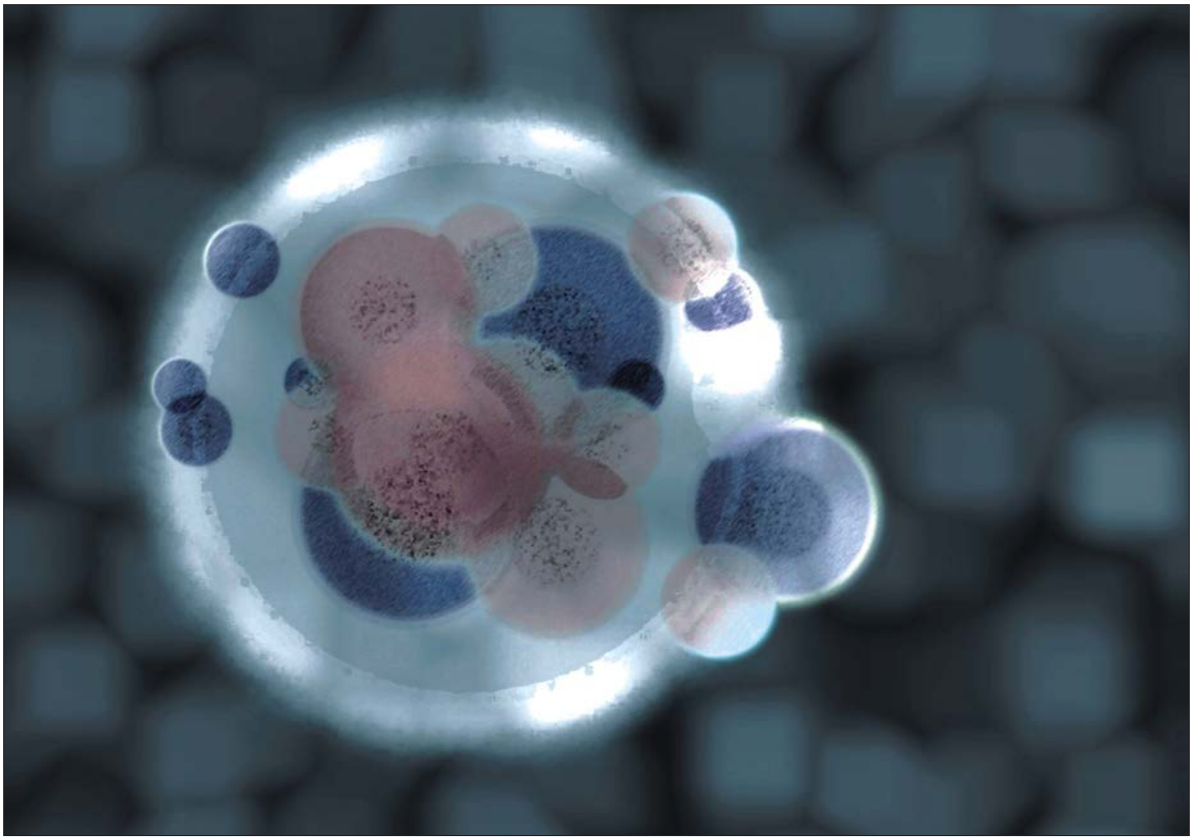

Journal of Biological Sciences

ISSN 1727-3048

science alert

ANSInet
an open access publisher
http://ansinet.com

Journal of Biological Sciences 8 (2): 446-450, 2008
ISSN 1727-3048

Influence of Storage Conditions on Quality and Shelf Life of Stored Peas

[1]L.A. Babatola, [2]D.O. Ojo and [2]I.O. Lawal
[1]Department of Agronomy, University of Ibadan, Nigeria
[2]National Horticultural Research Institute, Ibadan, Nigeria

Abstract: An experiment was conducted from April through September 2000 at Department of Agronomy, University of Ibadan, Nigeria to evaluate the effects of storage conditions on the quality and storage life of peas, using four storage conditions; Deep Freezer (0°C; 95%RH) -DF, Room Refrigerator (12°C; 85% RH)-RR, Storage Incubator (8°C; 80% RH) -SI and Ambient Storage Environment (as control, 32°C, 85% RH) ASE and three peas varieties: Green pea (*Pisum sativum*) -GP, Green bean (*Phaseolus vulgaris*) -GB; Runner Bean (*Phaseolus coccineus*) RB. Storage conditions in terms of quality preservation ranked in the order: DF > RR > SI > ASE, while for variety RB > GP > GB in terms of pod yellowing and Vitamin A content while for pod rottening it ranked in the order: RB > GB> BP

Key words: Peas, storage, relative humidity, temperature, quality, shelf life

INTRODUCTION

Peas belong to the family leguminoseae. The protein rich vegetable peas are especially important in Sub-Sahara Africa (SSA) where per capital food production has steadily declined over the past three decades and poverty, religion and social circumstances either prevent or restrict meat consumption as a source of protein. The average vegetable and protein intakes of SSA populace fall short of FAO and WHO recommendations (FAO, 1999).

Worldwide postharvest fruit and vegetables losses are as high as 30 to 40% and even much higher in some developing countries. Reducing postharvest losses is very important; ensuring that sufficient food, both in quantity and in quality is available to every inhabitant in our planet. The prospects are also that the world population will grow from 5.7 billion inhabitants in 1995 to 8.3 billion in 2025. World production of vegetables amounted to 486 million ton, while that of fruits reached 392 million ton. Reduction of post-harvest losses reduces cost of production, trade and distribution, lowers the price for the consumer and increases the farmers income (Fasana, 2006).

Vegetable-peas are highly perishable and thus have an inherently short shelf life. They remain in salable condition at 0°C and 95 to 100% Relative Humidity (RH) for 7-9 days. Exposure to 20°C for 30 min each day can reduce this storage-life by half (Hardenburg *et al*., 1986; Varoquarux *et al*., 1996). This rapid quality loss at relatively modest temperatures emphasizes the critical need for immediate cooling of vegetable pulse (Thompson *et al*., 1998) especially in the humid tropics of SSA.

Proper postharvest processing and handling is an important part of modern agricultural production. Postharvest processes include the integrated functions of harvesting, cleaming, grading, cooling, storing, packaging, transporting and marketing. The technology of postharvest handling bridges the gap between the producer and the consumer - a gap often of time and distance. Postharvest handling involves the practical application of engineering principles and knowledge of fruit and vegetable physiology to solve problems (Fasana, 2006).

Utilizing improved postharvest practices often results in reduced food losses, improved overall quality and food safety and higher profits for growers and marketers. It is estimated that 9 to 16% of the product is lost due to postharvest problems during shipment and handling. Mechanical injury is a major cause of losses. Many of these injuries cannot be seen at the time that the product is packed and shipped, such as internal bruising in tomatoes. Other sources of loss include over-ripening, senescence, the growth of pathogens and the development of latent mechanical injuries (Fasana, 2006).

Many factors contribute to postharvest losses in fresh fruits and vegetables. These include environmental conditions such as heat or drought, mechanical damage during harvesting and handling, improper postharvest sanitation and poor cooling and environmental control. Efforts to control these factors are often very successful

Corresponding Author: I.O. Lawal, National Horticultural Research Institute, Ibadan, Nigeria

in reducing the incidence of disease. For example, reducing mechanical damage during grading and packing greatly decreases the likelihood of postharvest disease because many disease-causing organisms (pathogens) must enter through wounds (Fasana, 2006).

The challenge faced by decision-makers in many nations of SSA is how to preserve fresh vegetable produce in order to feed an increasing population. Many attempts have been made in the past. Commercially, preservation of vegetable products is difficult because of transportation networks and high environmental temperatures that favour decay rather than storage. Caught in between these fires of dilemma many decision makers resort to importation of preservation techniques for the temperate regions, which is to no avail in this part of the world. Very little information exists however on the benefit and optimum preservation temperature of existing small scale storage conditions. The object of this study was therefore to evaluate the effects of traditional storage conditions on the quality and storage life of three peas cultivars.

MATERIALS AND METHODS

Plant material: Peas pods were got from peas fields established specifically for the purpose of this experiment on the experimental grounds of the Department of Agronomy, University of Ibadan, Nigeria in the year 2000. The land (7°30'N, 4°30'E) had been under tomato and pepper cultivation in the previous year. The area during cultivation had average of 21.3°C temperature and relative humidity of 85%. Three peas namely Green Pea (*Pisum sativum*), Green Beans (*Phaseolus vulgaris*) and Runner Bean (*Phaseolus coccineus*) where used. NPK 15:15:15 was applied at 60 kg ha^{-1}, all other agronomic practices for the growth of crop follows essentially that used in Ojo and Olufolaji (1998). Pre-planting soil analyses showed the soil to contain nitrogen 0.03%, organic matter 0.03%, available P 0.24 g kg^{-1}, potassium 0.14%, calcium 0.52%, pH (1:1 H_2O) 3.99 and a sandy loam texture. Pods from the four replicates containing each of the cultivars were bulked, washed 3 times in distilled water at 23°C and then packed in cardboard boxes containing 98 kg each of produce. Transport to the laboratory took 20 min after which the pods were allowed to freely drain of excess water under ambient temperature 23.8°C. They were then divided into samples of 500 g and sealed in commercially available ZiplocTm bags with microperforations (DowBrands Canada, Paris, Ontario).

Storage treatment: Four traditionally available storage conditions were utilized: Deep freezer (0°C, 95% RH), Room refrigerator (12°C; 85% RH); Storage Incubator (15°C; 80% RH) and ambient storage environment (32°C; 85% RH). Each storage condition had three replicates of bags of 50 samples from where treatments were randomly selected for each cultivar. RH within the bag was maintained at >95%. Each group of bags was held separately in a commercially available 580×720×155 mm vented plastic container and the containers were stalked in the appropriate storage condition in the dark. No free water accumulated in the bags during storage.

Table 1: Rating scales used for measuring peas overall freshness

Rating descriptor	Percent	Ratings
4 Excellent	0	Overall appearance excellent; pod green and crisp, no major defects.
3 Good	25	Overall appearance good, some pod showing sign of yellowing/blackening at the tips; few defects; acceptable crispness of pods.
2 Acceptable	50	Appearance of the limit of being acceptable; pod flaccid; pod tip brown/black; some with brown streaks; several/many defects.
1 Unacceptable	75	No freshness, pods with black streaks and brown grooves.
0 Poor	100	Musty odour, pods brown, dry or slimy/decayed, many streaks and black.

Source: Overall freshness in terms of pod shelf life, yellowing, cracking, shriveling and rottening qualities

Quality analyses: The Vitamins A and C contents of the peas were evaluated before and after storage by method of Dubois and his Colleques through proximate analyses. Overall freshness was evaluated using a scale of 0 to 4 in line with that used in IPGRI/IITA descriptor for cowpea (1997) (Table 1). Weight loss was determined as a percentage of the original sample weight.

Statistical analyses: This was done using the completely randomised design with three replicates per treatment. There were 12 combinations of storage conditions (DF, RR, SI, ASE) with 3 cultivars (green pea, green beans, runner beans). Data were analysed using the General Linear Models Procedures of SAS (SAS Institute, 1998). Least Significant Different (LSD) and Duncan's Multiple Range Test (DMRT) was used to compare the means at 5% probability.

RESULTS AND DISCUSSION

Pods were green, crisp and had excellent overall appearance at the onset of experiment.

Across storage conditions, rate of pod yellowing ranked in the order DF > RR > SI > ASE while that of the variety ranked: Green pea > Runner bean > Green bean (Table 2). As the storage temperature increase yellowing increases. This agrees with the findings of Bachmann and

Table 2: Influence of storage condition and variety on percent pod yellowing in storage

Treatments*	Time sequence Initial	1 week	2 weeks	3 weeks	4 weeks
Storage condition					
ASE (32°C; 855% RH)	0.0	77.8	100.0	100.0	100.0
RR (12°C; 85% RH)	0.0	16.7	25.0	66.7	83.7
NSR (8°C; 80% RH	0.0	33.3	91.7	100.0	100.0
DF (0°C; 95% RH)	0.0	0.1	0.0	8.3	8.3
LSD (p = 0.05)	-	13.2	13.5	19.1	12.5
Peas variety					
Green pea	0.0	43.8	56.3	81.3	81.3
Green bean	0.0	43.8	56.3	68.8	68.8
Runner bean	0.0	31.3	50.0	56.3	68.8
LSD (p = 0.05)	-	6.1	5.3	10.7	7.2

*: ASE = Ambient Storage Environment, RR = Room Refrigeration, SI = Storage Incubator, DF = Deep Freezer. Interaction (storage condition × variety): not-significant at $p \leq 0.05$

Table 3: Influence of storage condition and variety on percent pod cracking in storage

Treatments*	Time sequence Initial	1 week	2 weeks	3 weeks	4 weeks
Storage condition					
ASE (32°C; 855% RH)	0.0	33.3	41.7	58.3	68.7
RR (12°C; 85% RH)	0.0	25.0	25.0	25.0	25.0
NSR (8°C; 80% RH	0.0	25.0	25.0	58.3	58.3
DF (0°C; 95% RH)	0.0	25.0	25.0	25.0	25.0
LSD (p = 0.05)	-	3.1	9.2	8.4	9.1
Pulses variety					
Green pea	0.0	31.3	31.8	43.8	58.2
Green bean	0.0	25.5	18.0	37.5	56.3
Runner bean	0.0	25.5	12.5	31.3	50.0
LSD (p = 0.05)	-	4.6	5.2	4.6	3.2

*: ASE = Ambient Storage Environment, RR = Room Refrigeration, SI = Storage Incubator, DF = Deep Freezer. Interaction (storage condition × variety) non-significant at $p \leq 0.05$

Table 4: Influence of storage condition and variety on percent pod Shriveling in storage

Treatments*	Time sequence Initial	1 week	2 weeks	3 weeks	4 weeks
Storage condition					
ASE (32°C; 855% RH)	0.0	50.3	58.7	83.3	100.0
RR (12°C; 85% RH)	0.0	0.0	0.0	25.0	100.0
NSR (8°C; 80% RH	0.0	11.0	50.0	66.3	100.0
DF (0°C; 95% RH)	0.0	0.0	0.0	0.0	0.0
LSD (p = 0.05)	-	8.1	2.9	9.4	10.9
Pulses variety					
Green pea	0.0	18.3	20.8	31.2	41.2
Green bean	0.0	12.5	2.9	20.8	31.2
Runner bean	0.0	12.5	6.7	25.0	28.0
LSD (p = 0.05)	-	3.9	5.8	4.9	9.8

*: ASE = Ambient Storage Environment, RR = Room Refrigeration, SI = Storage Incubator, DF = Deep Freezer. Interaction (storage condition × variety) non-significant at $p \leq 0.05$

Earls (2000). The variation in yellowing colouration among varieties could be attributed to genetic factors. Water deficit induces stress and increase ethylene production which in turn causes yellowing. Increased temperature in storage increases metabolic activities, which induce ethylene production and this in turn causes pod yellowing. These findings agree with the report of Wilson *et al.* (1995) that higher temperature causes toughening, yellowing and decay of fruits. There were no significant interaction in cracking rate of pods between the storage conditions and varieties (Table 3). However, ASE was significantly least up till the second week; while ASE and SI were significantly least from third to fourth week in terms of pod cracking in storage (Table 3). In the storage conditions pod shriveling generally follows the order DF > RR > SI > ASE; while variety ranked Runner bean > Green bean> Green pea (Table 4). Pod shriveling increased with increase storage days. Moisture loss is common from temperature difference of 2 to 4% (Thompson *et al.*, 1998), which in turn can cause wilting, or shriveling as witnessed in the storage conditions used (Table 4).

Table 5: Influence of storage condition and variety on pod rottening in storage

Treatments*	Time sequence Initial	1 week	2 weeks	3 weeks	4 weeks
Storage condition					
ASE (32°C; 855% RH)	0.0	0.0	0.0	0.3	0.0
RR (12°C; 85% RH)	0.0	0.0	6.7	40.4	51.0
NSR (8°C; 80% RH	0.0	0.0	45.0	63.7	100.0
DF (0°C; 95% RH)	0.0	0.0	0.0	0.0	0.0
LSD (p = 0.05)	0.0	0.0	12.5	7.9	3.3
Pulses variety					
Green pea	0.0	0.0	26.5	45.5	50.0
Green bean	0.0	0.0	12.8	32.5	32.8
Runner bean	0.0	0.0	0.0	0.0	31.0
LSD (p = 0.05)	0.0	0.0	14.3	5.1	8.8

*: ASE = Ambient Storage Environment, RR = Room Refrigeration, SI = Storage Incubator, DF = Deep Freezer. Interaction (storage condition × variety): not-significant at p≤0.05

Table 6: Effect of storage condition and variety on Vitamin A (mg kg^{-1}) content of peas in storage

Treatments*	Storage period Before	After	Percent decrease
Storage condition			
DF (0°C; 95% RH)	256.0	134.2	47.6
ASE (32°C; 85% RH)	244.0	108.0	55.7
NSR (8°C; 80% RH)	240.0	126.0	47.5
RR (12°C; 85% RH)	250.0	130.0	48.0
LSD (p = 0.05)	5.0	7.2	
Variety			
Green pea	260.0	111.1	57.3
Green bean	204.2	102.5	49.9
Runner bean	280.0	126.4	54.9
LSD (p = 0.05)	20.0	10.2	49.0

*: ASE = Ambient Storage Environment, RR = Room Refrigeration, SI = Storage Incubator and DF = Deep Freezer. Interaction (storage condition × variety): not-significant at p≤0.05

Table 7: Effect of storage condition and variety on Vitamin C (mg/kg) content of peas in storage

Treatments*	Storage period Before	After	Percent decrease
Storage condition			
DF (0°C; 95% RH)	33.5	19.6	57.6
ASE (32°C; 85%RH)	25.1	11.7	46.6
NSR(8°C; 80%RH)	17.2	10.6	61.6
RR (12°C; 85RH)	30.0	16.0	53.3
LSD(p = 0.05)	5.2	4.6	
Variety			
Green pea	29.3	18.6	63.5
Green bean	26.7	13.8	51.7
Runner bean	24.7	13.9	50.2
LSD	2.5	4.3	

*: ASE = Ambient Storage Environment, RR = Room Refrigeration, SI = Storage Incubator, DF = Deep Freezer. Interaction (storage condition × variety): not-significant at p≤0.05

Rottening was not observed in storage conditions and among pulse varieties until 2nd week after storage (Table 5). The deep freezer treated peas did not rot at all even till 4th Week after Storage (WAS). This ranked DF best in shelf life preservation against rottening decay, followed by ASE, then, RR followed by SI (Table 5). Just like any other bean varieties are chilling sensitive, thus the rottening observed at the 2nd to 4th week of storage in lower temperatures might be due to chilling injury combined with relatively higher humidity.

No significant interactions between storage conditions by variety in Vitamin A (Carotene) content. The result was therefore summarized separately as shown in Table 6. Vitamin A (Carotene) content decreased drastically after the 4th week of storage in order of increasing Vitamin C (Ascorbic acid) content after the 4th week of storage in storage condition. Average across varieties was ASE > DF > RR >SI; while for variety ranked Green pea > Runner bean > Green bean which was to the tune of 20%, respectively (Table 7).

CONCLUSION

In summary, traditional storage conditions significantly influence post harvest quality and shelf life of peas. Quality of peas could best be preserved by the deep freezer, followed by room refrigeration, then in storage incubator and then ambient storage environment. Variety generally ranked best in storage shelf life the order Runner bean > Green pea > Green bean.

REFERENCES

Bachmann, J. and R. Earles, 2000. Post harvest handling of fruits and vegetables. ATTRA Horticultural Technical Note, 2000, pp: 19.

FAO (Food and Agricultural Organisation of the United Nations), 1991. FAO Annual Reports. Rome, Italy.

Fasana, P., 2006. Post harvest handling of fruits and vegetables. http://www.eco-web.com/editorial/060529.html

Hardenburg, R.E., A.E., Watada and C.Y. Wang, 1986. The commercial storage of fruits, vegetables and florist and nursery stocks. Agric. Ddbk. 66, US. Dep. Agric., Res. Branch.

IPGRI/IITA, 1997. Descriptor for cowpea. International plant genetic resources institute. Rome, Italy/International Institute of Tropical Agriculture, Ibadan, Nigeria, pp: 66.

Ojo, O.D. and A.O. Olufolaji, 1998. Optimum NPK fertilization rates for the growth and yield of *Solanium macrocarpon*. J. Vegetable Crop Prod., 3: 73-77.

SAS, 1998. SAS/STAT User's Guide. Release 6.03 Edn., SAS Inst., Cary, N.C., USA.

Thompson, J.F., F.G. Mitchell and R.F. Rasmire, 1998. Room, Vacuum, Transport and Ice Cooling. In: Commercial Cooling of Fruits, Vegetables and Flowers. Thompson, J.F., F.G. Mitchell, T.R. Rumsey, F. Kasmire and C.H. Crisosto (Eds.), Publ. 21567, University of California Division of Agriculture and Natural Resources, pp: 28-32.

Varoquarux, P., G. Albagnac, C. Nguyen and F. Varoquaux, 1996. Modified atmosphere packaging of fresh bean sprouts. J. Sci. Food Agric., 70: 224-230.

Wilson, L.G., M.D. Boyette and E.A. Estes, 1995. Postharvest Handling and Cooling of Fruits, Vegetables and Flowers for Small Farms, Part I: Quality Maintenance. N.C. Coop. Exten. Serv. Hortic. Info. Leaf. No. 800. Wilson, L.G., M.D. Boyette and E.A. Estes, pp: 4.