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Effects of Storage Temperature on Post-harvest of Potato

Bikash Khanal* & Dipti Uprety#
*****Major author, Teaching faculty, Department of Horticulture and Floriculture Management, Mahendra ratna multiple campus, Tribhuwan University
Email: bikaskhanal@gmail.com
#Corresponding author:
Teaching faculty, Department of Horticulture and Floriculture Management, Mahendra ratna multiple campus, Tribhuwan University

Abstract

Post harvest of potato is important for making available of potato for longer period of time in the market. Different factors are responsible for affecting storage of potato in store houses. Potato should be stored at different temperatures according to the purposes they are used later. Low temperature storage is better in case of potato storage. Potato tuber should be stored with proper environmental condition in store houses such that they could be preserved by maintaining their quality parameters. Higher amount of starch in the tuber and less sprouting favors in longevity of potatoes in lower temperature storage. With the storage of potatoes at lower temperature there will be increase in production of malic which results in increase in longevity of potatoes. Respiration rate decreased in low temperature storage of potatoes upto certain limit which shows long term storage of potato tubers.

Keywords: Potato, Low and high temperature storage, Carbohydrate accumulation

Introduction

Potato *(Solanum tuberosum)* is an herbaceous plant belonging to solanaceae family. Potato is one of the major tuber crops grown in temperate regions in the world. The plant height of potato depends upon the varieties grown. The color of flowers is one of the determining factors for color of potato tuber. The white flowers produce white skin in tubers and the colored flowers produce tubers with pinkish skins (Winch, 2006). Potato is the crop which could be grown in only one season as field crop. It results in deficiency of the potato during other time period of the year. In this condition, fresh potatoes could be in the market for only fewer periods. It is essential to have better storing conditions such that it will help in less loss of the potato tubers during storage. It is also important to store potato in such a way that, it would be less damaged by the climatic imbalance, pathogen and the quality of potatoes is also maintained (Kaur et al., 2009).

Postharvest means the methods of preserving the commodity after harvesting. A lot of people produce a lot of fruits and vegetables in their fields. These produce could be used for the fresh purpose but due to the lack of the techniques of post harvest the produce are lost without reaching the consumer hands. So if we properly use the techniques then it will certainly be conserve the food for longer period and it could be transported to the larger distances from the production area. It readily helps in decreasing the food crisis (Wills, 2007). Post harvest means the techniques which

are use after the crop is harvested. The main aim of post harvest is to provide fresh products and the healthy products to the consumers. For this there should be good interaction of between the energetic, environmental and cultural factors including plant nutrients (Wills, 2007). Post harvest of potato results in several changes in the case of potato. It results in the change of physicochemical, morphological rheological and thermal characteristics of starch from different cultivars (Singh et al., 2008).

The availability of the fresh potatoes is higher during the period of fresh consumption for 3-4 month. For this there should be proper storing facilities for potato in proper temperature and proper conditions to maintain its quality, morphological and physiological conditions. Those potato tubers which are to be used for seed purpose are to be stored in 2°C and those are used in processing and the consumption purposes these are stored at 8-12°C. It helps to maintain the quality of the potatoes for processing (Mehta and Ezekiel, 2006). For storing of potatoes for longer period they are kept in cold storages until they are needed for the market. Different storage conditions and handling procedures affect the quality of the potato tubers (Bentini et al., 2009). Potatoes which are ultimately used for the seeding purposes are stored at lower temperature at about 4°C and those potatoes which are used for the processing purpose are stored at 8°C (Van Es, 1987). The process of cell division and the suberization are sensitive to temperature. Higher rate of wound healing at higher temperatures is observed than the lower temperatures .The wound healing process in case of potato stored at 5°C is three times slower than the potato stored at 10°C and potato stored at 10°C is also three times slower than potato stored at 20°C (Wigginton, 1974).

Review:

Storing facilities for potato in regarding proper temperature conditions to maintain its quality and physiological conditions is most important factor. Those potato tubers which are to be used for seed purpose are to be stored in 2°C and those are used in processing and the consumption purposes these are stored at 8-12°C. It helps to maintain the quality of the potatoes for processing (Mehta and Ezekiel, 2006). Potato storage conditions regarding temperature prevail in different conditions as:

a. Carbohydrate composition:

Storage conditions in potato make several differences in the physiochemical properties of the tubers and textures. Sugar and starch are important components of carbohydrates in case of potato. The amounts of the components are affected by the storage temperatures. The amount of these components differ in case of higher and lower temperature (D. Kazami, 2000). Potato stored at low temperature is influenced in accumulating glucose and fructose. It results in dark coloring during frying process of the potatoes (Knowles et al., 2009).

Low concentration of sucrose content in potato is very important consideration in case of potato processing. It is one of the important quality criteria in case of processing industries. It is because too high sucrose level produces black coloration during frying of the potato which is not acceptable (Burton, 1957). In domestic consumption also high amount of sucrose is not desirable. In different cultivars the properties of starch shows that the storage temperature affects the surface morphology of the starch granules. Pasting, solubility, textural and thermal properties are also altered along with the starch properties. These had very less difference in swelling power and amylose content of the potato

tuber if they are observed in different high and low temperature (Kaur et al., 2009).

Potato stored at lower temperature (4°C) shows the higher proportion of small size granules than the potato stored at higher temperature (20°C). It indicates that there is reduction in the number of small starch granules as the temperature of the storage is increased. The surface smoothness is also affected by the storage of potato. The non stored potatoes are less smoother than the stored potatoes (Golachowski, 1985). The surface granules have more pits in those potatoes which are stored at lower temperature than the potatoes stored at higher temperature (Cottrell J.E., 1995). It is also observed that the potato tubers stored at 20°C have high swelling power than the tubers stored at 4-16°C. Solubility of the starch is also higher in the tubers stored at higher temperatures than the tubers stored at lower temperatures. There is significant in the swelling power of the starch of the potato which is stored at different temperatures. Potatoes stored at higher temperature has higher swelling power than the potato stored at lower temperature (Kaur et al., 2009). When the potatoes are stored at lower temperature then the solubility of starch, swelling power and the light transmittance capacity of starch is decreased but there is alternate characteristics in case of starch amylose content. Earlier researches indicates that with the decrease in storage temperature there is increase in the content of the amylose content (Singh et al., 2008).

Potato tubers placed in warm temperature after putting them in cold temperature results in the decrement of invertase level and increment of inhibitors. There is not only effect on sugar balance after the low temperature treatment but also in the invertase system which also includes a macromolecular inhibitor and enzyme (Datir and Sagar, 2011). The fresh tuber contains lower amount of total invertase activity and the reducing sugars. When these tubers are stored in low temperature there is rapid conversion of starch to hexose along with increase in invertase (Zommick et al, 2014). After long period at the low temperature, there is maximum amount of hexose is obtained but there is decrease in total invertase along with the basal activity which results in excess of inhibitors (Pressey and Shaw, 1966). Those starch which are isolated from the different cultivars of potato there is decrease in the solubility with the increase in the lower temperature storage time and on the other way the parameters which are thermal and the viscosities are increased with the storage time (Singh et al., 2008).

b. Sprouting:

Sprouting in potato is generally not seen in first part of the storage period. When the dormancy period ends then there starts the sprouting phase of the potato tuber. The sprouting in potato tubers is not desirable at the condition except seed potato then for preventing from sprouting they are stored at low temperatures. It should be done to those potatoes which are not later used for processing purposes (Lindblom, 1970). Potato stored at low temperatures (1-2°C) has a lot of advantages which includes prevention from almost all rotting, decrease in evaporation losses and also prevention from sprouting (Harkett, 1971).

Temperature also plays major role in sprout growth during storage. Potatoes stored at higher temperature about 85°F sprouts are seen after few weeks of storage. The effect of humidity and light on tuber growth is seen in later period of storage of potatoes. Excellent tubers for longer period are seen when they are stored at 35°F and slower sprout growth (Davidson, 1958). Potato stored at different temperatures for different storage period shows that the potato tubers that are stored at lower storage temperature about 4°C could be stored for longer period without sprouting and in good quality

compared to the potato stored at other higher temperatures (8°C, 12°C, 16°C and 20°C). Low temperature storage maintains the quality of potato tubers for longer period rather than potato tubers stored at higher temperatures. Lower the storage temperature the longer the quality of potato tubers which is shown in fig.1 (Nourian et al., 2003). High temperature is also inducing factor of post harvest glycoalkaloid formation in the tubers of potato. Potato should be stored at 5-8°C which prevents not only potato tubers from sprouting but also controls the glycoalkaloid increment (Sengül et al., 2004).

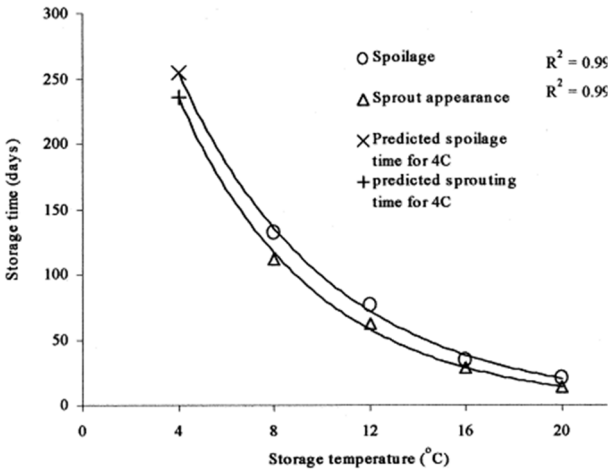

Fig.1 Time taken for appearance of the sprout and spoilage in potatoes at different temperatures (Nourian et al., 2003).

c. Organic acid:

Storage temperature effects on the content of citric acid and malic acid of the potato tubers is also observed. There is a marked difference in these organic acid contents with the storage temperature. Potato tubers stored at 7°C have more pronounced changes in citric acid and tubers stored at 13°C have changes in the content of malic acid. When the tubers are stored at 7°C for 6 months it loose about 41% of citric acid. And in case of potato stored at 13°C for 6 months there is increase in the content of malic acid by 32%. But in case of potato tubers stored at 7°C, malic acid increased up to 14 (Lisinska and Aniolowski, 1990). The phenolic compound which is found in inner tissue of potato tubers is also found to be increased when stored at lower temperature. The potato tubers stored at 40°F contains more chlorogenic acid than the potato tubers stored at 60°F where main reason of the increment of this chlorogenic acid is due to sugar accumulation due to cold storage (Hasegawa et al., 1966).

d. Respiration rate:

Respiration rate of potato tubers does not decline consistently with the temperature decrease during storage. It decreases to the least point up to 3°C and if temperature is further decrease to 0°C then the respiration increases which is due to the concentration of sugar changes at 0°C which increases respiration (Hopkins, 1924). Respiration rate is increased with the increase in temperature which could be seen in the fig.2 (Nourian et al., 2003). With the increment in the respiration there is increment in the deterioration of potato. The carbohydrate is more utilized during respiration of potato tubers which leads them to deterioration. Previous researches also showed that there is maintenance of high dry matter content and reduction in respiration while storing potatoes at 4°C (De Freitas et al., 2012).

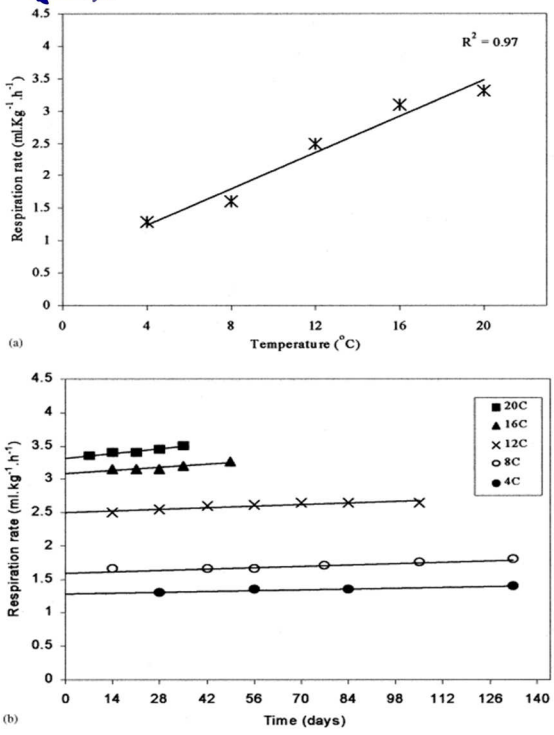

Fig.2 RR of potatoes at different temperatures, (a) prior to storage and (b) during storage (Nourian et al., 2003).

Conclusion:

Post harvest temperature had both positive as well as negative role regarding the level of the storage temperature. Higher temperatures had negative effect on the potato tuber whereas lower temperatures upto certain limit helps in maintaining the quality and enhancing the storing days of the potato tubers in the storehouses.

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