are some other methods of drying such as vacuum drying, dehumidified air drying etc. which can be explored in order to assess the effect of different operating parameters on quality of green peas as it contains several essential nutrients and has huge medicinal value. Combination of two or more drying methods or multimode drying techniques can also be adopted for drying of green peas. Moreover, there is a scope for establishing proper correlation between drying conditions and energy consumption of dehydrated green peas. Further research can be done to recommend suitable method of drying and to optimize the requisite conditions for drying of green peas.

References

1. Agarwal P, Rodriguez R, Saha NK. Studies on some important varieties of green peas of Northern India I. Physiochemical characteristics. Indian Food Packer. 1969; 23(6):12-16.
2. Azadbakht M, Ghajarjazi E, Aminr E, Abdigoal F. Determination of some Physical amd mechanical properties of pofaki variety of pea. International Journal of Agricultural and Bio Engineering. International Scholar and Scientific Research and Innovation. 2015; 9(5):486-493. Scholar.org/1307-6892/10001262.
3. Black RG, Brovwer JB, Meares C, Lyer L. Variation in physicochemical properties of field peas (*Pisum Sativum*). Fd. Res. Intn. 1998; 31(2):81-86.
4. Borgolte G, Simon EJ. Fluid bed processes in the manufacture of snacks products. CED review for chocolate, Confectionery and Bakery. 1981; 6(2):7-8, 10.
5. Chauhan AKS, Srivastava K. Optimizing drying conditions for vacuum assisted microwave drying of green peas. Drying Technology. 2009; 27:761-769.
6. Chen G, Wang W, Mujumdar SA. Theoretical study of microwave heating patterns on batch fluidized bed drying of porous material. Chem Eng Sci. 2001; 56:6823-6835.
7. Davies DR, Berry GJ, Heath MC, Dawkins TCK. Pea (*Pisum sativum* L.). p. 147-198. In: R.J. Summerfield and EH Roberts, (eds.), Williams Collins Sons and Co. Ltd, London, UK, 1985.
8. Deshmukh V, Chandraker N, Thakur RS, Chandrakar AK. Analysis of moisture content of pulses pellets using fluidized bed dryer. Journal of Chemical and Pharmaceutical Research. 2015; 7(6):447-451.
9. Duke JA. Hand book of legumes of world economic importance. Plenum Press, New York, 1981, 199-265.

10. Edelenbos M, Christensen LP, Grevsen K. HPLC determination of chlorophyll and carotenoid pigments in processed green pea (*Pisum sativum* L.) cultivars. J Agric. Food Chem. 2001; 49(10):4768-74.
11. Eshtiagh A, Zare D. Modeling of thin layer hot air-infrared drying of green peas. Agricultural Engineering International: The CIGR e-journal. 2015, 246-258.
12. Gibert H, Baxerres JL, Kim H. Blanching time in fluidized beds. In Food Process Engineeing; 1: Food Processing Systems, (P. Linko, Y. Malkki, J. Olkku and J. Larinkari Eds), Applied Science Publishers, London, 1980, 75-85.
13. Giner SA, Calvelo A. Modelling of wheat drying in fluidized beds. Journal of Food Science. 1987; 52(5):1358-1363.
14. Hovmand S. Fluidized bed drying. In hand book of industrial drying. (A.S. Majumdar eds). Marcel Dekker, NY, USA, 1987.
15. Jadhav DB, Visavale GL, Sutar N, Annapure US, Thorat BN. Studies on Solar Cabinet Drying of Green Peas (Pisum sativum).Drying Technology, 2010, 28. DOI: 10.1080/07373931003788064:600-607.
16. Kaur G, Shukla FC, Singh D. Studies on varietal differences in physiochemical characteristics of some varieties of peas. Indian Food Packer. 1976; 30(4):5-9.
17. Khurdiya DS, Ambadan, Muralikrishna M, Phal R, Chaudhoury B. Varietal trial on dehydration of peas. Indian Food Packer. 1972; 26(4):5-7.
18. Lin DL, Lee YC. The development of vacuum cooling technology in Taiwan. Proceedings of a symposium on research and application of postharvest technology of horticultural crops. Agricultural Research Institute, COA. Taichung, Taiwan, 2005.
19. Madhlopa A, Ngwalo G. Solar dryer with thermal storage and biomass-backup heater. Solar Energy. 2007; 81:449-462.
20. Michael, Eskin NA. Quality and preservation of vegetables. CRC Press Inc., Boca Raton, Florida, 1984.
21. Pablo García-Pascual, Odilio Alves-Filho, Ingvald Strømmen, Trygve ME. Heat Pump atmospheric freeze drying of green peas. Drying 2004 -Proceedings of the 14th International Drying Symposium (IDS 2004) São Paulo, Brazil, 22-25 August 2004; C:1521-1528.
22. Pandey S, Gritton ET. Protein levels in developing and mature pea seeds. Can. J Plant Sci. 1975; 55:185-190.
23. Pardeshi IL, Arora S, Boker PA. Thin layer drying of green peas and selection of a suitable thin layer drying model. Drying Technology. 2009; 27:288-295.
24. Pawar VN, Gunjal BB, Ingle UM, Ghatge UM. Studies on the varietal differences in some physico-chemical characteristics and quality of frozen peas (*Pisum sativum* L.). Indian Food Packer (July-August) 1994, 5-13.
25. Priyadarshini, Shukla RN, Mishra AA. Microwave drying characteristics of green peas and its quality evaluation. International Journal of Agriculture and Food Science Technology. ISSN 2249-3050, 2013; 4(5):445-452.
26. Renu, Bhattacharya L. Proximate composition of improved genotype of peas (*Pisum sativum*). Bull. Grain Technol. 1989; 27:118-123.
27. Savage GP, Deo S. The nutritional value of peas (Pisum sativum): A literature review. Nutrition Abstracts and Reviews (series A). 1989; 59:66-83.
28. Sharma GP, Prasad S. Drying of garlic (*Allium sativum*) cloves by microwave-hot air combination. Journal of Food Engineering. 2001; 50:99-105.
29. Shete YV, More MM, Deshmukh SS, Karne SC. Effects of pre treatments and drying temperatures on the quality of dried green peas. International Journal of Agricultural Engineering. 2015; 8(2):EISSN:0976-7223, DOI:10. 15740/ HAS/ IJAE/8.2/220-226..e 8.
30. Shilton NC, Niranjan K. Fluidization and its applications to food processing, Food Structure. 1993; 12:199-215.
31. Shukla RN, Priyadarshini, Mishra AA. An Experimental Study and Mathematical Modeling of Microwave Drying of Green Peas. International Journal of Advances in Engineering & Technology. 2014; 6(6):2618-2624.
32. Sunil, Varun, Sharma N. Modeling the drying kinetics of green peas in a solar dryer and under open sun. International Journal of Energy and Environment. 2013; 4(4):663-676.
33. Vanecek C, Markvart M, Drbohlar R. Fluidized bed drying, Lenard Hill London, UK, 1966.
34. Zhanyong Li, Jingsheng Ye, Hongtai Wang, Ruifang Wang. Drying characteristics of green peas in fluidised bed. BECTHNK. ISSN 0136-5835.TTTY.TOM 12.No.3A.Tractionons TSTU. 2006, 668-674.
35. https://ndb.nal.usda.gov/ndb/foods/show/11304.
36. https://www.backyard-vegetable-gardening.com/varieties-of-peas.htm.
37. http://www.fao.org/faostat/en/#data 2017.
38. http://whfoods.org/genpage.php?tname=foodspice&dbid=55.
39. http://www.whfoods.com/genpage.php?tname=foodspice&dbid=56.