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Research Paper :

Effect of evaporatively cooled storage on potato

ANJALI CHANDRA AND AJEET KUMAR SINGH

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See end of the article for authors' affiliations

Correspondence to:

ANJALI CHANDRA
Department of Home Science, Ram Krishan Misson Ashrama, Divyayn Krishi Vigyan Kendra, RANCHI (JHARKHAND) INDIA

ABSTRACT

Potatoes contain 80% water and therefore are semi-perishable in nature. The quality of potato and its storage life is reduced by the loss of moisture, decay and physiological breakdown. These deteriorations are directly related to storage temperature, relative humidity, air circulation and gas composition. Potatoes, being a living organism, require an effective management for storage. Quality of the potatoes deteriorates gradually during storage. Bruise prevention, minimum weight loss and storage diseases prevention are the main parts which are to be looked after during storage. Many attempts have been made by researchers to investigate the suitability of various storage systems over the years for safe storage of potatoes. In this study, attempts have been made to find out an affordable and effective storage system of potatoes in rural condition. For getting it, the effectiveness of storage of potatoes in zero energy cool chamber was tested. It was found effective as compared to storage in heaps and other structures. Minimum storage losses as weight loss sprout loss and rottage have been recorded in case of its storage in zero energy cool chambers.

Key words : Potato, Storage technology, Sprouts

Potato is the most important food crop in the world after wheat, rice and maize. Potato ranks fourth in the world and third in India with respect to food production. In India, 73% of potatoes are consumed in different forms such as cooked, roasted, French dried, chipped etc. Cooking often reduces mineral and vitamin constituents. In case of processed products, it is possible to add missing or low ingredients in order to enhance overall nutritional value of the product. Potatoes contain 80% water. The high water content makes handling and storage of potatoes very difficult. It has been estimated that under tropical and sub-tropical countries, losses due to poor handling and storage amount to 40-50%. Therefore, it is of utmost importance to minimize storage losses. It makes sense to minimize storage losses to increase the availability of potatoes because it costs less to store than to produce a given quantity of potatoes. The potato is a semi-perishable commodity. Appropriate and efficient post-harvest technology and marketing are critical to the entire production consumption system of potato because of its bulkiness and perishability. Unlike in temperate regions, in India the potato is harvested in the beginning of summer. Due to inadequate cold storage facilities to hold the produce for longer periods, prices plunge at harvest time and larger quantities are spoiled before they could be disposed off. Consumers are also unable to develop a habit of consuming more potatoes because potato stocks disappear from the market within a few months of harvest and in later part of the relative prices of potato are high. The purpose of storage of potato is to maintain tubers in their most edible and marketable condition and to provide a uniform flow of tubers to market and processing plants throughout the year. Four variables to determine storage losses are the potato variety, pre-storage conditions, storage conditions and storage duration. It must be realized that storage losses can not be avoided even by optimal storage. Good storage can merely limit storage losses in good product over relatively long periods of storage. Storage losses are often specified as weight losses and losses in the quality of potatoes, although the two can not always be distinguished. Storage losses are mainly cased by the processes like respiration, sprouting, evaporation of water from the tubers, spread of diseases, changes in the chemical composition and physical properties of the tubers and damage by extreme temperatures. These processes are influenced by storage conditions and therefore can be limited by maintaining favourable conditions in the store. However, the storability of potatoes is already determined before the beginning of storage, by such factors as cultivar, growing techniques, type of soil, weather conditions during growth, disease before harvesting, maturity of potatoes at the time of harvesting, damage of tubers during lifting, transport and filling of the store (Rastovsky, 1987 and Burton *et al.,* 1992).

Good storage should prevent excessive loss of moisture, development of rots and excessive sprout growth. It should also prevent accumulation of high concentration sugars in potatoes, which result in dark coloured processed products. Temperature, humidity, CO_2 and air movement are the most important factors during storage (Harbenburg *et al.*, 1986 and Maldegm, 1999).

Rastovsky (1987) has reported the approx. values of storability of potatoes at different temperatures (Table 1) and ideal storage temperature for potato as per different uses (Table 2). In addition to this, the atmospheric humidity must in general, be as high as possible, in the range of 85 to 90%.

Table 1 : Storability of potatoes at different temperatures

Average storage temperature (^{0}C)	Storability months	Average storage temperature (^{0}C)	Storability months
5	6	20	2-3
10	3-4	25	2
15	2-3	30	1

Table 2 : Recommended storage temperature for potatoes for different usages

Purpose	Storage temperature (^{0}C)
Fresh consumption	2-4
Chipping	4-5
French frying	7-10
Granulation (mashed potato)	5-7

Traditional storage practices:

Storage methods, which were in vogue in the warm plains of India till recently, are described by many authors and are as follows :

– Storage in cool dry rooms with proper ventilation on the floor or on bamboo racks, and

– Storage in pits.

The former was generally followed in the plains for seed potatoes during the period from February-March to September-October. Storage in pits was adopted in the erstwhile Bombay State from February-March till the onset of monsoon season in June (Kishore, 1979).

Scientific storage systems:

Evaporatively cooled storage, cold storage, vapour compression cooling, forced drought cooling, CO_2 control system, irradiation etc. are scientific storage systems for potato storage.

Evaporatively cooled storage:

Evaporative cooling is nature's very own method. The ancient Egyptians used a primitive form of evaporative cooling dating back to 2500 BC. Evaporation of water produces a considerable cooling effect and the faster the evaporation, the greater is the cooling. Evaporative cooling occurs when air that is not already saturated with water vapour is blown across any wet surface. This evaporative cooler consisted of a wet porous bed through which air is drawn and cooled and humidified by evaporation of the water (Khader, 1999).

The farm level storage system, which is less capital intensive and extends the shelf-lives of fruits and vegetables sufficiently to realize better prices after the storage period was very much needed. EC storage was thus considered to meet the much desired need and hence studies were initiated on this aspect in the early eighties at CFTRI, Mysore; CPRS, Jalandhar and IARI, New Delhi (Rama and Narsimham, 1991).

Roy and Khurdiya (1982) constructed four types of evaporatively cooled chambers for storage of vegetable. The first chamber was made of cheap quality porous bricks and riverbed sand which was later known as zero energy cool chamber. The other three chambers were ordinary earthen pots placed in three tanks; the first one made of bricks, the second one an ordinary wooden box and the last an ordinary fruit basket. The gap in all the cases was filled with sand. The sand and the gunny bags covering the top of the chambers were kept saturated with water. The cool chambers maintained a temperature between 23-26.5^{0}C and relative humidity between 94-97% as against the ambient temperature between 24.2-39.1^{0}C and relative humidity between 9-36% during the months of May-June.

Chamber 1 *i.e.* the zero energy cool chamber, performed best with the enclosed air temperature remaining between 23-25.2^{0}C. Roy (1984) reported that 6 tonne cool chamber was constructed with two layers of bricks living approx. 75 cms. gap in between them. This gap was filled with riverbed sand. The floor was made of wooden planks. Below the floor, a 33 cms. deep tank was constructed with 4 air ducts made of brick opening at the centre and submerged under wet sand. The sand in the wall and surrounding the ducts was saturated with a drip system. The top of the chamber was insulated and incorporated with an exhaust fan. The air while passing through saturated duct and walls cooled sufficiently and took away heat from the produce. Sprinkling of water twice daily was enough to maintain the desired temperature and humidity.

Anonymous (1985) and Roy and Khundiya (1982) reported the detailed method of construction of a zero energy cool chamber. A chamber for storage of about 100 kg. horticultural produce was constructed with two layers of bricks aside walls leaving approx. 7.5 cms. gap between them. This gap was filled with river bed sand. The top of the storage space was covered with khaskhas

/ gunny cloth in a bamboo framed structure. There was no provision for mechanical ventilation. The side wall and top cover were kept completely wet during the period of storage. It was observed that the cool chamber had a temperature of less than 28^{0}C during summer when the maximum outside temperature was 44^{0}C. The average minimum temperature of the cool chamber was either less than or near the outside average minimum temperature excepting in winter when it maintained a few degrees in centigrade more than the outside average minimum temperature.

Though refrigerated storage is the best option for long term storage needs, considering the rising cost of construction, equipment and energy required for additional refrigerated storage capacity, alternate storage methods should be considered for meeting short term storage requirements. Further, seasonal production pattern, limited alternate market outlets and high cost of cold storage often results in gluts and consequent reductions in the price of potato during harvesting period. Potato prices rise rapidly in April – May and are almost double in July – August. Therefore, holding the produce for 3-4 months and then selling in market is advantageous. So, a study was done to test the efficiency of a non-refrigerated cooling system *i.e.* zero energy cool chamber in hot summer conditions.

METHODOLOGY

An on farm trial in Randomised Block Design with three treatments and ten replications was conducted in 2008 at Gesway village of Burmu Block under Divyayan Krishi Vigyan Kendra, Ram Krishna Mission Ashrama Ranchi, Jharkhand. Normally, the maximum and minimum temperature ranges from 37.2^{0}C to 20.6^{0}C and 22.9^{0}C to 10.3^{0}C and 654 m above sea level. The treatments imposed were:

T_1-Farmers practice (Storage of potatoes in heaps)

T_2- Storage of potatoes in bamboo iceless refrigerator.

Bamboo iceless refrigerator is a bamboo basket stitched with a gunny bag which was always kept wet to decrease the temperature of the basket.

T_3- Storage of potatoes in zero energy cool chambers

For this purpose (T_3), a zero energy cool chamber 3.5 feet high, double walled made by bricks with a flooring of bricks was also constructed. The gap between two walls of cool chamber was 7.5 cm and this space was filled by river bed sand. The top of the storage space was covered by gunny clothes in a bamboo framed structure.

The study was done with 50 farmers who grow potato in large quantities in Burmu block of Ranchi district. They were previously facing problems in storing potatoes as cold storage is very far from their villages and so a proper storage system for potatoes was required immediately by them which do not require electricity or any other power system.

FINDINGS AND DISCUSSION

The daily maximum temperature inside the cool chamber was 6-13^{0}C lower than the outside temperature. Relative humidity inside the cool chamber was high 72-98 % as noted during the study.

Potatoes were stored for 90 days as three treatments stated above and different types of losses in potatoes stored were noted. There was weight loss, sprout loss and rottage seen in potatoes in every treatment. The mean data in percentage were calculated as follows:

Storage	Weight loss (%)	Sprout loss (%)	Rottage (%)	Total loss (%)
T_1- Heaps	8.30	1.85	5.30	15.45
T_2- Bamboo bins covered with wet gunny bags	7.58	1.20	4.80	13.58
T_3- Zero energy cool chamber	5.50	1.00	3.50	10.00

During the storage period, the total ambient temperature was 36.8^{0}C and the decrease in temperature in heaps, bamboo bins and zero energy cool chambers were 7, 9.6 and 10.7^{0}C, respectively. The relative humidity was also recorded as 50.2%, 61%, 86% in heaps, bamboo bins and zero energy cool chambers.

The data reflect that the decrease in temperature and increase in relative humidity extend the shelf-life of potatoes and decrease the percentage of losses.

Bamboo iceless refrigerator (bamboo bins covered with wet gunny bags) is also useful for farmers as it decreases the percentage loss of potatoes during storage by 1.87% and also is less expensive and easy to built.

Zero energy cool chambers reduce the losses of potatoes during storage by 5.45% which can contribute much to the farmer's income. It is easy to build up and no energy is required to run it.

Authors' affiliations:
AJEET KUMAR SINGH, Department of Soil Science, Ram Krishna Mission Ashrama, Divyayn Krishi Vigyayn Kendra, RANCHI (JHARKHAND) INDIA

REFERENCES

Anonymous (1985). Zero Energy cool chamber. Research bulletin No. 43, IARI, New Delhi.

Burton,W.G., Van ES, A. and Hartmans, K. J. (1992). The Physics and Physiology of storage. In: Harris, P.M. (eds) The potato crop: The scientific bases for improvement. Chapman & Hall, London.

Harbenburg, R.E., Watada, A.E. and Wang, C.Y. (1986). The commercial storage of fruits, vegetables and florist and nursery stocks. U. S. Department of Agriculture : pp. 66-68.

Khader, V. (1999). *Text book on food storage and preservation*. Kalyani Pub., India.

Kishore, H. (1979). Storage Technology In : Post harvest Technology and utilization of potato. Proc. International Symposium. The International Potato Centre, Region VI, New Delhi and Central Potato Research Institute, Simla.

Maldegem, J.P.V. (1999). State of the art techniques for the potato storage. Abstract, Global Conference on Potato, New Delhi, Dec. 6-11, 1999.

Rama, M.V. and Narsimham, P. (1991). Evaporative cooling of potatoes in small naturally ventilated chambers. *J. Food Sci. Technol.*, **28** (3) : 145-148.

Rastovski, A. (1987). Storage losses In: Rastovski, A. and Van ES, A. (eds) Storage of potatoes. Post-harvest behaviour, storage design, storage practice, handling pudoc., Wagningen.

Roy, K.S. and Khurdiya, D.S. (1982). Keep vegetables fresh in summer. *Indian Hort.,* **27** (1):5-6.

Roy, S.K. (1984). Post harvest storage of fruits and vegetables in a specially designed built in space. In : Proc Internat. workshop on energy conservation in buildings. CBRI Roorkee, U.P., India, pp. 190-193.

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