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Analysis of Physio-chemical Properties of Pear cv. 'Patharnakh' (*Pyrus Pyrifolia* Burm. F. Nakai) During Storage

Monika Kundu[1], *Arvind Jaiswal*[2], *Sangita Bansal*[2]

Abstract: *Pear is one of the most important fruit crops of temperate regions in India. Pear should be harvested at full maturity. Maturity at harvest is the important factor that determines storage life and final fruit quality. The parameters such as size, sphericity, TSS, colour and electrical properties were determined during the fruit development and storage as well. For that fruits were harvested in three batches, at immature stage, mature and at over mature. Their storage study was done at alternate days starting from zeroth day of harvesting up to 10 days. With the advancement of ripening the average size of pear fruit decreases while with the advancement of maturity from batch 1 to batch 3 the fruit size increases. TA also follows the decreasing pattern with both ripening as well as maturity stages. TSS and pH, followed increasing trend with storage period. In color values 'a' and 'b' shows increasing trend while 'L' values decreases. Thus the study enlighten the changes in various physio-chemical properties with maturity and ripeness. Results can be used to develop a maturity index and ultimately portable and rapid instruments.*

Keyword: *Maturity, pear, physio-chemical, ripeness, storage.*

INTRODUCTION

Pear is one of the most important fruit crops of temperate regions. Himachal Pradesh and Punjab are prime pear growing areas in India. India also exported 3.39 tonnes of pears in 2013-14 worth Rs 1.40 lakh (APEDA). While pears are not an unusual source of conventional antioxidant or anti-inflammatory nutrients (for example, vitamin E or omega-3 fatty acids), the phyto nutrient category is where this fruit excels. For example, in the Baltimore Longitudinal Study of Aging (1,638 participants, average age range 62-69 years), the combination of apples/pears ranked as the second highest source of flavonols among all fruits and vegetables. Average flavonol intake in the study was about 14 milligrams per day, and one pear can provide about half of this amount all by itself. The list of phyto nutrients found in pears has been of special interest to researchers, and the list below summarizes their findings about key phyto nutrients provided by this fruit. As a result, intake of pears has now been associated with decreased risk of several common chronic diseases that begin with chronic inflammation and excessive oxidative stress. These diseases include heart disease and type 2 diabetes.

When fruits are harvested it is often the case that the crop is of varying degrees of ripeness. Often no special steps are taken to separate the crop according to the extent of ripeness. A Maturity level at harvest is critical to the development of good flavour quality in the fruit when fully ripe (Kadar, 2008), it is important for individuals harvesting fruit to have effective methods of determining pear maturity. The fruits that are sent for storage may already be ripe and ready for consumption and unripe fruit may be offered for sale. It is, therefore, a matter of chance to some extent whether the fruits at the point of sale are in the optimum condition of ripeness for consumption. Ripe fruits put into cold

1 Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi, India.
2 ICAR-Central Institute of Post Harvest Engineering and Technology, Ludhiana, India.

storage tend to be over-ripe by the time they have been removed from the storage and transported to the retail outlet (Slaughter, 2009). Frequently such produce cannot even be sold at all and has to be thrown away. This is a serious problem. It has been estimated that a very large quantity of fruits is wasted because, being over-ripe when it arrives at the point of sale, it is unsaleable. Problems of a different kind arise with under-ripe produce.

This may look quite acceptable when displayed at the point of sale. However, when a purchaser consumes unripe fruits a strongly negative impression is received. This may have the effect of persuading the purchaser not to buy such produce from the same retail outlet again. Hence, if sorting based on maturity level is not done prior to storage/ packing it lead to reduction of storage life and on canning such fruits develop unattractive chalky color, turbid syrup and insipid flavour(National Horticultural Mission). The condition of fruit at the time of harvest has an important effect on the consumer's level of satisfaction at consumption. While many consumers use the terms mature and ripe interchangeably to describe the state of a fruit when it is ready for consumption. Sorting harvested mangoes according to their maturity stage in the packinghouse can eliminate immature-green mangoes and separate partially-mature from fully-mature green mangoes in order to improve the uniformity of ripening in lots of fruit at destination.

It is important to know the stage of ripeness for determining the optimal postharvest strategy for handling and marketing fruit. Often no special steps are taken to separate the crop according to the extent of maturity. As a result fruits that are sent for storage may already be ripe and ready for consumption and unripe fruit may be offered for sale. Ripe fruits put into cold storage tend to be over-ripe by the time they have been removed from the storage and transported to the retail outlet. Frequently such produce cannot even be sold at all and has to be thrown away (Jha et al., 2010). This is a serious problem. Quality of fruits of improper maturity can never be improved by post-harvest treatments. when a purchaser consumes unripe fruits a strongly negative impression is received. Thus sorting harvested fruits according to their maturity stage in the packinghouse can eliminate immature fruits and separate partially-mature from fully-mature fruits in order to improve the uniformity of ripening in lots of fruit at destination.

It is possible to mechanically sort and grade fruit on the basis of their colour, size, degree of sweetness and firmness etc., but there is no hand-held non-destructive Indian indigenous non-destructive instrument for determination of maturity of mango and pear fruits. The first observable sign of ripening is a color change from green to yellow (Marriott *et al*., 1981). Further research was carried out to find correlation between soluble solids content, indicative of sweetness, and the permittivity of honeydew melons for quality sensing (Nelson *et al*., 2006). Measuring maturity is of paramount importance to harvest fruit to have good post-harvest quality and is also dependent on physio-chemical quality parameters such as total soluble solids (TSS), Ph, titratable acidity (TA), and colour.

MATERIALS AND METHODS

Sampling and Size Measurement

For sample collection trees of pear cv. 'Patharnakh' (*Pyrus pyrifolia* Burm. F. Nakai) were selected in PAU Ludhiana, farm orchards, based on flowering amount, size of trees and location for the study in summer, 2015 and randomized block design of sampling was adopted. One pear from each direction (east, west, north and south) of each tree was manually plucked from zeroth day of harvest, (when pear was not fully matured) and brought to laboratory for the study. After the plucking the pears were stored in corrugated boxes at ambient temperature. The parameters such as size, sphericity, TSS, colour and electrical properties were determined during the fruit development and storage as well. For that fruits were harvested in three batches, at immature stage, mature and at over mature. The size was measured in three major axes using a vernier calliper (least count 2 mm) and expressed in terms of geometrical mean diameter as per method described by Moninson, 1980

$$\text{Size} = (abc)^{1/3},$$

Where a = longest intercept; b = longest intercept normal to a; c = longest intercept normal to a and b.

Color Measurement

The colour of mangoes in terms of *L*, *a*, *b* values was determined using Hunter Lab minis can XE Plus colorimeter (HAL, USA, Model 45/0-L). The nose cone was positioned in the surface of the mango such that the light thrown by the colorimeter is not leaked. The colour was measured in four places of each sample and average values were recorded for the study. Before measuring, the colorimeter was standardized with black and white calibration tiles provided with the instrument. After the colour measurement the mangoes were peeled (about 0.2 mm skin thickness) with the help of a knife and pulp was grinded in a grinder then the juice was extracted by filtering the pulp paste with help of a muslin cloth. New piece of cloth was used for filtering each sample.

TSS, TA and pH

TSS is the quality indicator which currently requires samples from the internal tissues and is a destructive test. The TSS was estimated using a hand held refractometer (ERMA, Japan) with a scale of 0–32° Brix (least count 0.2° Brix). The juice of the mango was taken out from the mango pulp paste by filtering the paste through a muslin cloth piece. The pH of pear juice were measured thrice (Jha and Matsuoka, 2004) using digital pH meter (Thermo Fisher Scientific Inc., Singapore), respectively, and the average values were noted. Titrable acidity of pear juice was determined by the AOAC (2005) method. Five gram of pear juice was taken in a conical flask and then it was mixed with 25 ml of distilled water. Two or three drops of phenolphthale in indicator were added, and then the flask was shaken vigorously. It was then titrated immediately with 0.1N NaOH solution from the burette till indicative pink colour appeared. The volume of NaOH solution required for titration was recorded and TA was further calculated.

Sensory Evaluation

Sensory evaluation of the stored mangoes was conducted on alternate days starting from the day the mangoes were plucked. Fruit was cut into small pieces from the equatorial region. The fruit pieces were tasted by 5 persons and were asked to rate the mangoes based on Flesh colour, sourness, Aromatics, Firmness, Crunchiness and Juiciness.

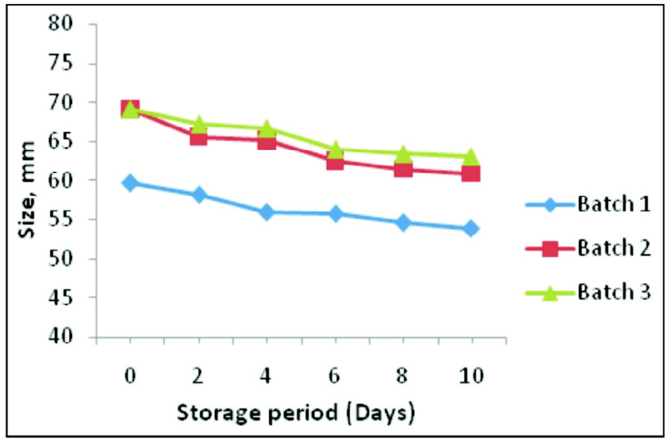

Figure 1: Variation in Size with Storage period for patharnakh pear

RESULT AND DISCUSSION

Size

It is evident from the trend of graphs that with the advancement of ripeness the average size of pear fruit decreases while with the advancement of maturity from batch 1 to batch 3 the fruit size increases (Figure 1). During the study of pears under ambient storage conditions the size of the fruit reduces linearly due to loss of moisture and the onset of shrinkage. In general, shrinkage occurs as a result of volume reduction due to evaporation of the moisture contained in the solid. Heating and loss of water cause stresses in the cellular structure of the fruit and lead to changes in shape and decrease in dimensions (Touil *et al*., 2014).

TSS and Color

The total soluble solids content of the pear fruit was found to be increased in a linear order leading to the relative sweetness of the fruit. The TSS content increased from 10.15 ± 0.84 to 13.15 ± 1.05 degree brix from the day of harvesting to final maturity respectively (Figure 3).

The total soluble solids increased during storage (Rivera, 2005). The increase in TSS could be attributed to the breakdown of starch into sugars or the hydrolysis of cell wall polysaccharides (Crouch, 2003). The colour change of the pear sample as measured by the hunter colorimeter can be concluded to be changed from light green to pale yellow during ambient storage conditions (Figure 2).

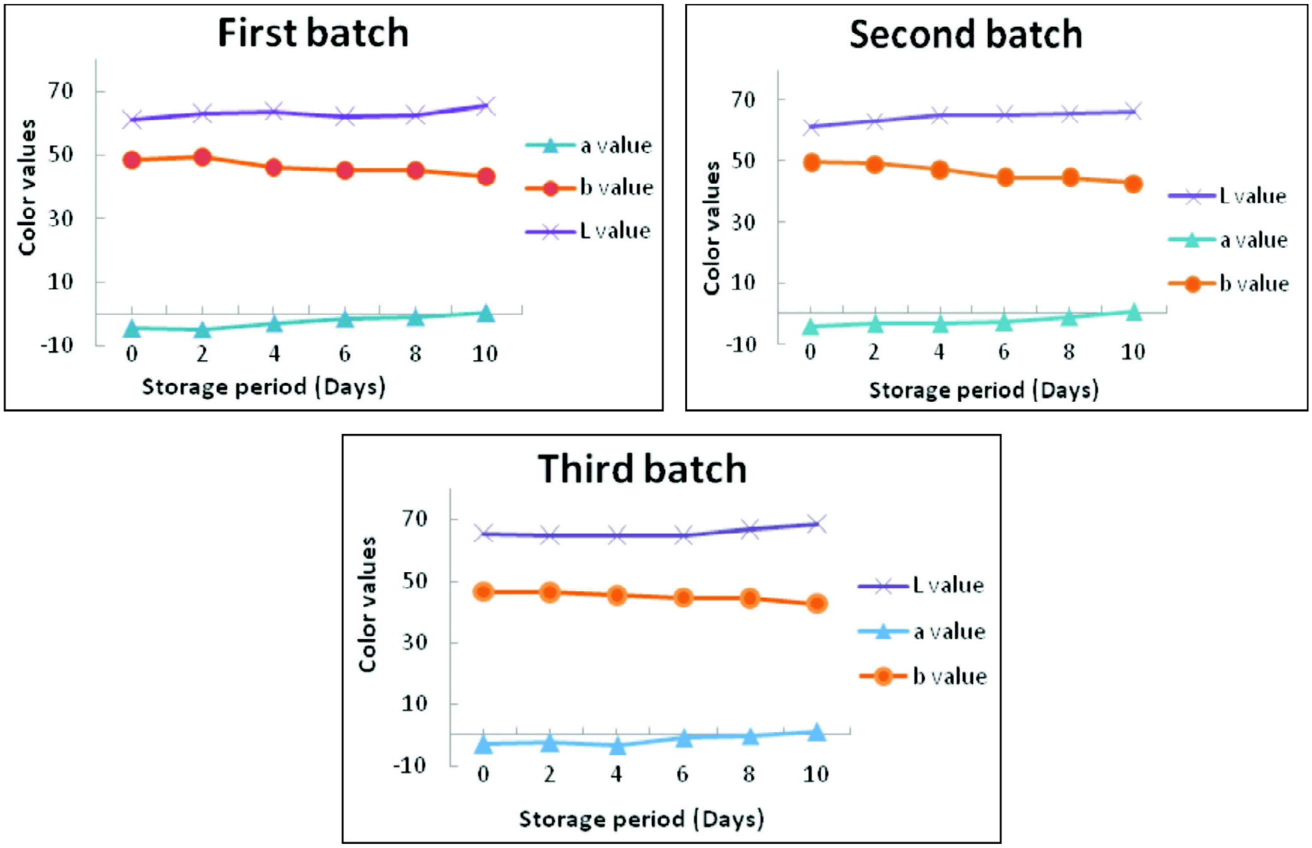

Figure 2: Variation in color values with Storage period for patharnakh pear

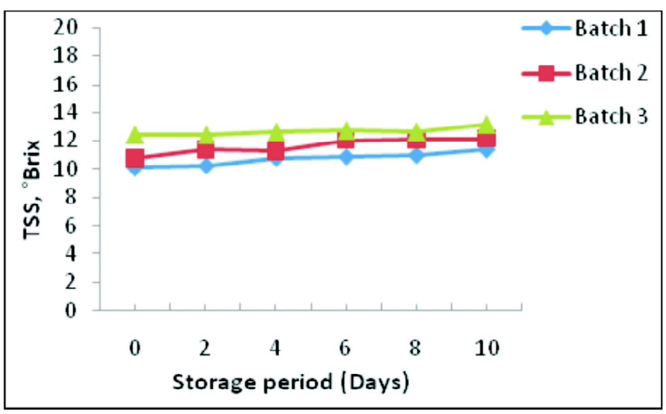

Figure 3: Variation in Total Soluble Solid content with Storage period for patharnakh pear

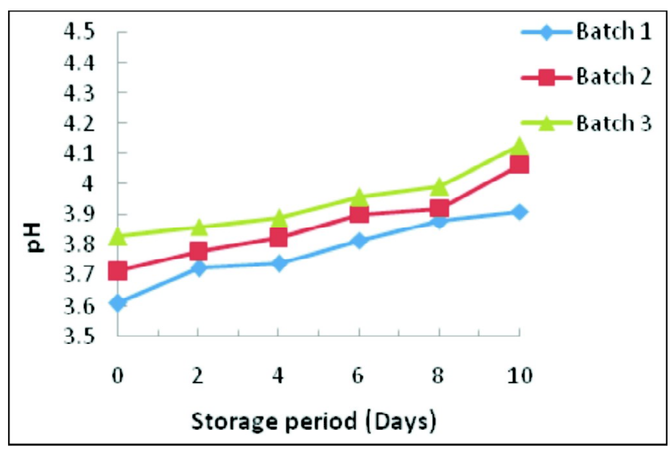

Figure 4. Variation in pH with Storage period for patharnakh pear

pH

The pH of the sample was found to be increased from the initial value of 3.61 ± 0.30 to 4.13 ± 0.14 during the study period indicating the ripening of the fruit (Figure 4). The changes in titratable acidity are significantly affected by the rate of metabolism (Clarke *et al.*, 2001) especially respiration which consumed organic acid and thus decline acidity (Rivera, 2005; Ghafir *et al.*, 2009). The pH of the fruit depends mainly on organic acid in the fruit, which are consumed in respiration, resulting lower acidity and high pH with increasing storage duration (Khalid, 1974; Chang *et al.*, 1999; Rivera, 2005; Ghafir *et al.*, 2009).

Titrable Acidity

The acidic content of samples increased with storage period resulting in the increment in acidity

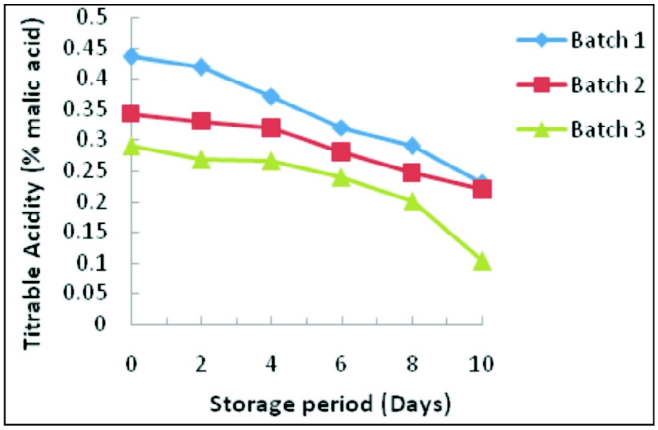

Figure 5: Variation in Titrable Acidity with Storage period for patharnakh pear

(Figure 5). The changes in titratable acidity are significantly affected by the rate of metabolism (Clarke *et al*., 2001) especially respiration, which consumed organic acid and thus decline acidity (Rivera, 2005; Ghafir *et al*., 2009). All these trends are found to be varying in same way as the sensory score obtained.

The increase in organoleptic rating was found to be associated with improvement in fruit color, increase in TSS, decrease in acidity and fruit size. The decrease in organoleptic rating after certain period of ripening might be associated with increase in some biochemical changes. The juicy and buttery texture of ripened pear fruits also indicates the involvement of cell substances and then degradation by enzymes (pectinase and polygalacturonase) during ripening process (Chen *et al*., 1981).

CONCLUSION

Pear being an important temperate fruit crop of India, has immense potential to be produced for export purposes. For increasing the shelf life of pear and reduce the post harvest losses the maturity related parameters should be intensively studied. The harvesting of pear should be done based on appropriate maturity level.

Although the maturity status determining parameters discussed here in this work are evaluated through destructive techniques, a maturity index can be developed based on these findings. Various sensors or instruments can be further developed to rapidly determine the maturity of pear on tree itself.

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